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The UNIDO *Global Report* is prepared annually and submitted to the UNIDO policy-making organ, the Industrial Development Board, at its regular session in November. The *Report* is available to the general public from the Sales Section, United Nations, Geneva (for readers in Africa, Europe and Western Asia), or New York (for Asia and the Pacific and North and South America). For addresses please see the back cover of this publication. The *Report* is also available for direct sales at the Vienna International Centre. For sales made directly at Vienna, address orders to the Chief, Documents Units, F-355N, UNIDO.

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INDUSTRY AND DEVELOPMENT

GLOBAL REPORT 1992/93

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna, 1992

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Acknowledgements

UNIDO gratefully acknowledges the contribution made in the preparation of *Global Report 1992/93* by Lord Desai, London School of Economics, and, for regional forecasting, by the following persons: Idrak-Ul Zaman Bhatty, National Council of Applied Economic Research (New Delhi); Fan-Zhang Huang, Economic Research Centre, State Planning Commission (Beijing); Akram Karmoul, Economic and Social Commission for Western Asia (Amman); Rolf Langhammer, Kiel Institute of World Economics, (Kiel); Kazimierz Laski, Wiener Institut für Internationale Wirtschaftsvergleiche (Vienna); Hiromichi Mutoh, Japan Centre for Economic Research (Tokyo); Sheila Page, Overseas Development Institute (London); Elfatih Shaaeldin, African Development Bank (Abidjan); Jean-Pierre Verbiest, Asian Development Bank (Manila); and Ziga Vodousek, Inter-American Development Bank (Paris). For the preparation of chapter III, UNIDO is grateful for information and data contributed by the Institute of Developing Economies (Tokyo). For sectoral monitoring, UNIDO is grateful for contributions made by the following experts and editors of professional journals: Anderson Ashburn, Editor Emeritus, *American Machinist* (New York); Anderson Baxter, *Financial Times* (London); Brigitte Bocoum, College of Mineral and Energy Resources, University of West Virginia (Morgantown); Brian Cooper, *Steel Times International* (Surrey); James Fry, Landell Mills Commodities Studies Ltd. (Oxford); Iain Howie, Shoe Trades Publishing Ltd. (Oakham); Peter Marsh, *Financial Times* (London); Carmine Nappi, Institut d'économie appliquée (Montreal); Robert Smart, British Investment Casting Trade Association (Birmingham); Kenneth Stanford, *Metallurgia* (Surrey); Peter Sutton, Pulp and Paper International (Brussels); and Jordan Yale, Statistikon Corporation (New York). The opinions expressed in this *Global Report* do not necessarily represent those of the persons and institutions mentioned above.

Industry and Development: Global Report 1992/93 was prepared by the Global Issues and Policy Analysis Branch of UNIDO as an annual review of the world industrial economy. The Industrial Statistics and Sectoral Surveys Branch provided the relevant basic statistics. In the drafting of this *Global Report*, Young Rin Cho and Takao Fukuchi were responsible for chapter I. The sections on short- and medium-term forecasts presented in chapter I were drafted by Jack Weeks with the assistance of Gerhard Margreiter and in consultation with Alois Geyer, Institut für Unternehmensführung, Wirtschaftsuniversität Wien (Vienna). Youngil Lim, assisted by John Cody and Kee Yung Nam, was responsible for chapter II. Mojmir Mrak and Victor Richardson were the authors of chapter IV, and Se-Hark Park, with the assistance of Kee Yung Nam, was responsible for chapter III and, with that of Walter Labys, for chapter V, which includes a survey of 12 industries. Bruno Dissmann assisted in the preparation of graphs and Maria Fermie was responsible for coordinating and preparing the final manuscript. Valuable comments were received from the Industrial Operations Technology Division and the Industrial Technology Development Division of UNIDO. The project was carried out under the direct supervision of Domingo L. Siazon, Jr., and the general guidance of T. Fukuchi and Y. R. Cho.

ID/382

UNIDO PUBLICATION
Sales No. E.92.III.E.4
ISBN 92-1-106276-4

Preface

The 1990s continue to fulfil their prophecy of being a turbulent decade. The trends set in motion in 1990 took on a particular intensity in 1991 and 1992. Events such as the demise of the Soviet Union, the break up of Yugoslavia, the unrelenting transition to a market economy in Eastern and Central Europe, and the slow but sure defeat of apartheid were prominent features of change and are surveyed in the present *Global Report*.

In the economic sphere the persistence of gloom and recurrence of past practices make for despondency. In the trade negotiations conducted under the General Agreement on Tariffs and Trade (GATT) stalemate prevails while new and various trade barriers are being devised. Huge trading blocs in terms of income as well as population are being formed as the rich countries endeavour to maintain their prosperity. By pursuing deflationary policies they continue as in the past to transfer the cost of high interest rates to developing countries.

After the lost decade of the 1980s, the developing economies of Latin America are slowly regaining momentum. They have made structural adjustments, albeit at a serious loss in terms of output foregone. The reverse capital flow from the South to the North has been halted, and Latin America is now attracting foreign investment. As industrial growth revives in Latin America and maintains its rapid pace in Asia, high interest rates and sluggish demand from the North present possible obstacles. For the legions of unemployed in the rich and poor countries it is of paramount importance that growth be swiftly revived in the developed market economies.

The adoption of market-oriented policies in preference to central planning has been taken most seriously in Eastern Europe. These economies are experimenting with the wholesale privatization of a publicly owned economy. This experiment offers opportunities and poses challenges. Yet other countries, developed and developing alike, are coming to realize that the ways of implementing privatization are as numerous as the reasons for wanting to do so. The importance of privatization as a favoured policy tool cannot be denied. This year's *Global Report* has thus taken up privatization as its special theme in an endeavour to help policy makers contemplate privatization for the first time as well as to reassure those who have embarked on that course and might be encountering problems.

Even after 200 years, the process of industrialization remains a challenge to our ingenuity. To achieve sustained industrialization over a long period of time calls for an ability to adapt to constant change. That self-same adaptability, however, has to permeate to all sectors of the economy since industrialization is a process that transforms non-industrial sectors as well: the key lies in symbiosis rather than polarity between industry and agriculture, and between manufacturing and services. As industrial growth proceeds, labour productivity increases and fewer workers are required for the same volume of output. Only in exceptionally fast-growing economies does employment in manufacturing not shrink as a result. As productivity gains are passed on in the form of lower prices, manufacturing value added does not expand apace with volume; the result is a drop in the share of manufacturing in national income. Increasingly services are claiming pride of place in terms of their share in national income and the size of the work-force. This, however, should be looked upon as a positive outcome of industrialization and not as a sign of its decline. Growth in labour productivity is the sole guarantee of a rise in real incomes, while the drop in the relative price of manufactures is a continuing benefit to consumers. The strength of the industrialization process lies in its achieving continued technical progress while maintaining its constant upward pressure on the improvement in living standards over the long term.

In championing industrial growth UNIDO does not underestimate the difficulties of its achievement, nor does it belittle the contribution of other economic activities. The key concept is one of interdependence between industry and the larger economy, between the industrialized rich countries and the industrializing poor ones, between economy and ecology. The task of UNIDO is to help in this industrialization process by seeking the best ways of harnessing that interdependence. To this end, this year's *Global Report* covers issues related to technological interdependence, the efficiency of privatization and the strategies applied to build up human skills and institutions. The wealth of solutions prepared is supplemented by sectoral studies and a detailed statistical annex.

UNIDO is dedicated to the task of furthering balanced global industrial growth. The search for solutions is a continuous process. Ever since its first issue in 1985, the *Global Report* has endeavoured to reflect on current policy issues that are constantly changing. As I enter my final year of office, I am doubly conscious of the achievements of UNIDO to date and the challenges ahead. I hope this *Report* will be useful in furthering industrialization and strengthening still further the commitment of UNIDO to the task of assisting developing countries.

DOMINGO L. SIAZON, Jr.
Director-General

تمهيد

لا يزال عقد التسعينات يحقق التنبؤات بأنه سيكون عقدا حافلا بالاضطراب . فقد اكتسبت الاتجاهات التي بدأت في عام ١٩٩٠ حدة خاصة في عامي ١٩٩١ و ١٩٩٢ . ويشكل ما وقع من أحداث مثل انهيار الاتحاد السوفياتي ، وتفكك يوغوسلافيا ، والتحول دون هوادة الى اقتصاد السوق في أوروبا الشرقية والوسطى ، والهزيمة التدريجية ، المحتومة مع ذلك ، لنظام الفصل العنصري ، المعالم البارزة للتغيير التي يفحصها هذا التقرير العالمي .

وفي المجال الاقتصادي ، يبعث استمرار التشاؤم وتكرار الممارسات السابقة على القنوط . ففي المفاوضات التجارية التي تجرى في اطار الاتفاق العام بشأن التعريفات الجمركية والتجارة (الغات) تسود خلافات مستعصية في حين تبتكر حواجز تجارية جديدة ومتنوعة . ويجري تكوين تكتلات تجارية ضخمة من حيث دخلها وعدد سكانها سعيا من البلدان الغنية الى الحفاظ على رخائها . وباتباع السياسات الانكماشية ، تواصل تلك البلدان ما كانت تفعله في الماضي من نقل لتكلفة أسعار الفائدة العالية فيها الى البلدان النامية .

وبعد عقد الثمانينات الخاسر ، بدأت الاقتصادات النامية في أمريكا اللاتينية تسترد اندفاعتها الاولى بالتدريج . فقد اضطلعت بعمليات تكييف هيكلي ، وان كان ذلك على حساب خسارة كبيرة في فرص الانتاج السابقة . وتوقف التدفق العكسي لرأس المال من الجنوب الى الشمال ، واصبحت أمريكا اللاتينية تجتذب الآن الاستثمار الاجنبي . ومع انتعاش النمو الصناعي في أمريكا اللاتينية واحتفاظه بمعدله السريع في آسيا ، يمكن لارتفاع أسعار الفائدة وبطء الطلب من الشمال أن يشكل عقبات . ومما له اهمية كبرى بالنسبة الى الاعداد الغفيرة من المتعطلين عن العمل في البلدان الغنية والبلدان الفقيرة ، أن يحدث انتعاش سريع في نمو اقتصادات السوق المتقدمة النمو .

ويؤخذ اتباع السياسات الموجهة الى السوق بدلا عن التخطيط المركزي مأخذ الجد تماما في أوروبا الشرقية . ويتم حاليا تجريب هذه الاقتصادات عن طريق الخوصصة الشاملة لاقتصاد مملوك ملكية عامة . وتتيح هذه التجربة فرصا وتطرح تحديات . غير أن هناك بلدانا أخرى ، متقدمة النمو ونامية على السواء ، بدأت تدرك أن طرائق تنفيذ الخوصصة لا تقل في عددها عن أسباب الرغبة في تطبيقها . ولا يمكن انكار اهمية الخوصصة باعتبارها أداة مفضلة من أدوات السياسة العامة . لذلك اختار التقرير العالمي لهذه السنة مسألة الخوصصة لتكون موضوعه الخاص ، في محاولة لمساعدة مقرري السياسات الذين يعتزمون تنفيذ الخوصصة للمرة الاولى ، وكذلك لطمأنة من انطلقوا بالفعل في هذا السبيل وربما كانوا يواجهون بعض المشاكل .

ولا تزال عملية التصنيع ، حتى بعد مضي ٢٠٠ سنة ، تشكل تحديا لقدرتنا على الابداع . ويتطلب تحقيق التصنيع المطرد لفترة طويلة من الزمن القدرة على التكيف مع

عملية التغير المستمرة . غير أن تلك المقدرة على التكيف نفسها يجب أن تتغلغل في جميع قطاعات الاقتصاد ، لان التصنيع عملية تؤدي الى تحول القطاعات غير الصناعية أيضا . ويكمن مفتاح الحل في التضافر ، لا في التناقض ، بين الصناعة والزراعة ، وبين الصناعة التحويلية والخدمات . ومع اطراد النمو الصناعي ، تزداد انتاجية العمل ويقل عدد العمال اللازم لانتاج نفس الحجم من الناتج . ولن يمكن تفادي انكماش العمالة في الصناعة التحويلية نتيجة لذلك الا في الاقتصادات التي تنمو بسرعة استثنائية . وبالنظر الى أن ازدياد الانتاجية يفضي الى انخفاض في الاسعار ، فان القيمة المضافة في الصناعة التحويلية لا تجاري الزيادة في حجم الانتاج ، وتكون النتيجة هي حدوث انخفاض في حصة الصناعة التحويلية في الدخل القومي . وقد أخذت الخدمات ، بشكل متزايد ، تحتل مركز الصدارة من حيث حصتها في الدخل القومي وفي حجم قوة العمل . بيد أنه ينبغي اعتبار ذلك نتيجة ايجابية للتصنيع لا علامة على ضعفه . فالنمو في انتاجية العمل هو الضمان الوحيد لحدوث ارتفاع في الدخول الحقيقية . في حين أن انخفاض الأسعار النسبية للمصنوعات يحقق منفعة مستمرة للمستهلكين . وتكمن قوة عملية التصنيع في تحقيقها للتقدم التقني المستمر مع المحافظة على ما يحدثه هذا التقدم من ضغط مستمر صاعد في اتجاه تحسين مستويات المعيشة على الأجل الطويل .

واليونيدو ، في ريادتها للنمو الصناعي ، لا تستهين بالمصاعب التي ينطوي عليها تحقيقه ، كما أنها لا تستخف بمساهمة الانشطة الاقتصادية الاخرى . والمبدأ الرئيسي الذي تسعى الى تحقيقه هو كفالة الاعتماد المتبادل بين الصناعة والاقتصاد عموما ، والتكافل بين البلدان الصناعية الغنية والبلدان الفقيرة الآخذة في التصنيع ، والتوافق بين الاقتصاد والبيئة . ومهمة اليونيدو هي المساعدة في عملية التصنيع هذه بالبحث عن أنجع الوسائل للاستفادة من هذا الاعتماد المتبادل . وتحقيقا لهذه الغاية ، يتناول التقرير العالمي لهذه السنة قضايا تتصل بالاعتماد المتبادل في مجال التكنولوجيا . وبكفاءة عمليات الخوصصة ، وبالاستراتيجيات التي تطبق من أجل بناء المهارات البشرية والمؤسسات . وتدعم الحلول الوفيرة التي أعدت بدراسات قطاعية وبمرفق احصائي تفصيلي .

وتكرس اليونيدو جهودها للاضطلاع بمهمة تعزيز النمو الصناعي العالمي المتوازن . وعملية البحث عن الحلول عملية متواصلة . وقد سعى التقرير العالمي ، منذ صدور عدده الأول في عام ١٩٨٥ حتى الآن ، الى القاء الضوء على مسائل السياسات العامة الراهنة ، وهي مسائل دائمة التغير . وانني ، في بداية الشهور الستة الختامية في منصبي ، ليتضاعف ادراكي للمنجزات التي حققتها اليونيدو حتى اليوم وللتحديات التي سيتعين عليها مواجهتها مستقبلا . وآمل أن يفيد هذا التقرير في تعزيز التصنيع وفي زيادة توطيد التزام اليونيدو بمهمة تقديم المساعدة الى البلدان النامية .

دومينغو ل . سيازون ، الابن

المدير العام

序 言

1990年代，一如人们所预言的，确实是风雷激荡的十年。 自1990年发端的动荡趋势，到了1991年和1992年，势头尤其猛烈。 苏联的解体，南斯拉夫的四分五裂，东欧中欧各国坚定不移地走向市场经济，种族隔离制度一步一步地然而不可挽救地趋于覆灭，这些都是动荡变革的突出事例，也是本期《全球报告》所包括的内容。

在经济领域，萧条的阴影历久不散，故技一再重演，着实使人心灰意冷。 在关税及贸易总协定（关贸总协定）主持下展开的贸易谈判，僵局仍未突破，与此同时，又正在设置种种新的贸易障碍。 富有国家力图保持其强盛地位，以收入和人口为基础形成了一些大国贸易集团。 由于采取通货紧缩政策，这些国家一如既往地继续把高利率的代价转嫁给发展中国家。

经历了1980年代一蹶不振的整整十年之后，拉丁美洲各发展中国家正开始缓慢地恢复元气，重聚势头。 它们都实行了结构性调整，尽管为此而在产量方面忍受了较大损失。 资金从南方倒流至北方的现象已经被遏止，拉美各国重新吸引着外国投资。 不但拉丁美洲重新呈现了工业增长，而且在亚洲，此种增长速度继续迅猛不衰，但来自北方的高利率和疲软需求有可能形成障碍。 对于无论是富国还是穷国的失业大军来说，至为重要的事莫过于发达的市场经济国家迅速地恢复增长势头。

东欧一些国家已开始郑重其事地实行市场导向政策，放弃了中央计划。 这些经济体正试验着把公有经济成批地转向私有化。 这种试验一方面提供着成功机会，但另一方面又面临种种挑战。 而另一些国家，包括发达国家和发展中国家在内，正逐渐认识到，实行私有化的途径甚为繁多，如同想要实行私有化的理由亦不一而足。 私有化作为一种优先的政策手段，其重要性是不可否认的。因此，本年度的《全球报告》选定了私有化这个特别主题，目的是使之有助于那些首次考虑私有化政策的决策者，对于已经作出了私有化决策但实践中又遇到种种问题的人来说，也许也能使他们坚定自己的信心。

即使再过200 年之后，如何实现工业化的问题同样存在，仍然是有待我们开动脑筋、运用智慧的一个难题。 为在一段较长时期内实现持续的工业化，人们必须有能力适应不断出现的变化。 但是，此种适应能力必须遍及所有各个经济部门，因为工业化的进程势必同时改变着其他的非工业部门：关键在于促使工业与农业的共存共荣，制造业和服务业的并肩发展，而不是相互排斥。 随着工业的发展，劳动生产率会不断提高，单位产量所需要的人力会减少。 也许只有极少数几个高速增长的经济体其制造业的就业人数不会因此而减缩。由于生产率的上升势必体现于产品价格的下降，制造业的增值自然跟不上产量增长的速度；结果是制造业在国民收入中所占的比重必然下降。 与此同时，服务业在国民收入总额中的比重会越来越大，所占的劳动力也越来越多。 但是，我们应当把这一点看作是工业化带来的积极成果，不应把它看作是工业化滑坡的标志。 劳动生产率的上升是人们实际收入得以提高的唯一保证，而工业制成品相对价格的下降则始终是消费者的一种福利。 工业化进程的

力量在于它可以带来持续不断的技术进步，同时又产生一种恒久的推动力，在长期内促使生活水准的攀升。

在大力促进工业增长的过程中，工发组织并未低估欲达此目的之艰难，同时也未看轻其他经济活动的贡献。 一个极为重要的概念是相互依存概念：工业与大经济的关系、工业化的富国与谋求工业化的穷国的关系、经济与生态的关系，都是一种相互依存关系。 工发组织的任务是尽力找到促成这种相互依存关系的最好办法，以便有助于这一工业化进程。 为此，本期《全球报告》论及了关于技术依存关系、私有化的效率、培养人才和建立体制的战略等问题。 在提出了众多的解决途径之外，还增加了按部门的研究，附件中还载列了详细的统计数据。

工发组织全力以赴的目标是：推进全球平衡的工业发展。 它每年每月都在寻找达此目标的解决办法。 自1985年创刊以来，《全球报告》一直力图反映出当前的政策问题，跟上不断变化的形势。 本人已进入届将卸任的最后六个月，此时此刻，我加倍地意识到工发组织迄今已取得的成就，也更体察到面临的挑战。 希望这本报告材料对于推动工业化进程有所助益，而且能进一步加强工发组织对于援助发展中国家的使命感。

总干事

小多明哥·L ·夏松

Préface

La prophétie selon laquelle les années 90 seraient une décennie tumultueuse ne s'est toujours pas démentie. Les tendances qui se sont dessinées à partir de 1990 se sont encore accentuées en 1991 et 1992. Parmi les bouleversements examinés dans le *Rapport* figurent la disparition de l'Union soviétique, la dislocation de la Yougoslavie, la marche sans relâche vers l'économie de marché en Europe orientale et centrale et le démantèlement lent mais inexorable de l'apartheid.

Dans la sphère économique, le marasme persistant et la réapparition de pratiques anciennes ont eu un effet démoralisant. Les négociations commerciales engagées dans le cadre de l'Accord général sur les tarifs douaniers et le commerce (GATT) sont au point mort alors que s'érigent de nouvelles barrières commerciales. On assiste à la création de blocs commerciaux gigantesques, tant par le revenu que par la population, les pays riches s'attachant à préserver leur prospérité. Appliquant des politiques déflationnistes, ils s'efforcent, comme par le passé, de transférer le coût des taux d'intérêt élevés aux pays en développement.

Après une décennie perdue, les pays en développement d'Amérique latine renouent peu à peu avec la croissance. Ils ont procédé à des ajustements structurels, mais ils ont, de ce fait, considérablement amputé leur production. Le flux des capitaux du Sud vers le Nord s'est inversé et l'Amérique latine attire aujourd'hui des investissements étrangers. La croissance industrielle ayant été relancée en Amérique latine et s'étant poursuivie à un rythme soutenu en Asie, ce sont aujourd'hui les taux d'intérêt élevés et la demande anémique du Nord qui font problème. En raison du chômage massif que connaissent pays riches et pauvres, il faut impérativement que les pays développés retrouvent le chemin de la croissance.

Les pays d'Europe orientale se sont prononcés nettement pour une économie de marché et ont abandonné l'économie planifiée. Ils se sont engagés dans la privatisation intégrale de l'activité économique jusqu'alors dominée par l'Etat. Une telle politique est riche de promesses mais les écueils sont nombreux. D'autres pays, développés et en développement, ont pris conscience du fait que les méthodes de privatisation étaient aussi nombreuses que les raisons militant en sa faveur. La privatisation demeure un outil économique dont l'importance est incontestable. Aussi, le *Rapport* met-il la privatisation en exergue dans le souci d'aider les gouvernants qui envisagent d'avancer dans cette voie et de rassurer ceux qui l'ont déjà choisie et pourraient se heurter à des difficultés.

Vieux de plus de deux cents ans, le processus d'industrialisation nous impose néanmoins une remise en cause permanente. Toute industrialisation de longue haleine suppose une faculté d'adaptation au changement. Or, cette aptitude doit se manifester dans tous les secteurs de l'économie, car l'industrialisation a aussi des incidences sur les secteurs non industriels. C'est dans la symbiose entre industrie et agriculture, d'une part, et production et services, d'autre part, qu'est la clef du succès. A mesure que la production industrielle augmente, la productivité du travail progresse et le nombre des emplois nécessaires à une production constante s'amenuise. Les seuls pays qui échappent à la contraction de la main-d'œuvre dans le secteur manufacturier sont ceux qui connaissent une croissance exceptionnellement rapide. Les gains de productivité se traduisant par une baisse des prix, la valeur ajoutée manufacturière ne progresse pas au même rythme que le volume de production, d'où un recul de la part de l'industrie manufacturière dans le revenu national. Le secteur tertiaire prend peu à peu la part du lion dans le revenu national et la main-d'œuvre. Cette évolution doit néanmoins être considérée comme un effet positif de l'industrialisation et non comme un signe de déclin. Seule une progression de la productivité du travail peut garantir une hausse des revenus réels et, partant, une baisse relative du prix des produits manufacturés, dont profite le consommateur. La force du processus d'industrialisation tient au progrès technique continu qu'il engendre et à l'amélioration à long terme du niveau de vie qui l'accompagne.

Défenseur acharné de l'industrialisation, l'ONUDI ne sous-estime pas les obstacles rencontrés, pas plus qu'elle ne mésestime l'importance des autres activités économiques. Dans ce domaine, le maître mot est interdépendance : interdépendance de l'industrie et du reste de l'activité économique, des pays riches industrialisés et des pays pauvres en voie d'industrialisation, et aussi de l'économie et de l'écologie. L'ONUDI a pour vocation de favoriser ce processus d'industrialisation en s'efforçant de trouver les meilleurs moyens de promouvoir cette interdépendance. C'est pour cette raison que le *Rapport* examine les questions que soulèvent l'interdépendance technologique, l'efficacité de la privatisation et les stratégies visant à renforcer les ressources humaines et les organismes d'appui. Les multiples solutions proposées sont complétées par des études sectorielles et une annexe statistique détaillée.

L'ONUDI est tout entière dévouée à sa mission de promotion d'une croissance industrielle mondiale équilibrée. La recherche de solutions est un processus sans cesse renouvelé. Depuis la première parution du *Rapport* en 1985, on s'est efforcé d'y faire le point sur les questions toujours différentes que pose l'industrialisation. Alors qu'il ne me reste plus qu'un an à la tête de l'Organisation, j'ai pleinement conscience des succès que l'ONUDI peut porter à son crédit et des défis qu'elle devra relever. Je forme le vœu que le *Rapport* contribue à promouvoir l'industrialisation et à renforcer encore l'engagement de l'ONUDI en faveur des pays en développement.

Le Directeur général,

DOMINGO L. SIAZON Jr

Предисловие

Предсказание о том, что десятилетие 90-х годов будет неспокойным, продолжает оправдывать себя. Тенденции, которые проявили себя в 1990 году, стали еще более отчетливыми в 1991 и 1992 годах. К числу крупных перемен, которые произошли в этот период и рассматриваются в настоящем Глобальном докладе, относятся такие события, как прекращение существования Советского Союза, распад Югославии, решительный переход к рыночной экономике в странах Восточной и Центральной Европы, а также медленное, но неизбежное исчезновение апартеида.

Что касается экономики, то ее нынешнее неблагополучное состояние и возврат к прежним методам не дают оснований для оптимизма. Торговые переговоры, проводимые в рамках Генерального соглашения по тарифам и торговле (ГАТТ), зашли в тупик; разрабатываются планы введения всевозможного рода новых торговых барьеров. Формируются огромные торговые блоки стран с учетом уровня доходов и размеров населения по мере того, как богатые страны стремятся обеспечить свое дальнейшее процветание. Проводя дефляционную политику, эти страны продолжают, как и прежде, перекладывать бремя высоких процентных ставок на развивающиеся страны.

После напрасно потраченного прошедшего десятилетия экономика развивающихся стран Латинской Америки постепенно набирает силу. В этих странах были осуществлены структурные изменения, хотя этому предшествовало, к сожалению, значительное сокращение объема производства. Остановлен отток капитала с Юга на Север; Латинская Америка становится регионом, в который начинает поступать все больший объем иностранных инвестиций. Возможными препятствиями на пути вновь активно развивающейся промышленности Латинской Америки и сохраняющей высокие темпы роста промышленности в Азии являются высокие процентные ставки и вялый спрос со стороны Севера. Для армий безработных в богатых и бедных странах первостепенное значение имеет скорейшее восстановление темпов роста в странах с развитой рыночной экономикой.

Страны Восточной Европы всерьез приступили к переходу от централизованного планирования к созданию опирающейся на рынок экономики. В этих странах предпринимается попытка осуществить широкомасштабную приватизацию государственного сектора экономики. Этот эксперимент открывает широкие возможности и одновременно ставит новые задачи. В то же время другие страны, как развитые, так и развивающиеся, начинают понимать, что пути осуществления приватизации столь же многочисленны, как и причины, которые привели к ее осуществлению. Значение приватизации как одного из наиболее предпочтительных элементов политики невозможно отрицать. Поэтому в данном Глобальном докладе в качестве специальной темы выделены вопросы приватизации, с тем чтобы помочь директивным органам впервые глубже рассмотреть эти вопросы, а также вселить уверенность в тех, кто уже вступили на этот путь и, возможно, сталкиваются при этом с проблемами.

Даже спустя 200 лет процесс индустриализации постоянно требует от нас проявления всех наших способностей. Для обеспечения устойчивого промышленного развития в течение продолжительного периода времени необходимо адаптироваться к постоянно изменяющимся условиям. Однако такая же способность к адаптации должна проявляться во всех секторах экономики, поскольку индустриализация ведет также к изменениям и в непромышленных секторах: решением является скорее симбиоз промышленности и сельского хозяйства, а также производства и сферы услуг, а не их противопоставление. По мере развития промышленности растет производительность труда, и для выпуска аналогичного объема продукции требуется все меньше рабочих. Сокращение занятости не происходит лишь в странах с исключительно высокими темпами экономического роста. Поскольку рост производительности проявляется в виде снижения цен, темпы увеличения добавленной стоимости обрабатывающей промышленности отстают от темпов увеличения объема производства; в результате этого происходит сокращение доли обрабатывающей промышленности в национальном доходе. Обслуживающие отрасли экономики выступают на первое место, учитывая их долю в национальном доходе и численность занятой в них рабочей силы. Однако этот процесс следует рассматривать в качестве положительного результата индустриализации, а не как признак ее ослабления. Рост производительности труда – единственная гарантия повышения реального дохода, при этом снижение относительной цены готовой продукции неизменно выгодно для потребителей. Залогом успешного промышленного развития является обеспечение непрерывного технического прогресса в условиях постоянного давления в сторону неуклонного повышения уровня жизни.

Выступая за промышленный рост, ЮНИДО сознает трудности, связанные с его обеспечением, и не умаляет важного значения других видов экономической деятельности. Ключевой концепцией является концепция взаимозависимости между промышленностью и экономикой в целом, между богатыми промышленно развитыми странами и процессом индустриализации бедных стран, между экономикой и экологией. Задача ЮНИДО заключается в том, чтобы помочь этому процессу индустриализации путем поиска наиболее эффективных путей использования этой взаимозависимости. С этой целью в данном Глобальном докладе рассматриваются вопросы, связанные с технологической взаимозависимостью, эффективностью приватизации, а также практическими стратегиями, направленными на совершенствование профессиональных навыков и деятельности учреждений. Многочисленные разработанные решения дополняются секторальными исследованиями и подробным статистическим приложением.

Деятельность ЮНИДО направлена на обеспечение дальнейшего сбалансированного роста мировой промышленности; при этом идет постоянный поиск решений. Начиная с первого издания в 1985 году, Глобальный доклад стремился отражать постоянно изменяющиеся современные вопросы политики. Сейчас, когда мне осталось пребывать на своем посту последние шесть месяцев, я отчетливее, чем когда-либо вижу успехи, достигнутые ЮНИДО к настоящему времени, и задачи, которые стоят перед ней в будущем. Выражаю надежду, что этот Доклад будет содействовать процессу дальнейшей индустриализации и расширению усилий со стороны ЮНИДО для решения задачи по оказанию помощи развивающимся странам.

ДОМИНГО Л. СИАЗОН, мл.
Генеральный директор

Prefacio

El vaticinio de que el decenio de 1990 sería un período turbulento sigue cumpliéndose. Las tendencias que empezaron a perfilarse en 1990 adquirieron especial firmeza en 1991 y 1992. Acontecimientos como el desplome de la Unión Soviética, el desmembramiento de Yugoslavia, la inexorable transición a regímenes de economía de mercado en los países de Europa central y oriental, y la lenta pero segura derrota del apartheid, fueron las características más sobresalientes de los cambios registrados en el mundo que se analizan en el presente *Informe Mundial*.

En el terreno económico, la persistencia del pesimismo y el resurgimiento de prácticas pertenecientes al pasado son motivo de desánimo. Las negociaciones comerciales llevadas a cabo en el marco del Acuerdo General sobre Aranceles Aduaneros y Comercio (GATT) permanecen estancadas, al tiempo que se proyectan nuevas barreras comerciales de diversa índole. Movidos por el deseo de mantener su prosperidad, los países ricos forman bloques comerciales de enormes proporciones por el volumen de sus ingresos y el tamaño de su población. Al aplicar políticas deflacionarias, estos países siguen traspasando a los países en desarrollo el costo de sus elevados tipos de interés.

Tras el decenio perdido de 1980, las economías en desarrollo de América Latina van recobrando impulso lentamente. Estos países han realizado ajustes estructurales que han supuesto fuertes pérdidas por concepto de la producción a que han tenido que renunciar. Se ha detenido la corriente inversa de capital Sur-Norte, y América Latina atrae actualmente inversiones extranjeras. A medida que el crecimiento industrial se recupera en América Latina y mantiene su rápido ritmo en Asia, en el Norte los altos tipos de interés y la atonía de la demanda constituyen posibles obstáculos. Para las masas de desempleados de los países ricos y pobres, es de importancia primordial que en las economías de mercado desarrolladas se reanime rápidamente el crecimiento.

Los países de Europa oriental han tomado muy en serio la adopción de políticas orientadas al mercado en sustitución de la planificación centralizada. Esos países están experimentando la privatización general de sus economías estatizadas. Este experimento ofrece oportunidades y plantea problemas. Sin embargo, otros países, desarrollados y en desarrollo por igual, se están percatando de que hay tantos métodos de privatización como razones para propugnarla. La importancia de la privatización como instrumento de política preferido es innegable. Por ello, en el *Informe Mundial* del presente año se ha dado un relieve especial a la privatización, con objeto de ayudar a los encargados de formular políticas a plantearse por vez primera la posibilidad de la privatización y de tranquilizar a quienes ya hayan emprendido ese rumbo y tropiecen con problemas.

El proceso de industrialización, aun 200 años después de iniciado, sigue poniendo a prueba nuestra ingeniosidad. Para lograr una industrialización sostenida durante un largo período, es preciso poseer capacidad de adaptación a los cambios continuos. Ahora bien, esta capacidad de adaptación debe manifestarse en todos los sectores de la economía, pues la industrialización es un proceso que también transforma los sectores no industriales; para ello, debe promoverse una simbiosis, en vez de una polaridad, entre la industria y la agricultura y entre el sector manufacturero y los servicios. A medida que aumenta el crecimiento industrial, aumenta también la productividad de la mano de obra y disminuye el número de trabajadores necesarios para obtener el mismo volumen de producción. Sólo en economías de crecimiento excepcionalmente rápido no se produce, a consecuencia de ello, una disminución del empleo en la industria manufacturera. Como los aumentos de productividad se traducen en disminuciones de precios, el valor añadido manufacturero no crece a la par que el volumen; a consecuencia de ello, disminuye el porcentaje de las manufacturas en el ingreso nacional. Los servicios van ocupando un lugar cada vez más destacado en cuanto al porcentaje del ingreso nacional y al tamaño de la fuerza de trabajo. Este hecho, sin embargo, debería considerarse como un resultado positivo de la industrialización y no como un indicio de su declive. El crecimiento de la productividad de la mano de obra es la única garantía de un aumento de los ingresos reales, en tanto que la disminución del precio relativo de las manufacturas supone un beneficio continuo para los consumidores. La fuerza del proceso de industrialización consiste en que permite lograr un progreso técnico continuo y entraña un mejoramiento constante de los niveles de vida a largo plazo.

Al abogar por el crecimiento industrial, la ONUDI no subestima las dificultades que éste plantea ni resta importancia a la contribución de otras actividades económicas. El concepto clave es la interdependencia entre la industria y el conjunto de la economía, entre los países ricos industrializados y los países pobres en desarrollo, y entre la economía y la ecología. La tarea de la ONUDI consiste en coadyuvar a este proceso de industrialización buscando las mejores formas de aprovechar esa interdependencia. A tal fin, el *Informe Mundial* del presente año trata cuestiones relacionadas con la interdependencia tecnológica, la eficiencia de la privatización y las estrategias encaminadas a la formación de personal calificado y al desarrollo de instituciones. Las numerosas soluciones ya preparadas se complementan con estudios sectoriales y con un anexo estadístico detallado.

La ONUDI está dedicada a promover un crecimiento industrial equilibrado a nivel mundial. La búsqueda de soluciones es un proceso continuo. Desde que se publicó por primera vez en 1985, el *Informe Mundial* ha procurado tratar las cuestiones de política que están en constante evolución. Al iniciar mi último año de mandato, soy doblemente consciente de cuanto ha logrado la ONUDI hasta la fecha y de los problemas que la Organización deberá afrontar en el futuro. Confío en que este *Informe Mundial* sea útil para hacer progresar la industrialización y para potenciar aún más la dedicación de la ONUDI a la tarea de prestar asistencia a los países en desarrollo.

DOMINGO L. SIAZON, Jr.
Director General

CONTENTS

Tables

Figures

Boxes

EXPLANATORY NOTES

Reference to dollars ($) are to United States dollars, unless otherwise stated.

References to tonnes are to metric tons, unless otherwise specified.

A slash (1980/81) indicates a crop year or a financial year.

Industry categories referred to in this publication are based on Revision 2 of the International Standard Industrial Classification (ISIC)

References to ISIC codes are accompanied by a descriptive title (for example, ISIC 323- "Manufacturing of leather and products of leather, leather substitutes and fur, except footwear and wearing apparel"). Consideration of space, however, requires a shortening of this description (for example, ISIC 323 may be referred to simply as "Leather and fur products"). In some cases, ISIC categories have been aggregated and the descriptive titles adjusted accordingly.

The term "billion" signifies a thousand million.

Figures in square brackets [ ] refer to source material listed after chapter V.

The following symbols have been used in tables:

Two dots (..) indicate that data are not available or are not separately reported.

A dash (—) indicates that the amount is nil or negligible.

Totals may not add precisely because of rounding.

The following abbreviations and acronyms appear in this publication:

AIDS	acquired immunodeficiency syndrome
ASEAN	Association of South-East Asian Nations
BOT	build-operate-transfer
CAD	computer-aided design
CAM	computer-aided manufacturing
CMEA	Council for Mutual Economic Assistance
DAC	Development Assistance Committee
ECU	European currency units
EEC	European Economic Community
EFTA	European Free Trade Association
GATT	General Agreement on Tariffs and Trade
GCC	Gulf Co-operation Council
GDP	gross domestic product
GNP	gross national product
GLC	government-linked company
IFC	International Finance Corporation
IMF	International Monetary Fund
ISIC	International Standard Industrial Classification of all Economic Activities
MITI	Ministry of International Trade and Industry
MVA	manufacturing value added
NIC	newly industrializing country
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of Petroleum Exporting Countries
R and D	research and development

This report is based on information available as of March 1992.

Introduction: the structure of this *Global Report*

Political turmoil and economic doldrums—the pattern established during 1990—continued during 1992. The breakup of the Union of Soviet Socialist Republics (USSR) into 15 independent States was an epochal event. For nearly 75 years the USSR had been not only the citadel of socialism, but also the bearer of its distinctive message for industrializing economies. Its death meant more than the dissolution of a federation: it signalled the demise of a strategy for industrialization based on central planning and publicly owned, vertically integrated giant industries. Market forces and privatization have now become virtually universal strategies for industrialization and development.

Market forces, however, require clear orientation. The macroeconomic picture continued to be gloomy for the developed market economies. Fears of rekindling inflation are being constantly admixed with concerns for mounting unemployment and faltering growth. This most recent recession has proved to be one of the longest. But the prospect is now at best of a sluggish recovery. Add to this the various issues of deindustrialization, and one begins to understand the obstacles to the successful completion of the Uruguay Round of trade negotiations within the framework of the General Agreement on Tariffs and Trade (GATT). It is almost possible to hear the hatches being battened down across emerging large regional blocs.

Chapter I continues the established practice of presenting UNIDO growth projections for GDP and MVA for all the regions. In 1991, for the first time in this half century, global output declined because of the recession and the collapse of the socialist economies. Although world growth is expected to become more expansive in 1993, the sluggishness of recovery in developed countries remains troublesome. If progress towards freer trade is seriously hampered in the coming months due to a failure to complete the Uruguay Round, then the task of developing countries in the process of industrialization will become even more difficult. Looking several years ahead, this slow-down in world growth is put in a long-run historical perspective to ask whether it represents the advent of a stationary state, predicted by the classical economists, or merely a turning-point in a Kondratieff long wave. Whatever the answer, the difficulties this poses for the world have serious implications.

A detailed analysis of the industrial performance of major economies around the world occupies chapter II. Developing countries are continuing to grow. The harsh rigours of the 1980s have ended for Latin America, which is witnessing a revival in growth and inward capital flows. Africa however continues to face difficulties. Since Asian economies everywhere—East, South-East, South—have become virtually self-sustained in their growth, sub-Saharan Africa constitutes the last but most serious challenge to development policy makers. While there is evidence that developing countries rely increasingly on internal sources as engines for growth, there is a great deal of disparity in their capacities to manage development. As to the policy aspects, therefore, the present *Global Report* analyses the interregional differences in labour productivity, and emphasizes the need for investment in human capital. The development and strengthening of human capability—skills in a broad sense of the term—goes hand in hand with investments in physical capital and institution-building.

Everywhere in the world economy, employment continues to be a major concern. The recession in the richer countries combined with some longer-run factors mean that there will be 30 million unemployed in member countries of the Organisation for Economic Cooperation and Development (OECD) in 1992. This is the highest figure since 1983. The transition to a market economy has meant large-scale open unemployment in the former socialist economies which boasted zero unemployment. In developing countries there are persistent complaints that industrial growth even when it is rapid fails to generate jobs at the rate needed to keep up with the growth of the labour force. These are not unconnected developments. UNIDO has consistently argued that a steadily expanding economy in the North is essential for rapid growth everywhere. But the fruits of rapid industrialization are as much in extra employment in other sectors of the economy as they are in manufacturing. The present *Global Report* contains in chapter III a structural analysis of eight Asian economies which demonstrates the symbiotic relationships between manufacturing and agriculture and between manufacturing and services. As a country moves up the ladder of industrialization, the services sector bears the major part of the burden of income generation and employment creation. However, manufacturing plays the crucial catalytic role in overall development.

In their search for the springs of growth, economies everywhere are experimenting with privatization. The economies of Eastern Europe have made the irreversible political decision to adopt a full-fledged market economy. They are perhaps the most ambitious in their plans to privatize, and may also be the most in need of the promised miracle to deliver greater prosperity. But in both developed and developing countries, there is a busy air of privatization to improve the efficiency of the economy, to relieve the public budget of large losses, to enhance the quality and range of products, and to spread the habits of share ownership as widely as possible. Chapter IV reviews the recent privatization experiments in some 50 countries. Although privatization has been seen as a panacea by many countries, the opportunities presented by this policy, the pressures that led to its adoption, and the serious obstacles that continue to impede speedy privatization are found to be not at all similar. The analysis is given an added dimension by answers from a questionnaire survey of managers of industrial enterprises facing the challenge of privatization.

Chapter V provides surveys and reviews of 12 selected industrial sectors based on contributions from editors of professional trade journals (see acknowledgements). These include three primary processing industries—aluminium, sugar-processing, and paper and paperboard; five intermediate goods industries—agrochemicals, investment casting, powder metallurgy, synthetic fibres, and iron and steel; three capital goods industries—machine tools, food-processing equipment, and mineral-processing equipment; and one consumer goods industry—footwear. Growth has levelled off, if not declined, in many of these industries, reflecting the slow-down in the world economy. Primary goods producers were especially hard hit. As no new capacity expansion in the intermediate products industries is on the horizon, the outlook for machine tool industries is clouded. The exodus of labour-intensive consumer product industries, such as footwear, from the Asian newly industrializing countries (NICs) to their neighbours is expected to continue.

The statistical annex gives the latest available information on output, employment and profit in each industrial branch in some 137 countries. This annex, a part of which appears in the annual edition of the *World Data Book* of *The Encyclopaedia Britannica*, has proven to be a valuable source of information to researchers and policy makers alike.

I. World industrial economy: short- and medium-term outlook

A. Short-term outlook

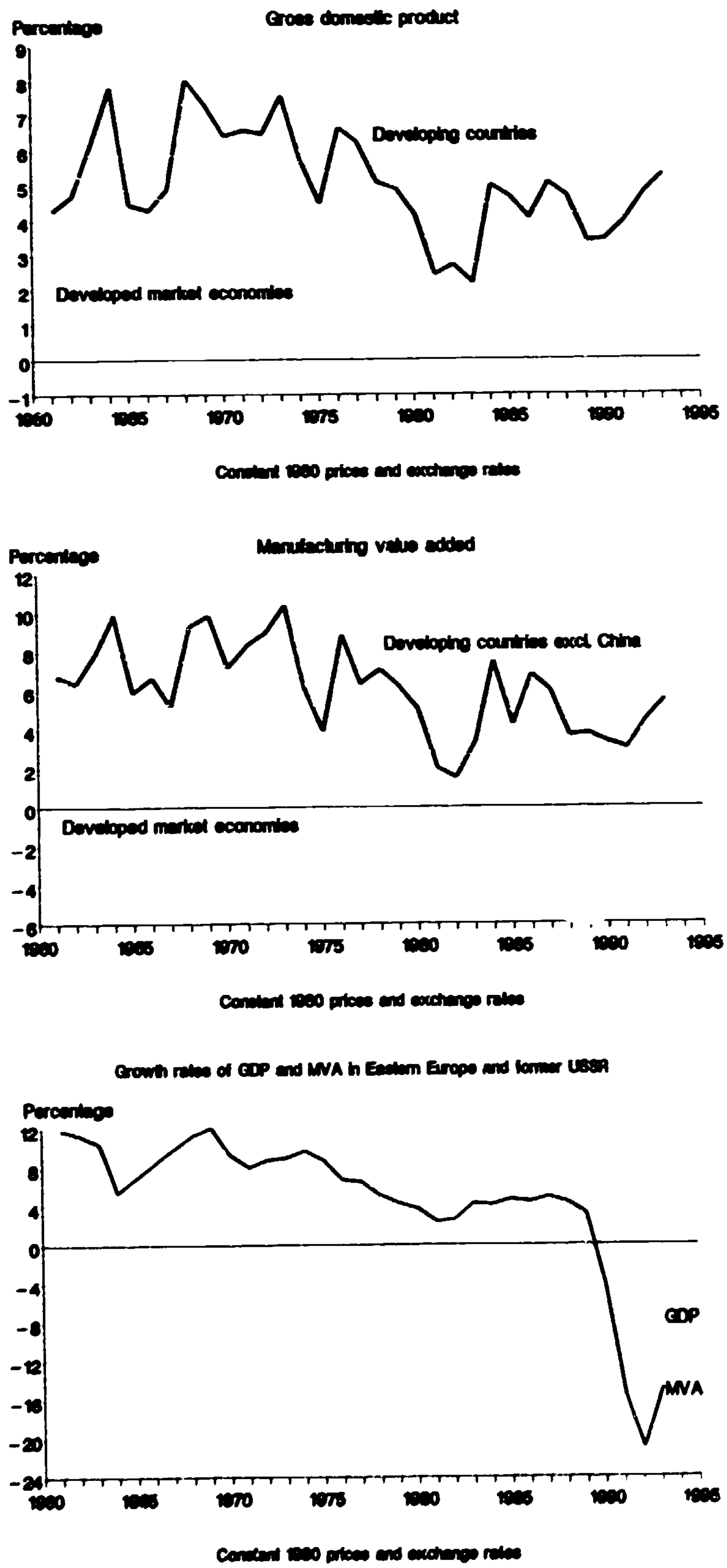
In 1991, for the first time in the second half of the twentieth century, global output declined. The fall was small, by 0.1 per cent. The depth of the current downturn is not the result of especially severe cyclical factors, but the combination of ordinary recessions in the United States, United Kingdom and Canada and slow growth in most other member countries of the Organisation for Economic Cooperation and Development (OECD), with the sharp fall in production in Eastern Europe and the former Union of Soviet Socialist Republics (USSR). For comparison, world growth in gross domestic product (GDP) at the bottom of the last two downturns in 1975 and 1982 was 1.1 per cent and 0.7 per cent, respectively. However, when Eastern Europe and the former USSR are left out of the calculation, 1991 GDP growth is 1.5 per cent, versus 0.8 per cent in 1975 and 0.5 per cent in 1982 (see figure I.1). From this perspective the downturn looks mild. But if the downturn looks mild, the recovery is expected to be mild as well, and it has been slow in coming. In the middle of 1991 most forecasters, including UNIDO, foresaw gradual recovery beginning late in 1991, with 1992 being a year of significantly higher growth. But as it turned out, at the end of 1991, not only had recovery failed to take hold in three of the seven largest industrial economies, the United States, United Kingdom, and Canada, but gross national product (GNP) was falling in Japan and Germany. So far these dire fourth-quarter 1991 developments do not seem to presage anything more serious than a postponement of recovery. Growth is expected to be positive in all seven of the largest industrial economies in 1992 and to become more expansive in 1993 (see table I.1).

Growth in the developing countries, including China, was 3.8 per cent in 1991 versus 3.6 per cent in 1990. Higher growth in centrally planned Asia and Latin America offset lower growth rates registered in each of the other regions. While the hoped for revitalization of growth in the developing economies has yet to occur, there is some reason for optimism in the fact that the global downturn did not bring about an actual decline in growth in developing countries. Falling commodity prices, and generally depressed export markets, were not on balance sufficient to offset internally generated positive factors. Among the factors that had a positive effect on growth in developing countries were progress in some countries in reaching debt restructuring agreements and the effects of lower interest rates in reducing debt service payments. Another positive factor was the increase in the number of countries that have proceeded far enough along with stabilization and structural adjustment programmes for them to now be producing higher growth rates. UNIDO forecasts of 4.5 per cent growth in 1992 and 5.2 per cent in 1993 for developing countries, including China, are based on the assumption that these positive factors will develop further and be reinforced by a stronger global economy.

World manufacturing value added (MVA) fell by 3.0 per cent in 1991, following three years of positive but declining growth, from 5.4 per cent in 1988 to 3.8 per cent in 1989 and to 0.4 per cent in 1990. The amplitude of cycles in manufacturing tends to be greater than that of GDP, and the current cycle is not an exception. While the GDP growth rate fell from 4.4 per cent in 1988 to −0.1 per cent in 1991, or 4.6 percentage points, the fall in the global MVA growth rate over the same period, from 5.4 per cent to −3.0 per cent, was 8.4 percentage points. In the developed market economies this four-year trend of falling MVA growth rates was nearly universal. Two exceptions were Austria and the western part of Germany where the cyclical downturn was postponed because of the spending associated with German unification and close involvement in the rebuilding of the economies of Eastern Europe. In 1991, however, MVA growth in both Austria and the western part of Germany registered sharp declines. In Austria MVA growth fell from 4.6 per cent in 1990 to 1.6 per cent in 1991, and in the western part of Germany it fell from 5.5 to 2.8 per cent. For the developed market economies, 1991 MVA growth of −1.3 per cent represented a decline of 7.7 percentage points from its 1988 peak. The developing countries, excluding China, as a group registered MVA growth of 3 per cent in 1991. This is a decrease over 1990 and continues four years of decline, from 6.8 per cent in 1986 to 3.3 per cent in 1990.

In the United States the hoped-for soft landing of 1990, when GDP growth slowed to 1 per cent, became an ordinary recession with a 0.7 per cent GDP decline in 1991. The UNIDO forecast for 1992 is 1.9 per cent growth. Higher growth is expected to begin late in 1992 and continue through 1993 to produce 3.7 per cent growth for the year. The extent to which the economies of the United States and Canada are intertwined normally results in shared cyclical conditions, as has been the case in the current recession. UNIDO forecasts Canadian GDP growth of 2 per cent in 1992, followed by 4.3 per cent in 1993. The combined 1991 growth rate for the countries of the European Economic Community (EEC) was 1 per cent. The soft

Figure I.1. Growth rates of GDP and MVA in developed and developing regions, 1961-1993



Sources: United Nations National Account Statistics and UNIDO database landing that it was thought the United States had achieved in 1991 seems now to have been achieved by the combined effect of the individual stabilization policies of the EEC countries. It will be interesting to see if they do as well in 6 to 10 years when, if all goes according to plan, the European Community will have a common currency and common monetary policy. The 1992/93 UNIDO forecast implies 1992 EEC growth of 1.7 per cent, rising to 2.6 per cent in 1993. The rate of economic growth in Japan fell from 5.2 per cent in 1990 to a still robust 4.6 per cent in 1991, but nearly all of the growth occurred in the first half of the year. The slow-down in the second half of 1991 is expected to last through 1992 and produce growth for the year of 2.8 per cent. Higher growth of 3.5 per cent is expected in 1993.

In Eastern Europe and the former USSR, GDP fell by 4.6 per cent in 1990 and a further 16.7 per cent in 1991. UNIDO expects further output decline of 14.0 per cent in 1992 and 7.4 per cent in 1993. While the transformation process has been going on for two years or longer in the Eastern European countries, it has just begun in the former USSR. Despite this the newly independent States of the former USSR have undertaken several important steps, including extensive price decontrol, drafting of new tax legislation and the creation of central banking institutions. Privatization measures have been developed and some of the States plan substantial privatization during 1992.

Stabilization efforts have been reasonably successful in Eastern Europe, although inflation increased in 1991. The International Monetary Fund (IMF) reports that in Eastern Europe inflation, measured in terms of consumer prices, was 135 per cent in 1991, and forecasts 95 per cent in 1992. It estimates that for the former USSR inflation was 86 per cent in 1991 and expects it to be around 1000 per cent in 1992. Part of the increase in prices in the former USSR was the result of extensive price decontrol and the devaluation of the rouble, but the main factor was the creation of money to finance government expenditures. The need to rely on money creation as a source of government revenues will diminish as new tax measures are implemented, and should make stabilization efforts in most of the new States more effective in 1993.

MVA in the reform economies of Eastern Europe and the former USSR fell by 4.2 per cent in 1990 and by 15.5 per cent in 1991. This decline approximately matches the decline in GDP. In 1992 and 1993 the decline in MVA is expected to exceed the decline in GDP, and over time the share of MVA in GDP is expected to continue falling. MVA shares are typically much higher in the reform economies than in other economies at a similar stage of development. In the short-run the disruptions associated with the reform process will result in the downsizing or closing of many large manufacturing facilities. Also in the short-run, price decontrol will favour agriculture as both higher real prices and increased output work to increase its share of GDP. Over the longer run the service sector will increase its share of GDP at the expense of both agriculture and industry. Wholesale and retail trade, finance, communications, real estate, insurance and marketing are the types of activities that will show the highest growth rates as they expand to meet the needs of the new market-controlled economic system.

GDP growth in Latin America increased from 0.3 per cent in 1990 to 2.9 per cent in 1991, the highest since 1986. This growth was largely accounted for by four countries, Argentina, Chile, Mexico and Venezuela. Vigorous measures undertaken to reduce inflation, liberalize trade, and strengthen the role of market forces were in part responsible. Debt restructuring, debt relief and lower market interest rates also were factors. All four of these high-growth countries are among the 15 heavily indebted countries identified in the Baker debt relief proposal. Brazil continues to face a period of slow growth associated with austere stabilization measures, but zero growth in 1991 was a substantial improvement from the 4.3 per cent decline in 1990. For Latin America as a whole, UNIDO forecasts growth of 3.1 per cent in 1992, increasing to 4.0 per cent in 1993. Growth of 4.0 per cent, if achieved, would be the highest growth rate in Latin America since 1980. MVA growth increased by 3.3 percentage points from −1.7 per cent in 1990 to 1.6 per cent in 1991, as the 1990 fall of −7.3 per cent in Brazil slowed to −2 per cent, and Argentina, Chile, Mexico, Puerto Rico and Venezuela recorded substantial MVA growth.

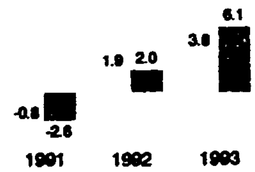
Growth in Tropical Africa fell from 2.7 per cent in 1990 to 1.8 per cent in 1991. In Nigeria, the fall in the international price of oil was one factor contributing to the decline in growth from 8.2 per cent in 1990 to 4.3 per cent in 1991. For Tropical Africa excluding Nigeria, 1991 growth of 1.2 per cent was slightly lower than the 1.6 per cent recorded in 1990. This group of countries has recorded falling per capita GDP in every year for the last decade. Lower commodity prices and generally poor export markets contributed to holding down growth in 1991. Tropical beverage prices were down 7 per cent over the year. Poor agricultural conditions and civil disturbances also were negative factors in some areas. In southern Africa extreme drought conditions will make it necessary to import 8 million tonnes of grain in 1992, according to a report of the Southern Africa Development Coordinating Conference. For 1992, GDP growth in Tropical Africa as a whole is expected to be 2.2 per cent. With recovery in the world economy and an improvement in commodity prices, growth in 1993 is expected to increase to 2.7 per cent.

MVA growth in Tropical Africa in 1991 declined slightly to 2.7 per cent from 2.9 per cent in 1990. Capacity utilization rates increased somewhat in 1991, but remained generally very depressed, probably not exceeding 50 per cent for the region as a whole. Part of the installed capacity in Tropical Africa is unused because the markets it was intended to serve will not absorb its output. In some cases markets or raw material inputs were never sufficient for installed capacities. In other cases the deterioration of economic conditions after facilities were put in place made it impossible to run them at their intended capacities. The shift in recent years toward more intensive use of local resources has helped to improve manufacturing performance. The reduction in trade barriers, decontrol of prices, and the rationalization of many manufacturing facilities through privatization or improved financial controls is likely to further increase the local resource intensity of manufacturing as enterprises gain more latitude to respond to market incentives. Despite

Table I.1. Regional and country estimates of GDP and MVA

Regions, countries and areas	GDP growth rates (percentage) 1991	1992	1993	MVA growth rates (percentage) 1991	1992	1993
World	-0.1	1.4	3.0	-3.0	-1.4	2.0
Developing countries excluding China	3.2	3.8	4.6	3.0	4.4	5.5
Developed market economies	0.7	2.0	3.2	-1.3	1.3	3.8
China	7.0	8.3	7.8	...	...	...
Eastern Europe and former USSR	-16.7	-14.0	-7.4	-15.5	-21.1	-14.9
North America	0.8	1.9	3.8	-2.6	2.0	6.1
Bermuda	3.2	1.9	1.5	2.7	2.3	2.2
Canada	-1.5	2.0	4.3	-6.7	2.0	4.7
United States	-0.7	1.9	3.7	-2.3	2.0	6.2
Western Europe	0.7	1.5	2.5	-2.0	-0.1	1.9
Austria	3.5	2.5	2.4	1.6	2.2	2.7
Belgium	1.3	1.2	1.6	-2.9	1.0	2.0
Denmark	1.8	1.8	2.0	2.3	1.5	1.6
Finland	-6.2	0.5	3.1	-10.2	-0.5	3.2
France	1.3	2.0	2.5	-1.0	-0.2	0.9
Germany, Eastern Part	-10.0	5.0	5.0	-12.0	6.6	6.8
Germany, Western Part	3.6	1.5	2.4	2.8	-0.1	1.6
Greece	0.7	1.5	2.0	-1.3	0.0	1.1
Iceland	1.0	1.5	1.0	-1.1	-0.2	-0.9
Ireland	1.3	2.0	2.5	2.3	4.6	4.5
Israel	4.0	3.1	2.7	7.3	3.5	3.2
Italy	1.1	1.3	2.1	-2.6	-0.6	1.5
Luxembourg	3.0	1.6	3.0	0.4	-0.8	2.4
Malta	4.7	4.2	5.7	0.7	3.2	6.2
Netherlands	2.5	1.3	2.1	0.9	1.5	2.1
Norway	1.9	5.0	4.7	-2.0	1.4	1.6
Portugal	2.0	3.0	3.2	-3.0	2.3	2.5
Spain	2.4	2.4	3.2	-1.4	0.3	2.1
Sweden	0.7	0.7	2.0	-8.2	-1.8	2.6
Switzerland	0.5	0.9	1.1	0.5	0.4	1.4
United Kingdom	-2.1	1.0	3.2	-5.2	-0.8	2.9
Yugoslavia	-15.0	-17.0	-5.0	-21.3	-22.9	-15.8
Eastern Europe incl. former USSR	16.7	14.0	-7.4	15.5	21.1	14.9
Albania	-14.0	-16.0	-5.0	-40.0	-20.0	-9.6
Bulgaria	25.7	-14.0	-6.5	...	...	...
Czechoslovakia	19.5	10.0	-5.0	-24.8	-12.7	-6.5
Hungary	-8.0	-4.0	-1.0	10.0	-5.0	-1.3
Poland	9.8	-5.0	4.4	15.0	-7.3	-6.9
Romania	-1[illegible].5	10.0	-5.0	20.5	-20.1	13.5
USSR	17.0	-15.0	8.0	14.7	-22.3	16.1
Japan	4.6	2.8	3.5	2.1	2.6	4.3
Other developed countries	-1.7	1.9	2.9	-4.3	0.9	2.6
Australia	-2.1	2.0	3.3	-5.4	0.5	2.8
New Zealand	-1.9	0.9	1.6	-2.6	1.0	1.9
South Africa	-0.6	2.0	2.4	2.5	1.6	2.3
Latin America and the Caribbean	2.9	3.1	4.0	1.6	2.7	3.9
Argentina	5.0	6.0	5.0	6.3	8.9	7.2
Bahamas	-0.8	0.7	3.4	...	...	...
Barbados	2.1	4.3	1.9	-2.6	3.5	1.6
Belize	6.3	0.9	6.9	6.4	1.9	2.1
Bolivia	4.1	3.6	4.3	4.4	3.8	4.6
Brazil	0.0	1.0	3.0	2.0	0.7	1.9
Chile	6.0	4.1	1.9	5.2	3.6	0.7
Colombia	2.0	[illegible].6	3.7	0.5	1.4	3.2
Costa Rica	1.3	3.7	5.8	0.5	4.1	7.1
Cuba	0.1	1.0	1.0	0.3	1.1	1.1
Dominican Republic	0.5	0.2	0.2	1.6	2.3	2.4
Ecuador	2.5	2.5	6.1	7.6	2.4	3.8
El Salvador	3.5	3.3	2.5	3.2	3.5	3.0
French Guiana	-0.5	0.6	0.2	2.1	2.4	1.9
Guadeloupe	0.0	1.7	4.7	0.9	1.1	2.5
Guatemala	3.2	3.8	5.3	2.6	3.5	5.4
Guyana	6.0	4.5	1.4	0.7	8.5	2.1
Haiti*	0.8	1.0	0.4	2.4	1.0	0.2
Honduras	2.2	2.6	4.2	3.2	3.5	5.2
Jamaica	2.5	2.1	1.7	2.4	2.0	1.6
Martinique	5.1	5.9	5.0	2.0	1.9	2.1
Mexico	4.6	5.0	5.6	3.7	5.8	6.3
Montserrat	8.5	0.7	2.2	10.0	6.4	4.3
Netherlands Antilles and Aruba	1.9	-1.0	2.1	2.5	2.8	2.4
Nicaragua	-0.7	1.5	0.9	0.7	2.6	1.2
Panama	9.3	3.7	0.9	8.7	3.1	0.2
Paraguay	2.5	2.6	5.0	1.7	1.6	4.4
Peru	2.8	-1.0	-2.0	3.1	-2.0	-3.3
Puerto Rico	1.9	3.9	4.3	2.8	5.0	5.4
Suriname	1.9	3.5	1.0	-1.7	-0.3	-2.6
Trinidad and Tobago	1.5	-0.2	-3.0	-0.1	-1.8	-2.9
Uruguay	1.2	2.1	2.8	0.8	1.8	2.7
Venezuela	9.2	5.0	6.0	10.1	6.1	7.0
Tropical Africa (Sub-Sahara)	1.8	2.2	2.7	2.7	4.0	4.4
Benin*	-2.1	2.6	-0.4	0.5	2.1	0.1
Botswana*	2.4	4.0	7.0	...	...	...
Burkina Faso*	4.1	2.8	2.7	5.4	3.0	1.6
Burundi*	3.8	1.9	3.4	3.0	3.4	3.4
Cameroon	-2.5	0.1	-0.6	0.6	3.8	2.6
Cape Verde*	6.4	5.6	5.3	...	...	...
Central African Republic*	1.0	0.2	0.6	2.1	1.9	2.0
Chad*	2.7	0.4	-2.2	2.9	0.7	-1.8
Comoros*	1.3	0.2	2.3	2.7	0.9	1.5

NORTH AMERICA



LATIN AMERICA
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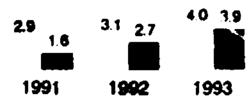

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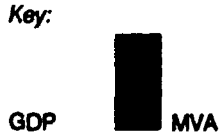


(Percentages)

growth for 1991 and projections for 1992 and 1993

Regions, countries and areas	GDP growth rates (percentage) 1991	1992	1993	MVA growth rates (percentage) 1991	1992	1993
Congo	2.5	3.2	5.9	0.6	2.9	4.4
Côte d'Ivoire	-1.5	0.0	1.0	0.3	0.7	2.1
Djibouti*	3.1	3.1	2.0	4.4	4.0	3.7
Equatorial Guinea*	5.3	-0.7	-2.1	0.4	-1.9	-4.3
Ethiopia*	-4.6	1.0	1.0	-3.7	-1.6	1.5
Gabon	2.0	3.5	3.4	...	...	...
Gambia*	4.0	4.5	5.3	6.9	7.0	6.1
Ghana	4.0	5.0	4.0	6.9	9.3	6.9
Guinea*	3.5	2.0	2.5	2.9	2.5	2.6
Guinea-Bissau*	1.4	1.8	2.6	-0.3	-0.7	-0.3
Kenya	3.5	4.0	4.5	5.8	6.0	6.4
Lesotho*	5.4	6.2	4.1	...	...	...
Liberia*	3.2	1.3	-0.1	5.9	3.5	1.8
Madagascar*	0.3	-0.3	0.7	3.2	3.2	3.3
Malawi*	7.8	5.3	5.1	5.2	6.0	6.4
Mali*	0.5	0.7	3.1	0.7	3.2	5.5
Mauritania*	2.5	1.4	2.2	6.6	6.3	6.4
Mauritius	4.3	5.5	6.8	7.5	8.7	9.9
Mozambique*	0.9	2.0	2.5	4.3	2.4	3.8
Namibia	1.7	1.7	0.5	...	...	...
Niger*	0.8	2.0	2.2	1.5	1.2	1.8
Nigeria	4.3	4.0	5.0	6.1	7.0	8.0
Reunion	3.8	4.8	4.7	4.4	4.1	4.3
Rwanda*	-2.0	-3.0	-2.0	...	...	...
Sao Tome and Principe*	0.6	0.8	-2.5	1.2	1.3	-1.3
Senegal	3.4	2.1	2.5	5.4	2.6	4.0
Seychelles	1.7	1.1	3.9	8.2	7.9	9.2
Sierra Leone*	2.0	3.9	0.2	1.3	1.2	0.3
Somalia*	-3.0	-3.5	0.6	...	...	...
Swaziland	3.2	4.7	7.1	6.1	6.4	7.2
Togo*	-2.0	-1.5	2.3	-1.9	-1.4	2.2
United Republic of Tanzania*	2.5	2.1	2.9	1.2	2.8	3.1
Uganda*	1.6	3.0	-1.0	2.8	6.4	-1.4
Zaire*	-0.3	-2.0	-1.1	-1.9	-3.9	-2.9
Zambia*	-0.8	0.8	0.4	-7.5	1.6	3.3
Zimbabwe	4.0	4.2	3.5	5.0	5.3	4.5
North Africa	2.5	2.8	3.1	3.1	4.2	4.9
Algeria	0.5	0.4	2.0	0.0	-0.8	0.4
Egypt	2.3	5.0	3.1	2.2	6.0	7.0
Libyan Arab Jamahiriya	5.9	3.0	3.3	9.1	9.9	10.1
Morocco	3.0	3.8	4.7	4.1	4.4	4.7
Sudan*	1.1	2.0	1.7	0.5	1.1	0.9
Tunisia	3.5	5.0	5.2	6.7	8.2	8.4
Western Asia	3.0	4.5	4.4	4.5	7.5	5.8
Bahrain	-1.4	1.6	3.6	3.3	6.2	6.5
Cyprus	4.3	3.6	6.2	4.4	4.0	6.8

(continued on page 8)

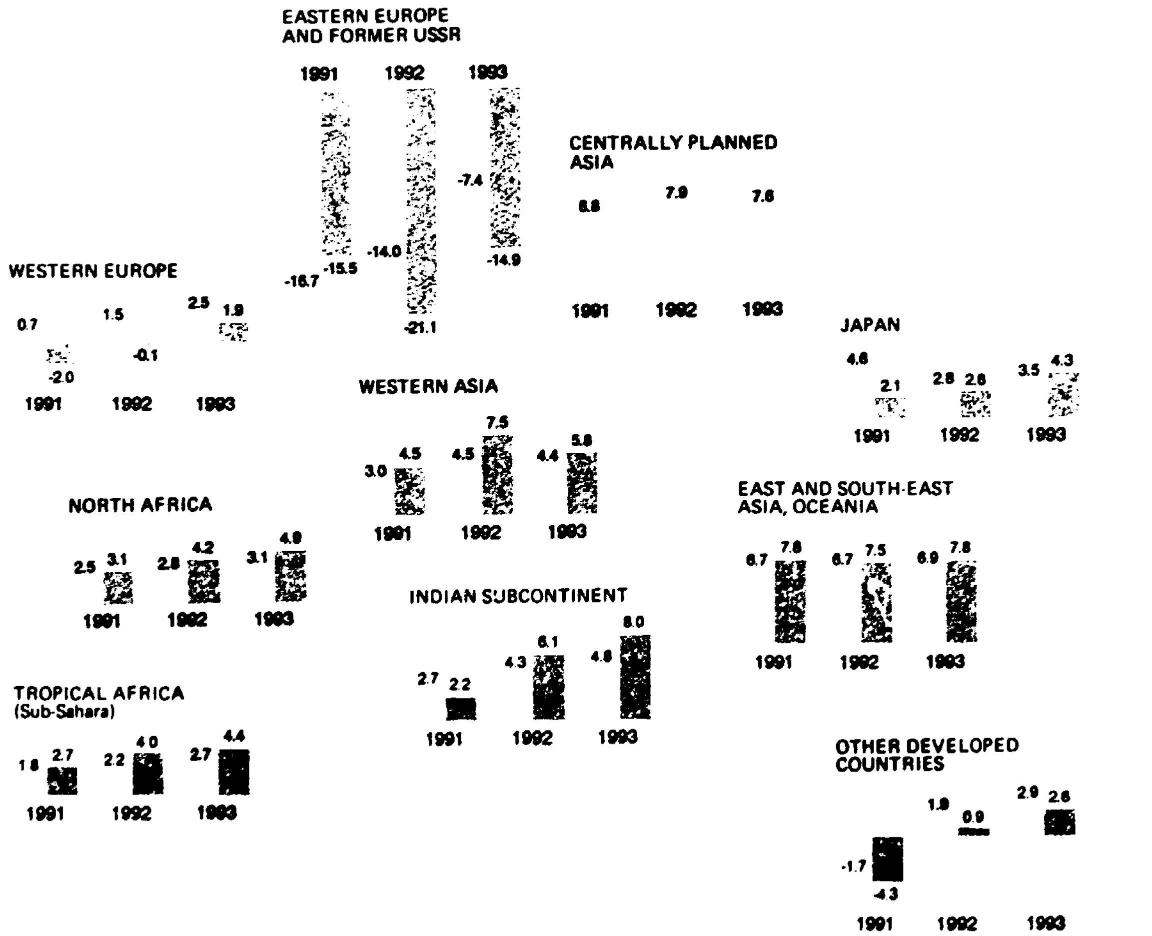


Table I.1. Regional and country estimates of GDP and MVA growth for 1991 and projections for 1992 and 1993

(continued)

Regions, countries and areas	*GDP growth rates (percentage)* 1991	1992	1993	*MVA growth rates (percentage)* 1991	1992	1993
Iran (Islamic Republic of)	6.0	5.0	2.7	6.4	6.0	4.3
Iraq	-30.0	-2.0	-1.0	-4.1	46.0	-26.3
Jordan	1.0	1.1	3.2	-3.2	1.6	2.6
Kuwait	8.0	6.7	15.0	-5.0	7.6	12.2
Oman	5.0	7.0	11.4	...	...	...
Qatar	3.5	4.0	-3.8	8.8	8.9	8.1
Saudi Arabia	7.1	6.5	5.0	8.8	8.7	8.2
Syrian Arab Republic	5.0	-2.0	0.0	...	...	...
Turkey	1.5	2.6	5.1	2.2	5.2	6.5
United Arab Emirates	7.5	8.0	4.0	10.1	10.5	8.7
Yemen*	7.6	4.6	6.8	8.8	8.9	9.0
Indian Subcontinent	2.7	4.3	4.8	2.2	6.1	8.0
Afghanistan*	5.0	3.0	7.3	-2.1	2.1	6.5
Bangladesh*	3.6	4.1	4.6	7.6	...	...
Bhutan*	8.0	10.2	7.6	4.0	6.0	8.0
India	2.0	4.1	4.5	1.5	6.0	[illegible]
Myanmar*	5.5	5.0	4.1	4.7	4.5	6.0
Nepal*	4.1	2.4	2.8	3.1	2.8	3.7
Pakistan	5.6	5.5	6.3	5.7	7.0	3.0
Sri Lanka	4.8	6.0	5.1	3.5	7.5	8.0
East and South-East Asia, Oceania	6.7	6.7	6.9	7.8	7.5	7.8
Brunei Darussalam	-3.1	0.3	1.5	-3.0	0.6	1.9
Fiji	4.0	1.8	1.0	-7.0	5.0	4.3
French Polynesia	0.4	4.0	5.7	3.5	5.2	4.6
Hong Kong	3.5	6.1	7.0	0.4	4.6	6.6
Indonesia	7.0	5.9	7.1	7.5	8.0	7.0
Macau	...	...	...	...	...	...
Malaysia	8.6	8.6	8.0	11.2	12.1	11.5
New Caledonia	20.0	18.7	17.2	-0.9	1.8	3.6
Papua New Guinea	9.3	5.1	9.0	7.2	10.7	10.5
Philippines	-0.1	2.5	4.1	-2.2	3.0	5.0
Republic of Korea	8.4	7.5	7.0	9.9	7.5	8.0
Samoa*	-2.3	1.9	-1.0	2.1	0.4	-1.5
Singapore	6.7	7.5	8.0	7.2	7.5	8.0
Taiwan Province	7.0	7.2	7.0	7.9	7.0	7.2
Thailand	7.9	7.0	6.7	10.1	8.8	8.4
Tonga	3.7	5.1	4.1	7.6	10.0	5.7
Tuvalu*	...	...	...	...	...	...
Vanuatu*	3.4	2.9	3.4	13.4	13.4	13.4
Centrally planned Asia	6.8	7.9	7.6			
China	7.0	8.3	7.8	...	...	...
Democratic People's Republic of Korea	5.3	2.9	3.8	...	...	...
Lao People's Democratic Republic*	6.1	5.9	6.2	12.0	5.9	1.9
Mongolia	-18.0	-21.5	-11.8	-26.1	-25.0	-15.0
Viet Nam	3.8	1.2	3.5	...	...	...

*Least developed country

Note: Calculations are based on 1980 United States dollars figures.

Table I.2. Estimated share of industrial value added of developing countries in world total in 1975 projected shares for 1990 and 1993

(Percentage)

ISIC	*Branch of industry*	*Share of developing countries in world total*[a] 1975	*Projected* 1990	1993	*Average annual growth rates* — *Developed countries*[b] 1975-1985	1985-1993	*Developing countries* 1975-1985	1985-1993
3	Manufacturing	11.6	14.5	16.9	2.3	1.1	4.9	4.9
311	Food manufacturing	14.5	16.6	19.2	1.9	0.4	3.6	2.9
313	Beverages	19.2	22.5	26.3	0.8	0.1	2.8	3.6
314	Tobacco manufactures	32.4	34.7	35.6	2.1	2.7	4.3	3.7
321	Textiles	18.6	26.1	31.6	0.2	-1.9	2.7	3.6
322	Wearing apparel	11.7	20.4	25.9	0.8	-2.1	4.4	5.9
323	Leather and fur products	18.0	32.1	39.2	-0.4	-3.1	4.5	4.1
324	Footwear, excl. rubber or plastic	18.7	30.8	39.9	0.5	-3.6	5.3	4.1
331	Wood and cork products	12.4	14.0	16.6	0.3	-0.1	2.0	3.7
332	Furniture and fixtures	9.9	10.1	11.0	1.7	1.3	3.0	3.0
341	Paper and paper products	10.0	11.2	12.3	1.7	3.5	4.7	5.3
342	Printing and publishing	8.7	6.5	6.8	4.0	3.3	2.9	4.4
351	Industrial chemicals	8.9	13.2	15.1	1.5	2.5	6.4	5.5
352	Other chemical products	15.5	16.3	17.2	3.6	3.6	5.0	5.7
353	Petroleum refineries	31.0	45.6	52.5	0.7	0.8	7.2	5.2
354	Miscellaneous petroleum and coal products	6.5	13.1	19.0	2.0	1.3	8.6	4.3
355	Rubber products	13.0	21.9	26.5	1.2	-0.6	5.9	6.0
356	Plastic products n.e.c.	[illegible]	14.2	15.7	5.8	4.1	7.4	5.7
361	Pottery, china and earthenware	14.0	17.2	21.9	0.9	-0.8	2.5	4.7
362	Glass and glass products	11.3	14.1	16.7	1.5	1.4	4.5	4.4
369	Other non-metallic mineral products	[illegible]	19.3	[illegible]	1.0	—	4.5	4.4
371	Iron and steel	9.7	11.4	13.5	1.5	0.7	4.2	4.7
372	Non-ferrous metals	3.7	17.8	21.4	0.8	1.8	7.1	7.8
381	Metal products, excl. machinery	9.6	11.5	13.5	1.5	0.7	4.2	4.6
382	Non-electrical machinery	5.0	5.2	6.3	3.7	0.4	4.7	4.2
383	Electrical machinery	7.9	12.7	14.8	5.0	1.1	7.6	8.8
384	Transport equipment	7.7	9.0	10.2	3.2	1.3	5.6	4.5
385	Professional and scientific goods	2.6	4.1	4.8	3.7	4.6	8.8	8.5
390	Other manufactures	10.4	16.1	20.5	2.8	0.3	6.6	7.6

Sources: UNIDO statistical database, estimates and forecasts by UNIDO/PPD/IPP GLO.

[a] Excluding China.

[b] Including Eastern Europe.

Notes: Projections and growth rates are based on deflated national currencies converted to 1985 United States dollars.

Growth rates are derived from 117 sample countries: 32 "developed" and 85 "developing" (Industrial Statistics consolidated by UNIDO).

China and other centrally planned Asian economies are not included in the sample. (The share in world is estimated to amount to 2.4 per cent in 1990 for total manufacturing.)

ISIC = International Standard Industrial Classification of all Economic Activities (Revision 2).

the low growth rate of MVA for the region as a whole, 15 of the 45 countries in Tropical Africa have registered annual MVA growth of 5 per cent or more over the last six years.

In North Africa GDP growth declined from 2.6 per cent in 1990 to 2.5 per cent in 1991. In Western Asia it fell from 4.0 per cent in 1990 to 3.0 per cent in 1991. Both regions were affected by the Persian Gulf war and its aftermath. Some oil-exporting countries benefited from the increase in oil prices in late 1990, but these gains were generally not sufficient to offset their contributions to pay for the war. The economic disruption and war costs strained government finances and added to inflationary pressures. In Iraq and Kuwait the direct effects of the war had a drastic impact on production. In those countries that supplied large numbers of workers to the two countries or had significant trade with them, the loss of markets and foreign earnings were also significant. In Iraq the disruption of normal trade relations has continued in compliance with the trade embargo imposed by the United Nations. Some impetus to growth in the region will result from spending in Kuwait on reconstruction. Oil-producing countries have benefited from the removal of Iraqi oil from world markets, which has been particularly important in supporting oil prices during the downturn. UNIDO expects growth in North Africa to improve in 1992 to 2.8 per cent and further in 1993 to 3.1 per cent. In Western Asia growth is expected to be 4.5 per cent in 1992 and 4.4 per cent in 1993.

The rate of GDP growth in India fell from 4.7 per cent in 1990 to 2 per cent in 1991. Among the factors contributing to slower Indian growth were depressed conditions in its export markets, particularly in the former USSR, higher prices for oil imports during the Persian Gulf war, the loss in remittances from Indian nationals working in Iraq and Kuwait, and domestic political uncertainties. The immediate cause of the slow-down was the depletion of foreign exchange reserves following the Persian Gulf war. Import restrictions met the immediate need to replenish reserves, and a comprehensive stabilization and restructuring programme to deal with underlying problems and to position the economy for longer-term growth was announced in July of 1991. MVA growth fell from 8.0 per cent in 1990 to 1.5 per cent in 1991, partly in response to the curb on imports as restricted access to imported materials created manufacturing bottlenecks. The restructuring programme announced in July 1991 contains many measures that will stimulate growth in the industrial sector, and are likely to more than offset the downsizing and closures that will result from the government's announced intention to reduce subsidies to State-owned companies. UNIDO expects GDP growth to gradually improve, reaching 4.1 per cent in 1992 and 4.5 per cent in 1993. The other countries of the Indian Subcontinent generally experienced medium to good growth in 1991, exceeding 4 per cent in all countries except Bangladesh. GDP in Pakistan grew at a rate of 5.6 in 1991, which was up from 5.3 per cent in 1990. UNIDO expects GDP growth in Pakistan to rise to 5.5 per cent in 1992 and to 6.3 per cent in 1993.

Growth in East and South-East Asia fell only slightly in 1991 from 7 per cent to 6.7 per cent. For four newly industrializing countries (NICs),* namely Hong Kong, Republic of Korea, Singapore and Taiwan Province growth in 1991 was 7.1 per cent compared to 6.8 per cent in 1990. The rate of growth increased in Hong Kong and Taiwan Province, and fell in the Republic of Korea and Singapore. Despite the recession in North America, export growth for the four economies combined was higher in 1991 than in 1990. The weaker North American market was offset by increased exports to China and the EEC. The NICs will benefit in 1992 and 1993 from continued strong growth in China and recovery in North America. The main constraint on short-run growth for all four economies will be the need for action to curb inflation, which has increased to nearly 8 per cent for the four economies combined. UNIDO expects growth for the four economies to be little changed from 1991, with 1992 growth of 7.2 per cent and 1993 growth of 7.1 per cent.

Indonesia, Malaysia and Thailand all grew by 7 per cent or more. Growth was down in 1991 in Malaysia and Thailand, but remained constant at 7 per cent in Indonesia. More restrictive policies implemented to counter rising inflation and growing current account deficits held down growth, as did generally weaker export markets. These policies are likely to continue in all three countries in the short-run, but improved export markets will help to maintain growth rates near their current levels.

MVA growth in the region of East and South-East Asia as a whole increased slightly from 7.7 per cent in 1990 to 7.8 per cent in 1991, defying cyclical downturns in most of its major export markets. Increased domestic demand and increased sales in the EEC and China enabled the region to maintain strong MVA growth despite the slower growth of exports to the United States and Canada. For East and South-East Asia as a whole UNIDO expects 1992 MVA growth to be 7.5 per cent and to rise to 7.8 per cent in 1993.

Growth in China slowed to 3.9 per cent in 1989, but has since climbed back toward the levels achieved in the mid-1980s. In 1990 output growth was 4.7 per cent, and rose to 7 per cent in 1991. Economic reform and emphasis on international trade and international joint ventures remain key elements in the development strategy of China. This is reflected in the growth of trade and the rapid growth of the non-State sector. The latter sector, which comprises collectives and private enterprises, including joint ventures between the State and private or collective enterprises, has been growing rapidly for more than a decade. In 1990 it accounted for 64 per cent of GNP and employed 82 per cent of the labour force. While the initial focus of the move to give more play to market forces and non-State enterprises was confined to agriculture, it has since been extended to services and industry. In 1990, 46 per cent of gross industrial output was accounted for by the non-State sector. Higher global growth, and particularly more rapid growth in its North America market, will contribute to maintaining the momentum in export growth in 1992 and 1993. UNIDO forecasts GDP

*The term "NICs" is used extensively to describe developing economies, be they countries, provinces or areas, where there has been particularly rapid industrial growth. It does not imply any political division within the ranks of developing countries and is not officially endorsed by UNIDO.

growth in China of 8.3 per cent in 1992 and 7.8 per cent in 1993.

The 28-sector disaggregation of MVA growth rates broken down by all developed countries and all developing countries for the 10-year period 1975-1985 and for the eight-year period 1985-1993, is shown in Table I.2.* This table also shows the shares of the developing countries in disaggregated and total manufacturing for the years 1975, 1990 and, as forecast by UNIDO, for 1993. Official data are not available for all countries for 1990. In those cases where official estimates are not available, data from unofficial sources or UNIDO estimates are used in the aggregations.

The share of developing countries in world manufacturing will be considerably higher in 1993 than in 1990. UNIDO projects the share to be 16.9 per cent in 1993, which is 2.4 full percentage points higher than in 1990 (see figure I.2). This gain would nearly match the 2.9 percentage point gain over the period from 1975 to 1990. The gain stems partly from the declining MVA growth rates in the developed market economies. In 1991 MVA declined by 1.3 per cent for the group as a whole, and according to the UNIDO forecast, MVA growth will remain low in 1992, at 1.3 per cent. Even in 1993, MVA growth in the developed market economies is expected to lag behind growth in the developing countries excluding China by 1.7 percentage points. But the main factor underlying the increased MVA share of the developed economies is the fall in MVA in the economies of Eastern Europe and the former USSR. Between 1990 and 1993 the cumulative MVA decline in the region as forecast by UNIDO will be nearly 50 per cent.

Based on UNIDO projections for 1993, the average annual growth rate of manufacturing in the developing countries, excluding China, will be 4.9 per cent during the period from 1985 to 1993 which is the same growth rate as in the earlier period from 1975 to 1985. Relative to the 1975-1985 period, growth during 1985 to 1993 is forecast to be substantially higher (by 1 percentage point or more) in six sectors: pottery, china and earthenware (ISIC 361); wood and cork products (ISIC 331); printing and publishing (ISIC 342); wearing apparel (ISIC 322); electrical machinery (ISIC 383); and other manufactures (ISIC 390). Symmetrically, growth will also be 1 percentage point or more slower during the latter period in the following six sectors: transport equipment (ISIC 384); footwear, excluding rubber or plastic (ISIC 324); plastic products (not elsewhere classified) (ISIC 356); petroleum refineries (ISIC 353); iron and steel (ISIC 371); and miscellaneous petroleum and coal products (ISIC 354).

The MVA share of developing countries already in 1990 exceeded 25 per cent of world output in five sectors, namely petroleum refineries (ISIC 353), footwear, excluding rubber or plastic (ISIC 324) leather and fur products (ISIC 323), tobacco manufactures (ISIC 314) and textiles (ISIC 321). By 1993 developing countries will also account for 25 per cent of world MVA in rubber products (ISIC 355), beverages (ISIC 313) and wearing apparel (ISIC 322), and over 20 per cent in 13 of the 28 manufacturing sectors. Beyond 1993 the rate at which the share of developing countries increases will slow markedly. By the year 2000 the share of developing countries in world MVA is expected to be about 17.5 per cent (see figure I.3).

*The estimates shown in table I.2 are based on a sample of countries for which reliable data are available for the years included. The sample includes 32 developed and 85 developing countries. The sample does not reflect the situation in the centrally planned economies of Asia, since MVA data are not available for these countries over the periods considered. All of the reform economies of Eastern Europe and the former USSR are included in the developed country category.

B. Medium-term outlook

This part of the *Global Report* is devoted to the presentation of UNIDO medium-term projections on world industry and to discussion of the major economic trends on which UNIDO technical assumptions are based. Medium-term forecasts for the 10 regions of the world are summarized in table I.3. As to the discussion of major economic trends, the *Global Report* this year will review some of the so-called "long-term trends" in order to obtain some historical perspectives for analysing near-term problems and solutions. This is necessary for several reasons. There has been much criticism of the exclusive focus on the short term in the perceptions of private as well as public decision makers. A long-run perception is a h pful correction to this. At the same time, the world economy has gone through some fundamental but totally unanticipated changes which demand an examination within a broader historical context. It would not be too much of an exaggeration to say that the 1990s resemble the 1890s more than they do the 1960s. This is confirmed as much by the resurgence of anti-inflationary macroeconomic policies as well as the dominance of

Table I.3. Medium-term projections, 1992-1997
(Average annual percentage growth rate)

Economic grouping or region	GDP	MVA
World	3.4	3.1
Developed countries	3.2	3.5
North America	3.2	4.1
Western Europe	2.6	2.2
Japan	4.2	5.2
Other	2.6	2.0
Eastern Europe and former USSR	-2.1	-5.9
Developing countries (excluding China)	4.3	6.1
Latin America and the Caribbean	3.1	2.6
Tropical Africa (including sub-Saharan Africa)	2.7	3.9
North Africa	3.8	5.1
Western Asia	3.3	6.1
Indian Subcontinent	5.0	6.7
East and South-East Asia	7.5	10.6
Centrally planned Asia	7.8	..
China	8.0	..

Source: UNIDO database.

Figure I.2. Share of developing countries in world manufacturing production

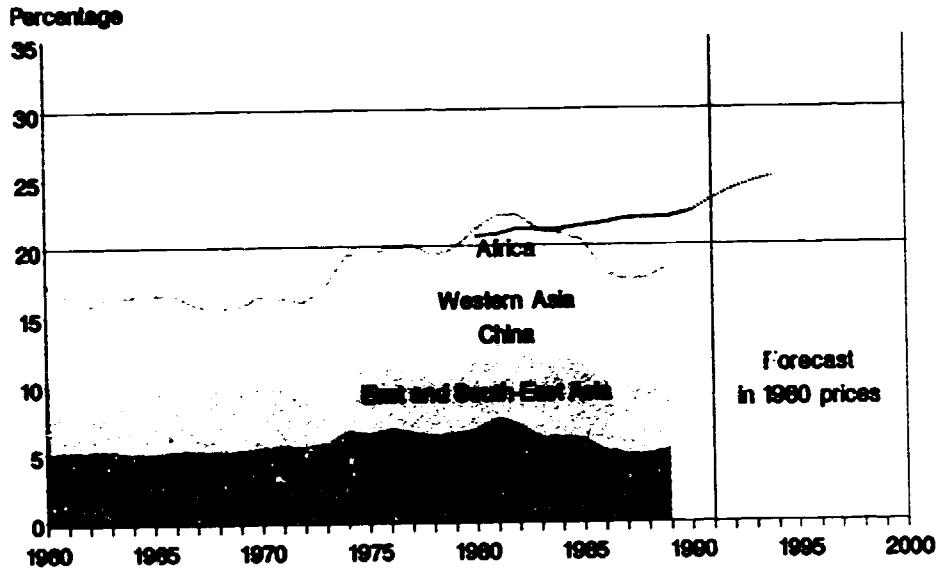
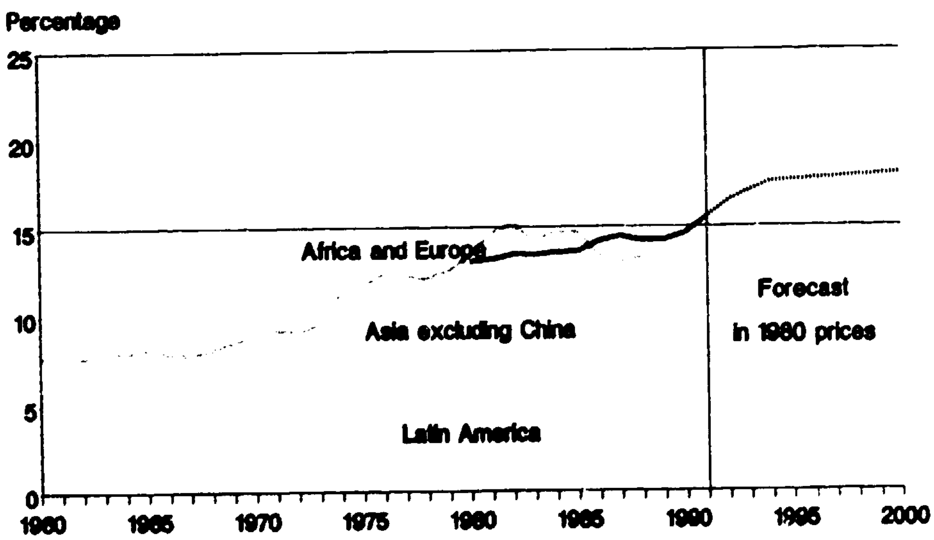


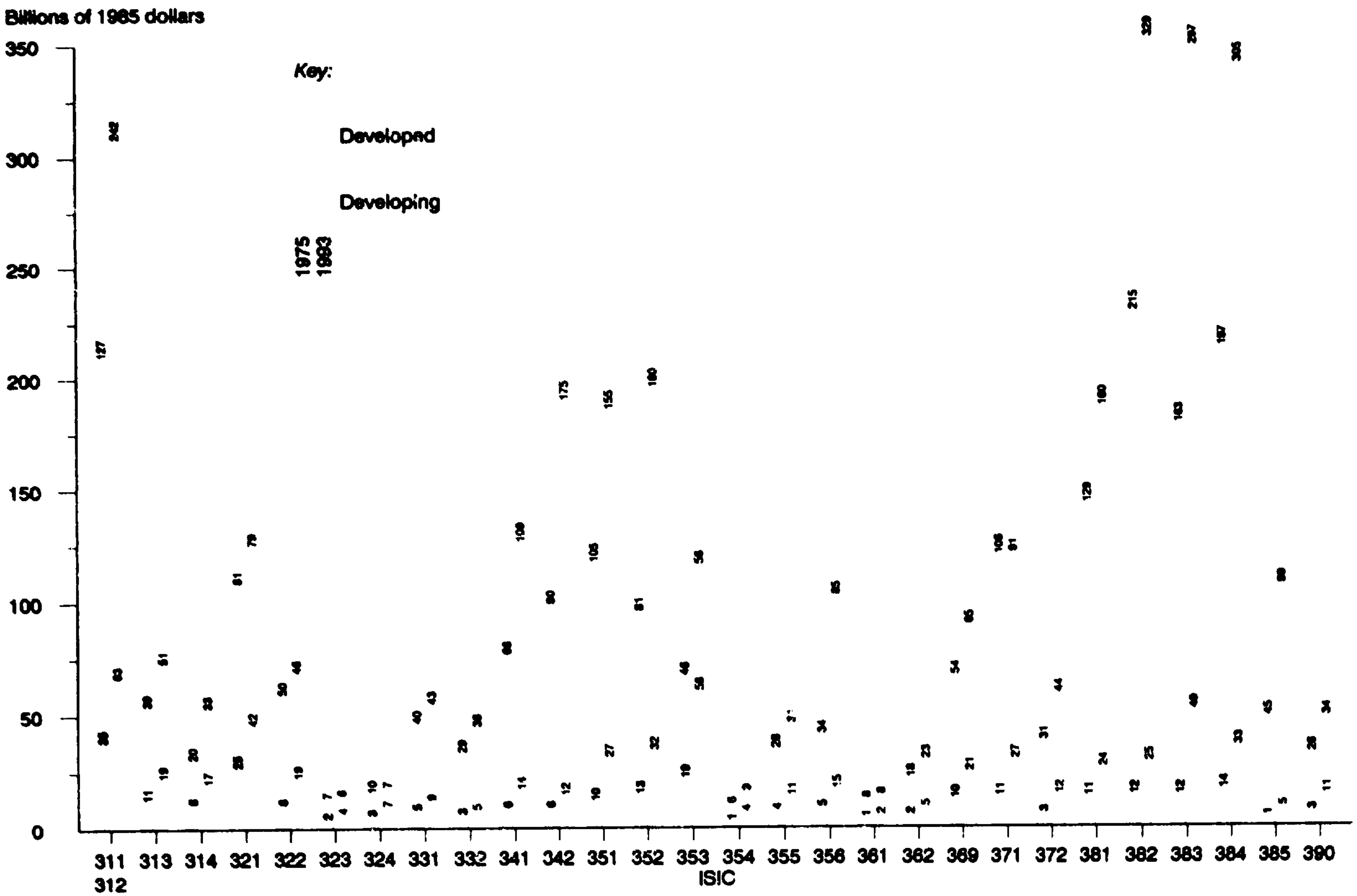
Figure I.2.
Share of developing countries in world manufacturing production, excluding China



Current prices (1960-1988) and constant 1980 prices (1980-1991) (including forecasts to 2000)

Source: UNIDO database

Figure I.3. Manufacturing value added of North and South, 1975 and 1993



Sources UNIDO database and United Nations National Accounts Statistics monetary over fiscal policy. Recent trends in the growth rate of overall output as well as of investment and consumption in developed market economies can be understood only in a historical perspective.

But important as a long-run perspective is, the past is an imperfect guide to the present and an unreliable pointer to the future. To be able to grasp the recent changes there is also a need to be clear about the causal influences which have led to the profound structural changes of recent years. The perception as well as the actual actions of economic policy makers are important among these influences. Among the developed market economies the search for non-inflationary growth continues, with the emphasis on the appropriate rate of growth as against the content of the output which is growing. One reflection of this is the ambivalent attitude towards free trade. The prolonged and as yet inconclusive negotiations in the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) reflect the fear of "deindustrialization" through international competition as much as the hope that freer trade may provide the stimulus required to avoid stagnation. Under the prevailing restrictive growth policy, the balance between gains from international specialization and the loss from continuous restructuring remains a delicate problem for many developed and developing countries. In the meantime, deindustrialization in the least developed countries continues unabated. The marginalization of the role of these countries, as well as that of the former centrally planned economies of Eastern Europe and the USSR, in the world industrial economy requires an urgent review of the historical process the world seems to be engaged in.

1. Is the world economy slowing down?

One of the assumptions which had a dampening effect on the UNIDO medium-term perspective is based on the statistical evidence of a long-term slow down in the world economy, as shown in figure I.1. The trend lines fitted against the respective group averages in the last three decades show negative inclines indicating a slow-down in the growth performance of both developed and developing countries. The evidence is contradictory as well as disconcerting, since the initial regional UNIDO forecasts indicate a steady recovery in industrialized countries and basic improvements in the growth prospective for developing countries as a whole. The generally positive short-term projections presented in the previous section are naturally influenced by signs of a cyclical upturn in the world economy. This time around, the cyclical impact on developing countries has been much less than expected, which UNIDO takes as an indirect but solid indication of the very structural change needed for these countries to turn in a much better industrial performance during the current decade than in the last. This is particularly true for Latin American countries, whose combined average growth rate is projected to be at least double the average for the 1980s. Although UNIDO foresees some inevitable adjustments in growth tempo for the Asian and the South-East Asian countries, they are expected to remain strong performers, especially if regional industrial cooperation, including China and other Asian centrally planned economies, expands. India, which has embarked on a bold new experiment, is rapidly gaining confidence as a producer of internationally tradable manufactured goods. And, with continuing support, the African countries should complete the structural adjustment processes needed to improve their future growth performances.

All these promising regional trends for developing countries, however, presuppose normal and trouble-free growth in the advanced industrial countries. The traditional interdependency relationship between these two groups of countries has been undergoing some complicated changes in recent years [1]. As already indicated, one of the reasons why some developing countries managed to escape negative growth during the latest global recession was the forcible shift to internal sources of growth achieved by these countries during the difficult years of the 1980s. Yet the prospect of slower growth in developed countries is still unsettling. Slower growth means a further diminution in investment profitability. Unemployment in the advanced industrial countries will become larger than the current 7 to 9 per cent, alienating a large portion of the population and creating a permanent pool of the unemployable. International competition in a slow-moving world economy will become truly predatory and adversarial. And countries trying to safeguard their national interest will retreat increasingly, singly or as a group, behind trade barriers. All the while, the industrialization prospects for developing countries will suffer because trade and finance provide the essential escape hatches for these countries from the dual economic constraints of limited resources and limited market size in introducing modern processing technologies

But what is the cause of this long-term slow down in the major industrialized countries? Economic trends, once quantitatively discerned and statistically captured, do not disappear easily, and the dismal trend towards lower world growth is statistically obvious. Admittedly, statistical findings are always open to interpretation. Thus, some argue that declining growth rates, particularly in the major industrialized countries, are the result of exceptionally high growth between the 1960s and mid-1970s, and that a proper trend line drawn without including this exceptional period of growth should not show the worrisome negative incline [2]. Whether or not this explanation is accepted, the argument certainly does not offer much comfort. It also raises the basic question as to what made the 1960s and early 1970s so exceptional, and why is the world unable to recreate those conditions. In fact, many economists are convinced that, if an exception has to be found, it more than likely resides in the low performance record of the 1980s.

Studies abound purporting to show that in the mid-1970s the world entered the downswing phase of a long-term Kondratieff cycle. According to one proponent, the first Kondratieff cycle or long wave (1790-1851) dates back to the Industrial Revolution which introduced steam power to the coal and textile industries. The second cycle (1851-1896) brought with it railways and the iron and steel industries, while the third (1896-1948) saw the introduction of diesel and electric power as well as the emergence of the basic chemicals and automobile industries. The current fourth cycle which began in 1948 was occasioned by the discovery of polymers and ushered in the electronics age. Since 1973, however, no major new industries have emerged to sustain the necessary technological innovations [3]. While the precise chronology of the Kondratieff waves may be open to dispute, the general logic of a long cycle of about 50 years is appealing. If it were true, it would be expected that a Kondratieff wave that began in the late 1940s should end and a new one should begin sometime in the 1990s. If so, the evidence of a slow-down in growth rates may be about to be reversed. Given the impression of the chronology, however, it is difficult to be either more precise or less uncertain. Indeed there have already been predictions, false as they turned out, during the 1980s of a long upturn based on genetic engineering and biochemistry, fibre optics and communications, new materials and miniaturization, as well as information processing.

Historicism has always had its fascination for the economics profession. Both Marx and Schumpeter saw what history had in store for the capitalist system and promptly set out to change the course of the system of history as well. But with the advent of Keynsian economics, there was an emerging confidence among economists that business cycles, long or short, would no longer be allowed to determine history. There were counter-cyclical demand management policies to smooth out the short cycle. For the long wave, since the root cause was the bunching of innovations, it was thought that continuing investment by corporations in research and development (R and D) would allow a smoothing-out of the innovation process as well. In this matching of short and long cycles, monetary policy had the task of providing a stable macroeconomic framework within which structural change could take place smoothly.

The quarter century following the Second World War did fulfil this expectation to a large extent. There was a steady stream of innovations from the corporate R and D laboratories while the counter-cyclical policies maintained a high level of employment. But in the years since the mid-1970s there has been a serious reversal as innovations in the industrial sector have slowed down, and those in the financial sector have revolutionized the context of monetary policy. Global financial markets with fully mobile capital have meant that control over money supply is difficult. Each country has become eager to attract the flow of capital to itself even though it has meant offering high interest rates and pushing a deflationary policy. In the 20 years since the oil price crisis of 1973, the world has witnessed three major recessions, the latest of which is even now proving too stubborn to overcome. Could it be that the upsurge in finance innovation has retarded the industrial innovation process, or is it a new qualitative phase of the same process?

Ever since the days of David Ricardo, serious economists concerned about the long-term future of capitalist economies have been harbouring a constant worry—that the economy will sooner or later attain a stationary state—a level of per capita income that will satiate the needs and wants of the average consumer, and the resulting "underconsumption" and "overproduction" will gradually undermine the profitability of investment. Marx as well as John Stuart Mill had a vivid description of this already happening in nineteenth-century England. Schumpeter emphasized the need for continuous product innovation to circumvent it, and Keynes prescribed public spending to postpone it. However, as Marx hinted, a stationary state in the modern version can happen at any level of employment or income, the essential features being no new investment and no net savings. The declining savings rate in the United States and in other major industrialized countries has been quite conspicuous for some time. And, as will be seen, the investment ratios in these countries declined throughout the 1980s. To modern-day economists who have been too busy "fine-tuning" to bring into balance investment and savings that behave independently, such synchronized behaviour between savings and investment is an apt reminder that, notwithstanding Keynes' admonition, human beings do not live only in the short-run.

The classical doctrine postulating that in the long-run savings cannot exceed investment, known as Say's Law, is based on the conviction that falling interest rates would eliminate any temporary excess of savings either by discouraging savings or by increasing investment, or by a combination of both. However, in an economy where effective demand becomes insufficient, investment would not increase. But savings would decline to match it through falling interest rates, on the one hand, and a decline of money wages and prices, which bring a contraction in income, on the other. So far no economist has seriously suggested that advanced economies are currently suffering from the chronic underconsumption characteristic of a stationary economy. There are, however, many indications to the contrary: for example, growth rates of prices and wages in the production sector in the advanced countries have long been declining, and the profitability of manufacturing has been low relative to its level in the 1960s. Long-term investment has declined drastically, and short-term investment is becoming more speculative in nature. In some countries, the problem of deindustrialization, perceived or real, is becoming a serious issue. And expansion in consumer demand, though supported by credits and declining household savings, is becoming more and more sluggish. Whether these tendencies represent a passing phase of a long cycle or symptoms of a stationary state remains a conjectural question. This question, however, remains academic as the world becomes more and more engrossed with short-term price stabilization at the cost of long-term growth and expansion.

2. *End of inflation in advanced countries*

Ever since the stressful period between 1973 and 1981 when oil-price-induced inflation reached double-digit figures, the major industrial countries have kept up their vigil against inflation. Currently, inflation in the major industrialized countries is converging in the range of 2 to 4 per cent, which is the same as the average rate observed in the 1960s. Encouraged by this development, many economists are predicting an era of zero or extremely low inflation. The commitment of the German Bundesbank to disciplining the German economy to price increases of 2 per cent or less a year is well-known. Many European countries, some seriously handicapped by persistent high unemployment, are now equally committed to low inflation through the European Exchange Rate Mechanism and through provisions for the European monetary union. In New Zealand, the Government has not only made the central bank independent, but has given it the task of bringing inflation down to between zero and 2 per cent a year. In Canada, the Government backed the decision of the central bank to tighten money supply in the face of imminent recession in order to bring down inflation to an annual rate of 1.7 per cent. In Japan, an unusually strong and independent stance taken by the Governor of the central bank of Japan burst the "bubble economy", bringing inflation down to 1.8 per cent. In the United States, however, the Federal Reserve Bank, which has lowered its discount rate in several successive steps over the past two years, now seems ready to step in again in the absence of strong signs of a real economic recovery.

Many have come to believe that low or zero inflation would actually assist growth by encouraging long-term investments because the long term would not only be easier to foresee, but the cost of borrowing money would become cheaper by removing the inflation premium which is frequently front-loaded, since the exclusive focus on the short-term that plagues the current economic scene is, in their view, nothing but the product of inflation. On the other hand, monetary theorists have long maintained that it is not so much inflation as uncertainty which clouds the long-term investment outlook. Such uncertainty is reflected in the course of monetary policy, which leads to high interest rates. This dispute has become largely academic, because in the never-ending fight against inflation a punishingly high interest rate has become an established feature in major industrialized countries. As of now, if real interest rates for any reason continue to stay higher than the actual physical rate of return combined on all investments within the country, something extraordinary must happen. Theoretically at least, the following three courses of action are open to the economy to pay for the extra charges: the economy either depletes its external reserves or incurs balance-of-payments deficits; it reduces the traditional income share of labour by either withholding real wage increases or creating more unemployment; or it forces the size of national investment to shrink until the lowered GDP growth path no longer generates inflation.

One of the perverse features of the world economy in the 1980s has been the so-called "reverse flow of capital" from developing to developed countries, which incidentally was accomplished through real rather than financial transfers. That the balance-of-payments situation has deteriorated during the 1980s for every major industrialized country, with the exception of Japan, and finally including Germany, is by now a well-established fact. The proof that the relative share of income for labour has declined in these countries is often reflected in the census data on income distribution and in the increasing labour and social unrest in these countries. Actual wage shares computed from national accounts statistics show the following changes between 1980 and 1989: United States, 60.4 to 60.3 per cent of GDP; Canada, 55.7 to 55.5 per cent; United Kingdom, 59.7 to 55.6 per cent; Australia, 52.8 to 48.6 per cent; Germany, 57.0 to 52.4 per cent; France, 56.1 to 51.6 per cent; Belgium, 60.0 to 52.1 per cent; and Japan, 54.3 to 55.2 per cent. The United States remains one of the highest wage share countries, reflecting the effort to maintain an employment level during the 1980s largely through deficits in external accounts and to some extent through the lowering of real wages.* Countries that expanded their income shares for labour during this period are those which have had a relatively cheaper credit policy such as Japan, Republic of Korea and other Asian NICs, as well as those with surplus capital, like Bahrain.

According to the IMF, the total gross fixed investment figure in Germany in 1992 is projected to be smaller than the one observed in 1973 in real terms, and it calculates the level of investment in Germany to have shrunk at the annual compound rate of 0.6 per cent during the past 20 years [4]. The IMF relates a similar story for the United Kingdom, where the absolute size of total fixed investment in 1992 is projected to be smaller than in 1973 after deducting price increases. In both cases, the primary reason for this is the restrained pace of investment in these two countries during the 1980s, which could not make up for the two sharp drops in investment during the 1973-1975 and 1981-1982 periods of economic crisis. The situation in other industrialized countries does not seem much better. The IMF estimated average annual growth rates of investment in other industrialized countries during the same 20-year period are as follows: the United States, 0.6 per cent; Italy, 0.6 per cent; France, 0.9 per cent; Japan, 2.3 per cent; and Canada, 4.8 per cent [4]. This means that Canada would be the only country that increased its investment-to-GDP ratio between 1973 to 1992.**

A policy of high interest rates discourages a country's investment activities in general, but at a particular cost to its long-term physical investments. One result of this has been the decline in social overhead capital investments in many advanced industrialized countries in recent years. Burdened with huge debt service charges, public spending on education has suffered a severe blow in many countries. Policy-induced interest rate premiums also encourage financial, rather than physical, investments, because the total value of a country's paper assets is more sensitive to interest rates than to the real physical rate of return on investment. Financial mergers and acquisitions, although greatly abated, outnumbered plant constructions in the 1980s. The boom and bust in the property and financial markets in many advanced

*The unit labour costs in the United States increased at the average annual rate of 7.5 per cent compared to the GDP deflator of 8.0 per cent and the consumer price index of 8.7 per cent between 1973 and 1992.

**This IMF account can be objected to because of the use of the projected 1992 investment figures. If the figures for 1989 (the last year before the economic slow-downs) were used instead, every country would have shown some increase in the absolute size of investment over the last 20 years. However, national investment ratios computed as the percentage share of GDP spent on gross fixed capital formation in 1989 still compare badly against those observed in 1970. These ratios are, respectively: the United States, 17.7 in 1970 and 16.6 in 1989; France, 25.2 and 20.8; Japan, 35.5 and 30.9; Canada, 21.2 and 22.2; Germany, 25.5 and 20.5; and the United Kingdom, 18.9 and 19.6. The use of 1989 figures thus saves many countries from the ignominy of an absolutely declining investment, but only barely.

industrialized countries in recent years have been as much the result of diverting the energy of the country to financial, rather than physical, investment activities, as the result of monetary stabilization policies.

If the world is slowing down, could the growth process be restarted without paying for it in inflation? According to the information compiled by *The Economist* [5] the consumer price level in the United Kingdom had not increased for almost two hundred and eighty years from 1661 until just before the outbreak of the Second World War, with the notable exceptions of the period of the Napoleonic Wars and of the First World War and its immediate aftermath up to the Great Depression. Since 1933 (when prices were some 10 per cent lower than in 1661), however, consumer prices have risen by 4,000 per cent in the United Kingdom and by 950 per cent in the United States. Despite periodic recessions and depressions, the United States economy is estimated to have expanded rapidly between 1867 and 1913 at an annual compound rate of up to 4.3 per cent.* The United States economy proceeded at a more sedate rate of 2.0 per cent thereafter until 1938, mainly because of the one-time loss during the Great Depression. This seems by no means a bad performance record—with or without inflation. The economy of the United Kingdom also achieved substantial progress during this pre-inflationary period: 2.4 per cent annual average growth between 1870 and 1913, and a 1.0 per cent cumulative average for the entire period of 1913-1938, which includes the years of the Great Depression. Growth thus appears to have taken place in the absence of inflation. However, it has also taken place in the presence of inflation. The compound annual GDP growth rates covering the period from 1950, when conflict in Korea started, to 1989, before inflation began to come down, stand at 3.4 per cent for the United States and 2.7 per cent for the United Kingdom.

Growth, therefore, takes place with or without inflation, though it is arguable that inflation has yielded a slightly higher growth rate over the past 40 years. It is this coincidence of growth with inflation which raises doubts regarding the feasibility, if not the desirability, of non-inflationary growth. One reason for this is the nature of consumption today as compared to the nineteenth century. Unlike in the old days, growth no longer takes the form of additional consumption of identical items, but rather of the consumption of goods in increased variety and of improved quality, the substitution of new products for old, and the consumption of higher quality services. In the high-income countries, a typical family buys 3,000 or more items in the course of a year in the form of specific commodities and services. The number of varieties produced and offered for each commodity is innumerable and has been constantly increasing. Price indices are, however, purposely designed so that the introduction of new products or the disappearance of old ones will have no effect. Thus, the introduction of goods such as washing-machines, television sets, synthetic fibres, personal computers and cellular phones, lighter and cheaper construction materials, numerically controlled machines and industrial robots, has had no effect upon the different price indices. This means that a stable price level for the economy as a whole can be obtained when higher-priced new products are introduced only with a corresponding price decrease for all the rest. Thus, as some activities grow, others decay. But while this is always true in all changing economies, there are special reasons why low inflationary scenarios affect the industrial sectors more adversely than the rest of the economy.

One important consideration is that, in the major industrialized countries, more than one half of GDP is usually generated in the tertiary sector, which provides services rather than producing commodities, and the price increase for services in these countries has been consistently higher than the national average for commodities and services combined ever since the 1950s. Thus, in spite of the general mobilization for the conflict in Korea, in the United States the prices of commodities rose by only 6 per cent and the price index for consumer durables actually declined by 3 per cent between 1950 and 1960. On the other hand, the index for medical care rose by more than 30 per cent, while the price of services as a whole rose by 23 per cent [6]. The obvious implication of this is that unless the general price level in the economy improves sufficiently each year, the country's manufacturing sector, along with its mining and agricultural sectors, will become ever smaller. The current GDP share of manufacturing in the United States is 19.2 per cent, compared to 28 per cent in 1960. Since 1960, the agricultural share (including fishery and forestry) in the United States has declined from 4 to 2 per cent, and that for mining and quarrying, from 2.9 to 1.9 per cent. On the other hand, the GDP share for community, social and personal services increased from 4.6 to 9.7 per cent, and the share for financial and business services from 17.3 to 25.3 per cent. During the same 31-year span, United States GDP increased at the annual rate of 3.1 per cent, with its manufacturing sector growing at 3.4 per cent per annum. The reduced share for manufacturing today is therefore due to lower prices for manufactured products which have increased at 3.2 per cent per annum while the general price level has been increasing at 4.9 per cent per year. The share of manufacturing is set to decline even in volume terms if the pressure for stable prices is borne exclusively by the production sector of the country.

3. Long-term prospects for developing countries

Are the prospects for avoiding slow growth any better for developing market-economy countries? Between 1980 and 1990, 71 out of 155 countries lost income. The fact that all 71 were developing market-economy countries requires some comment later. But the immediate question is why is there such a large and persisting income gap between developed and developing countries? Why is there such a heavy concentration of low-income countries with few middle-income ones? Broadly speaking there are four factors, in particular the technology gap, degrees of specialization, the importance of services, and the consumption pattern.

*These and other historical growth rates given here are based on William Fellner, *Trends and Cycles in Economic Activity* (New York, Henry Holt and Company, 1956).

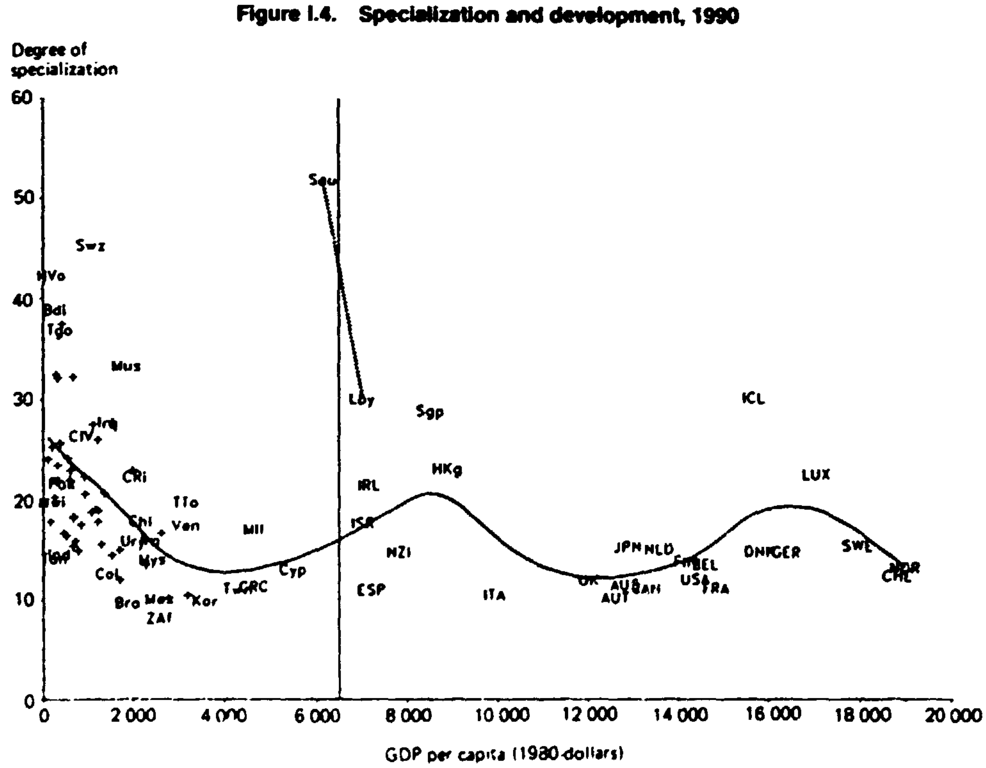
Technology gap. The income gap between developed and developing countries obviously stems from the technology gap. Developing countries are latecomers and can enjoy "opportunities to catch up". They can pick and choose from a considerable range of technologies already available without investing in R and D. They can push up the rate of capital formation faster because the widening and deepening of capital would not bring diminishing returns. Innovation by one firm does not have to be at the cost of other firms in the same sector. For the same reason, structural changes are much less painful because they do not entail an extensive "restructuring" of the whole economy—the virtuous circle of expansion proceeds without a matching vicious circle. This can be seen by a comparison of the extensiveness of structural changes undertaken by both developed and developing countries under the alternating economic circumstances of the last two or three decades. Specifically, structural changes in developing countries have always (except during the period of the oil crisis) intensified during cyclical upturns. However, in developed countries, intensive structural changes were invariably related to economic downturns, implying that they have been more of a forced or defensive type of restructuring. The intensity of structural change in the developing countries as a whole, however, slowed down in the late 1980s, especially in those countries which achieved the "real" income status of $5,000 per year and above. This signifies that these particular countries have reached some sort of a limit in emulating the advanced industrialized countries. Perhaps the "high technology" they have to import from those countries would now require a minimum level of investment in their own R and D.

Specialization. Another possible reason for the big chasm of income at the mid-$5,000 level is the difference in the configuration of manufacturing activities in developed and developing countries. Figure I.4 shows the relationship between the level of per capita income and the index of industrial specialization. A moving average line drawn across shows a distinct hump, or rather, two U-shaped curves overlapping the income range of $6,000 to $10,000—one for developing and another for developed countries. The index of industrial specialization measures the dominance of a few industries over the rest of the industries in the country.* Countries with per capita income of less than, say, $600 tend to show extreme industrial concentration simply because they have a "monocultural" industrial structure. In most of these countries, such as Burkina Faso, Burundi and Togo, food-, beverage- and tobacco-processing industries are practically the only industries they possess (notable exceptions are India, Pakistan and United Republic of Tanzania).

At a higher level of income, countries start adding different industries—from textiles and wearing apparel to petroleum refining (a sign of the times?), non-metallic mineral processing, metal fabricating, iron and steel, non-industrial chemicals, industrial chemicals, non-electrical machinery, electrical machinery and transport equipment. By the time a country attains a per capita income of some $3,500 (GDP per capita in 1980 constant dollar), its industrial specialization index drops to 10, meaning that the industrialization process has reached a stage at which the country can produce

*See the technical note in the statistical annex to the present *Global Report*.

Figure I.4. Specialization and development, 1990



Sources: United Nations National Accounts Statistics and UNIDO database various industrial products with a more or less full complement of intermediate and capital goods produced domestically.*

At a still higher level of income, however, the specialization index seems to increase once more, with the food-processing sector gradually regaining its prominence. For instance, the respective shares of the food beverage- and tobacco-processing industry in total MVA observed in 1989 were as follows: Hungary, 9 per cent; Republic of Korea, 12 per cent; Taiwan Province, 16 per cent; Greece, 22 per cent; Cyprus, 24 per cent; and Israel, 29 per cent. This in a way captures the essence of the qualitative shift in industry in these economies. The food-processing industry in the very low-income countries consists mainly of milling and grinding mills, slaughterhouses and dairy farms. The food industry in the middle-income developing countries produces an entirely different range of products—frozen, packaged and prepared foods individually wrapped and marketed under different brands.

The prominent industries in developed countries are non-electrical machinery, transport equipment, electrical machinery, metal processing, industrial chemicals, printing and food processing. The industrial specialization index generally stays within the bounds of 10 to 15, indicating the breadth of industrial activities carried out in developed countries. Thus, although the petroleum refining industry exists in all developed countries, its position is mostly dwarfed by the extensiveness of other industrial activities. Transport equipment industry figures prominently in Canada, the United States and Sweden, but comes only after non-electrical machinery in Italy and the United Kingdom, and after electrical and non-electrical machinery in Germany and Japan. The high specialization index for Luxembourg results from its concentration in iron and steel and industrial chemicals, and that for Japan is due to electrical and non-electrical machinery. The food and beverage industry in Iceland contributes 44 per cent, and that in Ireland 27 per cent, of total MVA. Altogether, in 12 out of 21 developed countries surveyed, the food processing industry occupies either the first or second position of importance, and generally the industrial specialization index of the country moves up with the relative importance accorded to the food industry.

To a certain extent, it is not surprising to find that food processing remains an important activity in both developing and developed countries. Their products, however, differ vastly, in effect constituting different industries. Other industries in developed countries produce the same products, but with different input requirements and different processing technologies. Furniture is made from steel, plastic, wood and glass, and is burnished, moulded, laminated and reinforced. In addition, industries in developed countries are more likely to be vertically integrated and produce a much wider range of output. Transport equipment and electrical machinery industries in developing countries with per capita income of less than $2,000 consist mainly of simple assembly shops using imported parts and components to produce a limited range of products. The petroleum refineries in these countries produce gasoline and tar, but not naphtha and other petrochemicals. This picture changes drastically once economies attain an income status beyond $2,000, as in Brazil, Malaysia and Mexico, and in NICs such as the Republic of Korea and Taiwan Province. However, the distinction between these economies and the developed economies still remains extensive in terms of product range and processing technologies.

Services. Another important distinction of development involves the relative status of the services industry in the economy. After examining the expenditure patterns in 138 countries in 1988, researchers found the slope defining the relationship between the real share of services to income "...essentially flat", or even "slightly negative" [7]. A simple illustration using this flat services-to-income relationship between, for example, India and the United States, would lead to the conclusion that at least 30 per cent of the United States real GDP per capita of $18,339 observed in 1988 was due to a higher price for services, which itself was some 60 per cent higher than the international average.

This "inflated" price of services in advanced industrialized countries, however, often includes the system-wide costs, which is not made explicit in individual price comparisons. Nobody would object if the cost of one kilowatt-hour of electricity supplied to a home, or of a bus ride in town, is different in one country, when in another, the electricity supply is constantly interrupted and the bus travels less frequently. For that matter, a visit to the dentist in the country with an uninterrupted electricity supply and a frequent bus service might be that much more worthwhile, especially if the dentist had the latest dental equipment. Even when apples are compared with apples, the price of an identical apple should differ depending on whether time has to be spent inspecting for signs of spoilage or not. Standardizing merchandise with a strict grading system does not alter the quality of the apple that is finally selected, yet it changes the quality of all the apples for every consumer. The systematic overpricing of services in richer countries will, therefore, largely disappear if an allowance is made to include those attributes which come with different services in those countries.

In both advanced industrialized countries and medium-income developing countries, services industries contribute some 50 per cent of GDP. However, in the lower-income developing countries, much needs to be done to expand the modern services sector. No economy can function without services industries such as finance, communications, transport, retail and wholesale trade, as well as medical care and education. The linkages and complimentarities between different production sectors are forged through these industries. One reason why new industrial ventures in developing countries often remain "enclaved" is due to this lack of efficient ancillary services industries. The absence of an efficient services sector also increases the unit cost of labour in developing countries despite the availability of cheap labour.

One interesting development in this regard is that the trend in advanced industrialized countries is to streamline the traditional manufacturing activities on the basis of professional and functional specialization. Typical

*See the complete list of industrial activities compiled for all developing countries in *Global Report 1990/91* (UNIDO publication, Sales No. E.90.III.E.12), chap. I, table I.4.A.

manufacturing firms in those countries have traditionally purchased professional services for finance, insurance and advertising. But today, professional services are sought for plant layout and maintenance, product design and its marketing, equipment leasing and financing, and even for employee relationships. For developing countries, the significance of these changes is that the stripped version of manufacturing activity can now be more easily and more profitably transferred to developing countries, as long as all the professional and commercial services required are packaged and offered from outside. The typical example is the manufacturing of products in developing countries under original equipment manufacturer (OEM) contracts. Under such a contract, developing countries perform the fabrication of products that have been designed and engineered in an advanced industrialized country by a manufacturer that markets the entire output under its own brand name. Sporting goods in Taiwan Province, rubber-soled shoes in the Republic of Korea, wearing apparel in China and India, electronic products in Malaysia and household appliances in Mexico are some of the more enduring examples of such an international division of labour.

Consumption pattern. One striking feature of the current income distribution in the world is, however, not so much its unevenness, as its "kinkedness". When all countries are listed according to their "real" per capita income in ascending order, the number of countries belonging to each strata of income suddenly declines at about the mid-$5,000 level, only to emerge again at the $10,000 level.* The only non-oil-exporting developing countries or areas included in this $10,000 or higher income bracket are the two city-states of Hong Kong and Singapore, and the Bahamas. Why is there such an enormous discontinuity in "real income" in the normal progression towards a higher standard of living?

If the prospect of stagnation due to high interest rates were real, it would remain currently a universal problem, not limited to those countries which have attained "real" GDP per capita approaching $6,000 in 1988. The list includes the following countries: Hungary, Poland, Portugal, Republic of Korea, Trinidad and Tobago, Uruguay and Venezuela. The group is an extremely heterogeneous one. One feature common to all these economies, however, is that they have achieved a level of "real" income at which the material content of the standard of living is surprisingly rich in substance. Specifically, the consumption standards in food, clothing and shelter, or the so-called "basic needs" goods, are fully met in these economies, in the sense that they are equivalent to or better than those observed in the high-income countries. At this particular level of income, the average household possesses two radios, one television set and one telephone. The average car ownerships in these economies combined came close to one car for every seven persons in 1988. Some of them support more than one national symphony orchestra and people go to the movies more frequently.** Higher income in these economies would, therefore, require a much bolder experiment with "materialism" and "consumer culture" than they have hitherto attempted and accommodated. Having an additional television set might be regarded as a simple comfort. Installing an additional telephone or becoming a two-car family, however, requires changes in their traditional family value systems. Purchasing two suits a year might be regarded as conspicuous consumption. However, imported luxury goods often serve as status symbols.

If economic stagnation is viewed as resulting from structural rigidities rather than from reaching an ecological limit, then some of the problems currently afflicting developing countries can be seen as much the same as those confronting developed countries. Some developing countries have reached or are about to reach a certain level of income at which the overall level of consumption will not expand as rapidly as before. In the production field, they have become adept and efficient in producing products which are already designed and marketed in advanced industrialized countries. Creating conditions for their own innovation and diffusion cycle might still take considerable time. In terms of traditional technologies, the advantage of "catching up" has been more or less exhausted. In developing countries, financial innovations have had a mixed effect on the real economy. Such innovations have made speculative investments attractive relative to the more secure but smaller gains from real savings and investment (plus hard work). But over many years the course of inflation in these countries and the attempts by successive Governments to repress it has led to many distortions, chief among which have been a disparity of interest rates between the "organized" and the informal money market, diversion of funds into inflation-hedging activities such as real estate investment and commodity stockpiling. There has been an attempt more recently to rehaul public finances, to mitigate the impact of financial repression and to restructure the banking sector. As a result, short-term rates have come down somewhat, even though they are still high.* Such high short-term rates continue to direct funds into speculative activities that promise high returns at the expense of real long-run growth-enhancing investment.

The prospects for growth in developing countries thus remain sombre. While they have in no way reached a stationary state, some of them may have reached a plateau, and others face considerable obstacles to further growth in trade and investment.

4. *Marginalization of least developed countries*

One of the most emotionally divisive issues facing the world has been the great disparity in income between the world's rich and poor countries. There are many statistical indications that income distribution in the 1980s have become more skewed in favour of the rich within developed as well as within developing countries. Given the continuing intercountry dis-

*In this part of the discussion, "real per capita income" refers to income denominated in international purchasing power parity (PPP).

**Abram Bergson, "The USSR before the fall: how poor and why", *The Journal of Economic Perspectives*, vol. 5, No. 4 (Fall 1991).

*Between 1990 and 1991, real interest rates fell from 9.5 to 5.5 per cent in Chile, from 34.7 to 15.9 per cent in Mexico, from 47.4 to 22 per cent in Argentina, and from 12.6 to 8.9 per cent in the Republic of Korea.

parities, this trend in intra-country income distribution could make disparities in world income distribution even more extreme.* The traditional concept of income distribution is, however, too static. Equity in a democracy rests on opportunities for growth, and an important consideration is mobility between income groups.

Figure I.5 shows the per capita income levels observed in 1970, 1980 and 1990 in 155 market-economy countries (all in 1980 constant dollars)—with countries arranged in ascending order of income from left to right. Figure I.5 clearly displays the continuing process of the so-called "catch-up" phenomenon by some middle-income developing countries. The countries ranked roughly between 50 and 130, and especially those between 91 and 130, seem to have improved their income levels substantially during the 1970s as well as in the 1980s. One historical fact is that in each downswing phase of the Kondratieff long waves, new members joined the world industrial centre. In the downswing phase of the second cycle, the United States, Germany, France and central and northern European countries joined with the United Kingdom. During the third cycle, Japan, Canada, Australia, New Zealand, Italy, Finland, the former USSR and some Latin American countries joined the group. In the current downswing phase, the new entrants are thought to have consisted of the southern European countries, the Asian NICs, and Brazil and Mexico.

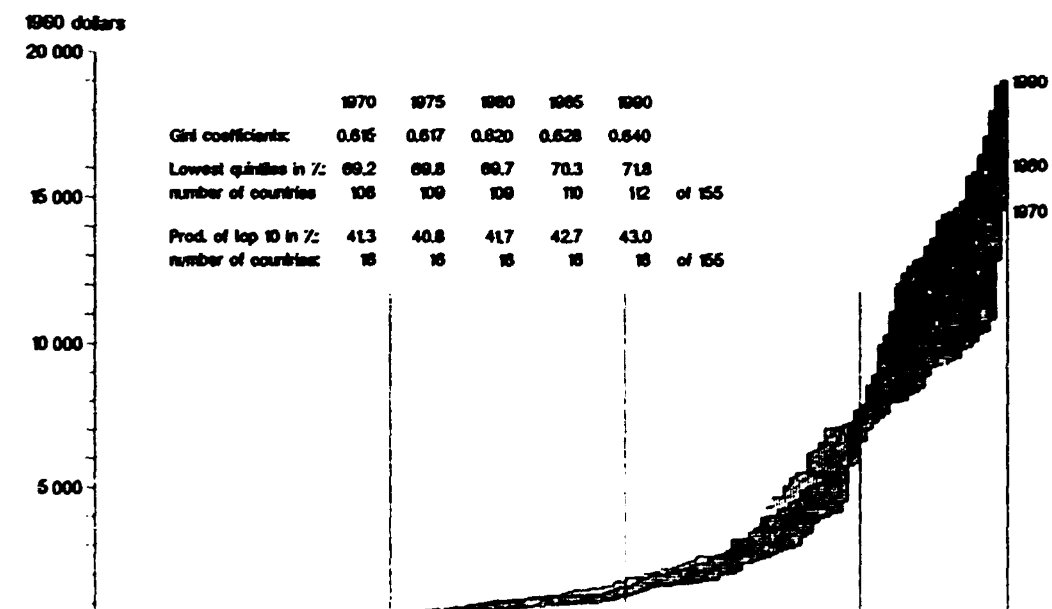
Figure I.5 also shows the impressive achievements made by high-income countries, especially during the 1970s. However, the trend towards a "convergence of income" observed during the 1950s and 1960s among the high-income major industrialized countries seems to have come to halt in the early 1970s. From 1890, when the United States overtook the United Kingdom in labour productivity, and from 1913, when its per capita income surpassed that of the United Kingdom, the United States had a higher level of per capita income and labour productivity than any other major industrialized country until the mid-1960s. The United States lead in income widened between 1913 and 1950 because European and Japanese growth was adversely affected by war. Since then, however, higher investment rates in the latter group of countries have considerably reduced the gap between leader and followers, and some have even managed to move ahead not only in per capita income, but also in labour productivity. As world trade expands, advantages in terms of natural resources and large internal markets become less significant, and the pace of diffusion of technology accelerates with improved transmission mechanisms.*

The most striking aspect of this picture of world progress is that progress seems to have completely eluded the world's poor countries. In 1970, the group of countries ranked 50 and below on the world income distribution scale had a combined GDP of $315 billion (all in 1980 constant dollars), with a total population of 1,207 million, yielding an average income of $261 per person. Two decades later, the group of 50 poorest countries in 1990 managed a combined GDP of $521 billion, with a population of 1,650 million, yielding an average income of $316 per person—a

*The "Gini-coefficients" calculated on the basis of the per capita income of 155 countries weighted by population size show this worsening trend in world income distribution: 0.665 (1970), 0.650 (1975), 0.655 (1980), 0.689 (1985) and 0.704 (1990).

*For a discussion of the convergence of income among the OECD countries, see [8]. It has been argued that the lack of income convergence among countries may be explained in terms of human capital (see chapter II of the present *Global Report*).

Figure I.5. Income distribution among 155 market-economy countries, 1970, 1980 and 1990



Source: United Nations National Accounts Statistics

20.8 per cent gain in two decades. Dismal though the situation appears, this picture for the world's poorer countries needs to be put in a proper perspective, especially since the composition of the two groups of the poorest countries is not identical. Thus, if the progress made by the identical group of 50 poorest countries in 1970 is traced, the group average shows one of the highest rates of growth in the 1970s and the highest in the 1980s among the four income groups.*

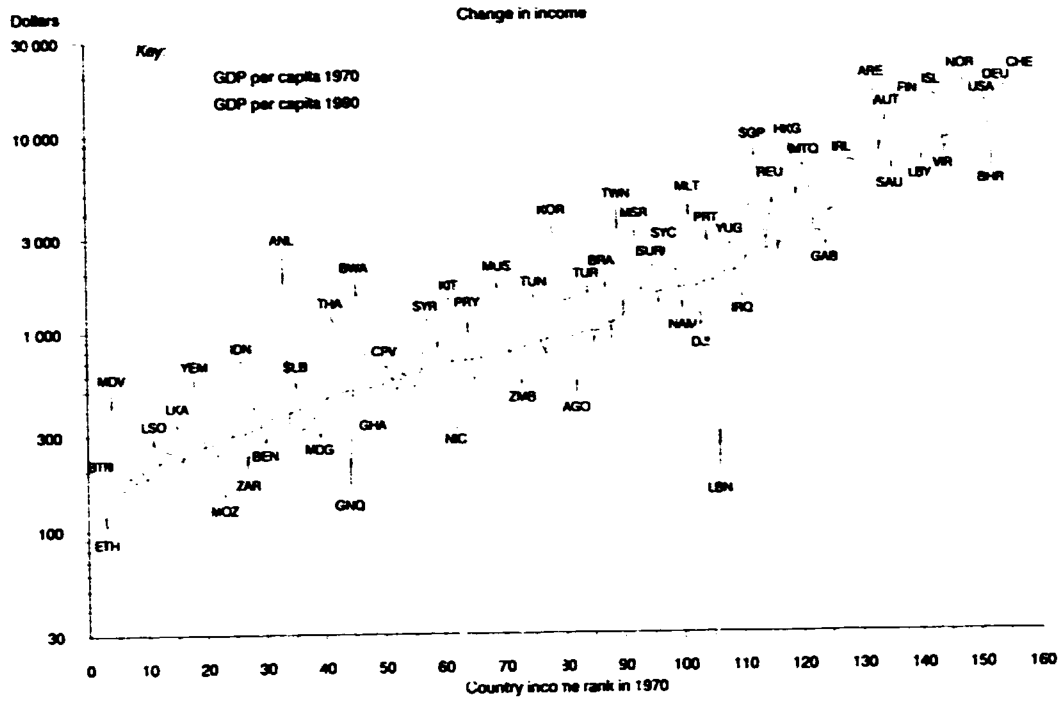
*The average growth rates of per capita income in the 1970s and 1980s were as follows. for the group of countries ranked 1 to 50 in 1970, 2.04 and 2.17 per cent per year; for the group of countries ranked 51 to 90, 4.47 and 1.36 per cent per year; for the group ranked 91 to 130, 2.41 and 0.12 per cent per year; and for the highest-income group ranked 131 to 155, 2.27 and 2.03 per cent per year.

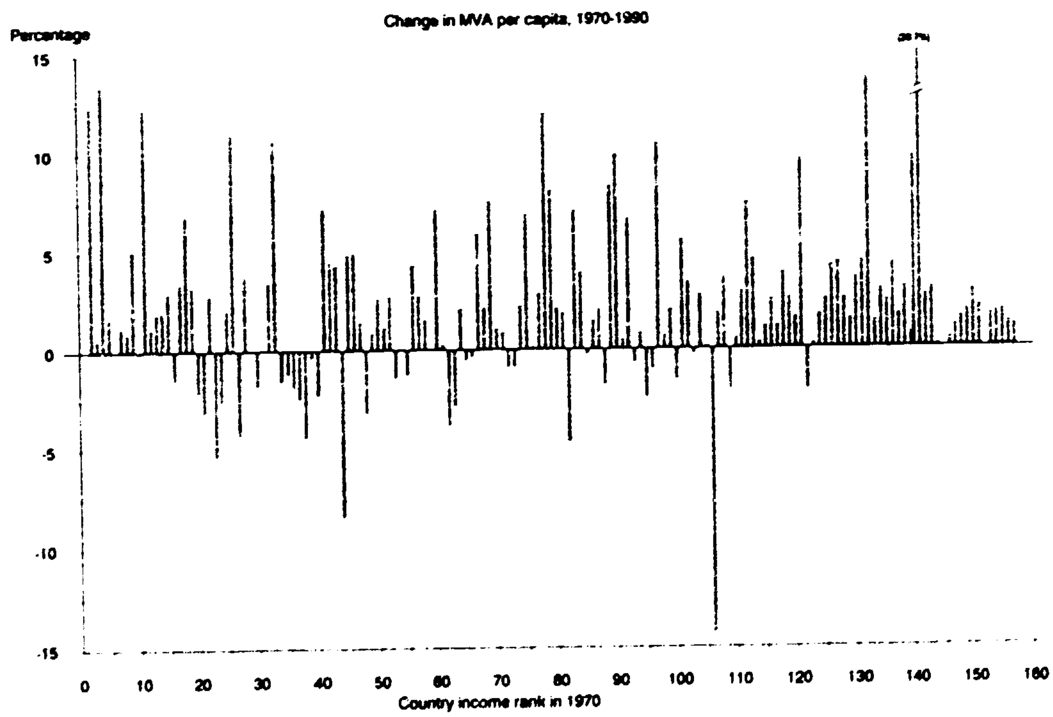
Figure I.6 and table I.4 show that the progress made between 1970 and 1990 by some of the individual lower-income countries has been quite impressive and often spectacular, although only in relative terms. Bhutan, the poorest country in 1970 with a per capita income of $66, improved its income to $188 and moved up the income ladder from first to eleventh place. Maldives moved from third to forty-third place with a 351 per cent improvement in per capita income, from $113 to $510. Lesotho moved from tenth to twenty-fourth place, and nearly doubled its per capita income from $164 to $296. The income of Yemen improved from $252 to $591, moving its place from seventeenth to forty-ninth. Indonesia more than doubled its income from $306 to $728 and moved out of the list of

Table I.4. Country and area income rank, 1970 and 1990

Country	Key	Income rank 1970	Income rank 1990
Algeria	DZA	102	100
Angola	AGO	82	41
Anguilla	ANL	33	105
Antigua	ATG	91	99
Argentina	ARG	109	89
Australia	AUS	145	140
Austria	AUT	133	139
Bangladesh	BGD	8	14
Barbados	BRB	111	114
Belgium	BEL	142	147
Belize	BLZ	81	85
Benin	BEN	30	22
Bermuda	BMU	149	146
Bhutan	BTN	1	11
Bolivia	BOL	72	54
Botswana	BWA	45	91
Brazil	BRA	87	93
British Virgin Islands	VGB	121	123
Burkina Faso	HVO	9	7
Burundi	BDI	12	21
Cameroon	CMR	56	51
Canada	CAN	136	142
Cape Verde	CPV	50	57
Central African Republic	CAF	36	25
Chad	TCD	23	5
Chile	CHL	105	97
Colombia	COL	80	82
Comoros	COM	40	31
Congo	COG	86	79
Costa Rica	CRI	99	96
Côte d'Ivoire	CIV	85	62
Cyprus	CYP	113	121
Denmark	DNK	153	150
Djibouti	DJI	103	66
Dominica	DMA	83	72
Dominican Republic	DOM	70	73
Ecuador	ECU	74	81
Egypt	EGY	24	56
El Salvador	SLV	66	55
Equatorial Guinea	GNQ	44	3
Ethiopia	ETH	2	1
Fiji	FJI	94	94
Finland	FIN	137	144
France	FRA	147	148
French Polynesia	PYF	135	136
Gabon	GAB	124	106
Gambia	GMB	27	39
Germany, western part	DEU	151	151
Ghana	GHA	48	36
Greece	GRC	119	117
Grenada	GRE	60	83
Guadeloupe	GLP	117	120
Guatemala	GTM	76	65
Guinea	GIN	31	35
Guinea-Bissau	GNB	20	17
Guyana	GUY	65	46
Haiti	HTI	11	15
Honduras	HND	51	50
Hong Kong	HKG	118	133
Iceland	ISL	141	149
India	IND	16	29
Indonesia	IDN	25	58
Iran, Islamic Republic of	IRN	1165	101
Iraq	IRQ	110	84
Ireland	IRL	127	128
Israel	ISR	129	126
Italy	ITA	130	134
Jamaica	JAM	96	80
Japan	JPN	131	141
Jordan	JOR	67	64
Kenya	KEN	32	40
Lebanon	LBN	106	8
Lesotho	LSO	10	24
Liberia	LBR	49	37
Libyan Arab Jamahiriya	LBY	139	125
Luxembourg	LUX	152	152
Madagascar	MDG	39	23
Malawi	MWI	4	10
Malaysia	MYS	79	102
Maldives	MDV	3	43
Mali	MLI	13	19
Malta	MLT	101	116
Martinique	MTQ	120	127
Mauritania	MRT	52	42
Mauritius	MUS	69	92
Mexico	MEX	107	103
Montserrat	MSR	92	112
Morocco	MAR	68	70
Mozambique	MOZ	22	2
Myanmar	BUR	7	6
Namibia	NAM	100	76
Nepal	NPL	5	4
Netherlands	NLD	148	143
Netherlands Antilles and Aruba	ANT	125	119
New Caledonia	NCL	144	138
New Zealand	NZL	132	131
Nicaragua	NIC	62	26
Niger	NER	34	28
Nigeria	NGA	21	20
Norway	NOR	146	155
Oman	OMN	140	135
Pakistan	PAK	18	38
Panama (excl. Canal Zone)	PAN	93	88
Papua New Guinea	PNG	77	59
Paraguay	PRY	64	77
Peru	PER	88	63
Philippines	PHL	47	53
Portugal	PRT	104	111
Puerto Rico	PRI	126	124
Republic of Korea	KOR	78	113
Reunion	REU	115	118
Rwanda	RWA	6	12
Samoa	WSM	53	52
Sao Tome and Principe	STP	63	27
Saudi Arabia	SAU	134	122
Senegal	SEN	54	47
Seychelles	SYC	97	107
Sierra Leone	SLE	15	16
Singapore	SGP	112	132
Solomon Islands	SLB	35	48
Somalia	SOM	55	54
South Africa	ZAF	114	10[illegible]
Spain	ESP	128	12[illegible]
Sri Lanka	LKA	14	32
St. Kitts and Nevis	KIT	61	86
St. Lucia	LCA	58	71
St. Vincent and the Grenadines	VCT	43	67
Sudan	SDN	37	30
Suriname	SUR	95	98
Swaziland	SWZ	46	69
Sweden	SWE	154	153
Switzerland	CHE	155	154
Syrian Arab Republic	SYR	57	75
Taiwan Province	TWN	89	115
Thailand	THA	41	78
Togo	TGO	38	34
Tonga	TON	42	68
Trinidad and Tobago	TTO	122	109
Tunisia	TUN	75	87
Turkey	TUR	84	90
Turks and Caicos Islands	TCA	59	61
Uganda	UGA	28	9
United Kingdom	GBR	138	137
United Republic of Tanzania	TZA	19	18
United States	USA	150	145
United States Virgin Islands	VIR	143	130
Uruguay	URY	98	95
Vanuatu	VUT	90	74
Venezuela	VEN	123	110
Yemen, northern part	YEM	17	49
Yemen, southern part	YMD	29	33
Yugoslavia	YUG	108	108
Zaire	ZAR	26	13
Zambia	ZMB	73	44
Zimbabwe	ZWE	71	60

Figure I.6. Changes in income and MVA in different countries and areas, 1970 and 1990





Sources: UNIDO database and United Nations National Accounts Statistics.

50 poorest countries, from twenty-fifth to fifty-eighth place. Anguilla had a 597 per cent increase in income, from $371 to $2,587, and jumped from thirty-third to one-hundred-and-fifth place. Thailand improved its income by 160 per cent from $468 to $1,221. Saint Vincent and the Grenadines moved from forty-third to sixth-seventh place, with an income change from $488 to $999. And Botswana, which improved its income from $545 to $2,126, moved from forty-fifth to ninety-first place.

Altogether, 29 out of the original 50 poorest countries have made a positive gain in income, with 11 countries at least doubling their per capita income during the 20-year span, in spite of their higher-than-average population growth rates. These include Egypt, Indonesia, Thailand, Yemen, and such land-locked countries as Bhutan, Botswana and Lesotho, and such small island countries as Anguilla, Maldives and Saint Vincent and the Grenadines. Their above-average performances resulted in 10 of the original 50 countries advancing into the fifty-first and higher income ranks. These were Indonesia, Egypt (24 to 56), Anguilla, Thailand (41 to 78), Tonga (42 to 68), Saint Vincent and the Grenadines, Swaziland (46 to 69), Philippines (47 to 53), Botswana and Cape Verde (50 to 57).

In spite of having had so many poor countries putting up an excellent performance, the group average for the world's poorest 50 countries did not improve appreciably, firstly because some of the remaining countries did not have any economic improvement at all, and secondly because the better-performing countries kept moving out of the group, only to be replaced by those previously higher-income countries which had the misfortune of experiencing serious economic problems. Surprisingly, 45 market-economy countries suffered an absolutely declining per capita income between 1970 and 1990. They were all developing countries and included some of the more unlikely candidates, such as Argentina and Saudi Arabia. Out of a total of 45 countries, 3 made partial recoveries during the 1980s (Angola, Comoros and Guinea-Bissau), a hopeful sign that the set-backs experienced in the 1970s may have been temporary. Eighteen countries suffered income losses for the first time during the difficult period of the 1980s, for various reasons, including Saudi Arabia (low energy prices), Argentina (the after-effects of the debt crisis and low prices for agricultural products), Peru (civil strife and the international credit squeeze) and others. However, there were 24 other countries whose income levels declined consecutively in the 1970s and 1980s. Six of them—Nicaragua, Sao Tome and Principe, Senegal, Somalia, Sudan and Zambia—eventually joined the ranks of the 50 poorest countries. The list of new entrants to the poorest 50 in 1990 was completed by four additional countries, Angola, Guyana, Honduras and Lebanon.

The list of countries that have lost income from 1970 to 1990 includes some of the world's poorest, and their losses were staggeringly large. For example, the per capita income of Mozambique dropped from $282 to $147 (−48 per cent), forcing the country to become the second-poorest country in the world in 1990 (from the position of twenty-second in 1970). Liberia suffered an income loss of 26 per cent, from $536 to $397. Chad, Zaire, Uganda, Madagascar, Benin, and Ghana all lost between 25 and 50 per cent of their income during these two decades. Those which lost between 3 and 25 per cent of their income include Ethiopia, United Republic of Tanzania (−11 per cent), Guinea, Niger, Guinea-Bissau, Central African Republic (−15 per cent), Comoros (−21 per cent), and Mauritania (−11 per cent). At least 11 of these countries suffered consecutive declines for two decades. The excessive concentration of sub-Saharan African countries in the poorest group is remarkable. Of the 10 countries that were poor in 1970 but escaped the ranks of the poorest 50, only 3 were in sub-Saharan Africa—Botswana, Cape Verde and Swaziland. On the other hand, 6 out of the 10 which joined this rank during this period were sub-Saharan African countries. Low ranks as such would obviously be irrelevant if actual income were rising everywhere, albeit at uneven rates. It is the decline in income—negative growth—in the poor countries that is worrying.

What chance is there that some of these countries will be able to restart the growth process during the 1990s in order to move up one notch in the world income scale? That the world economy slowed down considerably during the 1980s can be seen from the fact that the number of countries suffering negative income growth increased from 34 in the 1970s to 71 in the 1980s. One consequence of this slow growth in the 1980s was a marked slow-down in "social mobility" among the countries of the world. During the 1970s, 24 countries changed their relative income status: 14 moved in and out of the poorest 50; 8 moved in and out of the low-income 40; and 2 moved in and out of the middle-income 40. And in the 1980s, 20 countries moved in or out of their respective income groups, 8 in the group of the poorest 50; 6 in the group of the low-income 40; and 6 in the middle-income group. This means that the probability of escape for any country belonging to the poorest 50 was much greater in the 1970s (.140) than in the 1980s (.080). And this in turn implies that unless the world economy returns to the growth rate of the 1970s, 9 out of 10 of the current 50 poorest countries will be hopelessly stuck there at least for another decade. The odds of such a happening are 1 out of 7 under the conditions of the 1970s. If the last two decades combined provide any guide, by the year 2010, 10 countries will move out of the poorest group, and 2 of them will even achieve middle-income status.*

The conventional international definition of poor is anyone receiving less than $275 per year (in 1987 dollars). In 1990 there were 20 countries with a per capita income of less than that figure. If income distribution within these countries were as even (or uneven) as those observed in advanced democracies, the average income for the lowest population quintile in the poor countries would not have exceeded $30. There have been many theories about the causes of underdevelopment. The economic policy advice and other "technical" assistance extended to these poorest countries by the international agencies and bilateral

*A Markov chain analysis based on more detailed transition probability matrices, each constructed to cover a sequentially extended length of time, discloses a historical tendency since 1965 towards a less rigid stratification among developing countries. The status quo of the world's 22 richest countries remains, however, unassailable.

donors throughout the last two decades must amount to billions of dollars. The continuing immiserization of poor countries is as much an indictment against any specific theory as against external "expertise" in general. The current international consensus is that Governments in the poor countries have become much too interventionist, expanding the public sector at the cost of private initiatives, pursuing ambitious industrialization projects at the cost of traditional agriculture, and generally replacing a well-functioning free market with incompetent bureaucracy. Increasingly, therefore, international aid is being tied to privatization and liberalization of trade, and to human rights and democratization. In many poor countries, however, democracy and the free market still remain the ends rather than the means of economic development (as was argued by the external experts in the 1960s and 1970s). Others have argued that what poor countries require first and foremost is political stability, which is the essential precondition for economic development. It is very difficult to maintain political stability and practice democracy when the majority of the population is desperately poor. Neither does the market function properly if the majority of the people are unable to participate in it because they lack effective means to do so. If growth and equity are the primary objectives of any democratically oriented economic system, then helping poor countries to help themselves in alleviating poverty represents the foremost task which the world economic system must grapple with.

5. *Collapse of the communist economic system*

Economic trends obviously last only until they change. However, a mid-course change in trends, often accompanied by basic changes in policy or caused by spectacular events in the world, is hard to define and quantify before a sufficient time elapses. In recent years, the collapse of central planning in the former USSR and Eastern European countries unquestionably constitutes such an event. Any attempt to analyse the long-term economic consequences for the countries involved as well as their politico-economic implications for the rest of the world surely will take some time. One basic question which remains unanswered is whether these countries will really be allowed to participate in the global scheme of things, not only as importers and consumers, but as producers and exporters of manufactured goods in any near future? In the current debate, on the global economy, there is a tendency to discount the industrial potential of the Eastern European countries and the former USSR. It remains to be seen whether such an assessment is valid, but, in the meantime, an active helping hand should be extended to the countries concerned before they also become passive participants in the global economic system. The immediate concern of the present discussion, however, lies in something quite different, namely the probable cause of the collapse of communism.

The sudden and utter collapse of the economic system of the former USSR has been greeted in the West as a triumph for capitalism and as having provided the empirical evidence needed to prove the superiority of the capitalist system. Such a view, though perhaps justified, ignores an important aspect of this "wondrous" event, namely, that the system, long regarded as hostile to the western free market economy, apparently decided to dissolve itself—on its own volition and seemingly after exhausting its own internal dynamics, but without direct prodding from the outside. If it was indeed a spontaneous act, the vindication of the capitalist system seen in it has no validity until the actual cause of the collapse of socialism is established. Orthodox economics always maintained that replacing the market with planning begets inefficiency. However, inefficiency has never been used as an excuse to dissolve an empire before, and Marx himself had no doubt as to the ruthless efficiency of capitalism. An interesting question is, therefore, did socialism reach a stationary state?

Persistent shortages of goods and long queues were well-publicized features of the economy of the former USSR. However, in 1985, when Mikhail Gorbachev came to power, the level of per capita income in the former USSR in terms of internationally comparable prices is estimated to have been $6,266, or equivalent to 50 per cent of the United States figure of $12,532 [9]. This places the living standard in the USSR in that year below the level of Spain but considerably above that of Portugal. Thus, either after queuing for a long time or resorting to the black market, consumers in the former USSR were able to purchase and consume in 1985, on a per capita basis, 62 kilograms of meat, 295 kilograms of milk, 42 kilograms of sugar and 133 kilograms of grain and bread. This means that per capita consumption of food in the USSR was actually more than comparable to the average observed among OECD countries. For example, the per capita consumption figures of the United Kingdom in that particular year for the above-mentioned food items were, respectively, 74, 141, 37 and 83 kilograms each. The result was that in 1985, the average consumer in the USSR had a daily calorie intake of 3,394 and a protein intake of 105.6 grams each, while the corresponding United Kingdom figures were 3,218 and 88. The average food intake was smaller in Portugal (3,134 calories; 90.5 grams of protein) and in Turkey (3,146 calories; 87.5 grams of protein), and drastically lower in low-income developing countries.

Other than food, the available information on consumption levels in the former USSR, is hard to come by. The UNIDO database, however, discloses the following comparisons. In 1985, the consumer in the former USSR, on a per capita basis, smoked 1,412 cigarettes, compared to the per capita figure of 2,221 in the EEC countries as a whole. Again on a per capita basis, the USSR consumers drank 2.43 litres of beer, while their EEC counterparts consumed 9.12 litres. In that year, the male population in the USSR bought, on average, 1.76 pairs of leather shoes per person, while the average for EEC countries was 1.11. Women in the USSR were a little more frugal, purchasing only 1.62 pairs of leather shoes per person, which still compared favorably against the EEC average of 1.38 pairs. USSR consumers in that year used 6.45 kilograms of cotton yarn per head, against the EEC figure of 3.90. USSR consumers were, however, much more limited in terms of woven fabrics, having had access to 3.97 square metres of cellulosic fibre materials and 2.99 square metres of non-cellulosic fibre materials, against per capita consumption of respectively, 7.74 and 17.52 square metres in EEC countries.

Living standards among countries often diverge more sharply when comparisons are made in terms of consumer durables. In 1985, there were enough automobiles in the USSR to justify a figure of 36 passenger cars per 1,000 persons, which included 5 new ones acquired in that year. The EEC average in that year was roughly 400 passenger cars per 1,000 inhabitants, and 36 of them were newly produced models. The USSR figures, however, still compare favorably with lower-income OECD countries with respect to other durable household goods. According to one estimate based on data for 1970, the USSR "...compares no less well with the United States in respect of stocks of refrigerators and washing machines" ([10], p. 35). In 1985, each household in the USSR had more than one television set, which was not the case in Turkey, Portugal, Greece and Ireland. During that year, USSR consumers purchased, per 1,000 inhabitants, 35 new television sets (against 48 for the EEC as a whole), 32 units of radios (against 31 for the EEC) and 15 vacuum cleaners (against 36 for the EEC).

Obviously, any economic system which did produce such a variety of goods in such quantity for the average consumer could not have had a terribly inefficient production system. The results of the latest reappraisals by Western economists were presented at a symposium held by the American Economic Association and are published in *The Journal of Economic Perspectives* [11]. For instance, it is commonly assumed that in the socialist command economies, the lack of incentives to managers and workers alike would undermine "technical efficiency" at the enterprise level. This measures the extent to which an enterprise performs against its full potential. However, after comparing the results of 18 separate studies, one researcher concludes: "Clearly, these results do not allow one to conclude that technical efficiency is a particularly important problem for centrally planned economies" [12]. Especially surprising is the result of comparing agricultural productivity. According to one study, the average level of technical efficiency in USSR agriculture is estimated at 93 per cent, while it is 92 per cent in a sample of countries consisting of the United States, Canada and Finland. In industry proper, research contrasts the figure of 92.9 per cent estimated for cotton-refining enterprises in the USSR against the technical efficiency levels in 10 different industries in France which were in the range of 71 to 94 per cent. The figure of 92.9 per cent is quite acceptable even by the United States standards.

If there was no discernible difference in performance at the enterprise level, the suspicious finger points next in the direction of inter-firm and intersectoral allocative efficiency within the economy as a whole. Again, it is commonly understood that a socialist planned economy, being deprived of the unseen but benevolent hand guiding resource allocation, tends to produce wrong products or use wrong inputs. Although the above-mentioned study [11] refuses to tackle the first problem, that of consumer versus planner preference, it concludes that on the basis of their revealed international trade patterns, the allocative efficiency in the use of production inputs in Eastern Europe and the former USSR, with the exception of Poland, was higher than in the average OECD country. The former USSR imported food in exchange for oil because it had a relatively poor climate as well as cheap natural resources. The Eastern European countries, each specializing in products in which they excelled within the framework of now-defunct Council for Mutual Economic Assistance (CMEA), exported semi-processed products to developed market economies and imported high-technology items. There is enough evidence to show that the changes in USSR trade over time have been consistent with changes in the structure of domestic opportunity costs which should exonerate some of the planners in the former USSR for not performing as expected.

The President of the Russian Federation, returning from a tour in the United States in the fall of 1989, was impressed by the high living standard observed in the United States: "Their supermarkets have 30,000 items", he reported. His comment reveals the axiom which is taken for granted in Western societies today and was ignored in the socialist planned economies in the past, that choice as well as abundance makes up affluence, which in a sense provides a feeling of security, as well as social and even spiritual comfort. Traditionally, such a celebratory attitude towards materialism is frowned upon in most societies. The intellectual root of socialism is, of course, devoid of spiritualism. Yet its emphasis on an egalitarian society makes it generally immune to any form of consumer culture. It has been said that in the former USSR central planners were responsible for overseeing the production and distribution of some 22,000 commodities and services. Any traveller to that country, after the experience of witnessing its pervasive monotony, would have no difficulty giving credence to the story.

But could a system which imposed such a monotonous existence on its consumers have an income growth beyond a certain fixed level? Specifically, what would have made GDP in the former USSR move up continuously, once all 22,000 items of commodities and services had been produced more or less to the satisfaction of the planners? The obvious solution is either to revise and expand the list of commodities and services the society is deemed to require, or to keep producing the same list of goods and services more and more, in the belief that the "attainment of plenty beyond need" will come only with the advent of the prophesized communist state, which may take an eternity. In this regard, it may not be a mere coincidence that the economy of China started to move ahead when its leaders made a startling renunciation of the Maoist ethic of self-abnegation. An economy producing a limitless quantity of grey tunics obviously has limits to its growth. Between the two waves of reform in China during the period 1988 to 1991, the growth in consumer spending slowed to halt. The policy to encourage consumer spending again prompted the Government to try a novel approach by declaring 1991 as the "year of quality, variety and efficiency". Retail sales responded by an increase of 13.2 per cent to 940 billion yuan renminbi in 1991, and increased at much the same rate in 1992. But the pent-up demand in an economy still in the process of introducing "consumer culture" is still enormous, and is reflected in an individual savings figure which reached nearly 1,200 billion yuan renminbi ($224 billion) by March 1992.

A system that was tolerably efficient in relative terms, offering (after much queuing) a limited variety of products in adequate quantities, suddenly self-destructed. The problem could have been not so much the level of economic efficiency as its growth. There is evidence that the rate of growth of total factor productivity in the USSR slowed down from the mid-1970s onwards. While a parallel experience of stagflation in the capitalist West led to a rejection of full employment and a swing towards orthodox monetarist policies, no such *perestroika* (restructuring) took place in the USSR during the late 1970s or early 1980s, especially in the context of the relentless pressure of the arms race, and later the war in Afghanistan. By 1985, the developed market economies had bounced out of stagflation at the cost of two recessions. There were many financial innovations together with the adoption of new electronics and communications technology. An international division of labour which abandoned the old fordist technology in favour of flexible and small batch production, just-in-time inventories and global mobility of capital seeking the largest return—all these features made for the resurgence of capitalism.

The socialist countries did not undergo a similar economic reconstruction. The Eastern European countries in parallel with many developing countries borrowed from Western commercial banks, which recycled petrodollars at negative real interest rates in the late 1970s. As real interest rates turned sharply upwards with the advent of monetarist policies in the West, a debt crisis hit the socialist countries as much as it did the capitalist ones. It was then that the slow-down in productivity growth and the lack of quality of their manufacturing exports began to show up. In order to service their debts, socialist countries had to lower the real wages of their workers. This led to social unrest in Poland and elsewhere. Attempts to reform the economic system through political *glasnost* (openness) proved catastrophic. The system lost its orientation and disintegrated. China by contrast escaped the rejection of its political system and has been able to restructure its economic system without dissolving into separate States.

6. *Integration and fragmentation*

The collapse of socialism in the countries of Eastern Europe and the former USSR has led also to their fragmentation into separate units. Although the process is not yet complete, the emergence of the Baltic States and other separate States of the former USSR, the break-up of Yugoslavia into its constituent parts and the impending partition of Czechoslovakia are all noteworthy. While all these divisive forces are in full swing in Eastern Europe and the former USSR, the rest of world seems to be coming increasingly together, extending trade ties across and even eliminating traditional borders. Only with its current membership, the EEC forms a community of 360 million people, people of not so different ethnic and cultural backgrounds with similar political traditions and economic aspirations.

This trend toward regional integration, however, not only adds a new dimension to the existing framework of international cooperation, but is also expected to cause a large redistribution of industrial activities within the region itself. A recent study of the EEC [13] predicts a complete industrial restructuring within Europe. Under no regional trade restrictions, Germany will become practically the only European automobile-producing country by virtue of its absolute advantage in that particular industry. The German automobile industry will expand its output by 159.9 per cent, and both Italy and the United Kingdom will lose their respective automobile industries. On the other hand, the United Kingdom will dominate the European market for household appliances, increasing its market share by 50.2 per cent. The United Kingdom and a group of countries consisting of Belgium, Greece, Portugal and Spain are expected to expand their iron and steel industries by 37.7 per cent and 20.6 per cent, respectively, at the cost of the existing steel industries in other member countries. The unification of Europe will also affect the rest of the world, significantly altering the sectoral distribution of industry. The automobile industries in Japan, on the one hand, and the United States and Canada, on the other, will have to curtail their production by 5.6 and 9.1 per cent respectively, while boosting their output in household appliances, shipbuilding and the iron and steel industry. Developing countries producing these items will also fare well, especially in shipbuilding.

That any regional integration would necessitate a massive industrial restructuring within the region as well as worldwide is to be expected. The argument for regional integration based on economies of scale in production has, however, become increasingly unconvincing. Would any region in the world ever seriously contemplate forcing such a massive industrial restructuring for the sake of a 3 to 5 per cent gain in the combined GDP of the member countries over several years? Regional cooperation should therefore be seen in its real defensive context. Discussion of regional trade pacts often reflects the desire on the part of the participating countries to alleviate through barter trade or a regional payments union the balance-of-payment problems that have come to plague most countries of the world. In such circumstances, a successful conclusion of current GATT negotiations would not in itself bring a halt to the trend towards bilateralism and regionalism, until a more rational international payments system is instituted.

The continuous failure so far to reach a new GATT agreement basically reflects the uneasy feeling toward forcible restructuring in a slow-moving world economy. The orthodox proposition that countries benefit from trade through international specialization becomes meaningless when the prospect of full employment does not exist, and becomes invalid when world trade is conducted on the basis of absolute rather than comparative advantage, without ever reaching a worldwide equilibrium in trade and payment balances. Understandably, therefore, there is now a sharp disjuncture between theory and practice in the trade policies of advanced countries. In the meantime, developing countries have been converted *en masse* into enthusiastic free traders and practitioners of doctrinaire economic liberalism. The change of ideological persuasion in the countries of Eastern Europe also commits them to joining the ranks of the free traders.

Both groups of countries are underdeveloped—meaning that they have more legitimate reasons for seeking protection for their domestic industries from foreign competition. However, it has become clear to these countries that the best way to solve their industrialization problem is to persuade foreign manufacturers to render direct assistance. The promise of a liberal trade regime happened to be an essential condition for attracting foreign direct investment. The reason for both groups of countries to remain converted is, therefore, their enduring hope for attracting foreign direct investments, rather than their new found faith in free trade. However, there has so far been no significant foreign direct investment made in the former USSR and the Eastern European countries except for the former German Democratic Republic. Foreign direct investment in the countries of South and South-East Asia has declined perceptibly in recent years and the reasons are not entirely of a short-term cyclical nature. Many of the new industries they have acquired in recent years are essentially of an entrepôt type and therefore transient. In the long run, the only way to indigenize these newly acquired industries seems to be through expanded regional trade and cooperation. Unlike the countries of South and South-East Asia, Latin American countries individually and collectively possess large internal markets, and their attraction for foreign investors would not be seriously impaired even in the event of a breakdown in global trade and cooperation.

There are at present two contradictory trends characterizing the current international economic system. One is the continuing effort to maintain orderliness in the global economy through the harmonization of macroeconomic policies of different countries and through the institution of "fair competition" between countries. International cooperation through this approach therefore involves countries rather than individual industries directly. The other trend is to eliminate (within certain limits) this two-tier system of competition and cooperation by removing or redefining national boundaries among a group of physically adjacent countries. Although the EEC provides a striking example of such a process, the question whether such an experiment can or should be repeated on a continental or regional basis is being actively examined in North America and South-East Asia, and being raised in Latin America and even in Africa.

As long as it is not purely defensive, the trend towards regional or subregional cooperation involving not only the exchange of goods but a free movement of factors of production across national borders represents one of the most exciting experiments injecting a new source of dynamism into an otherwise stale and stagnant world economy which is preoccupied with "national" productivity gains. Productivity worldwide will improve if countries pool their resources and combine their separate national markets to exploit economies of scale in production. Essentially, such an experiment in different forms and on a much-reduced scale is proceeding along the border between and United States and Mexico, along the eastern and southern coastlines of China, and Malaysia and islands of Indonesia adjacent to Singapore.

A further factor reinforcing the tendency towards regional cooperation and integration is the emergence of a global financial market substantially independent of national monetary policies. With the rapidly moving flows of short term speculative financial capital as well as long-term direct investments, it is in the interest of each economic entity to attract as much of this flow of capital to itself as possible. In this context, large economies with substantial markets and ample scope for the free movement of factors of production enjoy considerable relative advantage. They, in turn, have to submit to the deflationary logic of global financial markets but this is a price they are willing to pay.

The consequence of this development is an increasing differentiation within these large economies as well as in the world economy as a whole. There is a growing economic underclass of unemployable, unskilled and deskilled workers, together with the persistence of backward regions caught in the vicious circle of stagflation while the prosperous regions are locked in a virtuous spiral of growth within the large economies. On a worldwide scale, it is the richer economies which are coming together in these large associations. Developing countries, especially the least developed ones, have been left out of this process. Unless trade and payments systems are reformed with a view to directing the flow of capital to these countries, and affording them access to the growing markets of developed countries, recent developments in the financial and industrial spheres can only reinforce inequalities rather than overcome them. Faster growth in the developed countries would also help, but it needs to be supplemented by fundamental reforms of the trade and payments system.

In conclusion, though a prima facie case can be made to prove the existence of Kondratieff cycles, the current slow-growth syndrome gripping the world economy rests on policy failures. In reviewing the declining growth rate of the world economy, UNIDO is convinced that the basic problem lies not on the supply side (involving, that is, the cost of natural resources, capital and labour productivity, and technological advances), but in the management of world aggregate demand, and especially in the difficulty of striking a fine macroeconomic policy balance between countries with different economic structures and policy orientations, and also in the extremely uneven and worsening income distribution in the world. On the supply side, there will be another substantial redistribution of industrial activities in the world as a result of the system change in the Eastern Europe and the former USSR, combined with the approaching integration of Europe. The world will, however, probably remain subject to a process of fragmentation. The worldwide tendency to overproduce and underconsume is bound to prolong global economic recessions, especially if countries are unable to capture sufficient shares of the global market. Intense competition in the global market, on the other hand, is encouraging enormous investment in excess capacities worldwide, through continuous upgrading and relocation of production facilities to gain an elusive competitive edge, thus lowering profit margins. There are already signs that the hard-working habits of some of those Asian countries accused of producing and exporting too much may be changing. One beneficial aspect of Asian industrial competition, often characterized as "predatory" or "adversarial", has been that the world did enjoy a stream of new manufactured products at reasonable prices. Many who take a kinder view of humanity claim that the structure of world politics as well as the system of economic interactions are shaped by evolutionary learning. The countries of the world now seem determined to take a break from such intense international competition, and began a prolonged pause for introspection, both individually and as groups, before facing the challenges of global industrialization in the next century.

II. Industrial prospects, productivity and policy issues in major regions, with emphasis on human skills

> "The West has grown rich, by comparison to other economies, by allowing its economic sector the autonomy to experiment in the development of new and diverse products, methods of manufacturing, modes of enterprise organization, market relations, methods of transportation and communication, and relations between capital and labour" [1].

These words summarize the findings of eminent researchers after having studied the history of industrial development from the Middle Ages to the 1980s. Experimentation and the search for the source of wealth are proceeding with increasing intensity. The countries of Eastern Europe and the former USSR are abandoning central planning; China is adopting a brand of "market socialism"; Western Europe is creating the European Economic Area; the North American Free Trade Area (NAFTA) seems to be a fact; Latin American countries are pushing regional integration movements; many African countries are trying to formulate their own version of fundamental reforms, with or without assistance from the World Bank; and India is shifting from an inward- to an outward-looking policy stance. In short, the whole world is in a state of flux, with attempts being made to redefine the industrial system so as to enhance productivity—the ultimate source of wealth in the long run.

The answers currently put forward are different from those given at the start of the development experience in the 1950s. It is no longer simply the accumulation of physical capital, the rate of savings or the enhancement of the capital-labour ratio that provide the key to overcoming the productivity gap. Increasingly attention is turning to the human agency in economic life. It is human skills and training, the quality of social relations within the enterprise, the subtle mix of competition and cooperation between enterprises as well as between the private and the public sector, and the total institutional context within which production takes place, that are emerging as the new areas to look at.

Some of these developments in 10 major regions are reviewed in the present chapter. The aim is to provide an informed basis for both short- and long-run industrial policy decisions and strategies. The first part of each section reports on the short-run outlook of industrial growth, and the second part provides information on labour productivity and human skills availability which may be useful in guessing what the long-run performance of industry in each region will be.

A salient issue which emerges from the comparative reviews of industrial performance is that of productivity. Raising productivity in manufacturing does not necessarily require natural resource endowments, but investment in building institutions and human capabilities (skills) in order to complement the accumulation of physical capital. The dynamic growth experienced in East Asia during the past two to three decades compels observers and students to reconsider the existing theories of wealth creation, resource endowments and comparative advantage.* Much of the thrust of changing perceptions comes from the new roles of technology in industrial production and in overcoming the lack of natural resource endowments. Changing theories and perceptions could help redirect the attention of policy makers toward more fundamental policy tools and priorities for industrialization than the ones favoured in the past.

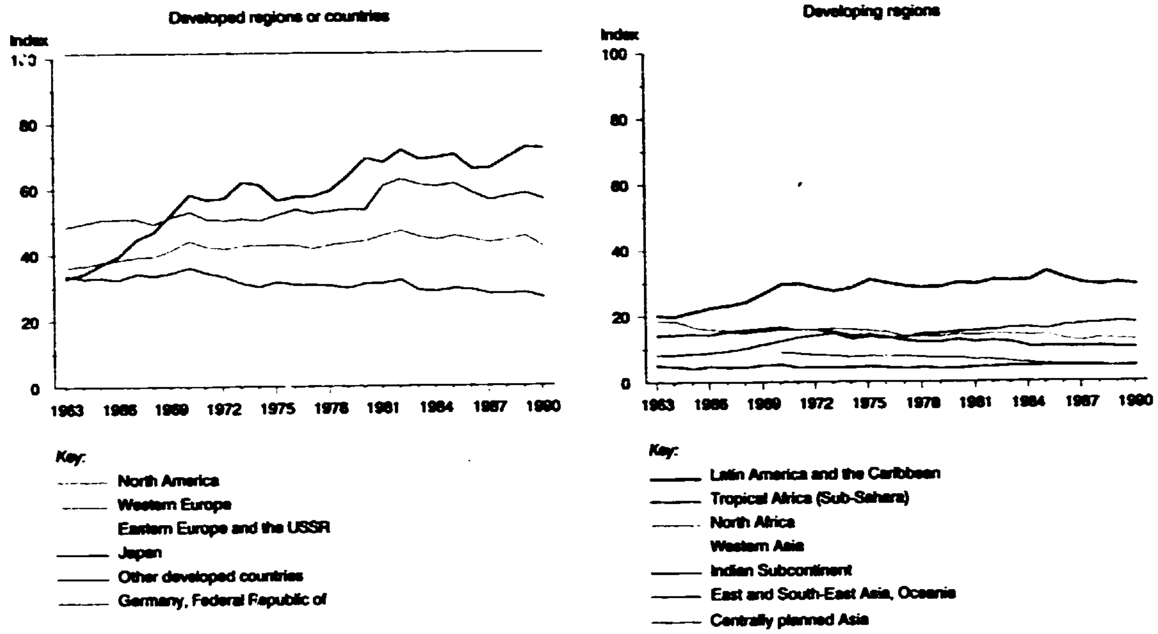
Institution-building activities taking place in major regions of the world were reviewed in chapter II of *Global Report 1991/92* [2]. The theme of the present chapter concerns the merits of building human capabilities (skills in a broad sense of the term) as well as the diversity of institutional arrangements for education and training activities. The two elements—namely, institutions and human skills—seem to go a long way toward explaining interregional differences in technical progress and hence industrial performance.

Figure II.1 gives some broad comparative perspectives on industrial performance between regions. It depicts a labour productivity index (MVA per worker) in manufacturing expressed as a proportion of the North American level which equals 100. MVA values are calculated in 1985 constant dollar terms for computation of the index. The year 1985 was one in which the United States dollar was overvalued, and as such the index may portray a distorted picture in favour of North American labour productivity. Nevertheless, the index presents a rough order of

*Recent efforts to revise the traditional theories include Paul R Krugman, *Strategic Trade Policy and the New International Economics* (Cambridge, Massachusetts, The MIT Press, 1987), and Giovanni Dosi, Keith Pavitt and Luc Soete, *The Economics of Technical Change and International Trade* (London, Harvester-Wheatsheaf, 1990). For the viewpoints of political scientists on the issue see Chalmers Johnson, Laura D'Andrea Tyson and John Zysman, eds., *Politics and Productivity: the Real Story of Why Japan Works* (New York, Ballinger Publishing Company, 1989).

Figure II.1. Labour productivity index in manufacturing by region, 1963-1990[a]

(North America = 100)



Source: UNIDO database; estimates and forecasts by UNIDO/PPD/GLO.
[a]As a percentage of North America.

relative magnitude between regions. The distance between the regional line and the horizontal line of the ceiling (100 per cent) could be regarded, broadly speaking, as the technological gap *vis-à-vis* North America.

Note that among developed regions, Japanese labour productivity has been catching up with the North American level at a fast pace—the fastest yet achieved. In 1990, the gap between Japan and the United States was a little over 25 percentage points, symbolizing a remarkable gain compared to the productivity level of 1963, which was only a little over 30 per cent of the North American level. Next comes Western Europe, although German productivity appears far above the regional average. Other developed countries include Australia, New Zealand and South Africa, with relatively lower productivity levels compared to the North American standard.

Among developing regions, Western Asia accounts for about 40 per cent of the North American level, and shows little progress in closing the gap. Latin America and the Caribbean come next, progressing from about the 20 per cent level in 1963 to about 33 per cent in 1985, but falling thereafter. East and South-East Asia started to climb steadily from 8 per cent of the North American level in 1963 to the 19 per cent level in 1990. Tropical Africa showed a tendency of continuous decline throughout the 1970s and 1980s. The Indian Subcontinent hovered around the 4 per cent level (the lowest recorded) throughout the periods covered.

A clear warning sign is provided by the figure, which reveals a productivity (or technology) gap that seems to be widening between the highest achiever (North America) and a region (Tropical Africa) lagging far behind it, although surprisingly at a level above that of the Indian Subcontinent. If this phenomenon is a valid reflection of reality, then it poses a challenge that the world industrial economy must confront. The possible implications of such a challenge are considered in the concluding section of this chapter.

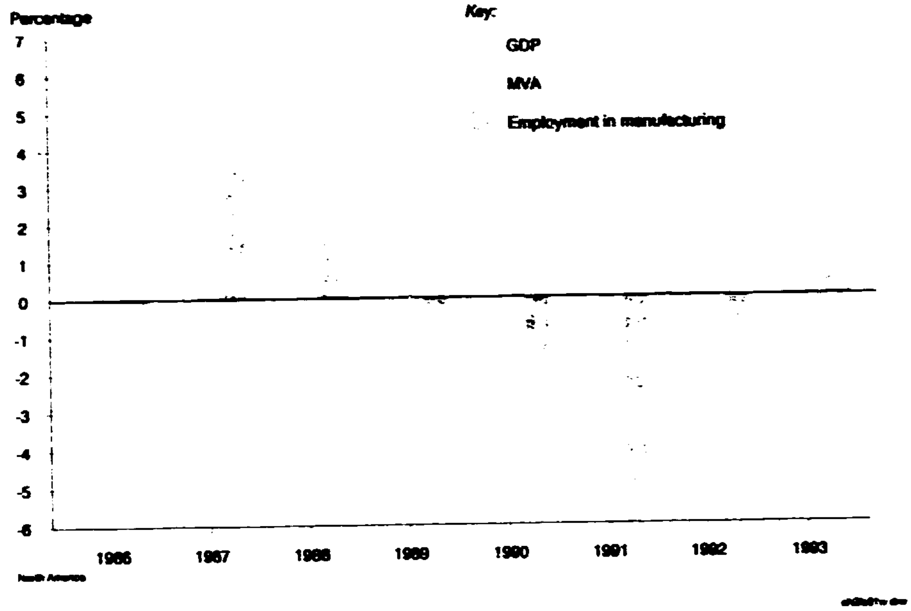
A. North America

1. *Short-run outlook*

The region appears to be entering into a slow recovery period in 1992, with an expected GDP and MVA growth of 1.9 per cent and 2.0 per cent, respectively. The year 1993 is projected to reap a 3.6 per cent growth of GDP and 5.9 per cent growth of MVA. These developments represent a reversal of the recessionary phases experienced in 1990 and 1991, when GDP grew by 0.9 per cent and -0.8 per cent, respectively (see figure II.2 for GDP and MVA patterns of growth in recent years and also for the pattern of structural change in industry).

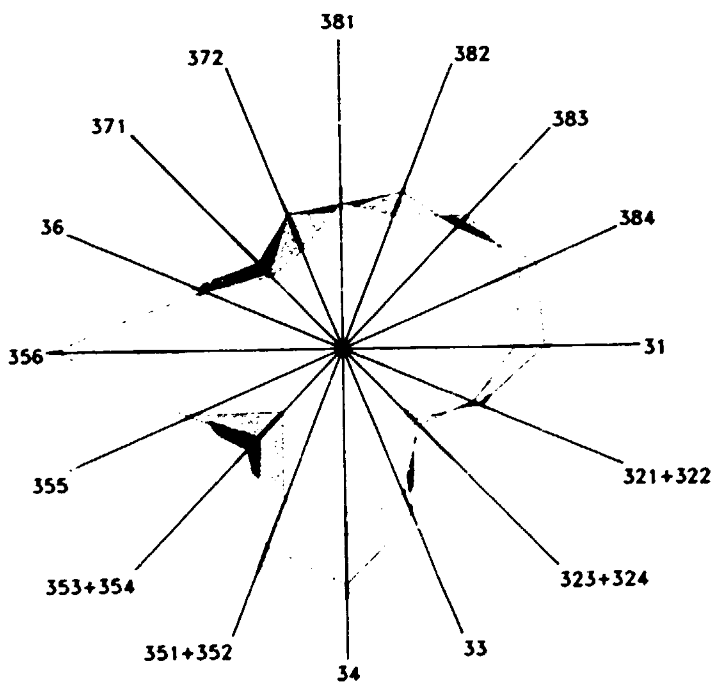
In 1991, MVA growth in the United States was -2.3 per cent—the first negative growth since 1985. The hardest-hit sector was steel products (-10.0 per cent)

Figure II.2. Growth rates of GDP, MVA and manufacturing employment, 1986-1993, and industrial structural change, 1980-1993: North America



Industrial structural change

(Index of value added: 1980 = 100)



g = 1.45, θ = 11.20

Key:

Deflated prices of 1985

g = Average annual growth rate, 1980–1993 (percentage)

θ = Index of structural change, 1980–1993

ISIC code	(industries):
31	(Food products)
321, 322	(Textiles)
323, 324	(Leather)
33	(Wood and furniture)
34	(Paper and printing)
351, 352	(Chemicals)
353, 354	(Petroleum and coal)
355	(Rubber products)
356	(Plastic products)
36	(Non-metal mineral products)
371	(Iron and steel)
372	(Non-ferrous metals)
381	(Metal products)
382	(Non-electrical machinery)
383	(Electrical machinery)
384	(Transport equipment)

1990–1993 forecast

1985–1990

1980–1985

Source: UNIDO database, estimates and forecasts by UNIDO/PPD/GLO followed by metalworking equipment, −9.2 per cent; motor vehicle and parts, −8.3 per cent; and construction materials, −4.5 per cent. Many product items belonging to these categories were protected by voluntary export restraints. Without such protection, the fall would have been greater. These subsectors are expected to turn around from negative to positive growth in 1992 following the general recovery of the economy.

The major forces behind the turnaround have been the robust growth of exports and slowly rising income and consumption during the early period of 1992. In 1991 GDP contracted by 0.8 per cent, it is expected to rise by 1.9 per cent and 3.7 per cent in 1992 and 1993 respectively. Noteworthy is the fact that United States exports of computers, peripherals and parts grew by 22.7 per cent to become the leading export items in 1991. Automotive vehicles, engines and parts were the second most important category on the export list (see table II.1). In contrast to the 7.6 per cent export growth, total United States imports grew only by 0.3 per cent. Merchandise trade deficits declined to $62 billion in 1992 from $89 billion in 1990.

But the growth of consumption outpaced export growth. Consumption expenditures rose to an annual rate of 5.3 per cent in the first quarter of 1992 from

Table II.1. United States: exports and imports of merchandise by end-use category in constant dollars, 1990 and 1991
(Billions of 1987 dollars)

Exports and imports	1990	1991	Percentage change 1990-1991
Merchandise exports			
Foods, feeds and beverages	30.7	32.4	5.5
Industrial supplies and materials	90.1	95.8	6.3
Durable goods	31.3	32.5	3.8
Non-durable goods	58.8	63.3	7.6
Capital goods, except automotive	149.8	164.6	9.9
Civilian aircraft, engines and parts	28.3	30.9	9.2
Computers, peripherals and parts	33.9	41.6	22.7
Other	87.6	92.2	5.3
Automotive vehicles, engines and parts	34.0	36.5	7.4
Consumer goods (excluding automobiles)	39.3	40.7	3.6
Durable goods	21.5	21.6	0.5
Non-durable goods	17.8	19.2	7.9
Other	25.5	27.4	7.5
Durable goods	12.8	13.7	7.0
Non-durable goods	12.8	13.7	7.0
Total	369.4	397.4	7.6
Merchandise imports			
Foods, feeds and beverages	25.5	24.6	-3.5
Industrial supplies and materials (excluding petroleum and products)	66.4	66.0	-0.6
Durable goods	32.6	31.4	-3.7
Non-durable goods	33.8	34.6	2.4
Petroleum and petroleum products	51.5	48.5	-5.8
Capital goods (excluding automobiles)	114.0	122.5	7.5
Civilian aircraft, engines and parts	9.2	10.1	9.8
Computers, peripherals and parts	30.1	38.6	28.2
Other	74.8	73.8	-1.3
Automotive vehicles, engines and parts	79.1	75.0	-5.2
Consumer goods (excluding automobiles)	93.3	95.1	1.9
Durable goods	50.0	50.3	0.6
Non-durable goods	43.4	44.8	3.2
Other	28.6	28.2	-1.4
Durable goods	14.3	14.1	-1.4
Non-durable goods	14.3	14.1	-1.4
Total	458.5	459.8	0.3
Other			
Exports of agricultural products	35.4	35.8	1.1
Exports of non-agricultural products	334.0	361.6	8.3
Imports of non-petroleum products	407.0	411.3	1.1

Source: *Survey of Current Business* (Washington, D.C., Government Printing Office, March 1992), p.12.

average negative figures in 1991. Whether consumers will keep spending at a strong pace remains a question because of debts built up in the past several years.

Business investment is not expected to add much to the demand force because of uncertainties in sales in the immediate future. However, the sector has been drawing down inventories, and at the same time through continuous restructuring has become leaner and fitter in order to meet greater competition in future (especially from abroad). Table II.2 shows that inventory cutbacks were concentrated in the last quarter of 1990 and the first two quarters of 1991. The return of the wholesale trade sector with a high rate of inventory growth (14.7 per cent in the fourth quarter of 1991) seems to augur well for the future.

Furthermore, many blue-chip enterprises seem to have completed restructuring, notably Bethlehem Steel, DuPont, Kodak, Xerox etc. The steel industry is reported to have regained international competitiveness after years of restructuring and adopting new technology. However, General Motors is about to begin its own restructuring, which is expected to have a significant impact on other enterprises. It has also announced a plan to eliminate 70,000 jobs and 21 plants during the next several years.

Another negative force is expected to originate from the need for restructuring the defence-related industries (though a positive factor in the long-run owing to the "peace dividend"). "Arms procurement is expected to drop to $50 billion in the mid-1990s from the 1985 peak of $126 billion" [3]. How quickly the affected defence industries could be transformed into civilian production (and laid-off workers retrained and re-employed) remains uncertain.

Nevertheless, for 1992, defence expenditures are expected to increase by $34 billion to $307.3 billion, one of the largest federal Government budget increases. The total "fiscal push" for 1992 amounts to $152.4 billion in 1991. In the medium term, fiscal pushes cannot be expected to play any important role mainly because of the large federal budget deficit, and the expected peace dividend may not provide a sufficient sum even to reduce the bulging debt burden.

2. *Long-run prospects*

The prime long-run issue for industry in the region appears to be that of competitiveness and productivity. Table II.3 offers a comparison of labour productivity between North America, Western Europe and Japan by 28 subsectors. It should be noted that in spite of heated debates on the erosion of United States competitiveness, United States productivity has been the highest and is expected to continue to grow. On average, North American manufacturing recorded

Table II.2. United States: change in business inventories by industry in constant dollars, 1990 and 1991
(Billions of 1987 dollars)

Item	1990 Third quarter	1990 Fourth quarter	1991 First quarter	1991 Second quarter	1991 Third quarter	1991 Fourth quarter
	Seasonally adjusted at annual rates					
Farm	4.0	-5.5	-1.7	0.4	2.9	-1.6
Non-farm	9.9	-25.7	-31.1	-30.8	-2.8	9.2
Manufacturing	5.4	-13.7	0.5	-14.2	-4.1	-11.4
Durable goods	4.0	-10.1	-7.8	-13.9	-4.0	-15.2
Non-durable goods	1.4	-3.6	8.2	-0.3	-0.1	3.8
Wholesale trade	2.5	0.9	1.9	-13.7	-1.5	14.7
Durable goods	4.4	-0.9	3.1	-13.1	-3.9	8.6
Non-durable goods	-1.9	1.8	-1.1	-0.7	2.4	6.1
Merchant wholesalers	1.7	3.8	3.5	-13.2	-3.0	16.5
Durable goods	4.7	0.6	2.4	-11.7	-5.2	9.7
Non-durable goods	-3.0	3.2	1.1	-1.5	2.2	6.8
Non-merchant wholesalers	0.9	-2.9	-1.6	-0.6	1.6	-1.8
Durable goods	-0.3	-1.5	0.7	-1.4	1.3	-1.1
Non-durable goods	1.1	-1.4	-2.2	0.8	0.2	-0.7
Retail trade	1.8	-8.9	-28.3	-3.0	6.2	7.2
Durable goods	4.8	-12.4	-26.2	-1.4	1.8	-6.3
Automotive	5.7	-9.7	-21.5	-1.1	-	-8.1
Other	-0.9	-2.7	-4.7	-0.3	1.7	1.8
Non-durable goods	-3.0	3.6	-2.1	-1.7	4.4	13.6
Other	0.2	-4.0	-5.2	0.2	-3.4	-1.3
Durable goods	-0.1	-3.9	-8.6	-2.2	-2.2	-0.6
Non-durable goods	0.3	-0.1	3.4	2.3	-1.2	-0.7
Change in business inventories	13.9	-31.2	-32.8	-30.4	0.1	7.6

Source: *Survey of Current Business* (Washington, D.C., Government Printing Office, March 1992), p.14.

Table II.3. Annual average growth rates of MVA per worker in North America, Japan and Western Europe, 1970-1991

Industry	North America 1970	North America 1991[a]	North America Average annual growth rate[b]	Japan 1970	Japan 1991[a]	Japan Average annual growth rate[b]	Western Europe 1970	Western Europe 1991[a]	Western Europe Average annual growth rate[b]
	(dollars)[c]		(percentage)	(dollars)[c]		(percentage)	(dollars)[c]		(percentage)
Food products	45 616	72 240	2.21	17 599	35 660	3.42	19 341	26 243	1.46
Beverages	60 774	137 000	3.95	33 725	89 870	4.78	30 646	41 875	1.50
Tobacco products	82 669	393 000	7.71	24 482	108 000	7.32	56 294	90 914	2.31
Textiles	25 099	37 759	1.96	14 096	27 150	3.17	11 093	17 217	2.12
Wearing apparel	20 655	25 762	1.06	9 630	14 414	1.94	10 061	12 668	1.10
Leather and fur products	25 097	40 478	2.30	16 960	24 022	1.67	12 770	16 491	1.23
Footwear, excluding rubber or plastic footwear	22 404	29 465	1.31	16 062	25 682	2.26	9 053	11 837	1.29
Wood and cork products	25 728	37 099	1.76	14 403	27 994	3.21	14 599	18 208	1.06
Furniture and fixtures	25 942	32 233	1.04	13 774	33 294	4.29	12 741	18 089	1.68
Paper and paper products	42 275	85 193	3.39	24 646	54 268	3.83	16 496	30 109	2.91
Printing and publishing	39 177	57 111	1.81	23 608	51 881	3.82	17 215	29 167	2.54
Industrial chemicals	72 315	155 000	3.70	56 120	109 000	3.21	29 155	49 133	2.52
Other chemical products	72 152	142 000	3.28	47 942	148 000	5.51	22 614	38 037	2.51
Petroleum refineries	100 000	279 000	5.01	115 000	199 000	2.65	84 505	121 000	1.72
Miscellaneous petroleum and coal products	59 742	95 338	2.25	37 264	81 356	3.79	32 794	49 480	1.98
Rubber products	42 119	53 485	1.14	20 367	43 011	3.62	17 746	27 740	2.15
Plastic products n.e.c.	34 672	48 032	1.56	19 592	38 003	3.21	16 859	27 104	2.29
Pottery, china and earthenware	27 272	41 763	2.05	13 974	28 596	3.47	10 436	21 038	3.39
Glass and glass products	41 820	58 267	1.59	33 955	76 972	3.97	14 581	25 688	2.73
Other non-metallic mineral products	41 740	57 934	1.57	22 495	51 932	4.06	19 374	30 850	2.24
Iron and steel	40 687	68 170	2.49	34 108	84 008	4.39	19 649	24 367	1.03
Non-ferrous metals	43 535	66 658	2.05	31 233	59 490	3.12	19 164	35 764	3.02
Metal products	38 132	46 138	0.91	20 933	40 775	3.23	14 636	22 501	2.07
Non-electrical machinery	41 048	63 480	2.10	25 219	51 481	3.46	16 381	26 630	2.34
Electrical machinery	37 654	65 257	2.65	22 314	43 122	3.19	15 076	27 825	2.96
Transport equipment	43 531	73 238	2.51	27 981	60 723	3.76	16 487	27 592	2.48
Professional and scientific goods	46 927	77 615	2.42	16 471	37 325	3.97	17 114	23 069	1.43
Other manufactures	30 869	44 829	1.79	16 617	38 202	4.04	14 716	20 359	1.56
All manufacturing	40 168	66 316	2.40	23 092	47 938	3.54	17 167	27 269	2.23

Source: UNIDO database.

[a] Estimates.

[b] Annual compounded growth rates.

[c] 1985 constant dollars.

$66,316 (estimated in 1985 prices) worth of value added per worker in 1991. This achievement compares with $47,938 for Japan and $27,269 for Western Europe in the same year. The figure for the western part of Germany is higher than the regional average at $37,589.

Noteworthy also is the fact that several subsectors in Japan—namely, furniture and fixtures, other chemical products, glass and glass products, and iron and steel—recorded a higher MVA per worker than their North American counterparts in 1991. While productivity growth is a complex phenomenon with many causal variables, there seems to be a consensus among analysts on the importance of continuous long-run innovations in the area of technology, factory organization and human skills. It would be particularly interesting for developing countries to carefully study the Japanese process of catching up (see section B on Japan for some details).

Numerous books and articles are reporting research results on the issue. But a recent publication by the Competitiveness Policy Council summarizes well the major points (see box II.1) The study emphasizes the need to raise the level of savings and investment, education and technology, as well as to improve corporate governance, health care costs and trade policy.*

The authors of the report rightly state that: "a country is only as competitive as its human resources". But the concept of human resources, though widely accepted as a crucial variable, is difficult to quantify and to relate to productivity gains in any precise manner. Nevertheless, it seems useful to study the available indicators of human resources. Table II.4 provides some comparisons among industrial countries.

It is to be noted that the United States maintains the highest level of mean years of schooling. Tertiary graduates account for 15.5 per cent of the corresponding age group, as compared with 12.4 per cent for Japan and 7.6 per cent for Germany. However, the number of scientists and technicians per 1,000 head of population was only 55, compared with 110 for Japan and 84 for Germany. While there are problems of definition, the difference seems to be consistent with the alleged superiority of Japan and Germany in production process technology, at least in certain lines of assembly engineering, such as quality control techniques and flexible manufacturing systems.**

Available studies and evidence would appear to suggest that the human capital enployed in R and D in the region exceeds that of other countries:

> "The number of employed scientists and engineers in the United States, at all degree levels, rose from 2.6 million in 1978 to 5.4 million in 1988. Of those, more than 800,000 are employed in research and development. The latter number is twice the size of Japan's R and D workforce and is slightly greater than the combined totals of Japan, West Germany, France, and Great Britain" [9].

Furthermore, the United States outperforms every other country in the production of scientific papers, Nobel Prize winners, breakthrough inventions etc. But, when it comes to diversification of products and diffusion of new processes, United States firms seem to be slower than Japanese enterprises. Part of the problem has been often alleged to originate in the motivation as well as the quality of workers. Thurow is explicit in ascribing the root of the problem to corporate organizations:

> "If sustainable competitive advantage swirls around workforce skills, Anglo-Saxon firms have a problem. Human resource management is not traditionally seen as central to the competitive survival of the firm in America or Great Britain. Skill acquisition is an individual responsibility, and business firms exist to beat wages down. Labour is simply another factor of production to be hired—rented at the lowest possible cost—much as one buys raw materials or equipment. Workers are not members of the team. Adversarial labour-management relations are part of the system" ([10], pp. 53-54).

The Japanese corporate system contrasts with that of the United States and the United Kingdom. Continuous upgrading of the skills of blue-collar workers on the job and letting them participate in some decision-making mainly characterize Japanese practices (see section B on Japan).

Along with the issue of industrial competitiveness, foreign direct investment (especially from Japan) has also emerged in recent years as a topic of intense debate. The dramatic rise of Japanese direct investment in the United States (see table II.5) jolted many observers into questioning its benefits to the region. Views range from the "Japanese Trojan Horse thesis", according to which Japan is trying to steal superior United States technologies and markets, to the thesis that the "best policy is free trade and investment". The debate is expected to continue and intensify as global competition becomes even more severe.

To keep matters in perspective, it seems worthwhile noting the comments of Robert T. Kudrle after reviewing four books on foreign direct investment ([10], [11], [12], [13]):

> "Finally, experience abroad suggests that the psychic bruises resulting from being visibly outperformed by foreigners in one's own land need not be permanent. Indeed, they can serve to stimulate resurgence. This may stand as the most important lesson of all as the United States confronts *le défi japonais* ...
>
> "Although each of the four books reviewed sees the situation differently, all recognize the influx of foreign firms as a significant but still rather minor part of a much larger economic drama. In particular, all of the books agree that America's main economic problems are still made in the United States. However knavish the behaviour of some of its international competitors, domestic problems such as the United States' unwillingness to pay for more current consumption with taxation, its low savings rate, and its inadequate system of training and education imply not just continued, but increasing, trouble in the years ahead. Inflowing foreign direct investment's various roles as messenger, menace and

*See also [4], [5], [6], [7] and [8].

**See box II.2 on white collarization of blue-collar workers in Japan.

Box II.1. Competitive Policy Council identifies six priority issues as challenges for the United States in the 1990s

1. Saving and investment

The low levels of saving and investment in the United States are clearly a major problem. Competitiveness is largely determined by national productivity. Productivity in turn depends on the stock and growth of physical capital as well as human capital, which relates directly to education attainment and training, and technology, which is driven critically by the ability of a society to innovate and respond dynamically to market opportunities. Hence national investment is central. In turn, it is ultimately financed by national savings. Capital can be borrowed from abroad but only for a time and only with significant costs. National investment and saving are thus crucial for competitiveness.

2. Education

The Council believes that education reform is another critical ingredient of any national competitiveness strategy. *A country is only as competitive as its human resources.* Japan, the Republic of Korea and other East Asian economies that have created the most dramatic of the "economic miracles" in the post-Second-World-War period have done so importantly on the strength of rapid improvement in the education of their workforces.

By contrast, United States educational performance —particularly in the pre-kindergarten stage and in primary and secondary schooling—is inadequate by any conceivable standard. The test scores of United States students have improved over the last decade, but these gains no more than offset the decline of the previous decade. United States students rank near the bottom on all recent international comparisons, which include a number of developing countries as well as other industrial countries. The goal must be a restoration of globally competitive performance by United States students by the year 2000.

3. Technology

Technology is the third area to which the Council has attached priority. The problem is not primarily at the level of scientific invention. To be sure, other countries are catching up to the United States on such indicators as patent filings and Nobel Prize winners. The United States need not be complacent on this front any more than on the others, or one key area of continuing United States leadership could founder as well.

The main problem at present, however, is in the relatively mundane area of manufacturing processes, where technological innovation is translated into commercial success—the "development" part of "research and development". Research, development, design and production, marketing and customer service are essential elements in a competitive manufacturing system. Neglect of any of these elements renders the system less efficient. No scientist, no researcher, and no sales or service facility can operate in an effective manner without communication and cooperation from all elements of the system. Good engineering and design occur when engineering specialists benefit from input from those who implement the science and from those who use the technology.

4. Corporate governance and financial markets

The fourth priority area is corporate governance. The Council believes that the responsibility for improving United States productivity lies primarily with United States industry and its workers, and that industry's ability to contribute effectively to a competitiveness strategy is thus of utmost importance. The competitiveness of a country ultimately rests on the quality, performance and cost of goods and services produced within its borders. This in turn places heavy emphasis on the nature and performance of the companies there (whatever the mix of domestic and foreign ownership). The environment set for them by government policy is of course critical to these outcomes, but the fundamental achievement of national productivity is largely up to the firms. Thus their *modus operandi* is of central importance.

5. Health care costs

Expenditures for health care have risen from 7 to 8 per cent of United States GDP in 1970 to 12 to 13 per cent today, and are projected to rise to 15 to 17 per cent, on current policies and practices, by the year 2000. This would be roughly double the level in all other industrial countries. The question is whether such costs, which divert a large share of national resources that could be used productively elsewhere, are significantly undermining United States competitiveness. They can do so in at least two ways: first, by raising the total costs to corporations that pay for health care for their workers and retirees (and thus the prices of those companies' products), especially for manufacturing industries where these costs fall particularly heavily; and secondly, by consuming resources that might otherwise be deployed for strengthening the infrastructure, supporting technology development, or improving education.

6. Trade policy

Trade is of course a central focus of the entire competitiveness debate. Some observers in fact view the trade balance as the best single proxy for the United States competitive position, or even as essentially defining the problem. The Council rejects that view because it believes that the ultimate test of a country's competitiveness is the standard of living of its own population, to which external trade is a very important but only one contributing factor. Moreover, macroeconomic problems such as large budget deficits can lead to trade deficits whatever the underlying state of the country's competitiveness.

Source: Competitiveness Policy Council, *Building a Competitive America: First Annual Report to the President and Congress* (Washington, D.C., March 1992), pp. 18-26.

Table II.4. Selected indicators of human capital formation in industrial countries, 1985-1990

Economic grouping, region, country and area	Mean years of schooling: Total 1990	Mean years of schooling: Male 1990	Mean years of schooling: Female 1990	Scientists and technicians (per 1,000 people) 1985-1989	R & D scientists and technicians (per 1,000 people) 1985-1989	Expenditure on R & D (percentage of GNP) 1985-1990	Tertiary graduates (percentage of corresponding age group) 1987-1990
United States	12.3	12.1	12.5	55	..	..	15.5
Canada	12.1	12.3	11.9	177	3.3	1.4	14.3
Norway	11.6	11.5	11.7	231	4.9	..	23.5
France	11.6	11.5	11.7	83	5.0	..	12.1
Australia	11.5	11.6	11.4	50	3.3	..	11.4
United Kingdom	11.5	11.4	11.6	..	..	..	11.0
Germany	11.1	11.7	10.6	84	3.7	2.8	7.6
Austria	11.1	11.7	10.5	21	1.9	1.3	3.7
Switzerland	11.1	11.5	10.7	202	3.9	2.8	2.6
Sweden	11.1	11.1	11.1	262	6.1	3.0	10.0
Japan	10.7	10.8	10.6	110	6.0	2.9	12.4
Belgium	10.7	10.7	10.7	..	3.7	1.6	10.2
Finland	10.6	10.7	10.5	104	4.3	1.8	10.7
Netherlands	10.6	10.4	10.8	65	4.3	..	9.4
Denmark	10.4	10.5	10.3	85	4.9	..	7.7
New Zealand	10.4	10.2	10.6	49	..	-	7.0
Israel	10.0	10.9	9.0	76	..	..	5.1
Hungary	9.6	9.5	9.7	46	..	2.0	5.4
Czechoslovakia	8.9	9.5	8.4	..	..	..	4.2
Iceland	8.9	8.8	9.0	..	..	-	..
Ireland	8.7	8.6	8.8	..	2.1	1.0	9.2
Luxembourg	8.4	8.7	8.2	..	..	-	..
Poland	8.0	8.3	7.7	..	..	-	6.6
Romania	7.8	8.3	7.4	..	..	..	2.2
USSR	7.6	8.0	7.2	..	..	..	6.0
Italy	7.3	7.4	7.3	82	2.0	1.5	3.7
Bulgaria	7.0	7.6	6.4	..	..	2.7	6.4
Greece	6.9	7.3	6.5	48	0.1	0.3	5.3
Spain	6.8	7.0	6.5	36	0.7	..	5.6
Albania	6.3	7.4	5.1	..	..	..	1.7
Yugoslavia	6.2	7.0	5.4	42	2.2	0.1	4.5
Malta	6.1	6.4	5.9	..	0.1	-	2.1
Portugal	6.0	6.8	5.2	..	0.8	..	2.2
Aggregates							
Developed countries	10.0	10.3	9.6	81	4.0	..	9.4
Developing countries	3.7	4.6	2.7	9	0.3	..	1.2
World	5.0	5.8	4.3	22	0.2	..	3.7
North America	12.3	12.1	12.4	67	..	..	15.4
OECD	10.9	10.9	10.8	83	3.9	2.5	11.3
European Community	9.8	9.9	9.6	..	3.1	..	8.0
Nordic countries	10.9	10.9	10.9	182	5.3	2.5	12.1
Southern Europe	6.8	7.2	6.5	58	1.4	1.3	4.3
Eastern Europe and former USSR	7.7	8.1	7.2	..	..	..	5.6

Source: United Nations Development Programme, *Human Development Report 1992* (New York, Oxford University Press, 1992), table 31, p. 190.

saviour should not distract Americans from larger, if more intractable, issues."*

All told, the long-run outlook of industry in the region appears good. There seems to be a broad consensus among policy makers and enterprise managers on the causes of productivity growth—notably, raising levels of savings, investment, education, technology and improving corporate governance and trade policy. In arriving at such a consensus, the Japanese competition seems to have contributed by awakening industries from complacency. The industrial readjustment process can be observed in many areas. In research, for instance, more than 250 R and D consortiums have been created in the 1980s. In designing, cooperative and participatory "design-in" has been arranged with parts suppliers, very much akin to the Keiretsu practices. In production, partnerships have been formed between manufacturer-assemblers and parts suppliers etc. These new arrangements and adjustments have been reported to be bearing fruit.

Furthermore, the region has an abundance of human capital resources, although there seems to be room for

*See Robert T. Kudrle, "Good for the Gander? foreign direct investment in the United States", International Organization, vol. 45, No. 3 (Summer 1991), p. 424

TOTAL	31.6	28.2	69.7	60.5	119.1	400.8

Source: *Survey of Current Business* (Washington, D.C., Government Printing Office, August, 1990)

a Suppressed by United States Department of Commerce to avoid disclosure of individual company data

improvement, especially in secondary education. The growing recognition that education and training must be a life-long process is expected to encourage greater investment in human capital formation. The role of government would be to build infrastructure in order to exploit skill externalities by internalizing them. The Government can also revise immigration policies to help solve problems of skill shortage—an additional tool lacking in other regions.

A final point to be observed from the industrial frictions between the United States and Japan concerns the "supremacy of manufacturing" as a factor in technological progress. A high rate of technical progress is indisputably correlated with a flourishing manufacturing sector. Moreover, a flourishing (rather than stagnant) manufacturing sector is capable of diffusing innovation not only internally but also to the services and agricultural sectors. This phenomenon is expected to be even more pronounced with high technologies (for example, electronics and telecommunications).

B. Japan

1. *Short-run outlook*

The slow-down of GDP growth in 1991 to 4.6 per cent from 5.7 per cent in 1990 is expected to continue in 1992 with a forecast of 2.7 per cent growth. The slow-down has been accompanied by a decline of capital spending after four years of continuous double-digit growth (see table II.6), falling construction orders, and enterprise bankruptcies resulting from speculative bubbles in the real estate and equity stock markets (see figure II.3 for GDP and MVA patterns of growth in recent years and also for the pattern of structural change in industry).

Besides, the economy has been suffering from labour shortages (particularly in skilled categories). The rate of unemployment at around 2.3 per cent hardly changed, the result of stable employment policies of enterprises compared with those of other developed market economies. Steady wages and salary bills helped to support continuing growth of private consumption. It is expected that 1992 will see a cyclical bottoming-out, with higher growth in 1993 (at 3.5 per cent for GDP). This turnaround will be boosted by the following factors: the lowering of the discount rate to 3.75 per cent (on 1 April 1992) from a 4.5 per cent level in the earlier period; front-loading of government expenditures; and rising levels of export generated by the recovery in the United States, Japan's primary trade partner.

Long-run prospects appear rather optimistic, judging from its past record of rapidly catching up with other developed market economies particularly the United States. Technological upgrading, continuous accumula-

Table II.6. Growth rates of investment in plant and equipment in Japan, 1986-1991

Year	All industries	Manufacturing	Non-manufacturing
1985	0.8	-7.8	7.0
1987	10.6	6.8	13.0
1988	26.7	31.5	23.8
1989	21.2	21.9	20.8
1990	12.9	18.5	9.3
1991	4.8	4.2	5.1

Source: Economic Planning Agency of Japan.

Table II.18. MVA, manufacturing employment, labour productivity and wages in Western Europe and selected countries, 1980-1990
(In constant 1985 dollars)

Country	MVA 1980 (million dollars)	MVA 1990 (million dollars)	Manufacturing employment 1980 (thousand persons)	Manufacturing employment 1990 (thousand persons)	Labour productivity 1980	Labour productivity 1990	Wage per worker 1980	Wage per worker 1990
North America	1 055 150	1 247 626	21 063	19 044	50 095	65 412	20 697	22 675
Japan	350 509	506 794	10 253	19 868	34 186	46 630	11 823	15 573
Germany, Federal Republic of	191 604	262 988	7 229	7 231	26 505	36 370	13 325	14 910
United Kingdom	127 326	145 751	6 462	4 757	19 704	30 638	9 617	12 174
France	119 940	128 079	5 103	4 234	23 112	30 253	15 801	18 804
Italy	84 265	74 276	3 330	2 894	25 282	25 668	9 488	10 249
German Democratic Republic	76 600	48 324	2 895	2 932	26 460	16 479	4 378	5 322
Spain	37 516	39 200	2 383	1 839	15 743	21 319	7 074	8 084
Netherlands	20 597	28 407	945	906	21 796	31 353	12 673	13 435
Switzerland	23 428	27 844	686	685	34 162	40 657	..	..
Sweden	22 792	26 671	853	726	26 720	36 759	11 678	12 318
Belgium	18 281	20 868	868	721	20 061	28 942	10 508	12 563
Yugoslavia	13 104	20 709	2 106	2 622	6 222	7 897	2 136	2 218
Austria	14 224	17 957	824	772	17 265	23 272	10 121	11 209
Finland	13 014	12 524	531	441	24 508	28389	10 800	13 627
Denmark	9 814	11 758	381	391	25 759	30 106	14 628	15 250
Ireland	4 950	8 254	225	194	22 028	42 525	9 610	11 044
Norway	8 267	7 841	354	269	23 359	29 189	14 089	15 504
Israel	6 369	6 085	259	275	24 628	22 093	13 182	9 754
Greece	5 919	5 979	474	424	12 491	14 111	4 872	6 392
Portugal	4 433	5 073	680	588	6 516	8 635	2 812	2 669
Luxembourg	785	1 084	38	33	20 797	33 065	13 509	14 156
Iceland	631	483	28	29	22 355	16 821	11 292	11 166
Malta	259	356	29	29	8 95	12 289	4 524	5 616

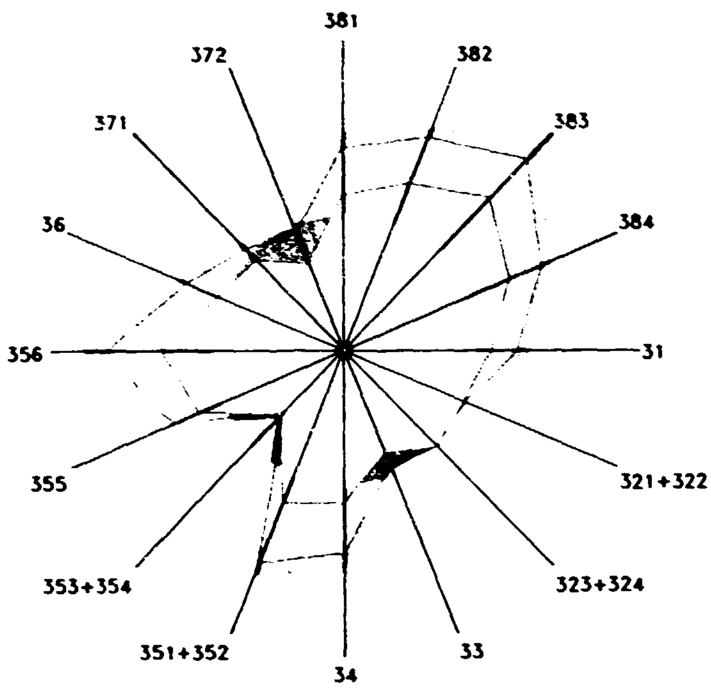
Source: UNIDO database.

Table II.19. Number of patent applications in EEC and selected industrially advanced countries, 1980 and 1987

Economic grouping	1980	1987 or nearest year

(ECU) ($3 billion) in 1992 to ECU 4.2 billion in 1997, to shift priorities toward selected technologies closer to the market for cars, semiconductors and liquid crystal displays, and to regenerate industries through the retraining of unemployed workers, the victims of business restructuring programmes.

Industrial structural change
(Index of value added: 1980 = 100)



g = 3.19, θ = 12.72

Key:

Deflated prices of 1985

g = Average annual growth rate, 1980–1993 (percentage)

θ = Index of structural change, 1980–1993

ISIC code	(industries):
31	(Food products)
321, 322	(Textiles)
323, 324	(Leather)
33	(Wood and furniture)
34	(Paper and printing)
351, 352	(Chemicals)
353, 354	(Petroleum and coal)
355	(Rubber products)
356	(Plastic products)
36	(Non-metal mineral products)
371	(Iron and steel)
372	(Non-ferrous metals)
381	(Metal products)
382	(Non-electrical machinery)
383	(Electrical machinery)
384	(Transport equipment)

1990–1993 forecast
1985–1990
1980–1985

Source: UNIDO database: estimates and forecasts by UNIDO PPD GLO

Table II.20. Technology gap of Japan *vis-à-vis* the United States

Technology	Least progressive	Less progressive	Equal	More progressive
More advanced		1 technology: safety of light-water nuclear reactors	9 technologies, including: optical fibres; industrial robots; fermentation; semiconductors; videodiscs	4 technologies, including: copiers; magnetic-levitated trains
Equal		5 technologies, including: moving communication systems; machine tools; automatic interpreters	19 technologies, including: large-scale computers; integrated circuits; optical communications; sensors	4 technologies: laser printers; artificial hearts; earthquake prediction; construction
Less advanced	3 technologies: CAD/CAM; medical lasers; seabed oil production	24 technologies including: space communications; microcomputers; nuclear fusion; uranium enrichment; rockets; intragenic recombination	11 technologies, including: coal liquefaction; extra-high voltage power; control of crop production	
Least advanced	1 technology: safety assessment of chemical materials	2 technologies: resource exploration; civil airplanes	1 technology: medical R & D	

Source: White paper of Science and Technology Agency of Japan (1985).
Note: Vertical entries reflect Japan's present status; horizontal entries reflect its future potential.

Table II.21. Technology gap of Japan *vis-à-vis* Europe

Technology	Least progressive	Less progressive	Equal	More progressive	Most progressive
Most advanced			2 technologies:	2 technologies:	3 technologies,

tion of human capital as well as "institutional capital",* all bode well for the future. However, increasing frictions (that is, trade and investment disputes) with its trading partners pose a daunting challenge for policy makers in Japan, as well as in the United States and EEC. The immediate cause for concern arises from the limitation of exchange rate policy as a means of correcting trade imbalances in favour of Japan. The mounting imbalances threaten full-scale protectionism against Japanese goods.

A more profound challenge lies in the disputes over the basic differences in market and non-market institutions and their functions between trade partners. A glaring example is given by the issue of whether the Japanese Keiretsu system is a competition-hindering device as the United States claims, or an efficiency-augmenting institution as the Japanese insist. Whether the dispute can be overcome through compromise, along the lines of a recent proposal** remains to be seen.

At any rate, despite the disputes among industrial countries, an intriguing question remains: whether the Japanese ways of producing and selling offer a model to developing countries as well as to the newly independent States of the former USSR and the countries of Eastern Europe.*** Some recent arguments are reviewed in the latter part of this section on Japan.

In the short-run, robust pump-priming is most likely to come from the speeding-up of public expenditures (see table II.7). According to the national emergency plan, 75 per cent of the total 1992 budget will be spent during the first half of the year. The leading public works would include road improvement, flood control, social infrastructure (for example, energy, gas and communications), agricultural infrastructure etc. These and other supplementary emergency measures are expected to push up GNP growth by approximately one percentage point.

*The term refers to investing money, time, efforts and ingenuity to create organizational arrangements at the firm, industry and national levels in order to enhance the productivity of both labour and capital in an economy. Japanese inventions include the Keiretsu system, just-in-time inventory management, lifetime employment, concensus-building in decision-making, teamwork or "groupism", general trading companies etc.

**Morita [14] proposes the following set of steps that Japanese companies should take:

"Manufacturing more products locally in the United States—reducing exports from Japan and creating high-quality jobs for American workers;

Discovering and developing more parts and components suppliers among American companies in the United States;

Augmenting American "human capital" by training workers in the most advanced aspects of Japanese production processes and by pursuing advanced R & D locally;

Building business partnerships with like-minded United States corporations, including technology exchanges and transfers;

Practicing "borderless" policies within Japanese corporations—internationalizing management as much as possible and offering equal training and promotional opportunities to all employees;

Participating fully as "corporate citizens" in community activities and philanthropic endeavours in the United States, with special attention to supporting education, skills training, and scientific research;

Working to reduce trade-related imbalances by identifying high-quality companies and products in the United States that can be introduced to the Japanese market."

***It has been reported that the World Bank has launched an in-depth study project analysing Japan and the Asian NICs with a view to extracting lessons for possible application in least developed and other developing economies.

Furthermore, private consumption has been growing, unlike investment, at over 5 per cent annually (6.2 per cent in 1990, 5.6 per cent in 1991, and 5.1 per cent forecast for 1992). The unemployment rate was only 2.1 per cent in 1991, tantamount to full employment, reflecting the reluctance of Japanese firms to curtail employment as a short-run cost adjustment when sales decline temporarily. Inventory adjustment is expected to be quick thanks to the inventory-saving (just-in-time) technology pervasive in Japanese industries. The stable contribution of growth in the service sector adds to the steady record of growth.

The lower interest rate would also add force to recovery by stimulating private demand for housing and construction as well as related manufacturing (including construction materials such as cement, steel, veneer, bricks, glass and household appliances). For the industrial sector as a whole, a 2.0 per cent growth is projected for 1992 and 5.9 per cent for 1993. The growth-leading subsectors will include, in broad categories, chemicals, non-ferrous metals and electrical machinery (see table II.8). Using a more detailed classification, the growth leaders will include robots, integrated circuits, computers and related equipment, mobile telephones etc. (see table II.9). The lagging subsectors are textiles, petroleum and coal products, iron and steel etc., in which Japan has been losing comparative advantage.

With regard to external demand, recovery in the United States, though sluggish, would stimulate recovery in Japan. However, an undesirable consequence would be a further increase in the Japanese trade surplus, particularly *vis-à-vis* the United States. Regardless of whether there has been a slow-down or acceleration of the global economy and trade, Japan has been amassing trade surpluses continuously since 1981, though at a declining pace up to 1990 after the 1987 peak year, when a $96 billion surplus was recorded. In 1991, however, the surplus bounced back to $103.3 billion from $63.5 billion in the previous year. The soaring surplus partly reflects the falling price of raw materials, particularly oil, which Japan heavily imports. Nevertheless, the persistent surpluses tend to exacerbate trade frictions and inflame disputes between Japan and its major trading partners.

Attempts to solve trade imbalances have taken various forms. Appeals for cooperation in macroeconomic management represent one form, usually on the occasion of summit conferences of the Group of Seven major industrialized countries, and the "structural impediment initiative" represents another, though the latter offers only a bilateral forum between the United States and Japan. To date, both approaches (and all others) have failed to produce any progress with regard to the trade imbalances. Apparently deep-seated, long-run structural factors, such as differences in the speed of productivity growth and technological capabilities, seem responsible for the persistent trade imbalances.

2. *Long-run prospects*

Japan has been rapidly catching up with the other OECD countries during the twentieth century. Assuming the pace remains constant, it is likely that

Table II.7. General account expenditures of Japan, 1991-1992[a]

Item	1991	1992[b]	Percentage change 1990-1991	Percentage change 1991-1992
Social security				
Public assistance	1 018.2	1 061.3	-3.1	4.2
Social welfare	2 634.0	2 818.8	7.7	7.0
Social insurance	7 646.4	7 898.4	6.1	3.2
Health services	600.5	641.1	6.9	6.8
Unemployment compensation	297.1	327.7	5.9	10.3
Total, A	12 196.2	12 737.3	5.6	4.4
Education and science				
Compulsory education	2 768.4	2 726.3	4.8	-1.5
Transfer to school account	1 304.8	1 379.6	3.2	5.7
Science and technology promotion	499.1	547.8	5.3	9.8
School facilities	254.4	271.9	4.1	6.9
School aid	649.5	668.8	-0.1	3.0
Student loans	86.5	88.9	3.3	2.8
Total, B	5 562.7	5 683.4	3.8	2.2
Public works				
Erosion and flood control	1 147.3	1 415.8	5.5	23.4
Road improvement	1 900.1	2 289.4	6.2	20.5
Harbours and airports	545.0	645.0	5.8	20.0
Housing	974.7	930.8	4.7	-4.5
Social infrastructure	1 034.5	1 340.1	8.1	29.5
Agricultural infrastructure	910.1	1 103.6	4.5	21.3
Forestry and industrial water supplies	165.8	218.4	5.1	31.7
Disaster reconstruction	654.6	68.2	-5.8	-90.0
Reserves	11.2	12.9	5.7	15.2
Total, C	7 343.4	8 024.2	4.7	9.3
Pensions				
Civil servants	104.7	101.5	-2.9	-3.1
Veterans	1 560.8	1 547.5	-1.2	-0.9
Other pensions	134.6	128.7	-4.5	-4.4
Administrative costs	8.1	6.2	1.3	-23.4
Total, D	1 808.2	1 783.9	-1.6	-1.3
Local finance				
Local allocation tax	15 800.2	15 771.9	-0.8	-0.2
Interest support and special grants	-	-	-	-
Total, E	15 800.2	15 771.9	-0.8	-0.2
Other				
National debt service	15 536.6	16 447.3	7.5	5.9
Defence	4 440.0	4 551.8	4.4	2.5
Economic cooperation	864.8	905.1	7.8	4.7
Small business assistance	214.6	195.6	-10.9	-8.9
Energy support	589.3	631.3	7.7	7.1
Food agency account	381.5	342.1	-5.7	-10.3
Miscellaneous	4 425.9	4 577.3	-21.6	3.4
Salary increase reserve	135.0	-	..	-100.0
Reserves	150.0	350.0	-53.8	133.3
Industrial investment special account	1 300.0	216.6	-	-83.3
Persian Gulf contribution[c]	300.0	..	..	..
Total, F	28 337.7	28 217.1	1.31	-0.4
TOTAL (A,B,C,D,E and F)	71 048.3	72 217.0	1.4	2.7

Source: Ministry of Finance of Japan.

a/ Revised budget figures include the supplementary budget.

b/ Initial budget. Percentage changes are based on the initial budget for 1991.

c/ 1,300 billion yen were appropriated in two supplementary budgets and included under miscellaneous. The 1991 amount was actually disbursed in 1990.

Table II.8. Indices of industrial production activities in Japan, by industry, 1988-1996
(1985 = 100)

Item	Fiscal year 1988	Percentage change 1987-1988	Fiscal year 1989	Percentage change 1988-1989	Fiscal year 1990	Percentage change 1989-1990	Fiscal year 1991	Percentage change 1990-1991	Forecast: Fiscal year 1992	Forecast: Percentage change 1991-1992	Forecast: Fiscal year 1993	Forecast: Percentage change 1992-1993	Forecast: Fiscal year 1994	Forecast: Percentage change 1993-1994	Forecast: Fiscal year 1995	Forecast: Percentage change 1994-1995	Forecast: Fiscal year 1996	Forecast: Percentage change 1995-1996
Industrial production	115.2	8.9	120.4	4.5	127.2	5.6	127.0	-0.1	129.6	2.0	137.6	5.9	142.9	4.1	144.6	1.2	152.9	5.8
Manufacturing	115.4	9.0	120.6	4.5	127.4	5.6	127.3	-0.1	129.8	2.0	137.5	5.9	143.1	4.1	144.8	1.2	153.2	5.8
Food and beverages	105.2	2.8	103.6	-1.5	105.8	2.1	106.9	1.0	107.8	0.8	110.9	2.9	110.0	-0.8	111.5	0.4	113.5	2.7
Textiles	94.1	-0.8	92.9	-1.3	90.4	-2.7	88.5	-2.1	86.3	-2.6	87.6	1.5	86.7	-1.0	83.4	-3.9	82.9	-0.6
Paper and pulp	121.2	9.0	128.7	6.2	135.1	5.0	138.9	2.8	140.7	1.2	147.3	4.7	154.7	5.0	158.9	2.7	169.0	6.4
Chemicals	123.8	9.3	128.7	4.0	136.6	6.1	137.2	0.4	141.4	3.0	151.2	6.9	158.4	4.8	160.3	1.2	171.1	6.7
Petroleum and coal products	97.8	5.2	103.6	5.9	112.9	9.0	114.5	1.4	115.0	0.4	115.4	0.3	118.2	2.4	119.1	0.8	122.6	2.9
Ceramics, stone and clay	110.5	6.9	115.8	3.9	121.1	5.5	120.6	-0.5	122.5	1.6	129.0	5.2	134.1	4.0	136.0	1.9	142.9	4.6
Iron and steel	105.4	5.7	106.8	1.3	110.5	3.5	107.2	-3.0	105.4	-1.7	109.7	4.1	110.8	1.0	110.2	-0.5	114.3	3.7
Non-ferrous metals	116.4	6.3	123.6	6.2	132.2	7.0	134.8	2.0	139.5	3.4	148.7	6.6	155.8	4.8	162.2	4.1	172.4	6.3
Fabricated metals	111.9	5.7	116.5	4.1	122.6	5.2	122.4	-0.2	125.2	2.3	133.7	6.8	140.4	5.0	144.2	2.7	153.0	6.1
Industrial machinery	114.5	15.2	123.3	7.7	129.5	5.0	130.7	0.9	132.5	1.3	141.2	6.5	149.8	6.1	153.4	2.4	162.6	6.0
Electrical machinery	135.8	14.7	142.7	5.1	153.6	7.6	157.0	2.2	163.3	4.0	173.9	6.4	183.9	5.7	187.7	2.1	201.8	7.5
Transport equipment	108.3	9.6	117.2	8.2	127.3	8.6	122.9	-3.5	125.8	2.3	134.9	7.2	140.4	4.0	138.8	-1.1	146.3	5.4
Precision instruments	117.4	9.1	121.6	3.6	138.7	14.1	142.4	2.7	142.2	-0.2	149.6	5.1	161.1	7.7	169.8	5.4	179.2	5.5
Other manufacturing	112.2	4.9	117.2	4.5	121.7	3.8	117.7	-3.2	120.0	1.9	127.8	6.4	131.5	2.9	132.9	1.0	140.4	5.7
Mining	84.1	-7.1	80.7	-4.0	78.1	-3.2	77.7	-0.5	77.0	-0.9	74.3	-3.6	69.7	-6.2	66.3	-4.8	62.2	-6.2

Source: Japan Centre for Economic Research.

Table II.9. Trends in selected products and services in Japan
(1985 = 100)

Item	Product and service	Unit	1985	1990	1995
Export-dependent	Synthetic fibres production[a]	Million tonnes	1.4	91.5	92.4
	Crude steel production	Million tonnes	103.8	107.7	108.7
	Automobile production	Million units	12.4	109.5	108.2
High-technology-related	Robot production[a]	Thousand units	48.5	163.7	293.4
	Integrated circuit output[a]	Billion yen	1 842.0	158.1	223.1
	Computer and related equipment output[a]	Billion yen	3 379.0	172.1	236.7
Information-related	Number of contracts for mobile telephones	Thousands	62.0	1 398.4	6 606.5
	Publishing and printing shipment[a]	Billion yen	9 163.0	137.6	178.9
	Information service sales[a]	Billion yen	1 562.0	376.2	785.5
Service-related	Leasing contracts	Billion yen	4 322.0	191.5	323.8
	Restaurant sales	Trillion[b] yen	19.4	131.5	174.5
	Travel services of 10 major agents	Billion yen	2 458.0	142.9	200.0

Source: Japan Centre for Economic Research.
[a] Based on calendar year.
[b] 1 trillion = 1,000 billion.

Japan's GNP per capita will equal that of the United States sometime before the close of this century. The figures in table II.10 illustrate such a possibility. Among the selected industrial countries, the United States still had the highest GDP per capita in 1989 with $18,317. The corresponding figure for Japan was $15,101 (82 per cent of the United States figure). But the coefficient of multiplication for the period 1820-1989 indicates 17 for the United States and 26 for Japan. Japan's pace exceeds that of the United States by over 50 per cent.

Similar observations can be made regarding the growth of labour productivity and wage earnings in the manufacturing sector (see table II.11). The figures are shown as percentages of labour productivity and wage earnings in North America. In 1970, the average manufacturing labour productivity was 57.5 per cent of that of the United States. The corresponding figure jumped to 71.1 per cent in 1990. Likewise, wage earnings per worker accounted for 38.3 per cent of the United States level in 1970, but the corresponding figure rose to 68.7 per cent in 1990. Such a catch-up

Table II.10. Levels of GDP per capita, selected industrial countries, 1820-1989
(In constant 1985 dollars)

Country	1820	1870	1913	1950	1973	1989	Coefficient of multiplication 1820-1989
Australia	1 242	3 123	4 523	5 931	10 331	13 584	11
Austria	1 041	1 433	2 667	2 852	8 644	12 585	12
Belgium	1 024	2 087	3 266	4 228	9 416	12 876	13
Canada	..	1 347	3 560	6 113	11 866	17 576	..
Denmark	988	1 555	3 037	5 224	10 527	13 514	14
Finland	639	933	1 727	3 480	9 072	13 934	22
France	1 052	1 571	2 734	4 149	10 323	13 837	13
Germany	937	1 300	2 606	3 339	10 110	13 989	15
Italy	960	1 210	2 087	2 819	8 568	12 955	13
Japan	588	618	1 114	1 563	9 237	15 101	26
Netherlands	1 307	2 064	3 178	4 706	10 267	12 737	10
Norway	856	1 190	2 079	4 541	9 346	16 500	19
Sweden	947	1 316	2 450	5 331	11 292	14 912	16
Switzerland	..	1 848	3 086	6 556	13 167	15 406	..
United Kingdom	1 405	2 610	4 024	5 651	10 063	13 468	8
United States	1 048	2 247	4 854	8 611	14 103	18 317	17
Arithmetic average	1 002	1 653	2 937	4 693	10 396	14 456	14

Source: Angus Maddison, *Dynamic Forces in Capitalist Development: a Long-run Comparative View* (Oxford, Oxford University Press, 1991), pp. 6-7.

Table II.11. Japan: Labour productivity and wage earnings per worker, 1970, 1980 and 1990 as percentage of the North American level a/

Industry	Labour productivity 1970	Labour productivity 1980	Labour productivity 1990	Wage earnings per worker 1970	Wage earnings per worker 1980	Wage earnings per worker 1990
	(percentage)			(percentage)		
Food products	38.58	48.70	47.00	31.80	50.01	58.60
Beverages	55.49	67.64	64.29	30.12	50.04	59.92
Tobacco products	29.61	38.70	29.75	..	..	103.88
Textiles	56.16	71.15	65.42	29.97	60.99	69.71
Wearing apparel	46.62	57.20	53.73	36.35	58.63	65.33
Leather and fur products	67.58	76.27	56.56	48.01	69.22	74.33
Footwear (excluding rubber or plastic footwear)	71.69	85.80	82.38	52.15	84.23	99.13
Wood and cork products	55.99	68.77	67.91	37.50	55.50	68.47
Furniture and fixtures	53.10	80.19	96.20	39.46	67.13	84.77
Paper and paper products	58.30	60.31	57.96	37.52	54.10	62.62
Printing and publishing	60.26	83.41	86.21	44.82	76.69	89.54
Industrial chemicals	77.60	66.29	72.19	44.18	62.48	67.68
Other chemical products	66.45	84.95	100.27	35.65	66.57	81.44
Petroleum refineries	115.00	92.91	75.49	42.98	60.24	77.79
Miscellaneous petroleum and coal products	62.37	92.93	78.91	36.95	58.83	71.48
Rubber products	48.36	76.03	79.07	36.15	60.20	72.86
Plastic products n.e.c.	56.51	77.75	80.33	40.40	65.71	75.48
Pottery, china and earthenware	51.24	59.78	65.11	38.07	54.13	72.86
Glass and glass products	81.19	99.98	127.96	45.60	65.46	75.36
Other non-metallic mineral products	53.89	71.78	86.24	36.73	54.96	72.05
Iron and steel	83.83	124.24	121.09	47.55	60.95	81.07
Non-ferrous metal products	71.74	88.73	91.86	46.59	58.31	73.06
Metal products	54.90	66.82	86.10	38.78	58.52	77.29
Non-electrical machinery	61.44	69.34	79.07	40.52	60.64	72.07
Electrical machinery	59.26	64.29	66.52	34.92	53.22	62.46
Transport equipment	64.28	71.66	80.18	37.95	53.10	66.43
Professional and scientific goods	35.10	43.67	49.39	35.05	50.17	54.22
Other manufactures	53.83	67.69	81.84	38.92	64.44	84.70
TOTAL	57.49	68.31	71.14	38.25	57.12	68.68

Source: UNIDO database.
a/ Measured in constant 1985 dollars.

pace seems pervasive in virtually all subsectors of manufacturing. Thus labour productivity has shown above-average improvement in capital (or engineering) goods and intermediate goods, and below-average improvement in traditional goods such as food, beverages, tobacco, textiles, apparel and footwear. Much of the progress in labour productivity has been supported by technological progress and organizational improvements (as noted in previous issues of the *Global Report*).

Improvement in labour productivity can be generally explained by a number of factors, including an increase of capital per worker, adoption of better technologies, greater work discipline, and more investment in education and training. Recent studies* elucidate some distinctive features of skill formation in Japanese companies (see box II.2). A combination of lifetime employment and job rotations, leading to the acquisition of multiple skills through in-house accumulation of experience, is a salient feature of Japanese industrial practice. Workers so trained become capable of shop-floor decision-making on day-to-day technological problems. After several years of such practices, the total sum of incremental progress crystallizes into company-specific technology. Such technology is embodied in the worker on the shop-floor as well as in the corporate system, and is therefore hardly subject to imitation by enterprises in other OECD countries. An author differentiates the Japanese system from practices in other OECD countries:

"Many Japanese companies undertake regular personnel reshuffling in the spring of each year. This is a uniquely Japanese practice. In the West, to replace experienced workers who are accustomed to a particular job on a regular basis with novices would be regarded as a totally inconceivable, even absurd, idea. As has already been pointed out, companies in the West adopt a stopgap strategy whereby, apart from when there is a significant problem relating to the ability of the worker who already holds the position, positions within a company are only changed when a gap appears and needs to be filled.

*See, for instance, ([15], pp. 49-69)

Box II.2. Skill formation and accumulation, Japanese style

The skills of Japanese blue-collar workers in large firms are partly of an intellectual character, involving a process of determining the causes of problems and adjusting to minor changes on the shop floor, and this intellectual character is shared with white-collar workers in general. With this type of skill, it is natural that both management and workers benefit from long-term employment, which has long been thought of as Japan's unique "permanent employment". For workers, it is beneficial to stay with one firm because skills can be developed; for management, finding and training substitutes takes time and is costly. And again, this long-term employment is not unique to Japan in the following two senses: it is confined to large firms; and it is also common for male white-collar workers in Europe. A Japanese feature is the extension of the white-collar characteristics to a section of blue-collar workers, in short, their "white-collarization".

Skill development over a long career with one firm can account for high worker morale. It is not only the foundation of high morale, but is also essential to it. The essence of the contribution of high morale is not in long work hours or in a heavy workload, but in devising better methods of work and production, which in turn demand technological knowledge by workers for maintenance. Without a proper technological background, no effective programme can last long. The development of wide-ranging skills requires such knowledge and promotes the ability of workers to determine the causes of problems on the shop floor and thus to contribute to productivity.

Even if workers can devise better ways to work, they do not practice them unless they sense a necessity to do so, which is also a matter of skill. As stated above, this type of skill can be better developed through promotion within a single firm. In order to elevate their own skills quickly, workers take an interest in the growth of their firm. If the company declines, promotion will be delayed and skill development slowed. In an extreme case, a firm has to lay off workers, and this represents a great damage to workers with special skills. To promote their skills, therefore, workers must maintain high morale lest their company lose out to rival companies and endanger their careers.

Again, high morale is not unique to Japanese workers, but shared with white-collar workers with promising prospects in other OECD countries. A common impression of the attitudes of Japanese workers is that promising white-collar workers are hardly more industrious than their counterparts in other OECD countries. Generally speaking, it is clear that without a promise of a career to some degree, no worker will make substantial efforts. The Japanese feature is that the prospects of blue-collar workers are raised, and, accordingly, morale is high.

Trade unions adopt a policy of cooperativeness with respect to production because they are democratic and reflect the desires of their members. The apparent difference between Japanese unions and unions in other OECD countries mainly results from one simple fact. Formal trade unions in European countries still consist, by long tradition, mostly of blue-collar workers (although the situation is changing and unions now include more white-collar workers). This was also common in Japanese unions before the Second World War. Defeat in the War brought new types of organization and the inclusion of both blue- and white-collar workers in the same unions in Japan. Formal trade unions in Europe usually do not include white-collar workers in the same organizations as blue-collar workers, and consequently, formal unions are not so cooperative as in Japan. If Japanese unions are compared with organizations of white-collar workers in other OECD countries, more similarities emerge. In other words, a comparison of Japanese unions with workers' councils in Europe might be meaningful because the latter include white-collar workers.

Source: Kazuo Koike, "Human resource development and labour-management relations" in *The Political Economy of Japan*, Kozo Yamamura and Yasukichi Yasuba, eds. (Stanford, Stanford University Press, 1987), vol. I, pp. 327-328.

In terms of short-term efficiency, one would have to say that Japan's system is totally inefficient. The reason for the system's use, however, is that of a rotation of positions represents a significant investment on behalf of the company in long-term education. When a worker assumes a new position, his general contribution to the company during the initial period that follows will normally be less than that of his predecessor. The extent to which it is less will, at that point, represent loss for the company. In the case of Western companies, this loss ultimately remains a loss. In Japanese companies, on the other hand, this loss could eventually become a gain since there is a possibility for long-term recovery of the investment" [16].

Top level managers of Japanese companies are also trained to be multifunctional and to become an organic part of the same corporate community throughout their career. The following best describes the making of managers in the Japanese style:

> "In most large corporations, entrance is possible only at the employee's school-leaving age and only after passing through a rigorous selection process. Future members of the elite cadre are groomed as such, being rotated from one functional area to another, and transferred from one location to another every few years. During this long process of training for senior positions, these employees acquire a great deal of knowledge about the corporation—its people, its products, and its culture—as well as becoming part of an intricate web of obligation and loyalty. At an appropriate age, some of the best qualified (or the best connected) of this elite cadre of managers are gradually moved into the top management ranks. Every Japanese corporation has such an elite group of key employees. Top

management positions are filled by members of this group, and the key decisions of the corporation are made collectively by this group, with junior members often supplying considerable input. The insider-outsider mentality of the Japanese is such that it is extremely difficult, if not impossible, for any outsider or latecomer to break into this inner circle. A managerial employee hired at an overseas location, even if he is a native-born Japanese, simply lack the quality of being an insider with all the requisite corporate cultural traits" [17].

Distinguishing characteristics of Japanese companies are also reflected in the relative freedom to retain a large share of earnings for growth investment. Table II.12 shows that, compared with the United States, Japanese firms pay out smaller proportions of corporate income for dividends and smaller proportions for employee compensation, and invest a larger sum of GNP in fixed capital formation. Japanese companies are under little pressure from take-over threats or stockholder demands to produce quarterly profits, or from the labour unions to match wage hikes in other companies and industries. These indicators show how aggressively and successfully Japanese corporations compete with United States companies to maximize market shares, to maintain competitiveness, and to speed up the process of catching up through accumulation of technologies and human skills.

Aggressive investment behaviour coupled with a corporate culture that considers trained workers as an asset rather than a cost item explains Japan's industrial performance. Japanese indicators show stronger industrial competitiveness, higher GDP and MVA growth rates, and a lower unemployment rate than other industrial countries regardless of phases of the business cycle. But as a consequence, the labour shortage problem has emerged as a constant problem, which has led Japanese enterprises to increasingly rely on robotization (see table II.13) and relocating production sites abroad (see table II.14).

Table II.12. Shares of capital and labour in national income and dividend payout ratio in Japan and the United States, 1970-1989

Year	Corporate fixed investment as percentage of GNP a/		Employees' compensation as percentage of national income b/		Dividends as percentage of after-tax corporate income b/	
	Japan	United States	Japan	United States	Japan	United States
1970	17.4	10.9	54.0	74.3	16.6	60.0
1975	14.3	10.4	67.5	73.6	c/	35.3
1980	14.5	11.9	66.8	74.3	29.1	35.9
1981	14.6	12.2	68.2	74.0	34.9	43.7
1982	14.3	11.6	68.6	75.7	30.5	62.8
1983	14.1	11.0	69.3	74.3	30.1	54.8
1984	15.1	12.1	68.9	73.1	26.7	54.1
1985	16.1	12.5	67.8	73.2	27.8	65.2
1986	16.4	11.8	67.9	73.6	29.6	79.2
1987	16.7	11.7	68.1	73.4	37.5	66.2
1988	18.1	12.1	67.7	72.9	36.7	60.9
1989	20.0	12.3	68.4	72.9	65.4	71.6

Source: United States Department of Commerce and Economic Planning Agency of Japan.

a/ At constant prices.

b/ At current prices.

c/ Reported Japanese corporate income after taxes and dividends was negative.

Table II.13. Industrial robot population in selected countries, 1974-1985

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Japan	1 000	1 400	3 600	4 900	6 500	9 100	14 250	21 000	31 857	46 757	67 300	93 000
United States	1 200	..	2 000	..	2 500	..	3 400	4 700	6 250	9 387	14 550	20 000
Germany, Federal Republic of	130	..	..	541	..	..	1 255	2 300	3 500	4 800	6 600	8 800
United Kingdom	50	..	..	80	125	..	371	713	1 152	1 753	2 623	3 017
France	30	..	..	..	..	..	580	790	1 385	1 920	2 750	..
Italy	90	..	..	..	300	..	454	691	1 143	1 850	2 585	..
Sweden	85	..	..	..	415	..	795	950	1 400	1 600	1 900	..
Belgium	..	..	..	12	21	30	58	242	361	514	860	..

Source: Akira Tani, "International comparisons of industrial robot penetration", *Technological Forecasting and Social change*, vol. 34 (1989), p. 193.

Table II.14. International comparison of overseas production, 1979-1990
(Manufacturing output of overseas affiliates as percentage of total production)

Country	1979	1980	1982	1984	1985	1986	1987	1988	1989	1990
United States	19.5 a/	..	21.1	18.1	18.1	21.0	21.0	24.9	..	..
Germany, Federal Republic of b/	9.2	10.1	12.1	14.2	13.7	10.3	..	..	11.5	..
Japan										
Textiles	..	4.0	2.7	4.7	2.7	3.4	3.1	4.2	1.3	..
Transport equipment	..	2.2	6.1	6.4	5.6	4.8	9.3	9.4	15.9	..
Total	1.6	2.9	3.2	4.3	3.0	3.2	4.0	4.9	5.7	6.3

Sources: Ministry of International Trade and Industry, Treasury Department and Economic Planning Agency of Japan.

Note: The data for the United States and the Federal Republic of Germany are based on the calendar year, while the figures for Japan are based on the fiscal year.

a/ 1977 data.

b/ Excluding production in other EEC countries.

Table II.15. Technology imports of Japan, 1975-1989

Year	Number of approved cases		Value	
	Total	Of which new	Total	Of which new
			(billion yen)	
1975	6 766	796	169.1	13.3
1976	6 050	632	177.3	17.9
1977	6 659	685	190.1	16.9
1978	6 573	936	192.1	38.2
1979	7 012	1 020	241.0	26.8
1980	7 248	919	239.5	27.7
1981	7 207	844	259.6	24.9
1982	6 936	929	282.6	44.4
1983	7 839	1 073	279.3	42.4
1984	7 316	982	281.4	31.8
1985	7 679	1 245	293.2	33.3
1986	7 494	1 414	260.6	33.6
1987	7 373	813	283.2	56.2
1988	8 356	1 382	312.2	54.6
1989	7 109	1 056	329.9	48.4

Source: Japan Management and Coordination Agency, "Report on the survey of research and development", as quoted in *Japan Economic Institute Report*, No. 36A (Washington, D.C., 27 September 1991), p. 16.

Accumulation of technologies is a difficult concept to measure despite its critical importance in industrial transformation, let alone quantifying the impacts of different technologies from different sources. Nevertheless, as table II.15 indicates, it is clear that Japanese industries have been relying heavily on imported technologies. In 1965 the number of agreements for technology imports totalled only 460, rising to 1,157 in 1970. The imported technologies have often been improved upon and re-exported to other countries.* At any rate, the Japanese strategy to climb up the technology ladder as fast as possible deserves attention and careful appraisal for policy purposes.

The Japanese experience of industrial transformation seems to suggest that the problem of industrialization viewed in terms of lack of natural resource endowments can be overcome by upgrading human resources and the industrial technology base. Careful crafting of the institutional and organizational structure could immensely facilitate the upgrading process. The Japanese have made skilful use of specific cultural traits, such as a group-oriented mentality (as opposed to Western individualism), consensus-building and focusing on the long-term, in order to engender technological progress at a fast pace.

Whether the Japanese system is capable of outperforming other forms of capitalism is a question that is often asked. Lester Thurow has the following answer:

"By reducing the individual's risks with lifetime employment and seniority wage system, the Japanese firm handicaps itself in the world of comparative statistics. It cannot efficiently cut costs. But if the name of the game is dynamic growth, lifetime employment means that no one will become unemployed if new technologies reduce the demand for labour. Workers will be retrained if new technologies come along and make one's skills obsolete. With seniority wages, whatever happens, one's wages will not be reduced. Producer economics forces investments in skills and creates motivation that may offset its static inefficiencies. It has what Ronald Dore, an MIT Japanologist, calls 'flexible rigidities'.

In the long-run, history will tell which theory is right. An empirical experiment is now under way. The profit-maximizing firms of the United States have faced off against the empire-building firms of Japan. Individualistic capitalism meets communitarian capitalism. Eventually, the winners will be known. In the end the winner will force the losers to change and play by the winner's rules" ([8], pp. 150-151).

Masahiko Aoki seems to have a different answer:

"Meanwhile, there is a greater tendency toward a convergence of organizational form and practice because of the strong force of natural selection operating through international market competition as well as deregulation within and across national boundaries" [18].

*Japan became a net exporter of technology only in 1989

C. Western Europe

1. Short-run outlook

The region has entered into a slow recovery phase after reaching the bottom of the business cycle in 1991. This reflects the global cyclical pattern rather closely. MVA in the region is expected to grow by −0.1 per cent in 1992 and 1.9 per cent in 1993, after a decline of 1.3 per cent in 1991. A roughly similar pattern of GDP growth can be expected, although GDP leads MVA growth at a higher rate (see figure II.4 for GDP and MVA patterns of growth in recent years and also for the pattern of structural change in industry).

No strong demand pull can be expected from any particular sector (or country). The expenditures on German unification appear to have lost steam after two years of providing a demand force in the region. Several countries have bottomed out from a negative growth in 1991 including Finland, Sweden, Switzerland and the United Kingdom, while the western part of Germany will hit the bottom in 1992 with a 1.5 per cent GDP growth. Growth in export demand, investment demand and consumption expenditures are expected to be sluggish, although growth momentum could be significant in 1993 largely due to the completion of the EEC single market, with its optimistic prospects for growth, and the establishment of the European Economic Area, with the associate membership of the countries of Eastern Europe. Thus the macroeconomic environment, that is, the demand side for industrial growth, appears positive though weak.

The supply side appears also to be positive but anaemic, especially compared with the 1987-1989 period. For instance, investment in equipment in the EEC is expected to rise by only 2.6 per cent in 1992, after a fall of 0.4 per cent in 1991. The corresponding figure for the 1987-1989 period was 9.4 per cent per year. Furthermore, considering the high unemployment rate (9.0 per cent) and "informal inflows" of Eastern European labourers, wage rates are not expected to rise. Likewise, interest rates and inflation rates (3-4 per cent) are expected to be subdued in the immediate future.

Of particular concern for European policy makers is the speed of restructuring and recovery of industry in the eastern part of Germany, for the longer the restructuring period, the greater the burden of unification financing, and hence the weaker the recovery process in the western part of Germany. The consequences of slow recovery could spread to other countries in the region. The public transfers from the western to the eastern part of Germany has been skyrocketing—from 43 billion deutsche marks in 1990 to 170 billion deutsche marks in 1991, and the sum for 1992 is estimated to rise to 215 billion deutsche marks. The public sector budget of the former Federal Republic of Germany was in surplus in 1989, at 0.2 per cent of GDP. In 1991, the budget deficits had soared to 3.6 per cent of GDP of unified Germany.

The question remains: could this widening budget imbalance be contained? How soon? The answer depends on how rapidly the industrial sector of the eastern part of Germany catches up with the productivity level of the western part. Signals transmitted from the east seem mixed on this issue. For instance, real wages are rising fast, but is this increase accompanied by improvement in labour productivity? Observers are unsure about this phenomenon because of a lack of reliable information. "The expected recovery of production and investment in 1992, however, does not yet reflect a self-supporting recovery in the new federal states. Consumer's expenditures as well as investment largely depend on public transfers. This year and in 1993 the transfers from West Germany will amount to about two thirds of the GDP of East Germany" [19].

However, the general optimism for the region's industrial prospects remains, largely due to the expected positive impact of the EEC single market. Implementation is on course. As of 25 February 1992, when the Council of Ministers reviewed progress, almost 80 per cent of the 282 items of EEC legislation was completed. Free movement of goods, services, money and people within the EEC region are expected to invigorate production and trade. Static effects alone could add 5.8 to 6.4 per cent to GDP (see table II.16). If dynamic effects, such as innovation, productivity gains and investment chain reactions, are taken into account, a further 0.2 to 0.9 percentage points can be annually added, "indefinitely in the foreseeable future", to the static gains already noted.*

The creation of the European Economic Area, whereby countries of the European Free Trade Association (Austria, Finland, Iceland, Liechtenstein, Norway, Sweden and Switzerland) could benefit from free trade with the EEC, will augment the market size. The 19 countries of the European Economic Area comprise 380 million people with an expected total GDP of over $7,500 billion in 1993. The agreement on the Area will take effect in 1993, concurrently with the launching of the single market (in principle at least). A possible snag may arise, however, from the constraint that EFTA members could have no influence over Community legislation and yet be obligated to accept not only the existing set of 1,500 Community rules, but new rules to be created in the future.

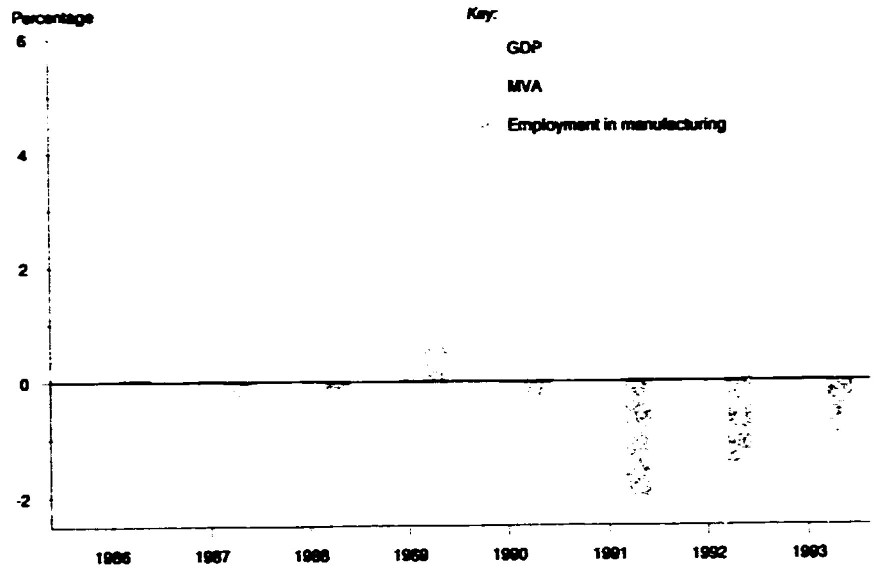
The potential impact of "associate membership" of Czechoslovakia, Hungary and Poland seem unclear for the immediate future. Rapid growth of trade may or may not be realized depending on EEC readiness to accept labour-intensive manufactured goods and agricultural goods. These require domestic restructuring in politically sensitive sectors of the EEC economy. In addition, an inflow of workers (with or without skills) would have depressing effects on wages. As a consequence, company profits may increase, but wage income might flow out of the EEC.

2. Long-run prospects

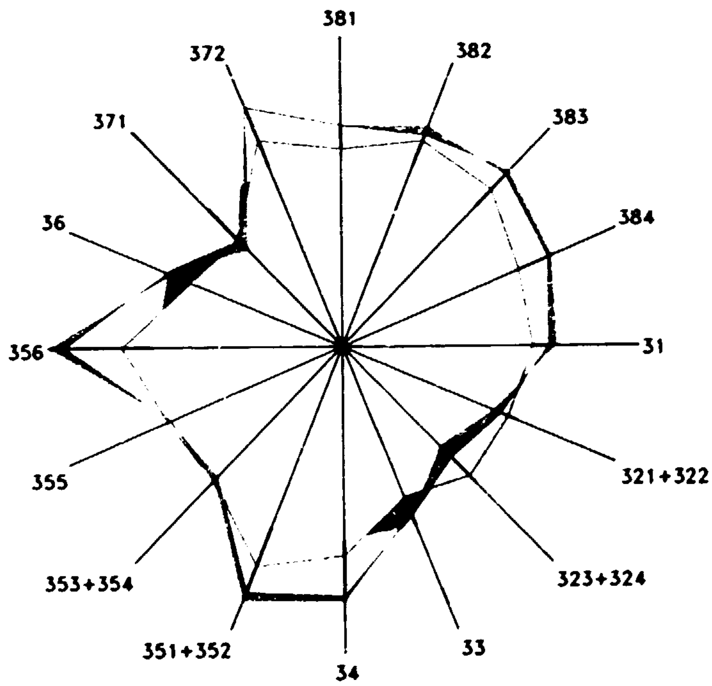
The process of Western Europe catching up with North America in industrial technology and productivity has been vigorous since the end of the Second World War. Several studies have already confirmed that the difference in output per worker-hour has been narrowed considerably between the United States and

*Such estimates are given in Richard Baldwin, "The growth effects of 1992", *Economic Policy*, vol. 9 (October 1989), pp. 249-281.

Figure II.4. Growth rates of GDP, MVA and manufacturing employment, 1986-1993, and industrial structural change, 1980-1993: Western Europe



Industrial structural change
(Index of value added: 1980 = 100)



g = 0.90, θ = 8.33

Key:

Deflated prices of 1985

g = Average annual growth rate, 1980–1993 (percentage)

θ = Index of structural change, 1980–1993

ISIC code	(industries):
31	(Food products)
321, 322	(Textiles)
323, 324	(Leather)
33	(Wood and furniture)
34	(Paper and printing)
351, 352	(Chemicals)
353, 354	(Petroleum and coal)
355	(Rubber products)
356	(Plastic products)
36	(Non-metal mineral products)
371	(Iron and steel)
372	(Non-ferrous metals)
381	(Metal products)
382	(Non-electrical machinery)
383	(Electrical machinery)
384	(Transport equipment)

1990–1993 forecast

1985–1990

1980–1985

Source: UNIDO database, estimates and forecasts by UNIDO PPD GLO

Table II.16. Estimates of total economic gains from completing the internal market, according to partial equilibrium estimation methods
(Based on benchmark data for 1985, at 1985 prices)[a]

Type	Variant A (billion ECU)	Variant B (billion ECU)	Variant A (percentage of GDP)	Variant B (percentage of GDP)
Stage 1				
Cost of barriers affecting trade only	8	9	0.2	0.3
Stage 2				
Cost of barriers affecting all production	57	71	2.0	2.4
Total direct costs of barriers (a)	65	80	2.2	2.7
Stage 3				
Economies of scale from restructuring and increased production	60	61	2.0	2.1
Stage 4				
Competition effects on X-inefficiency and monopoly rents	46	46	1.6	1.6
Total market integration effects				
Variant I (sum of stages 3 and 4) (b)	106	107	3.6	3.7
Variant II (alternative measure for stages 3 and 4) (c)	62	62	2.1	2.1
Total costs of barriers and market integration effects				
Variant I = (a) + (b)	171	187	5.8	6.4
Variant II = (a) + (c)	127	142	4.3	4.8

Source: CEC, "Facing the challenge of the early 1990s", *European Economy*, No. 42 (November 1989).

Notes: Variants A and B relate to the use of alternative primary sources of information introduced in the calculations in stages 1 and 2.

Variants I and II relate to different approaches to evaluating competitivity effects.

When the total figures, ranging above from ECU 127 billion to ECU 187 billion for the seven member States in 1985 prices, are scaled up to represent the same GDP share for the 12 member States in 1988 prices, the range becomes ECU 173 billion to ECU 257 billion.

[a] Estimates relate to seven EEC member States.

other industrial countries.* However, the relative stagnation of productivity growth in Western Europe during the 1980s and the meteoric performance of Japan, especially in high-technology industries, raised concern on the part of the European policy makers. The latter seem to be wondering whether the Japanese challenge can be met without drastic changes in the European strategy. The debate has raged particularly between the "interventionist school" in France and Italy and the "free market school" in the United Kingdom and the Benelux countries. How concensus is arrived at, regarding the Japanese challenge, remains to be seen.*

A catching-up indicator is shown in table II.17. Labour productivity and annual wage earnings are taken as basic indicators, each being percentages of the North American level, and the levels of 28 manufacturing subsectors shown for 1970, 1980 and 1990. For manufacturing as a whole, the relative labour productivity hardly changed for those selected years, although the relative wage earnings went up considerably. However, the aggregate figures mask country variations. For instance, in the Federal Republic of Germany, labour productivity rose to 55.9 per cent of the North American level in 1990 from 52.4 per cent in

*See, for instance, William J. Baumol, Sue Anne B. Blackman, and Edward N. Wolff, *Productivity and American Leadership: the Long View* (Cambridge, Massachusetts, The MIT Press, 1989); Moses Abramovitz, "Catching up, forging ahead, and falling behind", *Journal of Economic History*, vol. 46 (June 1986), pp. 385-406; and Angus Maddison, *Dynamic Forces in Capitalist Development: a Long-run Comparative View* (Oxford, Oxford University Press, 1991).

*For an interesting critical review of the French position, see David Bailey, George Harte and Roger Sugden, "Dirigism at the core of French approach to inward investment", *Multinational Business*, No. 2 (1991), pp. 34-43.

Table II.17. Labour productivity and wage earnings per worker in Western Europe, 1970, 1980 and 1990 as a percentage of the North American level[a/]

Industry	Labour productivity per worker			Wage earnings per worker		
	1970	1980	1990	1970	1980	1990
Food products	43.40	42.49	37.31	43.24	50.13	54.11
Beverages	50.86	43.54	33.06	45.11	45.58	46.93
Tobacco products	67.64	45.70	24.39	39.29	37.74	34.03
Textiles	44.46	50.05	46.95	41.29	48.14	46.58
Wearing apparel	49.51	59.23	50.34	47.22	59.18	59.42
Leather and fur products	52.36	56.83	42.57	41.93	51.53	50.37
Footwear, excluding rubber or plastic footwear	41.37	51.17	42.28	44.06	56.71	52.41
Wood or cork products	58.71	59.27	51.06	46.58	47.04	46.09
Furniture and fixtures	50.31	60.46	58.37	41.76	57.09	58.34
Paper and paper products	39.32	36.94	35.87	41.36	45.65	47.10
Printing and publishing	45.11	51.37	51.42	48.74	61.53	62.66
Industrial chemicals	40.64	35.14	33.09	48.60	50.14	47.12
Other chemical products	31.97	27.68	27.46	41.04	51.79	56.69
Petroleum refineries	85.67	43.31	47.83	41.77	37.07	43.67
Miscellaneous petroleum and coal products	57.92	51.03	52.57	32.81	40.56	39.73
Rubber products	42.19	56.63	52.72	43.57	49.53	51.52
Plastic products n.e.c.	49.11	53.00	56.90	50.43	58.45	62.33
Pottery, china and earthenware	39.45	54.36	52.31	33.31	44.02	48.59
Glass and glass products	35.31	42.12	43.54	41.48	47.58	49.51
Other non-metallic mineral products	47.11	46.79	51.99	43.70	47.59	50.77
Iron and steel	49.17	42.32	35.57	43.05	40.30	40.70
Non-ferrous metals	47.26	37.34	55.11	44.70	46.21	51.18
Metal products	39.84	42.44	48.21	41.87	49.96	54.18
Non-electrical machinery	41.65	41.02	41.29	42.87	47.54	47.24
Electrical machinery	41.02	43.13	40.93	39.87	49.80	51.59
Transport equipment	38.17	37.34	37.52	45.01	43.68	45.63
Professional and scientific goods	36.02	44.51	45.35	50.70	56.24	59.86
Other manufactures	47.76	48.89	45.35	50.70	56.24	59.86
Manufacturing	43.60	43.69	41.79	43.21	48.89	50.30

Source: UNIDO database.

a/ Measured in constant 1985 dollars.

1970 (not shown in the table). In the United Kingdom, labour productivity jumped from 38.9 per cent of the North American level in 1970 to 46.8 per cent in 1990.*

For Western Europe as a whole, the catch-up pace seems to be faltering. Capital goods sectors are no exception, that is, machinery (electrical and non-electrical), transport equipment and professional and scientific goods. There is mounting evidence that European companies are falling behind in several strategic high-technology areas. Between 1981 and 1986 the export-import ratio of Japan jumped from 2.75 to 6.63 for office equipment and computers. Corresponding figures for the former Federal Republic of Germany remained roughly the same, at 0.93 (1981) and 0.92 (1986). Similar observations can be made for France and the United Kingdom. For communication equipment and electronic components, the figure for Japan soared from 6.59 to 9.95, while other producers recorded small gains or losses.

Whether the Japanese will continue to outperform competitors is not an easy question to answer, but available evidence suggests an affirmative answer. Table II.19 shows the number of patent applications in the Federal Republic of Germany, the United States, France and Japan for 1980 and 1987. It is remarkable that in 1980 Japan's inventive activities as reflected in patent applications (numbering 165,730) exceeded those of the United States (62,098) and the 12 countries in the Economic Community (75,456) combined. In 1987, the figure for Japan jumped by 87.6 per cent, while the combined figure for competitors increased by only 4.6 per cent. Put in another way, Japanese inventive activities appear to be accelerating (almost 19 times faster than that of their competitors).

The qualitative assessment of these activities presents a formidable problem. But the low quality of Japanese products 30 years ago compared with their superior quality today compels observers to recognize the significance of the above numbers. Tables II.20 and II.21 present an assessment by the Japan Science and Technology Agency of how far Japanese technology has progressed *vis-à-vis* the United States and Europe in some selected strategic technologies.

Given the techno-industrial challenges coming from Japan, the countries of Western Europe are reviewing their priorities and policies of industrial restructuring. The most visible efforts include the establishment of R and D programmes, such as ESPRIT, BRITE, RACE

*For other indicators of country variation, see table II.18 at the end of this section.

Box II.3. Foremen and supervisory skills in Germany and the United Kingdom

The clearest differences in foremen and supervisory skills in Germany and the United Kingdom were observed at the foreman level. In a sample of 16 United Kingdom firms, production foremen (as distinct from maintenance foremen) had acquired their position purely as a result of experience on the shop-floor, without formal qualifications; in only two cases had they served an apprenticeship. In contrast, German production foremen in 16 firms had passed examinations as craftsmen; 13 had also acquired the higher certificate of *Meister* (master craftsman), and the remaining three had undergone additional training towards that qualification but had not yet passed their tests.

The course leading to the *Meister* qualification is intended to enable the foreman to carry out not only routine setting and maintenance of machines, but also to be proficient in staff supervision and work organization; in addition, it should equip him to carry out machine repairs though, if the repair is a heavy one, he may call in engineering assistance.

Above the *Meister*-level a German firm usually employs suitably qualified technicians, and production managers who are typically graduate engineers. All the senior staff in the sample of German factories were qualified engineers (except in one instance, where one was a qualified technician); in the United Kingdom, such positions are usually held by those with a sales or financial background or by persons who had learnt on the job.

This difference in technological qualification has become ever more important because non-engineers are less receptive to technological innovation; their lack of technical understanding leads to delays in installing technologically complex equipment because they are afraid to "chance their arm". For example, a United Kingdom maintenance foreman could not persuade his management to buy electronic equipment which would reduce heavy repair costs, because he was of the opinion that the management did not understand the technical potential of the equipment; the management were primarily salesmen and were suspicious that the equipment manufacturers were "trying to pull a fast one".

The role of the *Meister* in organizing production, in conjunction with the engineer where necessary, was coherently expressed by a plant manager in Stuttgart as follows: "Three-quarters of all improvements in productivity are achieved through ensuring an adequate documentation of exact machine-settings; ensuring that all parts are available and are of the right dimensions; that all drawings and measuring devices are available; that all involved know-how to do their jobs; that the product-design is appropriate; that the manufacturing and operation sheets are well prepared before work begins, and that no corrections will be necessary as production proceeds. This clear work method has to take place within a clean factory, with clean machines and in an atmosphere of order and discipline. These are the responsibilities of the *Meister* and engineer; if unforeseen interruptions take place, these men are sufficiently well-trained to know how to analyse the problem and act accordingly."

All this may seem unexceptionable. But in a United Kingdom factory things are different. In view of the limited technical training of foremen, there is a greater division of responsibilities—with maintenance men, production controllers, quality controllers, all working more or less in parallel to the foreman. Those directly involved in production typically have little more than informal training on the job, and those with formal technical training are in service functions available to the whole plant, such as maintenance, installation or toolmaking. This organisational pattern is consistent with the relative scarcity of technically trained persons in the United Kingdom, and should not merely be explained in terms of general "cultural" preferences. The lower technical competence of those directly responsible for production has consequences for productivity.

Source: A. Daly, D. Hitchens and K. Wagner [22], p. 156.

will provide firms with sufficient stimulation to increase the rate of diffusion.* If the analysis is valid, the disadvantages of small firms and new entrants could hinder the potential contribution of the latter toward achieving greater industrial innovation and competitiveness. Special measures and new institutions tailored to the needs of the latter and of Western Europe as a whole would seem urgent. The realization of the single market requires policy makers to shape a new competition policy and institutions (laws and regulations), most likely through trial and error. A good example is provided by the issue of how to harmonize the policy of state subsidies for industrial enterprises.*

In addition to the issue of pan-European industrial organization as noted above, the issues of human skills and intra-firm organization have also loomed large. Removing internal barriers for workers as well as goods and services to move freely could create the problem of conglomeration, that is, drawing skills and capital to strong industrial centres. Given the current situation, Germany could win at the expense of weaker countries. Studies have revealed that German indus-

*William S. Pierce "Innovation and diffusion in the single Europe: institutional structure and industrial prospects for the European Communities", *Technological Forecasting and Social Change*, vol. 39 (1991), pp. 42-43.

*A review of this issue of State subsidies is given in Commission of the European Community, *European Economy*, No. 48 (September 1991), pp. 70-75.

Table II.22. Type and numbers of qualified workers in selected major industrialized countries, 1985
(In thousands)

Qualifications	United States[a]	Japan[b]	Germany, Federal Republic of	France	United Kingdom
Doctorates[c]	0.5	0.3	1.0	0.3	0.7
Master's and enhanced degrees[c]	4	5	4+	6+	2
Bachelor's degrees	19	30	21	15	14
Technicians	17	18-27 [d]	44	35	29
Bachelors and technicians (subtotal)	36	48-57 [d]	65	50	43
Craftsmen	..	44 [e]	120	92	35

Source: S.J. Prais, "Qualified manpower in engineering: Britain and other industrially advanced countries, *National Institute Economic Review*, No. 123 (February 1988), p. 81.

a/ Adjusted for size of population equivalent to the United Kingdom (original numbers multiplied by 0.49 and rounded).

b/ Adjusted for size of population (original numbers multiplied by 0.23), excluding foreign students.

c/ Doctorates and master's degrees not added to bachelor's degrees.

d/ Mechanical and electrical qualifications only; the comparable United Kingdom total is 24,000.

e/ Including computing and data processing.

tries possess a greater number of engineers and skilled workers in various categories (see table II.22); are better organized, thus providing greater incentives to raise worker productivity (for example, through greater worker participation in decision-making (see box II.3); and pay higher wages to employees (compared to United Kingdom industries, for example).

> "Within our sample as a whole, about a half of those working on the shop floor in Germany had an apprenticeship-type qualification compared with a quarter in Britain. This was combined with larger pay differentials in Germany between skilled and semi-skilled workers. In addition, the pay of German skilled workers tended to be related to their experience according to an accepted scale, while British skilled workers were more often all paid at the same rate" [22].

If appropriate measures are not implemented, the "skills drain" could become an issue to grapple with, particularly the "skills-market externality problems", reflected in the fear of losing trained workers, which could lead to underinvestment in skills formation. The skills externalities must now encompass all 12 EEC countries, each of which may fear losing locally trained skills and professions to other EEC countries.

In spite of these policy issues, the net effect of the programmes and projects of the EEC single market will be to boost factor productivity (labour and capital) and thereby raise industrial competitiveness. However, there is a question whether successful EEC integration will help to enhance trade and investment for developing countries. Many scenarios are possible, but trade data since 1958, when the movement toward European integration began, does not allow an unqualified optimism (see tables II.23 and II.24). Between 1958 and 1990, the share of developing countries in the exports of the 12 EEC countries declined from 27.4 to 12.5 per cent, and imports by the 12 EEC members from the developing world declined from 29.5 to 12.8 per cent.

D. Eastern Europe and the former USSR*

1. Short-run outlook

In light of the tumultuous situation in this region, any discussion of the current position and short-term prospects for manufacturing in the area cannot be based on statistical data, largely unavailable or unreliable or piecemeal, except perhaps to point to the continuing nosedive in almost all economic indicators for 1992 throughout the region (see table II.25 and table II.26 for 1990-1991 indicators).

Industrial decline in the region generally has been the result of political upheaval, chaotic macroeconomic conditions and industry-specific problems, such as gross inefficiency, which have only been unveiled as a result of the political and macroeconomic conditions. All sorts of rigid interindustry linkages, based on central planning of quantity flows with little consideration of value, price or quality, have broken down and few substitutes have yet to be found. Throughout the region, a frantic search for new coordinating mechanisms—policies and institutions—and sources of financial support is under way. (see box II.4 for a selected list of laws introducing economic and institutional changes in the former USSR). Thus a

*UNIDO aggregate statistics for the region continue to include the new central Asian republics.

Table II.23. Structure of EEC exports by country and region, 1958 and 1990

	Exports of																							
	Belgium and Luxembourg		Denmark		Germany, Federal Republic of		Greece		Spain		France		Ireland		Italy		Netherlands		Portugal		United Kingdom		Total EEC	
Exports to	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990
EEC countries	55.4	75.1	59.3	52.1	27.9	54.3	50.9	64.0	56.8	64.9	30.9	62.7	82.4	74.8	34.5	58.2	58.3	76.5	38.9	73.5	21.7	52.6	37.2	61.0
Other European OECD countries	8.7	6.5	16.6	25.6	22.7	18.8	10.3	9.7	12.4	5.6	9.0	8.7	0.9	5.9	18.9	12.5	11.9	7.2	5.1	10.5	9.1	9.0	13.7	12.0
United States	9.4	4.3	9.3	5.2	7.3	7.3	13.6	5.6	10.1	5.5	5.9	6.1	5.7	8.2	9.9	7.6	5.6	3.9	8.3	4.8	8.8	12.6	7.9	7.1
Canada	1.1	0.4	0.7	0.5	1.2	0.7	0.3	0.6	1.3	0.6	0.8	0.9	0.7	0.8	1.2	0.9	0.8	0.4	1.1	0.8	5.8	1.8	2.3	0.9
Japan	0.6	1.3	0.2	3.3	0.9	2.7	1.4	1.0	1.7	0.9	0.3	1.9	-	1.8	0.3	2.3	0.4	0.8	0.5	1.0	0.6	2.6	0.6	2.1
Australia	0.5	0.3	0.3	0.5	1.0	0.6	0.1	0.8	0.3	0.3	0.5	0.4	0.1	0.6	0.8	0.6	0.7	0.4	0.6	0.2	7.2	1.6	2.4	0.6
Developing countries, of which	18.0	9.5	9.3	9.7	20.9	10.2	7.2	12.4	18.4	18.5	46.9	16.7	1.6	5.7	26.2	13.3	17.6	7.8	42.3	6.9	33.6	16.9	27.4	12.5
OPEC	3.3	1.8	2.3	2.0	4.8	2.8	0.9	3.9	2.6	3.3	21.3	4.2	0.2	1.8	7.5	4.1	4.5	2.3	2.0	0.6	7.0	4.7	7.6	3.3
Other developing countries	14.7	7.7	7.0	7.7	16.1	7.4	6.3	8.5	15.8	15.2	25.6	12.5	1.4	3.9	18.7	9.2	13.1	5.5	40.3	6.3	26.6	12.2	19.8	9.2
Centrally planned economies	4.3	1.3	3.9	2.9	5.5	4.3	16.2	5.1	4.6	2.1	4.9	2.2	0.2	1.1	5.3	3.6	2.2	1.8	1.9	0.9	3.4	1.7	4.3	2.8
Rest of the world and unspecified	2.0	1.3	0.4	0.2	2.6	1.1	-	0.8	4.4	1.6	0.8	0.4	8.4	1.1	2.9	1.0	2.5	1.2	1.3	1.4	9.8	1.2	4.2	1.0
World (excluding EEC)	44.6	24.9	40.7	47.9	62.1	45.7	49.1	36.0	53.2	35.1	69.1	37.3	17.6	25.2	65.5	41.8	41.7	23.5	61.1	26.5	78.3	47.4	62.8	39.0
World (including EEC)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Commission of the European Community, *Annual Economy Report 1991-92*, (Brussels, 1992), p. 257.

Table II.24. Structure of EEC imports by country and region, 1958 and 1990

	Imports of																							
	Belgium and Luxembourg		Denmark		Germany, Federal Republic of		Greece		Spain		France		Ireland		Italy		Netherlands		Portugal		United Kingdom		Total EEC	
Imports of	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990	1958	1990
EEC countries	55.5	70.7	60.0	53.8	36.3	54.3	53.7	64.1	31.8	59.1	28.3	64.8	68.9	70.8	30.2	57.4	50.7	59.9	53.4	69.1	21.8	51.0	35.2	58.8
Other European OECD countries	7.7	5.6	18.6	23.8	15.2	16.0	11.5	7.1	8.4	6.4	6.7	7.8	3.4	3.9	13.1	11.7	7.2	7.4	8.6	6.4	8.7	12.3	10.1	10.9
United States	9.9	5.8	9.1	5.5	13.6	6.2	13.7	3.7	21.6	8.3	10.0	7.3	7.0	14.2	16.4	5.1	11.3	8.1	7.0	3.9	9.4	12.7	11.4	7.6
Canada	1.4	0.6	0.2	0.5	3.1	0.8	0.8	0.3	0.5	0.5	1.0	0.6	1.0	0.6	1.5	0.8	1.4	0.7	0.5	0.8	8.2	1.7	3.6	0.8
Japan	0.6	3.5	1.5	3.4	0.6	5.4	2.0	5.9	0.7	4.1	0.2	2.8	1.1	4.4	0.4	2.3	0.8	4.0	-	2.6	0.9	5.4	0.7	4.1
Australia	1.7	0.4	-	0.2	1.2	0.3	0.3	0.1	0.8	0.2	2.4	0.4	1.2	0.1	3.0	0.5	0.2	0.4	0.9	0.2	5.4	0.7	2.6	0.4
Developing countries,	19.2	9.4	5.9	8.7	23.9	11.2	9.6	12.7	32.0	17.8	45.6	12.6	9.3	3.8	29.4	15.4	24.4	15.4	27.6	15.3	34.7	12.6	29.5	12.8
of which OPEC	5.7	2.0	0.3	1.3	6.7	2.5	1.7	5.8	17.7	7.0	19.7	4.4	0.7	0.3	13.9	7.0	11.5	6.2	6.3	6.8	11.3	2.2	20.8	4.0
Other developing countries	13.5	7.4	5.6	7.4	7.2	8.7	7.9	6.9	14.3	10.8	25.9	8.2	8.6	3.5	15.5	8.4	12.9	9.2	21.3	8.5	23.4	10.4	18.7	8.8
Centrally planned economies	2.2	2.5	4.6	4.0	4.5	5.3	8.1	4.8	4.0	2.9	4.2	2.9	1.8	1.3	3.7	4.8	3.1	3.8	0.7	0.8	3.7	2.5	3.8	3.7
Rest of the world and unspecified	1.8	1.5	0.1	0.1	1.6	0.5	0.3	1.3	0.2	0.7	1.6	0.8	4.3	0.9	2.3	2.0	0.9	0.3	1.3	0.9	7.2	1.1	3.1	0.9
World (excluding EEC)	44.5	29.3	40.0	46.2	63.7	45.7	46.3	35.9	68.2	40.9	71.7	35.2	31.1	29.2	69.8	42.6	49.3	40.1	46.6	30.9	78.2	49.0	64.8	41.2
World (including EEC)	100.0	[illegible]	[illegible]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Commission of [illegible]an Community, *Annual Economic Report 1991-92* (Brussels, 1992), p. 257.

Box II.4. Russian Federation: selected enactments of economic and institutional change, June 1990-January 1992

1990

Declaration of State sovereignty (12 June).
Law on property on the territory of the RSFSR (14 July).
Law on the implementation of the USSR law on taxation of enterprises and organizations in the RSFSR (1 December).
Law on banks and banking activity (2 December).
Law on the RSFSR central bank (2 December).
Law on the programme of revival of the Russian countryside (3 December).
Law on property in the RSFSR (24 December).
Law on enterprises and entrepreneurial activity (25 December).
Law on land reform (23 November, with amendments of 27 December).

1991

Law on the RSFSR State tax service (21 March).
Law on competition and limiting of monopoly behaviour on product markets (22 March).
Law on social protection of working people (19 April).
Law on public employment (19 April).
The RSFSR land code (25 April).
Law on privatization of State and municipal enterprises (3 July).
Law on personal privatization accounts and deposits (3 July).
Law on the privatization of the housing stock (4 July).
Law on foreign investment (4 July).
Law on budget arrangements and the budgetary process (10 October).
Law on land fees (11 October).
Law on indexation of incomes and savings (25 October).
Law on securing the economic basis of RSFSR sovereignty (14 November).
Law on amendments to the RSFSR criminal code (5 December).
Law on value added tax (6 December).
Law on excise duties (6 December).
Law on taxation of individual incomes (7 December).
Law on registration fee for individual entrepreneurs (7 December).
Law on property of individuals (9 December).
Law on a State levy (9 December).
Law on taxing the profits of enterprises and organizations (27 December).
Law on the fundamentals of the taxation system in the Russian Federation (27 December).

1992

Law on the budget system (24 January).

Source: Economic Survey of Europe in 1991-1992 (United Nations publication Sales No. E.92.II.E.1), p. 144

Table II.25. Stabilization results in Eastern Europe in 1991
(Percentage change from preceding year)

Country	GDP	Inflation[a]	Unemployment	Industrial output
Bulgaria	-26	250	10.7	-27
Czechoslovakia	-16	58	6.6	-23
Hungary	-7 to -9	35	8.3	-19
Poland	-9	70	11.5	-12
Romania	-13	344	3.1	-19
Yugoslavia	-15	164	19.6	-21

Source: Economic Survey of Europe in 1991-1992 (United Nations publication, Sales No. E.92.II.E.1) p. 45.
[a] Based on consumer price index.

discussion of the industrial situation must include a brief review of the political and macroeconomic background.

The region was transformed politically with the formal dissolution of the USSR, at the end of 1991, into 15 independent States, the Russian Federation being by far the largest (in GDP and population), followed by Ukraine. All but the Baltic States and Georgia joined the Commonwealth of Independent States, which now appears to be a transitory arrangement for negotiating the division of assets and liabilities of the former USSR, rather than an institution for re-building regional political and economic cooperation. Relations between Russia and Ukraine remain tense, civil unrest has occurred in several of the smaller States, and short-term prospects for all the new States seem none too bright.

Elsewhere in Eastern Europe, the breakup of Yugoslavia has brought human tragedy as well as economic chaos (except in Slovenia). Albania is very poor and weakly governed; Czechoslovakia is on the verge of splitting in two, albeit peacefully. Polish reform has ground to a halt due to disputes within the Government. In short, apart from Hungary and Czechoslovakia, the political institutions needed to push through urgent economic reforms are in crisis.

This is a far cry from what was expected, or hoped for, at the end of communist dominance of the region.

Table II.26. Economic performance of successor states of the USSR in 1990 and 1991
(Annual percentage change)

Item	USSR	Russian Federation	Ukraine	Belarus	Uzbekistan	Kazakhstan	Georgia	Azerbaijan	Republic of Moldova	Kyrgyzstan	Tajikistan	Armenia	Turkmenistan
						A. 1990 over 1989							
NMP[a]	-4.0	-5.0	-1.5	-1.4	..	..	..	..	..	..	..	..	..
Employment[b]	-2.2	-2.6	-3.8	-1.4	1.9	-0.4	-3.2	-0.2	-4.6	0.3	-0.2	-1.6	0.9
Industrial output	-1.2	-0.1	-0.1	1.6	1.8	-0.8	-5.7	-6.3	3.2	-0.6	1.2	-7.5	3.2
Agricultural output	-3.0	-3.6	-3.7	-5.9	6.0	7.0	7.0	-0.1	-13.0	1.0	3.0	-11.0	7.0
Gross investment	0.6	0.1	-1.5	1.0	13.0	-2.9	-14.4	-4.2	-0.5	11.3	0.7	-4.6	7.5
Retail sales	10.0	16.0	11.5	15.4	9.0	9.0	11.0	7.0	14.0	9.0	10.0	7.0	9.0
Retail prices	6.8	5.6	4.0	5.3	..	..	..	..	..	..	..	..	..
						B. 1991 over 1990							
NMP[a]	-15.0	-11.0	-11.0	-3.0	-0.9	-10.0	..	-0.4	-11.9	-5.0	-9.0	-11.0	-0.6
Employment	-1.7	-1.1	-2.0	-	2.5	-1.3	..	-	-4.8	-	10.5	-6.3	6.7
Industrial output[c]	-7.8	-8.0	-4.5	-2.1	1.8	0.7	-19.3[d]	3.8	-7.0	0.1	-2.0	-4.6[d]	4.1
Agricultural output	-7.0	-5.0	-12.0	-3.0	-5.0	-8.0	..	-	-11.0	-87.0	-10.0	11.0	-2.0
Gross investment	..	-11.0	..	..	..	..	..	..	..	..	..	..	..
Retail sales	-7.1	-6.0	-10.1	-2.7	-8.8	-14.2	-25.1[e]	-12.7	-16.1	-16.8	-21.9	-24.8	-11.8
Retail prices[f]	86.0	89.1	82.5	81.3	82.9	82.9	121.8[e]	86.5	97.4	88.2	83.5	90.7	84.6
Exports[g]	-32.6	-29.4	-46.3	-41.8	-34.5	-38.4	-37.0	-37.9	-41.3	-38.7	-40.4	-40.6	-30.8
Imports[g]	-43.9	-45.6	-38.8	-46.9	-42.1	-39.4	-41.6	-43.6	-50.6	-42.6	-48.5	-19.4	-36.8

Source: Economic Survey of Europe in 1991-1992 (United Nations publication, Sales No. E.92.II.E.1), p. 140.

a/ Net material product produced.

b/ State sector, workers and employees only, which account for 82-85 per cent of total employment.

c/ The data for the total 11 States are adjusted for inflation. Data for the individual States (except the Russian Federation) are based on enterprise-level information with only partial adjustment for inflation.

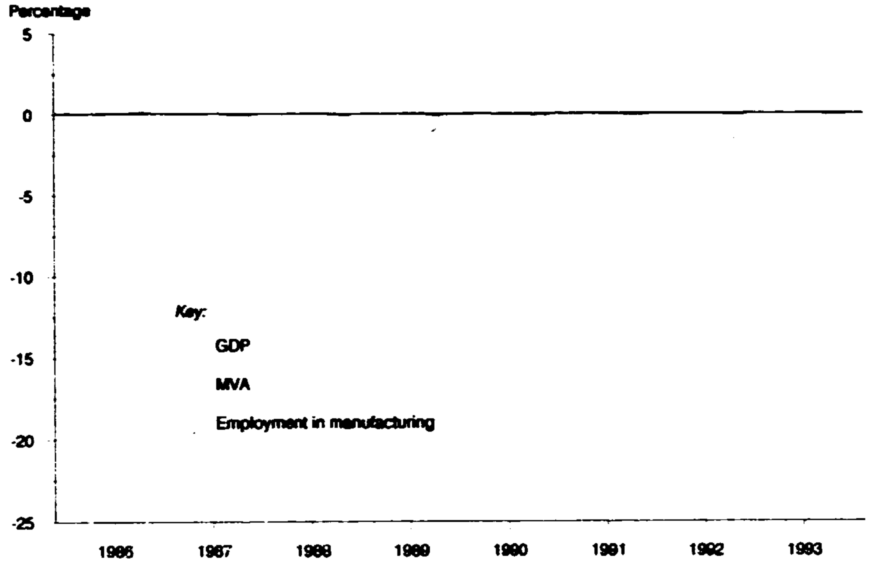
d/ January-November 1991.

e/ November 1991 over November 1990.

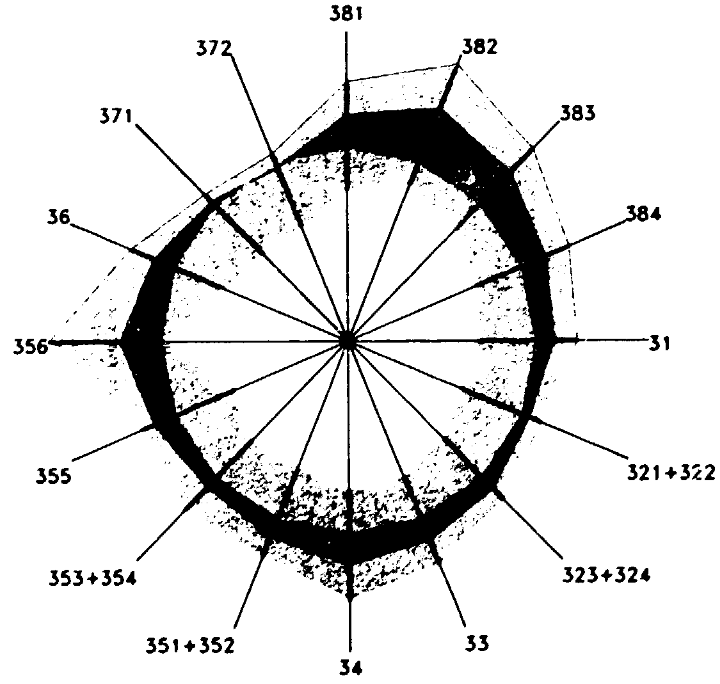
f/ Consumer goods and services.

g/ Nominal values in roubles at the commercial exchange rate.

Figure II.5. Growth rates of GDP, MVA and manufacturing employment, 1986-1993, and industrial structural change, 1980-1993: Eastern Europe and the former USSR



Industrial structural change
(Index of value added: 1980 = 100)



g = −2.04, θ = 7.12

Key:

Deflated prices of 1985

g = Average annual growth rate, 1980–1993 (percentage)

θ = Index of structural change, 1980–1993

ISIC code	(industries):
31	(Food products)
321, 322	(Textiles)
323, 324	(Leather)
33	(Wood and furniture)
34	(Paper and printing)
351, 352	(Chemicals)
353, 354	(Petroleum and coal)
355	(Rubber products)
356	(Plastic products)
36	(Non-metal mineral products)
371	(Iron and steel)
372	(Non-ferrous metals)
381	(Metal products)
382	(Non-electrical machinery)
383	(Electrical machinery)
384	(Transport equipment)

1990–1993 forecast

1985–1990

1980–1985

Source: UNIDO database, estimates and forecasts by UNIDO PPD GLO

Then it was widely assumed that democracy, a liberal market system, and generous financial and other support from developed market economies would allow almost immediate transformation. But the development of entirely new political and economic systems is no simple task. Even in the eastern part of Germany, which was largely handed the system and the finance, this is not happening as easily as was initially expected. The initial over-optimism must be partly to blame for the current political unrest and disagreements which are slowing down the pace of essential economic, especially macroeconomic, reforms, as well as foreign financing.

2. *Macroeconomic reform and industrial performance*

The macroeconomic environment in which a firm or enterprise, public or private, operates is of critical importance for decision-making at the firm level.

Under communist rule, the economies of Eastern Europe and the USSR had been highly integrated through central "command" planning. Industrial integration was far greater than in the EEC or even the United States. For this reason macroeconomic policy, as practised in developed market economies and most developing countries, hardly existed and was not really needed, since price and quantity changes unintended by the planners were highly restricted; as a consequence, quality suffered and consumer queuing became part of everyday life.

The introduction of viable macroeconomic policies in Eastern Europe and the former USSR is proving to be difficult, with a great debate centring on the question of how best to implement such policies, where "best" reflects numerous constraints which vary from country to country. Essentially, there are two opposing camps consisting, on the one hand, of those in favour of the "big bang", that is, immediate radical change, and, on the other, the gradualists (this admittedly is a great simplification of the issues and positions). Poland, for example, opted for the former, having instituted radical reforms as of the beginning of 1991, but now the country is turning towards the gradualist approach. On the other hand, Hungary, which had been the most market-oriented of the economies of Eastern Europe, has continued to follow a gradualist approach.* The debate has also revolved around the sequence of reforms, for example, whether privatization should follow inflation and money supply control policies or vice versa.

Analysis of these issues, widely discussed elsewhere, is beyond the scope of this review of the industrial situation, but they are mentioned as being critical for future industrial performance in the region. The ending of CMEA trade arrangements and rouble inflation have together destroyed established linkages between economic actors in the region. Industrial plants are not receiving essential inputs and are unable to sell their output to traditional buyers.** Energy supplies have been severely affected. In 1991, exports of the former USSR to its former CMEA partners fell by 57 per cent (and imports by 62.5 per cent), whereas total exports and imports fell by "only" 35 and 44 per cent, respectively.*

The collapse of regional trade has hit the Russian Federation somewhat less hard than its former trading partners, since that large country, which in 1990 accounted for 58.7 per cent of GDP and 66.4 per cent of industrial output of the former USSR, was less reliant on regional linkages. In 1991 the GNP of the former USSR as a whole is reported to have declined by 17.0 per cent, whereas the GDP figure given for the Russian Federation was only 9.0 per cent.** But economic linkages within the Russian Federation continued to decline, partly as a result of the increasing non-acceptability of the rouble as a store of value.***

A closely related problem has been the sharp decline in government revenues. In most of the region, revenues had come mainly from the surplus of public enterprises operating at distorted prices, rather than from income and consumption taxes. Disruption of economic linkages has sharply curtailed the surpluses, and attempts at economic liberalization have exacerbated this tendency [25]. Governments need to develop new, largely tax-based revenue sources. This will be needed not only to help check inflation, but to satisfy one of the conditions for IMF and World Bank loans and improving national credit ratings.

3. *Private foreign investment*

Investment in the region has been falling along with other economic indicators. Investment in the former USSR declined by 11 per cent in real terms in 1991 [27]. Private investment has not been able to compensate for the sharp decline in public investment, since many potential private investors are waiting for improved macroeconomic conditions and clarification of privatization measures and property rights.

From a small base, private foreign investment through joint ventures has been booming, although hard currency invested per joint venture has tended to be small, amounting perhaps only to "seed money". The number of registered foreign investment projects in the region rose from 3,287 at the beginning of 1990 to 14,726 at the beginning of 1991, and to 33,972 at the beginning of 1992, but the foreign capital component of these projects only rose from $2.5 billion to $9.63 billion as of 1 October 1991**** (see tables II.27, II.28 and II.29).

The real importance of many of these joint ventures may be that they supply management and production know-how, technology, and foreign market access. According to one analysis, "Whereas previously a certain *physical* infrastructure was often sufficient to attract foreign direct investment, now a highly developed *human* and *technological* infrastructure appears essential ... Lower production costs are being

*For a discussion of macroeconomic reform, see, for example, [23], [24] and [25].

**In the Russian Federation, only 14 per cent of expected delivery agreements for 1992 had been concluded by mid-December 1991.

*See [26], table 1/8.

**See [26], table 1/2.

***For a detailed account of the economies of the region in 1991, see *Economic Survey of Europe in 1991-1992* (United Nations publication, Sales No. E.92.II.E.1), chaps. 3 and 4.

****"Foreign direct investment in central and eastern European countries" (UNIDO/PPD.210, June 1992), p. 4. Many of these projects may not yet be operational or may be of little significance.

Table II.27. Foreign investment projects in the USSR, by industry, 1991[a]

ISIC code[b]	Industry	Statutory capital: Total (million roubles)	Foreign (million roubles)	Foreign (million dollars)	Number of projects
A	Agriculture, hunting and forestry	54.3	24.6	41.4	26
B	Fishing	52.8	2.4	39.6	10
C	Mining and quarrying	17.4	8.5	15.1	7
D	Manufacturing	3 249.1	1 215.9	1 930.6	1 029
41	Purification of water	7.6	3.8	6.0	3
F	Construction	166.0	80.0	110.2	94
G	Wholesale and retail trade	202.4	107.8	164.4	68
H	Hotels and restaurants	266.7	152.6	244.8	138
I	Transport, storage and communication	85.8	39.2	48.9	64
J	Financial intermediation	129.7	74.6	117.7	5
70	Real estate	17.4	8.7	8.3	6
71	Renting of machinery and equipment	19.7	9.5	15.1	25
72	Computer and related activities	103.3	48.3	70.2	117
73	Research and development	35.4	8.7	14.2	11
74	Other business activities	164.8	73.0	116.1	268
M	Education	12.0	5.4	8.5	22
N	Health and social work	116.1	49.1	79.4	46
90	Sewage and refuse disposal	15.5	7.7	12.4	11
92	Cultural and sporting activities	83.7	40.7	64.4	85
93	Other services	2.2	1.0	1.7	5
	Other[c]	42.1	26.4	42.6	10
	TOTAL	4 948.9	2 009.7	3 151.6	2 050

Source: Eonomic Commission for Europe database on joint ventures.

[a] As of 1 January 1991.

[b] Revision 3.

[c] Including activities not classified among industries.

Table II.28. Manufacturing foreign investment projects in the USSR, by industry, 1991[a]

ISIC code[b]	Industry	Statutory capital: Total (million roubles)	Foreign (million roubles)	Foreign (million dollars)	Number of projects
15	Food products	255.5	78.5	123.6	78
16	Tobacco products	-	-	-	-
17	Textiles	34.8	14.5	23.6	19
18	Wearing apparel	82.0	35.9	54.6	74
19	Leather	166.2	33.6	54.4	26
20	Wood and wood products	137.6	58.5	93.3	60
21	Paper and paper products	52.5	24.2	38.6	10
22	Publishing and printing	69.2	26.7	42.9	51
23	Coke, refined petroleum, nuclear fuel	76.7	30.2	33.5	4
24	Chemicals, of which	364.9	159.0	253.6	65
241	Basic chemicals	178.3	74.3	119.8	19
242	Other chemicals, of which	176.0	80.7	127.2	35
2423	Pharmaceuticals	30.0	15.0	23.7	9
2424	Cosmetics	106.6	48.2	76.8	12
	Other[c]	10.6	3.9	6.7	11
25	Rubber and plastics	149.0	64.7	104.0	29
26	Non-metallic products	149.6	60.6	97.9	56
27	Basic metals	46.4	17.5	28.7	5
28	Metal products	167.3	41.3	66.1	23
29	Machinery and equipment n.e.c., of which	330.4	111.9	178.4	111
291	General-purpose machinery	101.2	27.6	45.8	26
292	Special-purpose machinery, of which	191.7	69.5	108.9	64
2921	Agriculture and forestry machinery	13.9	2.6	4.3	4
2922	Machine tools	87.0	34.1	55.1	21

ISIC code[b]	Industry	Statutory capital: Total (million roubles)	Statutory capital: Foreign (million roubles)	Statutory capital: Foreign (million dollars)	Number of projects
2925	Food processing machines	19.2	7.1	11.4	5
2926	Textile machinery	24.1	6.5	10.7	4
	Other[c]	37.5	14.7	23.6	21
30	Office equipment and computers	191.2	83.2	133.7	110
31	Electrical equipment	328.3	127.7	220.4	21
32	Communication equipment, of which	155.6	63.7	90.7	51
3210	Electronic components	3.5	1.5	2.3	5
3220	Television sets, radio transmitters	62.1	30.1	34.5	8
3230	Television sets, radio receivers	2.4	0.8	1.2	7
	Other[c]	87.7	31.4	52.7	31
33	Precision instruments	140.1	61.4	97.6	71
34	Motor vehicles	40.2	12.2	19.1	17
35	Other transport equipment	21.5	4.1	6.1	12
36	Furniture and manufacturing, n.e.c.	174.4	56.4	91.1	72
37	Recycling	27.1	9.0	14.7	14
	Other[d]	88.4	41.1	63.8	50
	TOTAL	3 249.1	1 215.9	1 930.6	1 029

Source: Economic Commission for Europe database on joint ventures.
[a] As of January 1991.
[b] Revision 3.
[c] Including activities not classified in specific manufacturing ISIC group.
[d] Including activities not classified in manufacturing.

Table II.29. Operational foreign investment projects in Hungary, by industry, 1991[a]

ISIC code[b]	Industry	Statutory capital: Total (million roubles)	Statutory capital: Foreign (million roubles)	Statutory capital: Foreign (million dollars)	Number of projects
A	Agriculture, hunting and forestry	187.0	86.4	1.6	7
B	Fishing	52.2	20.2	0.3	2
D	Manufacturing	55 195.6	26 350.5	498.0	399
41	Purification of water	1.0	0.7	-	1
F	Construction	4 084.2	2 332.6	40.0	61
G	Wholesale and retail trade	5 816.5	2 742.5	59.7	226
H	Hotels and restaurants	1 137.5	755.2	14.4	10
I	Transport, storage and communications	1 864.3	580.2	11.0	55
J	Financial intermediation	15 717.7	8 056.8	156.3	13
70	Real estate	293.5	146.9	2.5	14
71	Renting of machinery and equipment	52.3	22.8	0.4	7
72	Computer and related activities	400.9	179.6	3.2	32
73	Research and development	114.3	53.3	0.9	6
74	Other business activities	4 472.4	2 302.3	46.0	138
M	Education	144.5	7.7	0.1	6
N	Health and social work	1 046.2	405.0	8.0	4
90	Sewage and refuse disposal	56.0	37.4	0.6	2
92	Cultural and sporting activities	447.7	198.4	4.6	19
93	Other services	1.0	0.5	-	1
	Other[c]	12.6	5.8	0.1	3
	TOTAL	91 097.4	44 284.9	847.8	1 006

Source: Economic Commission for Europe database on joint ventures.
[a] As of 1 January 1991.
[b] Revision 3.
[c] Including activities not classified among industries.

Box II.5 Human infrastructure in Eastern Europe and the former USSR

While central and Eastern Europe have an educated workforce, market economies require additional human attributes. There are open questions about motivation. As any visitor could attest, no one worked hard in the factories of the ex-communist countries. While work may now start to pay off, those in the ex-communist economies have had a lifetime to get used to not working hard. Will they start working hard once the right incentives are in place—once their standard of living can improve if they do work hard? No one knows for sure.

Initiative is a more important concern. Markets require individuals willing to take risks. After a lifetime of being told what to do and what not to do, initiative may be a hard attribute to recapture. Russian immigrants to the United States find it difficult to get apartments. They are used to putting their name on a list and don't know how to search. In the former USSR most citizens seem to be sitting around waiting for the market to happen. The market is viewed as just another economic system that the Government will organize, and there is little realization that their personal initiative is required. As stated by one government official, "Most people think the free market just means the shops will be full and work will be easier. They have no idea what's involved." Those who have studied managers in the former USSR report that "factory managers have no clear grasp of capitalism's cut and thrust. They refer constantly to co-operation. The idea of competition makes them acutely uncomfortable. But in a market economy the Government isn't going to do anything but get out of the way."

To some extent the initiative problem is a knowledge problem. No one really knows in detail what a market entails. This is equally true for the highest leadership, the leading economists, the plant managers, and the average citizen. They all know the labour market, but they all have very fuzzy ideas as to what it means where practical details are concerned. A study commissioned by the Swedish Foreign Ministry found "a widespread lack of understanding" of what a market entails even in the Baltic States. Since none of the citizens of these countries have ever lived in a market economy, this should not come as a surprise. Market behaviour isn't instinctive. Some are going to take longer than others to learn it.

Basic attitudes about fairness will have to change. After a lifetime of being told that income inequality is bad, the citizens of the ex-communist economies are going to have to learn to accept a lot more income inequality than they have had. Most people's absolute incomes will go up in the long run, but relative income gaps will widen. Since the bottom 40 per cent of the population had a much higher proportion of national income in the ex-communist countries than it will have in the new capitalist countries, that 40 per cent is apt to see itself as a big loser. A Hungarian study published midway through Hungary's transition found 10 per cent much better off, 30 per cent much worse off, and 60 per cent much the same.

Negative attitudes toward entrepreneurs are already visible in the former communist world, where those who have taken initiative—the newly wealthy—are often despised. In a study of Polish attitudes toward entrepreneurs, they were seen as "a class without culture, one that brings very little to society. It is one based on materialism, shady values and speculation." These new capitalists are seen very much as the United States public views the leaders of the savings and loan industry—unethical rip-off artists who got wealthy employing unscrupulous tactics. In public opinion polls the support for capitalism is very weak in the countries of Eastern Europe. In the former USSR, 79 per cent of the people still believe in government ownership of heavy industry, banks, transport and the media. Less than 25 per cent supported a shift to a free-market form of capitalism, and the population is evenly divided on whether business firms should be allowed to maximize profits. None of these attitudes are surprising, if it is remembered how every citizen of the USSR has been educated in the past 70 years, but they make the transition to a market economy very difficult.

Such attitudes are going to be difficult to combat, since at the beginning of the transition to a market economy, those who first become rich will not be those who make the products that the public wants. The quick rich will be the speculators and arbitragers who take advantage of the imperfections of the price system left over from communism. Market prices will be very different than those that existed under communism, and the first successful entrepreneurs will be those shrewd enough, or lucky enough, to control the assets that rise most in price. Speculative profits will be huge.

To an economist, these speculators and arbitragers perform a worthwhile activity (they equalize prices and bring them up to market levels), but to the average citizen their activities are going to be seen in a very negative light. What they gain by selling at higher prices, the average citizen is going to see himself losing. This is especially true since many of the new capitalists will be the old *nomenklatura* who have essentially seized the assets they used to manage as communist officials.

But what should happen to the collaborators—those in charge under the old system. Often the public does not want them to be in charge under the new system, but they have the knowledge and power to give themselves a head start in the market game. If it is a question of starting up new companies, they know the best assets to buy. Yet millions of people were involved as collaborators in the old system, and they cannot all be prevented from taking part in the new system. In the eastern part of Germany this has become a major problem. Who was and who was not an informer?

Shifting from a communist economy to a market economy requires an enormous shift in power. Those who have been giving the commands no longer do so. Those who have been running the factories under the command economy may not be those that do so under the market economy. A very different set of skills will be required, and there is no reason to believe that those who are good at functioning in a command economy are good at functioning in a market economy.

Enormous management problems exist. The plant managers of the ex-communist economies have not in any sense been business people. They were told what to do (given a plan), shipped materials, told

Box II.5. *(continued)*

whom to hire, what to pay, what to produce, and where to ship what they produced. They never bought anything, they never sold anything, they never set any prices, and they never made any decisions on what to produce. Basically, plant managers were army officers. Converting a military mentality to a market mentality is not easy. Management skills are going to be in very short supply.

Some of the market-management skills such as accounting, finance, and marketing simply don't exist. Those skills weren't needed in a communist economy. Such skills will have to be created, and that is going to take time.

Source: Lester Thurow, *Head to Head—the Coming Economic Battle among Japan, Europe and America* (New York, William Morrow and Co., 1992), pp. 96-99.

Table II.30. Manufacturing foreign investment projects in Hungary, by industry, 1991[a]

		Statutory capital			
		Total	Foreign		
ISIC code[b]	Industry	(million forints)	(million forints)	(million dollars)	Number of projects
15	Food products	2 710.8	1 181.3	43.2	29
16	Tobacco products	4 713.7	2 150.0	37.3	18
17	Textiles	1 263.7	534.3	10.2	23
19	Leather	110.3	47.3	0.8	5
20	Wood and wood products	845.7	531.5	11.0	16
21	Paper and paper products	5 339.7	2 171.0	34.8	7
22	Publishing and printing	973.3	377.4	6.5	33
24	Chemicals, of which	4 417.0	2 063.9	37.6	37
241	Basic chemicals	2 956.4	1 434.9	25.6	7
242	Other chemicals, of which	1 412.5	600.9	11.6	27
2423	Pharmaceuticals	239.2	106.1	2.3	10
2424	Cosmetics	411.3	206.2	3.8	6
	Other[c]	48.1	28.0	0.5	3
25	Rubber and plastics	967.7	454.9	7.7	15
26	Non-metallic products	10 488.5	6 120.5	113.5	16
27	Basic metals	546.8	169.8	2.9	7
28	Metal products	878.4	401.5	7.3	28
29	Machinery and equipment, n.e.c., of which:	2 675.9	1 353.8	25.0	56
291	General purpose machinery	1 029.5	539.7	8.9	17
292	Special purpose machinery, of which	1 355.7	598.7	10.9	27
2921	Agriculture and forestry machinery	116.5	68.0	1.2	3
2922	Machine tools	816.0	343.0	6.0	7
2925	Food processing machines	74.0	26.9	0.5	5
	Other[c]	290.8	215.4	5.2	12
30	Office equipment and computers	1 604.7	509.4	10.0	6
31	Electrical equipment	7 705.4	4 039.1	68.5	20
32	Communication equipment, of which	2 471.7	935.0	18.1	17
321	Electronic components	981.5	402.8	7.7	4
322	Television sets, radio transmitters	74.7	33.1	0.5	6
323	Television sets, radio receivers	1 322.5	466.1	9.2	3
	Other[c]	93.0	33.1	0.6	4
33	Precision instruments	764.5	369.1	7.3	19
34	Motor vehicles	2 987.5	1 561.8	31.7	12
35	Other transport equipment	862.4	439.8	7.7	2
36	Furniture and manufacturing, n.e.c.	993.1	531.7	9.6	17
37	Recycling	381.6	177.1	3.4	5
	Other[d]	1 493.4	230.0	3.9	11
	TOTAL	55 195.6	26 350.5	498.0	399

Source: Economic Commission for Europe database on joint ventures.

[a] As of January 1991.

[b] Revision 3.

[c] Including activities not classified in specific manufacturing ISIC group.

[d] Including activities not classified in manufacturing.

eclipsed by other qualitative investment determinants, such as skill levels, market size, the existence of an efficient industrial support network, the availability of a variety of support services as well as advanced telecommunications and information-processing facilities.* Among these bottlenecks and constraints, however, the "human resource infrastructure" would appear to be the most intractable variable (see box II.5).

Notwithstanding the need for foreign direct investment, fears exist of possible economic domination by large foreign firms. The take-over of Skoda in Czechoslovakia by Volkswagen of Germany, for example, was delayed by such questions, but Skoda automobile exports to Western Europe are now booming (from a small base), as the quality and product image have improved.

The former USSR and Hungary have so far been the largest regional recipients of foreign direct investment. For the former USSR, registered foreign capital as of 1 January 1991 amounted to $3,151.6 million, of which $1,930.6 million were in manufacturing. Major sectors were chemicals ($253.6 million), electrical equipment ($220.4 million), machinery and equipment and computers ($133.7 million), and food products ($123.6 million) (see tables II.27 and II.28). The corresponding data for Hungary were a total of $847.8 million, with $498 million in manufacturing, of which the largest sectors were in non-metallic products ($113.5 million) and electrical equipment ($68.5 million) (see tables II.29 and II.30).

4. *Prospects for manufacturing*

MVA growth in the region became negative in 1990 (−4.2 per cent), and worsened in 1991 (−15.5 per cent), and a further decline of 21.1 per cent is expected in 1992. A slow-down in the collapse of industry is forecast for 1993 (−14.9 per cent) (see figure II.5 for GDP and MVA patterns of growth in recent years and also for the pattern of structural change in industry). In 1991 the decline was greater than 10 per cent for all countries, but by 1993 only the former USSR, Romania and Albania are expected to continue to decline at rates above 10 per cent.**

As discussed earlier, the timing and extent of industrial recovery will largely depend on the creation of political stability and sound macroeconomic policies, which will provide a basis for a boom in private investment. Existing industrial plant and machinery is at present being rapidly run down, so that capital expenditure requirements will be high. The advantage of this will be that manufacturing activities will be renewed on the basis of the latest technologies.***

Much existing manufacturing activity will need to be radically restructured or closed down. Heavy industries, as well as chemicals and particularly metals industries, have tended to be wasteful in the use of underpriced primary inputs and to generate considerable pollution. Some may even have been operating at negative value added in terms of world prices. Privately-owned small-scale production in light industry is likely to grow rapidly in the new economic environment.

Medium-term prospects for industrial recovery in the region are good, assuming that the difficulties of transition to a market-oriented economic system can be overcome. Although the old economic regime was based on principles that worked badly in practice, the educational system tended to receive strong support. As a result, the region has a good supply of human capital, including people with engineering skills, without which machines are useless. In the new market-oriented economies, this human capital resource, combined with relatively low real wages, will become a major source of comparative advantage for the region. But for now massive retraining seems urgent at all skill levels.

E. Latin America and the Caribbean

1. *Short-run outlook*

Signs are increasing that the decade-long setbacks in investment and industrial output are slowly coming to an end. Thanks to achievements in containing hyperinflation in many countries, foreign direct investment has begun to flow in at a faster pace. Foreign direct investment, which was a major source of technology transfer in earlier years, slowed down somewhat in the 1980s. The privatization movement is opening up opportunities for investment, restructuring and new competition, with a promise to raise the stagnant level of productivity and efficiency. Debt-equity swap activities have progressed in tandem with privatization. Furthermore, regional and sub-regional movements for integration have returned, auguring well for an upsurge of trade and investment within the region.

The immediate outlook for industrial growth appears promising. MVA projections for the region as a whole indicate 2.7 per cent and 3.9 per cent growth in, respectively, 1992 and 1993 (see figure II.6 for GDP and MVA patterns of growth in recent years and also for structural changes in industry). This expected MVA growth performance represents a solid recovery from a decline of 1.9 per cent in 1990 and a meagre 1.6 per cent growth in 1991.

The most encouraging feature of the recovery process is the huge drop in inflation in many countries of the region. For instance, Argentina suffered from 3,103 per cent inflation in 1989, 2,314 per cent in 1990, 171 per cent in 1991, and only 25 per cent is expected in 1992. Similarly, Brazil reduced an inflation rate of 3,977 per cent in 1990 to 526 per cent in 1991, and about 600 per cent is expected in 1992.

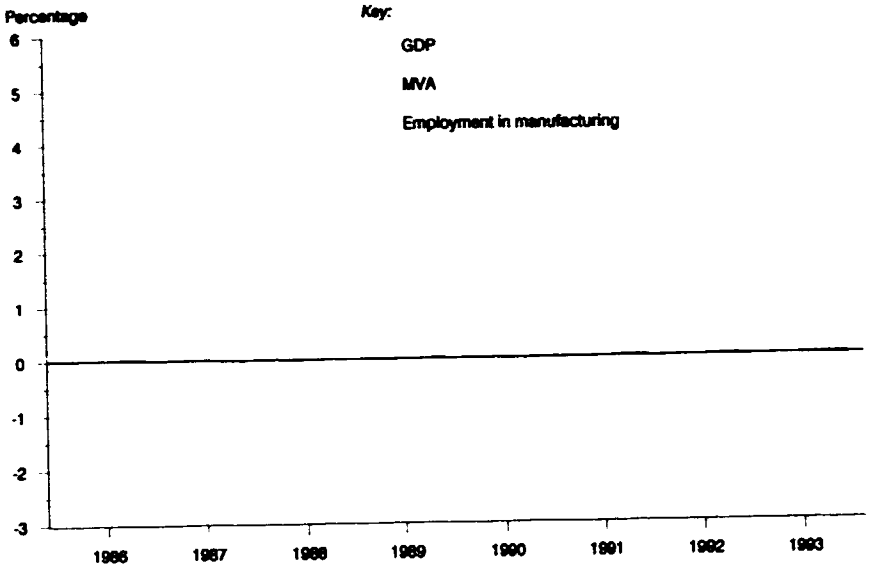
It must be emphasized, however, that containing inflationary expectations involved not just one policy action (such as freezing savings or exchange rates) but a package of multifaceted measures. Such a package sent strong signals that the Government meant business. Thus, for example, Argentina eliminated all subsidies, reduced trade barriers, deregulated markets for greater

*See "Foreign direct investment ...", p. 2.

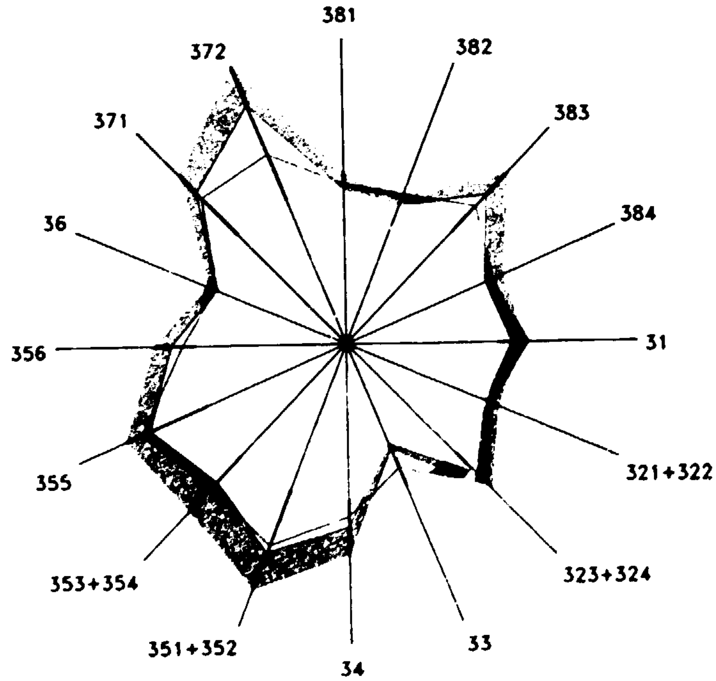
**As noted in the introduction to this section, data should be treated with extreme caution. For example, according to the Economic Commission for Europe, in 1991 the decline of industrial output in the former USSR was only 7.8 per cent.

***Following the Second World War, the renewal of manufacturing in the Federal Republic of Germany and Japan helped them to establish a competitive edge relative to the United States, where an older vintage of machinery was generally in use.

Figure II.6. Growth rates of GDP, MVA and manufacturing employment, 1986-1993, and industrial structural change, 1980-1993: Latin America and the Caribbean



Industrial structural change
(Index of value added: 1980 = 100)



g = 2.02, θ = 10.96

Key:

Deflated prices of 1985

g = Average annual growth rate, 1980–1993 (percentage)

θ = Index of structural change, 1980–1993

ISIC code	(industries):
31	(Food products)
321, 322	(Textiles)
323, 324	(Leather)
33	(Wood and furniture)
34	(Paper and printing)
351, 352	(Chemicals)
353, 354	(Petroleum and coal)
355	(Rubber products)
356	(Plastic products)
36	(Non-metal mineral products)
371	(Iron and steel)
372	(Non-ferrous metals)
381	(Metal products)
382	(Non-electrical machinery)
383	(Electrical machinery)
384	(Transport equipment)

1990–1993 forecast

1985–1990

1980–1985

Source: UNIDO database; estimates and forecasts by UNIDO PPD GLO competition, and privatized (or promised to privatize) State enterprises, in addition to adjusting the currency parity with the United States dollar and linking money supply strictly to dollar reserves and gold. Similar stringent measures were audaciously taken in other countries, including Brazil and Mexico. In short, a favourable business environment seems to be returning to the region.

Such indications are well exemplified by the willingness of investors to use the debt-equity conversion scheme as a vehicle for investment in the region. Table II.31 gives information on the progress made in Mexico. More foreign direct investment of this type is expected to intensify and add force to the recovery process.

The debt-equity conversion programme of Mexico is amongst the most effective and important in Latin America. Between April 1986 and October 1987, about $8.4 billion of eligible applications were received, and $3.1 billion were authorized in 1987. Between 1986 and 1988, the sectoral distribution of debt- equity conversions concentrated primarily in the priority manufacturing sectors, such as automobiles (16 per cent) and capital goods (12 per cent), with new investment projects or major plant expansions undertaken by firms such as Volkswagen ($141 million), Chrysler ($110 million) and Nissan ($60 million).

In 1991, foreign direct investment in Mexico amounted to $11.8 billion, and according to Banco México, 60 per cent went into stocks and shares. Foreign direct investment in the agro-industries will probably amount to $500 million, with Spain and the United States heading the list in this sector. Overall investment in agro-industries has been significant compared to the 1980s, particularly 1987, a year in which fixed investment and real investment outlays decreased in almost all the agro-industries.

Flows of private capital into five Latin American countries, including Argentina, Brazil, Chile, Mexico and Venezuela, tripled in 1991 to more than $40 billion, eight times the 1989 level. The inflows, diversified in nature, included a substantial repatriation of flight capital, equities, country funds and foreign direct investment placed abroad by the Latin American residents. The 1991 inflows were sufficient to generate nearly three times the funds needed to finance the deficits on the countries' trade in goods and services, and helped to boost foreign exchange reserves by $15 billion.

Factors accounting for the private capital inflow include the following:

(a) The low interest rates and the recession in Europe and the United States and the contrasting high domestic interest rates in Latin America;

(b) Improvements in the Latin American economies, including overall brighter investment opportunities, declining inflation rates and reduced fiscal deficits, privatization of State-owned enterprises and the move away from protected markets;

(c) New trade policies including negotiations between the United States, Mexico and Canada over a free trade agreement.

2. *Long-run prospects*

Reflecting these favourable developments, the Inter-American Development Bank has projected an optimistic scenario up to the year 2000 (see table II.32). Noteworthy is the return of flight capital back to the region. It is expected to provide a powerful push reaching to $10,201 million by 2000 from $2,600 million in 1992. Foreign direct investment will jump to $21,947 million in 2000 from $9,279 million in 1992. Exports of goods will more than double from $131,269 million in 1992 to $267,795 million in 2000.

It should be noted however, that the debt burden of the region is not expected to become lighter; it will remain at $461,211 million in 2000, compared with $417,467 million in 1992. This indicates that net

Table II.31. Mexico: debt equity conversions authorized, by sector and source, 1986-1988[a]

(Millions of dollars)

Industry	United States	United Kingdom	Financial centres[b]	Germany, Federal Republic of	Japan	France	Spain	Others	Total
Tourism	330.9	222.2	291.1	..	13.2	67.8	105.7	165.1	1 166.0
Automotive and transport	316.6	..	2.6	200.9	76.8	17.0	2.2	..	616.0
Capital goods	313.7	15.5	7.9	3.9	36.7	21.2	1.2	45.7	445.8
Export zone assembly	391.7	7.2	22.1	..	..	..	1.8	14.8	437.6
Electrical and electronic machinery	135.2	9.1	..	8.5	3.6	..	..	28.5	184.9
Non-metallic mineral products	51.6	66.6	0.8	..	..	..	..	52.0	170.0
Agro-industry	84.0	11.2	38.5	..	..	4.8	1.0	8.4	147.9
Basic metals	46.1	85.0	16.0	..	..	..	..	..	147.2
Other	203.6	114.0	85.9	7.7	13.6	5.0	0.4	109.2	540.4
TOTAL	1 843.4	530.8	464.9	221.0	143.9	115.8	112.3	423.7	3 855.8

Source: *Debt Equity Conversions: a Guide for Decision Makers* (United Nations publication, Sales No. E.90.II.A.22).

a/ To October 1988.

b/ Panama, Cayman Islands, Netherlands Antilles and Bahamas.

Table II.32. Principal economic indicators for Latin America and the Caribbean under the scenario of continuous policy reform, 1991-2000

Item	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Real growth (percentages)										
Gross domestic product	2.7	4.1	4.0	4.3	4.4	4.7	4.7	4.9	4.9	4.9
Total consumption	2.5	3.8	3.8	3.9	4.1	4.4	4.6	4.8	4.9	4.9
Total investment	9.1	7.6	6.2	6.6	6.3	7.1	6.5	6.6	6.3	5.9
Exports of goods and non-factor services	4.8	3.9	4.9	4.9	5.0	5.0	5.1	5.1	5.2	5.3
Imports of goods and non-factor services	19.0	7.4	7.1	6.4	6.6	7.0	6.9	7.2	7.1	6.9
Balance of payments (millions of dollars)										
Balance of goods and non-factor services	24 185	17 147	13 866	13 599	12 133	10 234	7 770	4 394	521	-3 220
Exports of goods and non-factor services	157 319	163 830	176 485	194 285	213 099	234 177	257 134	282 656	310 859	341 926
Imports of goods and non-factor services	133 134	146 683	162 619	180 686	200 966	223 943	249 364	278 262	310 338	345 146
Balance of goods traded	28 569	22 452	20 059	20 485	19 957	19 298	18 239	16 588	14 638	12 837
Exports of goods	127 945	131 269	140 486	154 408	168 947	185 216	202 848	222 443	244 046	267 795
Imports of goods	99 376	108 817	120 427	133 924	148 990	165 917	184 608	205 855	229 407	254 958
Balance of non-factor services	-4 383	-5 305	-6 193	-6 885	-7 824	-9 964	-10 469	-12 194	-14 117	-6 057
Exports of non-factor services	29 375	32 561	35 999	39 877	44 152	58 962	54 286	60 213	66 813	74 131
Imports of non-factor services	33 758	37 866	42 192	46 762	51 976	58 025	64 755	72 407	80 930	90 188
Balance of factor services	-33 749	-36 448	38 830	-38 626	-39 308	-39 002	-38 919	-38 774	-38 536	-38 412
Exports of factor services	8 238	9 305	10 027	10 482	10 965	11 435	11 811	12 341	12 793	13 292
Imports of factor services	41 988	45 753	48 856	49 098	50 273	50 437	50 730	51 115	51 329	51 704
Profit remittances	6 356	7 608	8 881	9 121	9 898	10 279	10 987	11 666	12 398	13 300
Interest payments and other capital income	35 632	38 145	39 976	39 977	40 376	40 158	39 743	39 448	38 931	38 404
Net transfers	4 795	5 147	5 557	6 004	6 405	6 847	7 322	7 837	8 396	8 999
Current account	-17 400	-14 154	-19 407	-19 023	-20 770	-21 921	-23 827	-26 543	-29 618	-32 633
Foreign direct investment	9 260	9 279	9 602	10 830	12 229	13 744	15 442	17 358	19 519	21 947
Portfolio investment	1 126	1 226	1 332	1 451	1 579	1 725	1 885	2 059	2 251	2 460
Return of flight capital	650	2 600	3 285	3 786	4 397	5 140	6 050	7 162	8 525	10 201
Change in reserves	-8 480	-5 045	-4 293	-4 279	-4 557	-3 170	-5 161	-3 495	-3 925	-6 146
Errors and omissions	-	-	-	-	-	-	-	-	-	-
Net borrowing gap	2 213	6 041	9 416	7 157	7 029	4 370	5 477	3 297	3 055	3 939
Memo items										
Total external debt	411 428	417 467	426 882	434 040	441 070	445 441	450 919	454 217	457 272	461 211
Debt reduction	4 750	-	-	-	-	-	-	-	-	-
Cumulative flight capital	181 213	189 111	197 486	205 621	213 556	220 910	227 441	232 852	236 785	238 801
Stock of foreign investment	109 189	118 468	128 069	138 899	151 129	164 872	180 314	197 673	217 192	129 139

Source: Inter-American Development Bank.

borrowing will have to go on, though at a reduced intensity compared to the 1980s.

Nevertheless, the expected industrial recovery should be sufficiently strong to reverse the retrenchment in manufacturing output and employment recorded in the 1980s (see table II.33). Between 1980 and 1990, manufacturing employment fell in Argentina, Brazil, Colombia, Dominican Republic, El Salvador, Mexico, Panama, Trinidad and Tobago, Uruguay and Venezuela. Shedding marginal or redundant employees has proved a major corporate tool for fighting hyperinflation and dwindling demand and keeping up labour productivity. In all the bigger countries, such as Argentina, Brazil and Mexico, there has been remarkable upward movement in labour productivity.

In contrast, between 1980 and 1990, wage earnings per worker tumbled in Argentina and Mexico, though they rose in Brazil. In fact, they fell in 12 countries (see the last column of table II.33). In other words, average wage earnings per worker fell to 15.1 per cent of the level of North American workers in 1990 from 17.2 per cent in 1980 and 18.4 per cent in 1970 (see table II.34). It is remarkable that, in comparison with wage levels of North American manufacturing, the wages of workers in the region have fallen in virtually all manufacturing sectors during the last two decades. Exceptions are other chemical products, miscellaneous petroleum and coal products, rubber products and plastic products n.e.c.

The relatively low wages in comparison with the North American level, essentially reflect technological differences. These differences, in turn, can be roughly captured by measuring labour productivity as a percentage of the North American level.* Such a measurement is shown in table II.34. On average, labour productivity in the region is shown to be roughly 30 per cent of the North American level. The remaining 70 per cent represents a "technology gap" between the two regions. This gap compares with a gap of over 80 per cent for the East and South-East Asian region. In other words, labour productivity of Latin America is 10 percentage points ahead of East and South-East Asia relative to the North American standard as of 1990. The flurry of comparative studies in recent years on the two regions appear to convey misleading pictures on this score.** The speed and level of change in technological advancement and productivity need not be confused.

It should be borne in mind that the relatively high level of labour productivity (compared with the Asian and African regions) has been achieved with the active participation of foreign direct investment in the manufacturing sector of the region. For instance, in the Brazilian manufacturing sector, foreign-owned firms account on average for a 28.5 per cent share of total sales, compared with 59 per cent for private domestic manufacturers and 12.5 per cent for State-owned manufactures. Sales of foreign-owned firms dominated in the case of tobacco (73 per cent), transport equipment (68 per cent), rubber products (63 per cent),

*Diverging movements over time between labour productivity and wage earnings—with the former rising and the latter falling—may indicate the extent to which wages are squeezed downward in favour of maintaining profits under a highly inflationary situation in the region.

**See, for instance, [28] and [29].

Table II.33. Manufacturing employment, labour productivity and wage earnings per worker in Latin America and the Caribbean, 1980 and 1990
(In constant 1985 dollars)

Country	MVA 1980 (million dollars)	MVA 1990 (million dollars)	Manufacturing employment 1980 (thousands)	Manufacturing employment 1990 (thousands)	MVA per worker 1980	MVA per worker 1990	Wage per worker 1980	Wage per worker 1990
Argentina	29 591	23 363	1 346	968	21 982	24 149	5 193	3 604
Barbados	77	101	8	8	9 963	11 991	6 275	7 680
Bolivia	1 231	985	102	167	12 093	5 886	3 595	1 473
Brazil	58 200	73 946	4 449	3 998	13 082	18 498	2 252	3 594
Chile	3 727	7 378	206	219	18 054	33 674	3 319	4 339
Colombia	6 490	9 365	508	492	12 770	19 045	2 351	2 714
Costa Rica	596	864	64	117	9 286	7 390	3 981	2 351
Cuba	3 714	4 796	501	712	7 416	6 741	1 983	2 468
Dominican Republic	689	1 019	146	132	4 722	7 705	1 270	932
Ecuador	1 577	1 748	112	114	14 114	15 305	5 564	5 030
El Salvador	606	457	39	25	4 855	18 038	4855	3 238
Guatemala	991	1 230	82	94	12 016	13 023	2 700	2 519
Honduras	501	608	55	71	9 107	8 581	2 892	3 352
Jamaica	296	472	44	64	6 686	7 351	3 145	3 064
Mexico	37 049	51 420	2 417	2 013	15 329	25 543	5 031	3 489
Nicaragua	803	885	34	48	23 625	18 549	6 885	3 801
Panama	560	500	32	31	17 768	15 922	4 460	5 462
Paraguay	569	735	70	103	8 068	7 159		..
Peru	4 425	3 547	273	307	16 193	11 572	2 508	1 980
Trinidad and Tobago	703	368	44	32	15 869	11 682	8 700	7 423
Uruguay	1 246	1 502	160	121	7 781	12 433	2 554	3 005
Venezuela	13 716	13 272	477	474	28 751	28 012	7 677	5 997

Source: UNIDO database.

Table II.34. Labour productivity and wage earnings per worker in Latin America and the Caribbean as a percentage of the North American level, 1970, 1980 and 1990
(In constant 1985 dollars)

	Labour productivity			Wage per worker		
Industry	1970	1980	1990	1970	1980	1990
Food products	21.18	20.52	19.23	15.74	15.04	13.82
Beverages	29.65	30.12	20.02	21.98	17.93	13.08
Tobacco products	45.16	35.61	15.83	18.93	15.78	13.48
Textiles	37.67	44.71	34.92	22.64	20.52	16.60
Wearing apparel	34.15	38.71	31.14	22.18	20.04	17.61
Leather and fur products	37.37	30.52	34.67	20.60	21.60	19.92
Footwear (excluding rubber or plastic footwear)	32.66	27.10	25.92	25.30	23.33	17.59
Wood and cork products	27.96	24.84	15.77	13.06	11.93	8.47
Furniture and fixtures	23.52	28.57	17.62	18.70	15.75	10.79
Paper and paper products	32.51	32.17	27.97	20.18	17.83	16.32
Printing and publishing	25.91	28.91	25.88	21.17	21.11	18.51
Industrial chemicals	29.50	30.29	32.33	23.00	23.06	16.03
Other chemical products	26.21	23.83	23.41	21.39	22.70	23.21
Petroleum refineries	91.47	67.32	108.30	33.37	31.54	28.09
Miscellaneous petroleum and coal products	34.06	53.44	81.67	23.63	23.70	24.07
Rubber products	37.49	38.89	54.53	22.43	23.67	24.70
Plastic products n.e.c.	36.09	33.64	32.25	18.96	18.08	22.29
Pottery, china and earthenware	40.68	32.34	32.86	19.35	16.97	15.02
Glass and glass products	24.89	29.73	33.68	22.64	21.52	18.79
Other non-metallic mineral products	22.89	20.24	17.75	14.47	12.85	11.37
Iron and steel	39.76	37.56	49.57	21.74	18.73	21.56
Non-ferrous metals	74.00	46.01	64.31	20.40	17.03	20.28
Metal products	21.78	24.26	27.81	18.23	17.81	15.49
Non-electrical machinery	22.58	25.42	18.88	19.59	18.72	15.39
Electrical machinery	27.21	31.28	34.41	22.24	18.76	18.88
Transport equipment	26.56	30.92	24.76	18.24	18.68	15.16
Professional and scientific goods	14.37	24.57	33.40	16.65	15.51	14.01
Other manufactures	37.08	34.82	31.70	20.11	16.92	19.52
Total	29.50	29.93	29.22	18.39	17.19	15.13

Source: UNIDO database.

soaps and toiletries (53 per cent) (see table II.35 for further details). Recent studies also show that foreign-owned firms are large in terms of size, pay higher taxes, are more export-oriented and have higher import propensities than locally owned firms.*

Brazilian policy makers may find the role of transnational corporations helpful in the current efforts to open up and liberalize the economy. Indeed, it can be expected that foreign direct investment will play a more important role than in the past in modernizing the industrial sector. It is remarkable that foreign direct investment continued to grow in Brazil even during the turbulent 1980s, although at a slower pace than in the 1960s and 1970s (see table II.36). There could be substantial new foreign direct investment flows if inflationary pressures are further contained in the 1990s and a speedy liberalization process is pursued (see table II.37).

But in the process of recovery and rapid industrial growth, the region is likely to encounter human capital bottlenecks. In *Global Report 1991/92*, it was reported that the burden of budget deficits led to cutbacks on educational expenditure in virtually all countries of the region.* For instance, during the 1980-1985 period, such expenditures declined by an annual rate of 6.14 per cent. The constraining impact is likely to be felt throughout the 1990s.

Nevertheless, retraining and restructuring the existing human capital stock could go a long way toward alleviating future shortages. The region seems to be reasonably well "endowed" with some critical elements of human capital (see table II.38).

To begin with, the adult literacy rate appears rather high, and is comparable to that of East and South-East Asia (ranging between the upper eighties and nineties in percentage). The mean years of schooling are also high, despite some wide divergences, for example, the 8.7 average years for Argentina as compared with 4.7 for Mexico and only 3.9 for Brazil.

It seems likely that human capital disparities explain the highly skewed income distribution within and between countries of the region. Although more research is needed in order to determine the precise relationships between education and training, on one

*See Larry Willmore: "Size of firm, like foreign ownership, has a positive effect on exports and imports, but the effect is stronger for exports than for imports" ([30], p. 333).

*See [2], p. 49.

Table II.35. Brazil: shares of domestic, foreign and State-owned firms in total sales, and manufacturing export orientation, 1975-1983

Industry	Firms: Domestic	Firms: Foreign	Firms: State	Ratio of exports to final demand: 1975	Ratio of exports to final demand: 1983	Ratio of exports to value of products[a/]: 1975	Ratio of exports to value of products[a/]: 1983
	(percentage)						
Metallic ores	72	28	-	93.9	98.3	32.6	26.1
Iron and steel	37	23	40	..	..	..	..
Non-ferrous metals	56	44	-	30.1	47.2	3.0	5.7
Metal products	75	23	2	17.3	70.2	1.8	14.4
Mechanical equipment	59	41	-	5.1	16.4	2.9	7.3
Electrical machinery	56	44	-	9.2	19.2	5.0	10.3
Transport equipment	29	68	3	8.7	25.9	5.0	15.1
Wood products	95	5	-	..	..	..	..
Furniture	97	3	-	..	..	..	..
Leather and skins	85	15	-	5.6	10.9	2.9	5.7
Printing and publishing	91	3	6	..	..	..	..
Miscellaneous	70	29	1	..	..	..	..
Paper and pulp	75	21	5	21.3	81.3	3.0	28.9
Rubber products	37	63	-	7.4	30.2	1.5	8.1
Chemicals	27	21	52	62.7	73.9	9.1	14.3
Plastics	83	17	-	..	..	..	..
Pharmaceuticals	28	71	1	0.8	2.3	0.7	1.9
Soap and toiletry	47	53	-	..	..	..	..
Textiles	78	22	-	15.5	25.3	6.2	13.3
Apparel and shoes	96	4	-	9.0	10.3	8.6	9.8
Food products	81	18	1	12.8	16.8	9.7	12.7
Beverages	85	15	-	9.4	13.9	7.4	10.5
Tobacco products	27	73	-	..	..	-	..
Total	59	28.5	12.5	11.7	24.8	5.4	11.9

Source: OECD, *Foreign Direct Investment in Brazil* (Paris, 1991), p. 32.
[a/] Exports as percentage of final demand.

Table II.36. Foreign direct investment in Brazil, 1947-1988
(In millions of current dollars)

Years	Foreign direct investment (cumulative flows): Inflows (1)	Reinvestment (2)	Total (1) and (2) (3)	Value of stock (4)	Registered stock (5)	Stock at 1986 prices (6)	(3) as percentage of manufacturing investment (7)
1947-1954	107	366	473	1 751	-	5 971	..
1955-1961	716	251	967	2 718	-	8 610	27.8
1962-1965	177	262	459	3 177	1 632	9 584	..
1966-1969	388	236	585	3 884	2 179	10 936	36.0
1970-1973	1 558	1 262	2 820	6 604	4 579	14 698	32.1
1974-1977	3 548	3 016	6 564	13 168	11 228	20 336	34.5
1978-1982	4 908	4 404	9 312	22 480	21 176	22 520	27.8
1983-1986	2 198	1 895	4 093	26 600	27 898	26 600	39.8
1987-1988	2 659	1 090	3 749	30 349	30 803	30 349	..

Source: OECD, Foreign Direct Investment in Brazil (Paris, 1991), p. 23.

Table II.37. Capital flows to Latin America, 1989-1991

Country and item	Million dollars: 1989	Million dollars: 1990	Percentage of GDP in 1990	Million dollars in 1991	Percentage of GDP in 1991
Argentina	1 400.5	521.5	0.8	5 100.0	7.6
Brazil	150.0	406.3	0.1	11 626.0	2.7
Chile	1 149.9	2 045.4	7.4	1 669.0	5.8
Mexico	702.3	8 395.2	3.6	16 072.8	5.9
Venezuela	1 020.2	1 842.6	3.7	4 797.0	10.0
Regional	577.2	175.0	..	829.0	..
TOTAL	5 000.4	13 386.0		40 093 8	
Percentage change					
1989-1990		167.7			
1990-1991		199.5			

Source: Salomon Brothers, reported in *The Financial Times*, 20 February 1992, p. 19.

Table II.38. Selected indicators of human capital in Latin America and the Caribbean, 1985-1990

Country	Mean years of schooling in 1990	Scientists, technicians per 1,000 people in 1985-1989	R & D scientists, technicians per 10,000 people in 1985-1989	Tertiary graduates as percentage of age group in 1986-1988	Adult literacy rate (percentage)	Combined primary and secondary school enrolment ratio [a] 1970	1988-1989
Barbados	8.9	11.6	..	..	..	..	..
Uruguay	7.8	..	..	..	96	100	95
Trinidad and Tobago	8.0	..	4.1	1.2	..	95	94
Bahamas	6.2	..	..	..	..	..	..
Chile	7.5	..	5.7	3.1	93	100	95
Costa Rica	5.7	..	..	2.7	93	87	78
Argentina	8.7	29.1	5.4	..	95	93	99
Venezuela	6.3	95.3	3.7	2.7	88	80	87
Mexico	4.7	..	5.2	2.5	87	77	86
Dominica	4.7	..	..	..	..	..	..
Antigua and Barbuda	4.6	..	..	..	..	..	..
Grenada	4.7	..	..	..	..	..	..
Colombia	7.1	..	0.6	2.6	87	94	80
Suriname	4.2	..	..	..	95	..	..
Brazil	3.9	29.5	..	2.5	81	75	91
Cuba	7.6	..	..	3.8	94	87	98
Panama	6.7	8.0	..	2.3	88	86	86
Jamaica	5.3	6.2	0.1	2.0	98	86	..
Saint Lucia	3.9	..	..	..	..	..	..
Saint Vincent	4.6	..	..	..	..	..	..
Belize	4.6	..	..	..	..	..	..
Ecuador	5.6	9.1	..	2.3	86	72	92
Paraguay	4.9	..	..	..	90	77	72
Peru	6.4	21.2	..	..	85	..	..
Dominican Republic	4.3	..	..	..	83	72	95
El Salvador	4.1	1.4	3.4	1.7	73	69	69
Nicaragua	4.3	..	2.7	0.9	..	62	73
Guatemala	4.1	1.4	1.9	..	55	40	54
Honduras	3.9	1.9	..	0.5	73	66	77

Source: United Nations Development Programme, *Human Development Report 1992* (New York, Oxford, 1991)
Note: Countries listed according to rank in terms of UNDP human development index.
[a] As proportion of North (=100). North refers to OECD countries.

hand, and social returns to such investment, on the other, the lesson coming from the industrialization experience of East and South-East Asia seems clear. Policy makers in the region face the challenge of the twenty-first century and reassess their priorities, upgrading this neglected item (human capital formation) in order to promote not only industrial growth but also equitable distribution. A recent study concludes with the following provocative question: "More radical ideas include the reallocation of funds from the military to education. Is this idea unrealistic?*

F. Tropical Africa

1. Short-run outlook

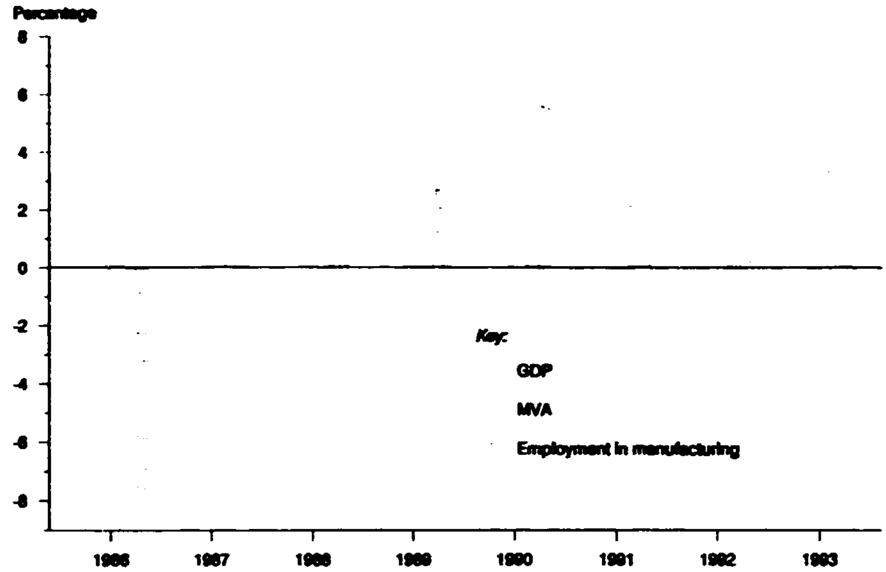
The short-run prospect is for slow recovery of industrial growth for the region as a whole. MVA growth rates are expected to climb to 4.0 per cent in 1992 and 4.4 per cent in 1993, from 3.4 per cent and 2.7 per cent in 1990 and 1991, respectively. These improvements in MVA growth rates exceed other sectors and lead GDP growth rates (see figure II.7 for GDP and MVA patterns of growth in recent years and also for structural changes in industry and table II.39 for GDP growth rates by country).

Although the manufacturing sector has performed better than other sectors in the past few years, its contribution to GDP is relatively small for the majority of countries in the region, and its importance in the economy varies from country to country. In Guinea the manufacturing sector accounted for only 1 per cent of GDP, while in Zimbabwe which has one of the largest, most diversified and better-integrated manufacturing sectors, the contribution was over 25 per cent of GDP. None the less, this sector absorbed an important proportion of the labour force in some countries, such as Ghana, where it accounted for 13 per cent of urban sector employment. This amounted to 53,600 employees, compared with public and social services which absorbed 193,800 employees. In Zimbabwe, employees in the manufacturing sector totalled 163,800.

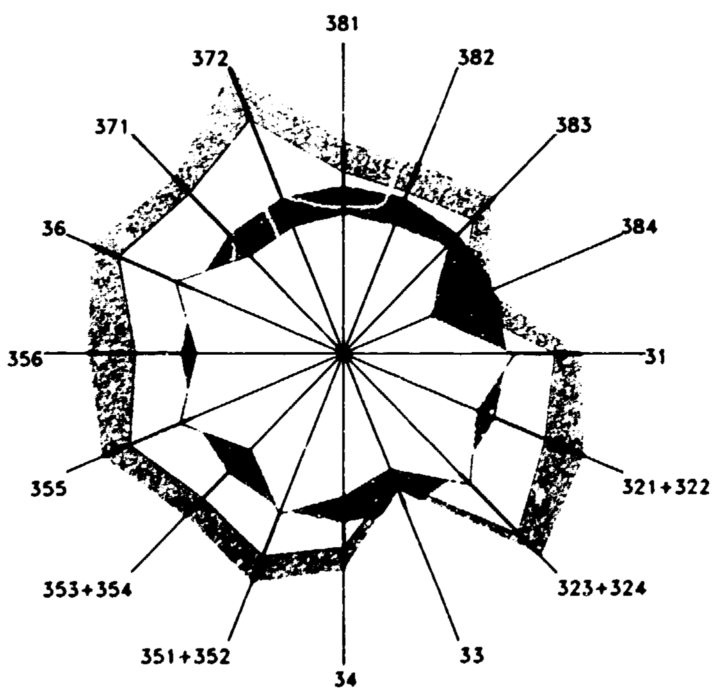
The overall good performance is largely attributable to increased use of domestic raw materials in industries such as breweries, cement, confectionery, cotton textiles, chemicals, fish conserving, footwear, leather goods, oil refining, paper, paint and synthetic fabrics. The performance was also facilitated by relatively

*See [31]

Figure II.7. Growth rates of GDP, MVA and manufacturing employment, 1986-1993, and industrial structural change, 1980-1993: Tropical Africa



Industrial structural change
(Index of value added: 1980 = 100)



g = 2.64, θ = 6.90

Key:

Deflated prices of 1985

g = Average annual growth rate, 1980–1993 (percentage)

θ = Index of structural change, 1980–1993

ISIC code	(industries):
31	(Food products)
321, 322	(Textiles)
323, 324	(Leather)
33	(Wood and furniture)
34	(Paper and printing)
351, 352	(Chemicals)
353, 354	(Petroleum and coal)
355	(Rubber products)
356	(Plastic products)
36	(Non-metal mineral products)
371	(Iron and steel)
372	(Non-ferrous metals)
381	(Metal products)
382	(Non-electrical machinery)
383	(Electrical machinery)
384	(Transport equipment)

1990–1993 forecast
1985–1990
1980–1985

Source: UNIDO database, estimates and forecasts by UNIDO PPD GLO

Table II.39. Annual growth rate of GDP in Tropical Africa at constant 1980 market prices, 1986-1991

Country	1986	1987	1988	1989	1990	1991
Angola	12.5	11.3	14.4	1.7	6.6	2.0
Benin	2.1	-1.5	3.0	2.3	1.3	2.2
Botswana	8.1	10.3	9.2	13.4	6.3	6.0
Burkina Faso	9.5	0.9	6.5	-0.5	1.0	4.0
Burundi	3.8	4.1	3.5	1.5	0.9	4.0
Cameroon	8.0	-6.5	-7.7	-3.4	-2.5	-6.2
Cape Verde	2.7	15.8	4.0	4.0	4.0	2.3
Central African Republic	1.7	-3.9	2.5	2.2	0.5	1.7
Chad	-4.1	-3.3	16.3	4.3	3.0	0.3
Comoros	3.1	2.1	1.4	-0.4	1.5	2.5
Congo	-6.9	0.1	1.9	1.7	1.5	0.2
Côte d'Ivoire	3.4	-1.6	-2.0	-0.7	-2.6	-0.6
Djibouti	1.8	3.7	0.9	-0.8	1.1	2.0
Equatorial Guinea	-0.4	4.3	5.1	-0.6	3.1	4.2
Ethiopia	6.9	9.9	2.4	1.1	-1.7	-5.4
Gabon	11.4	-18.4	0.1	4.0	5.5	7.0
Gambia	2.8	6.0	7.8	5.0	4.5	4.0
Ghana	5.1	4.6	5.5	5.0	2.6	4.5
Guinea	2.5	3.3	5.5	4.8	4.3	2.4
Guinea-Bissau	-1.0	7.8	6.9	8.7	3.4	2.8
Kenya	7.2	5.9	6.0	4.6	5.1	4.3
Lesotho	-0.9	7.3	12.3	8.0	7.3	9.9
Liberia	-0.9	1.3	3.1	2.8	-8.6	-10.2
Madagascar	2.0	1.2	3.8	4.1	3.5	0.9
Malawi	0.4	2.4	2.6	5.0	4.5	4.7
Mali	17.9	1.4	5.5	7.5	2.4	-0.2
Mauritania	5.6	3.1	3.7	3.4	-1.5	2.6
Mauritius	7.9	8.8	6.8	4.4	7.2	4.3
Mozambique	2.0	4.0	4.1	5.6	1.7	4.3
Namibia	6.8	-1.5	5.9	-4.1	4.3	2.9
Niger	6.4	-2.4	5.0	-3.5	3.1	-1.5
Nigeria	2.5	-0.7	9.9	7.2	8.2	4.3
Rwanda	5.5	-0.6	0.6	-2.4	-2.5	4.3
Sao Tome and Principe	1.0	-1.4	2.0	1.5	2.5	0.6
Senegal	4.6	3.8	5.1	-1.7	4.5	1.1
Seychelles	5.5	5.2	2.8	1.4	7.4	-3.7
Sierra Leone	-1.9	5.4	1.2	4.3	3.0	2.7
Somalia	3.5	5.1	-0.7	-	-2.7	-3.0
Sudan	9.7	1.1	-1.9	7.4	-8.0	-6.8
Swaziland	3.7	-1.3	8.9	4.1	2.1	4.0
Togo	3.4	1.5	5.0	3.9	-0.5	-3.0
Uganda	-8.6	6.4	7.2	6.6	5.7	4.0
United Republic of Tanzania	4.7	4.0	5.1	4.4	4.2	4.4
Zaire	4.7	2.7	0.6	-1.4	-2.4	-5.0
Zambia	0.2	3.1	5.6	0.2	0.6	-1.5
Zimbabwe	2.6	-1.0	9.3	5.5	8.9	3.8

Source: African Development Bank.

greater access to foreign exchange for imports of raw materials, spare parts and machinery. One positive effect of these developments was increased utilization of installed capacity, as illustrated in the case of Malawi, the manufacturing sector of which was reaching its peak capacity. Also, in Mozambique and Zimbabwe, the capacity utilization rate exceeded 50 per cent, while in Nigeria it reached the 43.2 per cent level in 1990.

In spite of these encouraging developments during the year, there were several causes for concern. The main one was the sharp increase in production cost recorded in 1991. High real interest rates for working capital or investment and energy costs, including electricity and oil, were the major factors pushing production costs upward, and thereby adversely affecting the competitiveness of the manufacturing sector of the countries concerned. There were also problems related to the productive base of manufacturing companies. The upward trend in capacity utilization needs to be seen in the context of the low absolute rates of capacity utilization, which, at under 50 per cent, imply continuing and substantial idle capacity in the manufacturing sector. Low capacity utilization as a result of limited export markets for African manufactures and raw material shortages, with a corollary increase in unit costs, was compounded by an associated shortage of spare parts and equipment, preventing adequate maintenance and increasing the number of production breakdowns and lay-offs.

These problems led many African Governments to commit themselves in the 1980s to various policy reforms with a view to increasing manufacturing efficiency. In that context, some countries envisaged a marked reduction in protective tariffs barriers and government regulation of pricing and employment. Also, some of the initiatives introduced emphasized greater use of local raw materials and incentives to boost investment in the sector.

In the region, an important determinant for industrial growth is the availability of foreign exchange in order to import components, parts and machines. For this reason the current account situation is being watched closely and the prospects are worrisome. Furthermore, commodity prices are not helping (see table II.40).

The current account situation for the region deteriorated in 1990, and continued to be precarious for a large number of countries. The ratio of current account deficit to GDP was substantial for most small countries, such as Chad, Comoros, Djibouti, Equatorial Guinea, Gambia and Guinea-Bissau. It was above 20 per cent for Lesotho, Mozambique and the United Republic of Tanzania. The deficits for most of these countries were financed by grants or accumulation of debt (long-term financing) mostly from official sources. Lesotho and the Sudan receive considerable workers' remittances, which for the Sudan declined as a result of the Persian Gulf war. Highly indebted, oil-exporting countries have been generating trade surpluses which they use in servicing debt. This was what Gabon and Nigeria did in 1990 following limited windfall gains from the oil price increase. Nigeria, Congo and Côte d'Ivoire each paid the equivalent of more than 4 per cent of their GDP as interest payments.

Table II.40. Commodity price indices in Tropical Africa, 1989-1991
(Base year 1978-1981 = 100)

Commodities	1989	1990	1991
Agricultural non-food	84.2	84.0	81.1
Agricultural food	81.5	75.2	73.0
Metals and minerals	121.1	112.7	102.2
33 selected commodities (excluding petroleum and steel)	95.1	89.0	84.9

Source: *African Development Report 1992* (Abidjan, African Development Bank, 1992), p. 39.

2. *Sluggish investment*

While the average investment rate in Africa was about 18 per cent in 1989, in many countries this rate fell below 10 per cent. This was partly due to domestic savings constraints and a decline in government and foreign investments. Furthermore, as compared with the 1970s, government investments have recently been significantly reduced, due partly to revenue constraints. Many countries resorted to borrowing in order to support the balance of payments, service debts or rehabilitate existing projects. In some instances, the withdrawal of Governments from productive activities was due to shifts in ideological leanings. Often, it has been the consequence of expenditure retrenchment.

Although the privatization process has been slow, the private sector seems to be taking important initiatives. However, it is less certain that the increases in the volume of private investments were sufficient to compensate for the decline in government, foreign or joint investments. Generally, weak economies and depressed international markets weakened the incentives to invest.

Flows of foreign direct investment into the region have continued to stagnate at low levels. Though some countries introduced new foreign investment policies, instituted investment guarantees (for example, though the Multilateral Investment Guarantee Agency), and signed bilateral investment treaties, the region seems to have a less attractive economic environment for investments than other regions. This is mainly attributed to the general macroeconomic situation and high indebtedness. It is also party due to increased competition from the industrial countries, the dynamically growing Asian region and Eastern Europe.

Evidence of declining foreign investment in the region could be gleaned from data on foreign direct investment of the countries belonging to the OECD Development Assistance Committee (DAC). Total net direct investment from DAC countries to the region fell from $1.5 billion in 1989 to $446 million in 1990 (the last year for which data is available). Several countries including Angola, Liberia, Nigeria, Togo, United Republic of Tanzania and Zaire experienced negative net foreign direct investment from DAC countries. Data from the United States revealed that the average growth rate of foreign direct investment in the region fell from 4.2 per cent per annum during the 1980-1984

Current account deficit as a ratio of GDP in Tropical Africa, 1990

Below 10 per cent

Angola, Benin, Cameroon, Cape Verde, Congo, Ethiopia, Gabon, Ghana, Kenya, Malawi, Mauritius, Nigeria, Senegal, Togo, Zimbabwe and Zaire

Between 10 to 20 per cent

Burundi, Central African Republic, Côte d'Ivoire, Gambia, Madagascar, Mali, Mauritania, Rwanda, Sierra Leone, Sudan, Uganda and Zambia

Above 20 per cent

Chad, Comoros, Djibouti, Equatorial Guinea, Guinea-Bissau, Lesotho, Mozambique and United Republic of Tanzania period to 0.8 per cent per annum during 1984-1988. Though the region's share in United States foreign direct investment was 1.4 per cent in 1988, this was mainly concentrated in Nigeria and Liberia.

3. *Long-run prospects*

The manufacturing sector of many countries in this region faces the challenge of reversing declining employment, labour productivity and wage earnings. Over the decade of the 1980s the sector has been afflicted by the confluence of several adverse factors such as the following: the global recession of 1981-1982; shortages of intermediate inputs, parts and machinery; declining availability of foreign exchanges and high and fluctuating interest rates. The built-in inflexibility of many State-owned enterprises (where, for example, employees cannot easily be fired) coupled with managerial weakness wrought havoc to the manufacturing sector (see box II.6). Table II.41 reflects the magnitude of the setback in some countries of the region.

Nigeria (a giant in the region) seems to have suffered most. Between 1980 and 1990, MVA fell from $2.7 billion to $2 billion (in 1985 dollars), employment from 432,000 to 393,000, labour productivity from $6,344 to $5,189, and wage earnings per worker from $1,388 to $1,058 (all figures in 1985 dollars).*

It is also noteworthy that many countries recorded a decline in both labour productivity and wage earnings

*This seems to be consistent with other studies. For instance, a UNIDO study concludes "... it is clear that factor productivity has declined substantially during the first half of the 1980s. It has been argued that productivity levels in the mid-1980s were about a third of the levels achieved a decade earlier." [32]

Box II.6. Strategic management of industrial development: experimental project for Tropical Africa

Numerous African countries have been assisted in their efforts to expand their industrial base, especially since these countries have equated economic development with industrial development. As a rule, assistance has taken the form of institution-building and training within ministries of industry. It has also supplemented and complemented assistance in drawing up "industrial development plans" which have carried time horizons of 10 to 20 years. Wherever these technical assistance endeavours succeeded—and there are not many such cases—the end-result was an even more interventionist and dirigiste State.

The late 1970s and early 1980s signalled the end of the usefulness of this approach to economic growth and development. Many countries in Africa and elsewhere, with the assistance—or at the insistence—of several multidonor agencies, began to adopt policies whereby the private sector began to assume its prime role as promoter of economic dynamism and restructuring; the public sector began to pull back its frontiers and to assume the role of provider of an "enabling environment" within which the private sector would function efficiently and competitively.

Given the above, UNDP/UNIDO assistance to industrial development needs an altogether new approach. The old classical approach of making long-term industrial plans is clearly outdated. A new approach has to be found.

The strategic management of industrial development (SMID) responds to this need. Its basic tenets may be summarized as follows:

(a) Developing countries lack the capacity to manage their industrial development;

(b) This capacity is needed in both the public and private sector, and the right way to build it is through learning-by-doing rather than through ad hoc short-term training courses or study tours;

(c) The appropriate method and the right policies and strategies for industrial revitalization, development and competitiveness cannot be a "master plan"; rather they can be attained through an effective dialogue between the public and the private sector in which the private sector can articulate its requirements to function efficiently and the public sector can commit itself to providing the enabling environment and the necessary conditions to satisfy these requirements within the existing internal and external constraints;

(d) The proposals resulting from such a dialogue are usually crystallized through "strategic committees" set up according to the importance of the subsectors and transmitted to decision makers who are, as a matter of policy, favourably disposed towards the new dynamic role of the private sector;

(e) These strategy and policy proposals are harmonized by the public sector via a coordination committee of the highest level and converted into concrete policy actions and strategies.

In a nutshell, the SMID approach provides assistance in the establishment of a mechanism to achieve an ongoing process of consultation and dialogue between the private and the public sector. This process in fact is one of the major results of fulfilling the specified objectives. It is not a "ready-made" planning exercise, but rather a flexible approach for industrial development whose degree of efficacy depends upon the existence of several preconditions and constraints in the recipient country.

The approach is currently being applied in several African countries with mixed results. This stems from the fact that in some countries the Government's commitment to SMID may not be altogether firm. Moreover, in several countries the SMID approach has been worked into ongoing projects which were initiated under the classical approach. It cannot be overemphasized that SMID intends to create a new vision and a new *modus operandi* for industrial development.

Source: Fuat M. Andic, S. Gor Misiani and Alain S. Théry, "Thematic evaluation of strategic management of industrial development in Africa", UNDP/UNIDO internal discussion paper (January 1992), pp. i-iii.

Table II.41. Industrial performance indicators for selected countries in Tropical Africa, 1980 and 1990
(In constant 1985 dollars)

Country	MVA 1980	MVA 1990	Manufacturing employment 1980	Manufacturing employment 1990	Labour productivity 1980	Labour productivity 1990	Wage per worker 1980	Wage per worker 1990
	(million 1985 dollars)		(thousands)					
Nigeria	2 742	2 042	432	393	6 344	5 189	1 388	1 058
Zimbabwe	1 186	1 692	161	193	7 376	8 770	3 083	3 228
Kenya	639	897	143	188	4 466	4 776	1 920	2 092
Ethiopia	662	811	77	107	8 635	7 530	1 270	1 560
Côte d'Ivoire	786	786	67	51	11 708	15 539	3 549	6 679
Zambia	510	760	59	63	8 631	12 143	2 122	3 257
Cameroon	549	715	51	50	10 845	14 207	3 757	4 636
Ghana	252	574	80	71	3 141	8 069	627	1 019
Sudan	303	405	65	52	4 644	7 835	1 615	1 645
Mauritius	104	341	43	121	2 429	2 823	1 270	1 248
United Republic of Tanzania	468	323	101	117	4 637	2 763	1 521	1 036
Senegal	200	221	32	44	6 307	4 999	2 710	2 573
Gabon	167	198	18	21	9 329	9 487	4 701	5 268
Burkina Faso	99	159	8	10	12 022	16 519	2 768	3 541
Madagascar	176	139	41	47	4 336	2 955	1 657	998
Rwanda	140	139	65	80	21 571	17 342	2 239	2 340
Burundi	58	109	3	5	16 726	21 364	2 408	2 154
Malawi	102	91	39	45	2 622	2 014	864	846
Botswana	28	80	5	19	5 141	4 149	2 530	1 284
Swaziland	75	74	11	15	6 936	5 060	2 798	2 518
Mali	51	54	14	21	3 724	2 585	1 029	834
Congo	48	47	5	10	8 972	4 384	3 169	2 365
Somalia	61	46	10	14	5 584	3 336	1 871	774
Togo	33	43	5	5	6 348	7 882	1 911	2 286
Benin	45	31	6	7	7 501	4 577	1 858	1 262
Niger	21	23	2	2	10 302	9 847	4 493	3 483
Gambia	10	17	2	3	5 124	5 470	1 298	1 195
Central African Republic	27	16	6	5	4 628	3 257	2 109	2 561
Lesotho	9	6	3	4	2 733	1 281	717	1 998

Source: UNIDO database.

per worker, notably, Benin, Botswana, Congo, Madagascar, Malawi, Mali, Niger, Nigeria, Senegal, Somalia, Swaziland and United Republic of Tanzania. It makes economic sense that wage earnings should reflect the changes in labour productivity. In the long-run, they move together.

As opposed to the cases of productivity deterioration, several countries showed a rising productivity coupled with an increase in wage earnings, notably Cameroon, Côte d'Ivoire, Ghana, Kenya, Zambia and Zimbabwe. Furthermore, the manufacturing sector created substantial employment in Ethiopia, Mauritius, Zimbabwe etc. On the whole, however, the manufacturing sector of the region achieved little progress during the 1980-1990 period in creating employment, improving labour productivity and increasing wage earnings. Relative to the North American level, labour productivity fell from 12.6 per cent in 1980 to 10.0 per cent in 1990 (compared with 15.7 per cent in 1970) (see table II.42). Likewise, wage earnings per worker fell to 8.7 per cent of the North American level in 1990, from 9.2 per cent in 1980 and 10.5 per cent in 1970.

In other words, the manufacturing productivity gap between North America and the region has widened over the last two decades. So has the relative wage differential. These general trends appear pervasive in the majority of manufacturing industries, with a few exceptions such as rubber products, pottery, china and earthenware. The region's manufacturing sector faces a herculean task to reverse these trends and to begin the process of catching up with the developed market economies, although the region seems slightly ahead of the Indian Subcontinent where, for instance, labour productivity in manufacturing registered only 4.5 per cent of the North American level in 1990, 50 per cent below the corresponding figures for Tropical Africa.

How can Tropical Africa meet the challenge? While the definitive answer would require systematic research involving a multitude of variables, it appears there is some consensus among experienced Africa observers about the basic requirements. Macroeconomists usually place emphasis on the importance of sensible macromanagement, involving control of inflation, money supply, interest rates, exchange rates etc. The case for this view has been amply demonstrated by the industrial experiences in Tropical Africa as well as in Latin America. But in recent years, development economists have begun to emphasize and distinguish

Table II.42. Manufacturing labour productivity and wage earnings per worker in Tropical Africa, as percentage of the North American level, 1970, 1980 and 1990
(In constant 1985 dollars)

Industry	Labour productivity 1970	Labour productivity 1980	Labour productivity 1990	Wage per worker 1970	Wage per worker 1980	Wage per worker 1990
Food products	13.02	9.59	9.77	10.39	9.71	10.00
Beverages	27.22	19.14	12.24	13.94	10.16	9.63
Tobacco products	16.19	8.90	4.06	17.44	9.87	8.90
Textiles	18.20	13.61	9.27	11.26	10.25	8.55
Wearing apparel	17.10	13.86	9.33	14.73	12.72	11.20
Leather and fur products	17.27	19.34	12.26	13.02	13.63	1.79
Footwear (excluding rubber or plastic footwear)	21.85	18.63	15.48	15.27	17.20	14.92
Wood and cork products	9.44	9.52	10.13	9.98	8.00	8.28
Furniture and fixtures	11.50	12.19	10.00	11.20	11.19	9.16
Paper and paper products	18.80	12.61	7.23	13.37	10.65	8.90
Printing and publishing	13.41	11.71	7.85	13.63	10.72	8.59
Industrial chemicals	13.27	8.27	5.96	14.34	11.35	12.77
Other chemical products	11.70	10.61	6.18	10.99	10.34	10.83
Petroleum refineries	60.01	14.40	10.96	29.74	15.68	12.37
Miscellaneous petroleum and coal products	85.24[a/]	32.19	12.02	13.05	19.88	15.91
Rubber products	12.39	11.58	15.29	8.78	9.80	13.46
Plastic products n.e.c.	16.17	11.69	11.77	10.74	11.40	11.70
Pottery, china and earthenware	13.08	13.30	20.57	9.22	12.28	16.50
Glass and glass products	12.10	15.73	7.90	10.01	11.88	8.32
Other non-metallic mineral products	14.40	10.24	12.90	9.99	8.00	9.53
Iron and steel	17.64	19.96	8.78	14.70	14.15	11.08
Non-ferrous metals	52.95	20.81	29.27	21.36	11.26	12.39
Metal products	13.23	11.67	12.88	10.69	10.83	10.35
Non-electrical machinery	14.11	11.12	10.81	13.29	11.96	11.06
Electrical machinery	15.63	12.04	10.59	12.82	11.20	10.52
Transport machinery	10.92	23.58	9.73	9.22	6.77	7.02
Professional and scientific goods	10.97	6.46	9.00	13.38	5.83	7.17
Other manufactures	23.23	17.53	11.22	15.65	13.75	13.92
Total	15.70	12.57	10.00	10.50	9.20	8.68

Source: UNIDO database.
a/ 1971 figure.

between physical capital, human capital* and organizational-institutional capital.** The latter two categories (or what one might be called "indigenous capabilities") have thus far fallen far short of their potential in the region. The following observation deserves a lengthy quotation:

> "The African countries that could overcome, to a greater or lesser extent, the shortage of indigenous capabilities by drawing upon foreign ones were those that were relatively successful in industrial development. There are three main ways of tapping foreign capabilities: having a foreign settler population that moves into industry; having direct foreign investment in manufacturing; and using aid or export earnings to hire foreign consultants or individual experts. All African countries drew to some extent on one or more of these sources, but all were not equally capable of exploiting them. Zimbabwe and Kenya were fortunate in starting with large, entrepreneurial settler populations (Uganda and the United Republic of Tanzania had such resources but for political or ideological reasons emasculated them). Côte d'Ivoire could draw liberally on French expatriates and foreign investors. Other countries did start with some foreign investments, but then restricted them severely, or failed to attract continuing investments (because of macroeconomic difficulties), or forced the pace of indigenization too rapidly. Yet others were too poor or remote, or ideologically hostile, to attract significant foreign capabilities in any form: these ended up with rudimentary industries, extremely

*For instance, in Theodore W. Schultz, *Restoring Economic Equilibrium—Human Capital in the Modernizing Economy* (Oxford, Basil Blackwell, 1990), p. 215, the author emphasizes:

> "We must develop theory to analyze the interactions of physical and human capital accumulations that induce investment in specialized human capital. Is it possible to identify the external effects of human capital ...? These effects spill over from one person to another. People at each skill level are more productive in high than in low human capital environments. Human capital enhances the productivity of both labour and physical capital ... human capital accumulation is a social activity, involving groups of people, in a way that has no counterpart in the accumulation of physical capital."

**Institution-building as a social asset (or capital) to be accumulated has been suggested in *Global Report 1991/92* ([2], p. 86). See also [33].

inefficient and ultimately a drain on national resources."*

The policy lesson would seem quite clear: the region should produce its own technicians, engineers, scientists and managers with the same qualifications as those of the expatriate if the region is to meet the challenges of the twenty-first century, that is, to enhance industrial efficiency and productivity growth, and consequently the level of wage earnings. Modern science and technologies cannot be expected to serve the goal of industrialization in the region unless human capabilities and skills are ready to combine with the progress of technological knowledge (see box II.7). These challenges look formidable indeed, given the current economic difficulties that the region has been going through.

For instance, a study shows that the government budgetary squeezes in the 1980s were mainly due to the external debt burden and contractional structural adjustment, which have caused education-related expenditures in the region to drop almost by half on a per capita basis (see table II.43).

This seems tantamount to correcting short-run distortions at the expense of long-run needs. It might be necessary to devise a special aid arrangement to meet the education needs of the future.

At any rate, available indicators show a rather low level of human capital accumulated in the region (see tables II.44 and II.45). The mean years of schooling for the region shows 1.6 compared to 3.7 years for all developing countries and 10.0 years for developed countries. Fifteen countries in the region registered less than one year of schooling. The rate of adult literacy in 1990 ranged from 80.2 per cent (Madagascar) to 18.2 per cent (Burkina Faso), with an arithmetic average of 51 per cent for the region. The latter figure, though a substantial improvement over 28 per cent in 1970, still lags behind virtually all other regions (except the Indian Subcontinent).

*See [34]. The same author notes that 76 per cent of professional employees in Zimbabwean industry, and 68 per cent of those in Côte d'Ivoire, were expatriates in 1984 ([34], p. 147).

Some information for 1987 on vocational training is shown in table II.45. For the region as a whole, 2.8 students were enrolled in vocational training per 1,000 inhabitants. This compares with 6.9 students for Asia. If the North African countries are excluded, the average ratio for Tropical Africa would be even lower.

Whether these figures would meet the skill shortages poses still another question. The UNIDO industrial rehabilitation programme in Tropical Africa repeatedly encounters skill shortages in middle management, supervisory staff, finance and marketing, accounting, quality control, repair and maintenance.* Mismatches of skill supplies and demand present a perennial challenge even in developed countries, owing to imperfections (for example, temporal externalities) of labour markets and the long lead times involved in decision-making for training in urgently needed skills.** In Tropical Africa, the problem appears even more difficult because of the virtual non-existence of a functional labour market in many countries of the region.***

While renewed efforts must be exerted to create a viable labour market to serve the industrialization process in the region, the education and training activities must be stepped up in order to make infrastructure more efficient. The causes of factory-level inefficiency have often been found to originate from temporary electricity cut-offs, telephone discon-

*A UNIDO study [35] describes country-specific and factory-specific problems of the shortage of skills for each of 50 countries in Africa.

**Michael Stewart observes:

"... in cases where training or retraining periods are long, or the time needed to construct new physical facilities is protracted, commitments need to be made well in advance: to revert to an earlier example, the pool of doctors and airline pilots available at a given time, or the capacity of hospitals or airports, typically depend on decisions made at least eight or ten years earlier. ... At a time of rapid displacement of existing jobs it is going to be increasingly unsatisfactory to rely for a solution to this problem on either the operation of market forces or a process of macroeconomic policy-making which looks no more than two or three years into the future". See [36].

***For a comprehensive analysis see [37].

Table II.43. Government expenditure in sub-Saharan Africa, 1985-1990

Item	1990	Most recent date	Number of countries: Rising	Falling	Per capita (1980=1987[a/])
GDP per capita[b/]	587	352 (1987)	11	36	0.60
Government expenditure as percentage of GDP	30.6	31.0 (1987)	20	18	0.61
Percentage of government expenditure:					
General public services	19.9	18.2 (1985)	7	17	0.55
Defence	12.1	10.0 (1985)	7	18	0.50
Education	14.9	13.0 (1985)	12	17	0.53
Health	5.1	4.9 (1985)	13	16	0.58
Economic services	26.4	22.5 (1985)	15	14	0.42
Agriculture	7.9	6.8 (1985)	13	12	0.51
Interest payments	5.8	13.4 (1986)	35	1	1.09

Source: Frances Stewart, "Are adjustment policies in Africa consistent with long-run development needs?", *Development Policy Review*, vol. 9 (1991), p. 428.

a/ Calculated by multiplying GDP per capita 1987 by shares of GDP going to various sectors for most recent date.

b/ In constant dollar prices.

Table II.44. Tropical Africa: selected indicators of human capital, 1970-1990

	Mean years of schooling 1990	Scientists, technicians per 1,000 people 1985-1989	R & D scientists, technicians per 10,000 people 1985-1989	Tertiary graduates as percentage of age group 1986-1988	Adult literacy rate (percentage)	Combined primary and secondary school enrolment ratio[a/] 1970	1988-1989
Angola	1.5	..	..	..	41.7	..	..
Benin	0.7	..	2.2	..	23.4	26	44
Botswana	2.4	1.2	..	0.6	73.6	53	89
Burkina Faso	0.1	..	..	0.3	18.2	21	22
Burundi	0.3	..	0.6	0.2	50.0	21	38
Cameroon	1.6	..	..	0.3	54.1	57	67
Cape Verde	3.7	..	..	..	53.0	..	..
Central African Republic	1.1	..	1.9	0.4	37.7	41	40
Chad	0.2	..	..	0.1	29.8	22	34
Comoros	1.0	..	..	..	61.0	22	54
Congo	2.1	..	..	1.2	56.6	..	..
Côte d'Ivoire	1.9	..	..	..	53.8	..	..
Djibouti	0.3	0.1	..	..	19.0	..	..
Equatorial Guinea	0.8	..	..	..	50.2	..	..
Ethiopia	1.1	..	..	0.2	66.0	13	29
Gabon	2.6	..	..	0.8	60.7	..	..
Gambia	0.6	..	..	..	27.2	18	43
Ghana	3.5	1.5	..	..	60.3	60	59
Guinea	0.8	..	3.3	0.3	24.0	27	23
Guinea-Bissau	0.3	..	..	..	36.5	33	39
Kenya	2.3	1.4	..	0.2	69.0	47	74
Lesotho	3.4	..	..	0.7	78.0	70	80
Liberia	2.0	..	..	0.3	39.5	..	..
Madagascar	2.2	..	1.0	0.4	80.2	57	55
Malawi	1.7	..	..	0.1	47.0	26	51
Mali	0.3	..	..	0.2	32.0	17	16
Mauritania	0.3	..	..	..	34.0	10	36
Mozambique	1.6	..	..	0.1	32.9	32	35
Namibia	1.7	..	..	..	40.0	..	..
Niger	0.1	..	..	0.2	28.4	9	18
Nigeria	1.2	0.9	0.7	0.3	50.7	24	49
Rwanda	1.1	0.2	0.2	0.1	50.2	48	48
Sao Tome and Principe	2.3	..	..	..	63.0	..	..
Senegal	0.8	..	..	0.1	38.3	27	39
Somalia	0.2	..	..	..	24.1	8	14
Sudan	0.8	0.4	..	0.4	27.1	27	37
Swaziland	3.7	..	..	0.7	72.0	79	71
Togo	1.6	0.2	..	..	43.3	45	66
Uganda	1.1	..	..	0.1	48.3	29	53
United Republic of Tanzania	2.0	..	..	0.1	65.0	27	41
Zaire	1.6	..	..	0.2	71.8	..	..
Zambia	2.7	4.4	..	0.2	72.8	70	69
Zimbabwe	2.9	..	..	0.5	66.9		

Source: United Nations Development Programme, *Human Development Report 1992* (New York, Oxford University Press, 1992).
[a/] As proportion of North (= 100). North refers to OECD countries.

nections, water stoppage, delays in delivery of parts and components, non-availability of engineering troubleshooters, slow banking services etc. Modern factory systems require the efficient services of a modern tertiary sector which cannot be operated efficiently without well-qualified professionals. But the indigenous supply of these professionals seems very slow materializing. Herein lies the central issue and the challenge for the region in the 1990s.

As could be expected, studies reveal a high return to education for Africa, although the calculated figures could very well be an underestimation (see table II.46). The private rate of return on higher education turns out to be 32 per cent—a higher figure than in all other regions, as is the 26 per cent for secondary and 45 per cent for primary education. The social rate of returns show 26 per cent for primary, 17 per cent for secondary and 13 per cent for tertiary education. But these rates could be an underestimation if the true externality values of education and long-run needs of the region were imputed in the calculation.

Given the realities and the importance of education and training for technical progress in industry, the following quotation seems to deserve special attention:

"An alarming element in the present situation is that the gap in science and technology between the developed and developing nations is widening. That has to be somehow arrested. There seems no way out except to devise measures internationally, and seek

Table II.45. Enrolment in vocational training in African countries, 1975-1988

Country and item	Enrolled Males	Enrolled Females	Enrolled Total	Population (millions)	Total enrolment per 1,000 persons	Total enrolment in 1975
Algeria	88 126	39 957	128 083	23.8	5.382	12 801
Benin[a]	3 674	2 441	6 115	4.2	1.456	1 151
Botswana	1 770	491	2 261	1.2	1.884	1 699
Burkina Faso	2 428	2 158	4 586	8.5	0.540	2 609
Burundi[a]	4 024	1 527	5 551	4.8	1.156	1 099
Cameroon	54 706	38 945	93 651	11.2	8.362	36 262
Central African Republic	1 077	886	1 963	2.9	0.677	1 972
Chad	1 927	719	2 646	5.4	0.490	714
Congo	11 887	15 108	26 995	2.1	12.855	7 125
Côte d'Ivoire[a]	15 561	9 767	25 328	10.7	2.367	15 758
Egypt	538 882	362 389	901 271	50.2	17.954	377 495
Ethiopia	5 300	..	5 300	47.4	0.112	4 969
Gabon	6 712	3 255	9 967	1.1	9.061	2 450
Ghana	26 534	8 755	35 289	14	2.521	18 919
Guinea[b]	3 736	1 376	5 112	5.4	0.947	1 518
Kenya	4 524	1 077	5 601	22.4	0.250	5 468
Lesotho	760	843	1 603	1.7	0.943	547
Liberia[c]	1 695	627	2 322	1.9	1.222	851
Libyan Arab Jamahiriya[d]	27 000	..	27 000	3.8	7.105	4 888
Madagascar	9 287	5 231	14 518	10.9	1.332	7 504
Malawi	852	92	944	8	0.118	529
Mali	5 577	2 059	7 636	8	0.955	5 008
Mauritania[a]	1 641	361	2 002	1.8	1.112	1 004
Mauritius	552	311	863	1.1	0.785	1 032
Morocco	11 808	5 434	17 242	24	0.718	13 350
Mozambique	7 656	1 662	9 318	14.9	0.625	9 401
Niger	730	63	793	7.3	0.109	233
Nigeria[e]	79 274	7 722	86 996	90.6	0.960	27 843
Rwanda	18 626	14 837	33 463	6.7	4.994	9 680
Senegal	3 353	1 431	4 784	7	0.683	8 182
Sierra Leone[f]	838	558	1 396	3.6	0.388	799
Somalia[d]	4 572	1 361	5 933	5.4	1.099	1 824
Sudan[d]	19 506	6 104	25 610	21.9	1.169	8 996
Togo	4 841	1 992	6 833	3.4	2.010	5 118
Tunisia	59 567	31 159	90 726	7.8	11.632	55 974
Uganda[a]	5 760	732	6 492	15.2	0.427	3 296
United Republic of Tanzania	-	-	-	24.7	..	..
Zaire[a]	155 945	71 062	227 007	31.7	7.161	54 905
Zambia[a]	3 229	1 338	4 567	6.9	0.662	2 377
Zimbabwe[a]	224	32	256	8.7	0.029	1 312
TOTAL	1 194 161	643 862	1 838 023	532.3	3.452	716 722
Average					2.806	
Standard deviation					4.092	
Number of countries					40	

Source: *Human Resources and Industrial Development in Africa* (UNIDO PPD.208, 11 December 1991) p. 14.

a/ Data refer to 1986.
b/ Data refer to 1988.
c/ Data refer to 1980.
d/ Data refer to 1985.
e/ Data refer to 1982.
f/ Data refer to 1984.

their implementation to make a start in narrowing this gap. Though the widening of the gap seems to be inherent in the present scheme of things, a well-thought-out mechanism can make it reversible. It is a very complex situation that has to be resolved, and concerted efforts—rather, movements—on a global scale have to be mounted to bring corrections to the imbalance and to stem the downward slide that has its own dynamism because of failings in human nature, often loaded with selfish traits. These traits are amply reflected in the policies pursued by many groups and most of the governments."*

*See [38]

Box II.7. Needs for technological-capability-building in Tropical Africa

In the last two years, a recurring theme in designing new mechanisms for African development is the question of capacity-building. In an incisive but wide-ranging symposium on the theme of scientific-institution-building in Africa, convened by the International Centre for Insect Physiology and Ecology, the African Academy of Sciences and the United States National Academy of Sciences, and held at Bellagio, Italy, in March 1988, the following distinguishing features of the science capacities in Africa today were recognized:

(a) The traditional system of science and technology education through guilds and apprenticeships was superseded during the colonial period by formal, white-collar-oriented education, which has resulted in most young Africans being "stranded midway between traditions to which they cannot wholly return and a modern, science-based society at which they have not yet arrived";

(b) The national education systems are now, in these times of deficit economies, not able to foster excellence, nor to reward innovation and achievement. The teachers are poorly paid, poorly trained, and overworked; learning is often by rote, and the sciences and mathematics are of low quality and of little relevance;

(c) The national research systems have a narrow focus and "have primarily aimed at short-term solutions to specific problems rather than at strengthening African capabilities to solve generic problems".

Even though, in the recent past, the promotion of the idea of capacity-building was frowned upon in Africa by the donor community, the Africans and their Governments have consistently espoused the cause of institution-building and human resource development. It is part of the reason that African educational programmes consume 35 per cent or more of government budgets.

The problem of capacity-building can no longer be tackled piecemeal or on a fragmented time-scale. It needs a coherent regional perspective, as well as a long-term commitment to the cause. In its long-term planning for the years 1992-2000, the African Development Bank has boldly suggested that an endowment fund, with an initial sum of $500 million, be set up to provide some 100 professional positions at its headquarters in Abidjan, and at least another 150 professional positions located in carefully selected centres of excellence in Africa, in order to provide the intellectual resources to design and advance growth-promoting policies and programmes that would assist the process of economic integration in Africa.

Hard on the heels of the Bank's proposal has come a similar but larger proposal by the Independent Group on Financial Flows to Developing Countries, reporting in June 1989, which argued that OECD countries should establish an endowment fund of $1 billion, to be administered by the African Development Bank. The Fund would be used to develop African leadership in policy-making, and professional, technological and managerial sectors, in order to confront—on a systematic and informed basis—the pressing and overwhelming crisis the continent is facing today.

Source: Thomas R. Odhiambo, "Designing a science-led future for Africa—a suggested framework", *Technology in Society*, vol. 14 (1992), pp. 127-128.

Table II.46. Average return on education by region
(Percentage)

Region	Social			Private		
	Primary	Secondary	Higher	Primary	Secondary	Higher
Africa	26	17	13	45	26	32
Latin America	26	18	16	32	23	23
Southern Europe and Western Asia	13	10	8	17	13	13
Advanced areas[a]	..	11	9	..	12	12
Asia and Pacific	24	15	12	34	16	18

Source: K. Gannicott, "The economics of education in Asian-Pacific developing countries", *Asia Pacific Economic Literature*, vol. 4, No. 1 (March 1990), p. 50.

[a] Developed countries.

G. North Africa and Western Asia

1. *Short-run outlook*

Uncertainty continues to beset the region for a variety of reasons, such as the aftermath of the Persian Gulf war, unpredictable oil prices and the difficult Arab-Israeli peace process. Nevertheless, reconstruction and defence expenditures should give a major short-run boost to aggregate regional demand. Investments for modernization and diversification of industries along with privatization are expected to bring long-run positive effects.

In North Africa, MVA growth rose from 1.5 per cent in 1990 to 3.1 per cent in 1991; in 1992 MVA is expected to grow by 4.2 per cent and in 1993 by 4.9 per cent. This recovery pattern mirrors that of GDP growth. In Western Asia, MVA is expected to bounce back with 7.3 per cent growth in 1992 from 3.1 per cent growth in 1991. MVA growth of 6.6 per cent is expected in 1993. The growth pattern of MVA and GDP for both subregions combined can be seen in figure II.8. It is remarkable that so far as industrial production is concerned, the destruction wrought by the Persian Gulf war appears to have had little direct impact, except in Iraq, Jordan and Kuwait. The indirect impact, however, especially of the return of migrant workers, seems enormous and far-reaching, above all in the poorer countries of the region.

(a) *The Persian Gulf crisis and migrant workers*

With the outbreak of the Persian Gulf crisis an estimated 2 million migrant workers and their dependants vacated the crisis zone and left for their respective home countries—to Egypt (700,000), Jordan and the Israeli-occupied territories (350,000), Lebanon (60,000), the Syrian Arab Republic (110,000) and Yemen (880,000), thus causing severe economic and social difficulties in those countries and territories. The migrant workers represent a significant percentage of the economically active population. The number of returnees was large in absolute and relative terms, particularly in Jordan and Yemen. They caused a sudden increase of 8.4 per cent in the resident population of Jordan and 7 per cent in that of Yemen by the end of 1991.

The sudden unplanned return flow of relatively large numbers of jobless migrant workers has aggravated the already excessive unemployment rates. These rates increased to levels that were both economically and socially critical after the outbreak of the Persian Gulf crisis, and they exceeded an estimated 30 per cent in both Jordan and Lebanon. In Jordan the returnees have caused a sudden 10 per cent increase in the labour force, in the Syrian Arab Republic 4 per cent, and in Yemen 15 per cent.

The Persian Gulf crisis has caused great losses to labour-exporting countries in Western Asia, estimated to exceed $45 billion. Officially estimated losses in Egypt amounted to $20 billion, apparently including loss of property and bank deposit accounts left behind in the war zone by Egyptians. In Jordan the Central Bank estimated the loss at $8 billion, including a $2.9 billion loss of Jordanian assets and bank accounts in Kuwait. In Lebanon the total loss incurred by the country due to the Persian Gulf crisis was estimated at $3.89 billion. Government estimates in the Syrian Arab Republic indicate that the total loss amounts to $2,179 million, excluding losses of the Syrian community in Kuwait, estimated at $9,174 million. In Yemen, officials estimated the direct losses resulting from adherence to United Nations sanctions at more than $1,384 million. This is over and above the loss of concessional loans from the Arab Fund for Economic and Social Development and the Kuwait Fund for Arab Economic Development, and the annual grants that were provided by Kuwait and Iraq for budget support. In the territories occupied by Israel the loss was put at $15 million a month (excluding $120 million annually in financial aid provided by Saudi Arabia and Kuwait).

Most damaging to labour-exporting countries was the substantial loss in remittances of migrant workers to their respective home countries. These countries are heavily indebted and have become increasingly dependent on workers' remittances in partially financing their chronic trade deficits and servicing their external debt. Combined total workers' remittances during the 1980s to Egypt ($32 billion), Yemen ($11.8 billion), Jordan ($9.9 billion) and the Syrian Arab Republic ($4 billion) exceeded $57 billion (see table II.47). In Egypt, remittances in 1989 exceeded the country's merchandise exports by 13 per cent, and helped to finance 55.5 per cent of the trade deficit. In Jordan, workers' remittances represented 56.5 per cent of merchandise exports in 1989, and financed 85.5 per cent of the country's trade deficit. In Yemen, remittances up to 1987 exceeded by far the country's merchandise exports.

Demand for health and social services and public utilities have increased considerably, and the sudden

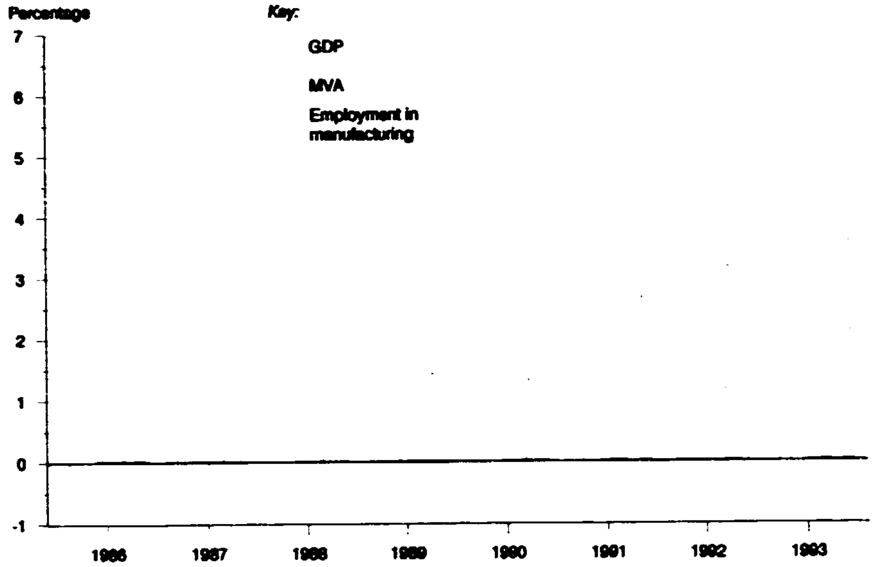
Table II.47. Remittances accruing to major labour-exporting countries in North Africa and Western Asia, 1980-1989

	Egypt		Jordan		Syrian Arab Republic		Yemen	
Year	Remittances (million dollars)	Remittances and trade deficit ratio (percentage)	Remittances (million dollars)	Remittances and trade deficit ratio (percentage)	Remittances (million dollars)	Remittances and trade deficit ratio (percentage)	Remittances (million dollars)	Remittances and trade deficit ratio (percentage)
1980	2 696	88.8	794	50.9	747	40.8	1 609	67.2
1981	2 181	55.7	1 033	49.6	436	19.9	1 335	57.9
1982	2 439	65.7	1 082	50.9	411	25.2	1 591	61.8
1983	3 666	80.4	1 110	52.3	387	18.4	1 652	68.9
1984	3 693	63.7	1 237	71.9	321	17.3	1 521	72.6
1985	3 212	61.6	1 022	62.4	350	16.7	1 214	73.5
1986	2 506	55.2	1 184	83.0	323	24.4	864	72.1
1987	3 604	72.4	938	63.9	334	38.4	1 018	66.7
1988	3 770	57.1	895	63.4	360	56.4	581	42.2
1989	4 257	55.5	627	85.5	355	35.8[a]	438	39.2
TOTAL	32 024	63.6	9 922	60.9	4 024	29.6	11 823	63.4

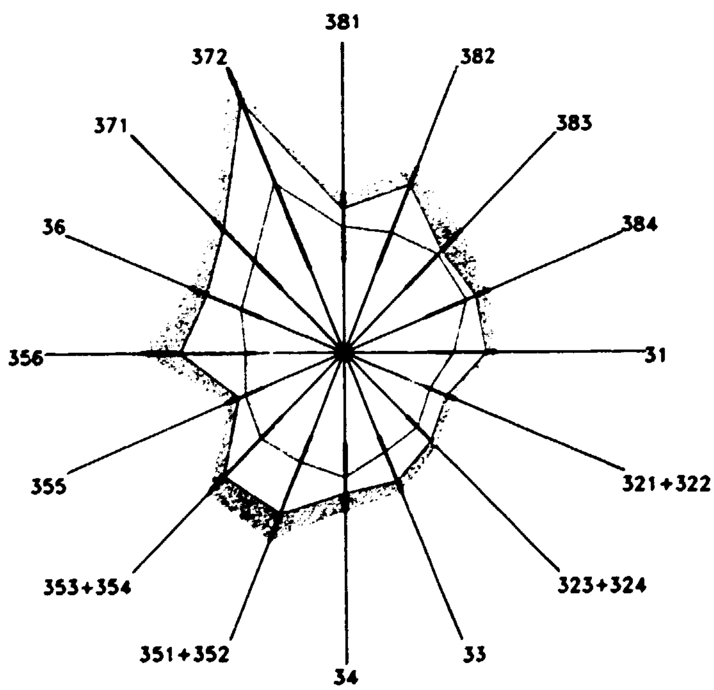
Source: United Nations Economic and Social Commission for Western Asia, based on database of the Department of International Economic and Social Affairs of the United Nations Secretariat.

[a] Trade balance recorded surplus in that year.

Figure II.8. Growth rates of GDP, MVA and manufacturing employment, 1986-1993, and industrial structural change, 1980-1993: North Africa and Western Asia



Industrial structural change
(Index of value added: 1980 = 100)



$g = 5.31, \theta = 10.51$

Key:

Deflated prices of 1985

g = Average annual growth rate, 1980–1993 (percentage)

θ = Index of structural change, 1980–1993

ISIC code	(industries):
31	(Food products)
321, 322	(Textiles)
323, 324	(Leather)
33	(Wood and furniture)
34	(Paper and printing)
351, 352	(Chemicals)
353, 354	(Petroleum and coal)
355	(Rubber products)
356	(Plastic products)
36	(Non-metal mineral products)
371	(Iron and steel)
372	(Non-ferrous metals)
381	(Metal products)
382	(Non-electrical machinery)
383	(Electrical machinery)
384	(Transport equipment)

1990–1993 forecast

1985–1990

1980–1985

Source: UNIDO database; estimates and forecasts by UNIDO PPD GLO.

and massive number of returnees continued to place enormous strains on social services and physical infrastructure in labour-exporting countries. According to a recent study [39], the absorption cost of the returnees in Jordan is estimated to be $3.14 billion over a three-year period. In the Israeli-occupied territories, Palestinian estimates set the cost of investments required to create jobs for the unemployed at between $1.5 billion and $2.5 billion, of which an estimated $300 million to $470 million are required in the industrial sector.

In some other respects, Egypt and the Syrian Arab Republic gained from the Persian Gulf crisis. As modest oil exporters, the increase in oil prices brought them additional revenue. Both countries, particularly Egypt, gained by obtaining debt forgiveness from their major creditors. The Government of the Syrian Arab Republic managed to secure the agreement of donor countries, including Kuwait and Saudi Arabia, to extend economic assistance in the form of soft loans and grants. By mid-April 1991, firm commitments made by donor countries were in the order of $1,971 million.

Major debt forgiveness was granted to Egypt by Western countries and members of the Gulf Cooperation Council (GCC). The external debt of Egypt has decreased by around $20 billion as a result of the Persian Gulf crisis. Saudi Arabia, the United Arab Emirates and Kuwait cancelled Egypt's outstanding $6 billion debt. The United States cancelled $7 billion of Egypt's military debt. In recognition of its efforts in implementing IMF recommendations, Paris Club creditors also cancelled at least 50 per cent of Egypt's government-to-government debts in May 1991.

(b) The growth performance of manufacturing

Preliminary estimates of manufacturing statistics for the year 1990 (table II.48) show that the sector experienced a very sharp decline in its activities, recording, at current prices, an average annual rate of

Table II.48. Performance of the manufacturing sector in Western Asia, 1988-1990
(Percentage)

Economic grouping, region and country	1988		1989		1990[a]	
	Share in GDP	Annual growth rate	Share in GDP	Annual growth rate	Share in GDP	Annual growth rate
GCC countries						
Bahrain	18.4	58.3	18.4	3.4	11.0	-37.0
Kuwait	13.5	-6.1	14.4	22.5	..	..
Oman	4.2	10.0	4.2	11.8	4.2	11.2
Qatar	14.3	49.4	13.0	0.2	11.6	-2.0
Saudi Arabia	8.6	7.3	8.1	3.1	7.5	3.9
United Arab Emirates	9.4	0.5	8.6	5.6	7.3	5.6
Total, A	9.7	6.6	9.4	7.5	7.5[b]	1.7[c]
Diversified economies						
Egypt	12.6	-17.4	12.6	1.3	15.4	9.2
Iraq	10.1	8.4	10.0	8.4	..	..
Jordan	10.1	16.6	11.1	-17.3	7.9	-39.2
Lebanon	12.6	53.8	12.6	-1.1	9.1	-24.5
Syrian Arab Republic	9.0	-58.5	15.3	88.7	13.8	0.2
Total, B	11.3	-15.9	12.2	14.5	13.9[d]	0.8[e]
Least developed countries						
Yemen	11.2	36.0	11.3	22.3	11.6	2.8
Total, C	11.2	36.0	11.3	22.3	11.6	2.8
Total, A, B and C	11.6	6.7	10.6	11.1	9.4[f]	-18.7[g]

Sources: The League of Arab States and others, *The Unified Arab Economic Report 1991* (Tunis, 1991); and *The NCB Economist*, vol. 1, No. 1 (Jedda, 1991).

a/ Estimates.

b/ Excluding Kuwait.

c/ Excluding Kuwait; if included (MVA 1990 for 6 months only), growth rate would be -12.5 per cent.

d/ Excluding Iraq.

e/ Excluding Iraq; if included (MVA 1990 for 6 months only), growth rate would be -26.8 per cent.

f/ Excluding Kuwait and Iraq.

g/ Including Kuweit and Iraq.

negative growth of −18.7 per cent compared to a relatively good performance of 11.1 per cent growth in 1989 (and 6.7 per cent in 1988). This deterioration is primarily due to the decline in MVA in both Iraq and Kuwait during the same year. However, if both countries' contribution to growth are excluded, manufacturing performance in the region remains meagre, recording an annual growth of 1.4 per cent in 1990.

Table II.48 also shows that the GCC subregion experienced a slower deceleration in its manufacturing activities compared to the rest of the region. Thus, while the GDP growth rate of the GCC subregion, excluding Kuwait, dropped in 1990 by 5.8 percentage points relative to that achieved in 1989, the drop in the diversified economies (as against oil-dependent economies), excluding Iraq, was more grave, around 13.7 percentage points.

Despite these adverse developments, the level of industrialization in the GCC subregion continued to advance during the last few years, particularly in Saudi Arabia, Bahrain and the United Arab Emirates. Moreover, the manufacturing sector in the diversified economies continued to dominate the growth performance of regional manufacturing activities.

Manufacturing statistics at the branch level are not available for 1991. It has been reported, however, that the general performance of the manufacturing sector was also relatively weak during this year, and continued to suffer from technical, financial and marketing bottlenecks. Overall growth for the whole Western Asia region is estimated to have been slow, with some industries, mainly food, beverages, clothing and construction, having benefited from increased demand for their products. In the GCC countries, growth performance has reportedly been better than in the rest of the region.

In the GCC subregion, the manufacturing sector, particularly in Saudi Arabia, is expected to receive a strong impetus from the reconstruction work in Kuwait (see table II.49). This will be supported by the GCC economic agreement which allows free flow of goods and services among its member countries. The construction materials industry is anticipated to benefit most, since it suffers from capacity underutilization. Fabricated metal products and cement, which are currently selling at below the average world price, should be able to offer competitive prices. Currently, inter-GCC trade still accounts for less than 7 per cent of the subregion's total trade of approximately $90 billion a year.

Table II.49. Estimates of expenditures for reconstruction in Kuwait

Item	Billion dollars
Damage to oil fields, petrochemical and refining sites	8.5
Power network	1.0
Ports, airport, Kuwait airways	2.0
Vehicle fleet	5.0
Telephone and communications	1.0
Residential housing	2.5
Hotels	0.5
Urban infrastructure	0.5
Medical facilities	0.5
Non-vehicle retail and wholesale goods	1.0
Gold reserves	0.5
TOTAL	23.0

Source: Economic and Social Commission for Western Asia (ESCWA), "Recent developments and prospects in the manufacturing sector in the ESCWA region" (March 1992).

Industrialization in the coming two years will mainly be dominated by the planned expansion of existing major industrial projects. This is projected to require more than $10 billion over the years 1992 and 1993. Most of the projects involve expansion of existing facilities, the majority of which are in the petrochemical industries. Financing will be sought from the commercial sector and not by concessional loans. Forms of financing would be either equity financing or foreign borrowings.

The Persian Gulf crisis has revealed several structural factors and risk elements that will affect the business climate in the subregion for some time to come. It may take longer for the private sector to regain its earlier level of activities and strength. Nevertheless, GCC countries will be more concerned with the sluggish growth in world energy demand in 1992, and with the impact of induced lower oil prices on their development plans.

In the fertilizer industry, increased demand for food caused by world population growth and changing consumption patterns, limitations on the availability of arable land, and the introduction of more intensive cropping and of higher yielding plant varieties, have all resulted in increased fertilizer requirements. Combined consumption of nitrogen, phosphate and potash nutrients will increase by 2.2 per cent per annum through the year 2000 (Stanford Food Research Institute estimates). The largest sources of demand for these nutrients are expected to be in Asia, particularly China and India.

The Arab fertilizer industry therefore has good market opportunities in the 1990s, at both the regional and international levels. However, the international fertilizer market is cyclical in nature as a result of factors such as farm income, weather conditions, world fertilizer capacity and government policies. These fluctuations will have a major impact on the Arab fertilizer industry.

In petrochemicals, the GCC countries need to formulate a joint strategy in order to strengthen their position regarding an agreement with the EEC on petrochemicals tariffs. An alternative is to negotiate a full trade pact with the EEC, covering petrochemicals, aluminium and refined petroleum products.

However, the EEC is not expected to provide major market opportunities for GCC producers in the 1990s. The drop in energy prices in 1992, which is expected to continue during the rest of the 1990s, is likely to provide the industrialized countries with a competitive advantage for the establishment of the increased petrochemical capacity that will be required in the current decade. Further investment in world-scale facilities will therefore be based on the proximity of production sites to markets, or on the proximity of feedstock sources in case energy-rich countries such as

Saudi Arabia are prepared to offer substantial discounts on international energy prices.

In Kuwait, the outlook for national reconstruction is still uncertain. The extent and nature of the rehabilitation of Kuwait's industrial base is still to be decided upon. The strong inclination is not to rehabilitate and repair the three domestic refineries (with combined refining capacities of 500,000 barrels per day), but to invest instead in downstream facilities and buy refineries and retail market shares in Europe, North America and East Asia. This, however, will be dictated by national security considerations and market access in the long-run. Such a policy would imply restricting the economy of Kuwait to the role of a *rentier* economy, with limited employment opportunities offered to the Kuwaitis in the productive sectors, particularly in industry.

In Bahrain, the Government will continue to pursue diversification of the economy in 1992, with emphasis on the promotion of industrialization. Government policy will be to facilitate inward industrial investment, and the implementation of a number of major projects to foster economic growth. At the same time, increased attention will be given to the promotion of light industries, which are viewed as one of the pillars of the economy. This policy will be supported by the establishment of the Industrial Development Bank of Bahrain, the provision of appropriate industrial facilities and the creation of the proper environment to attract foreign investment. The Government of Bahrain has already initiated efforts aimed at cutting red tape and other regulatory requirements. All these efforts, however, will only come to fruition in the longer run.

The Government of Bahrain is directly involved in industrial development through a number of major projects. These included two desalination plants, the second dry dock of the Arab Shipbuilding and Repair Yard, and the new port and industrial area at Haddid. Implementation of all these proposed projects will be in progress by 1993.

The main objectives of the Industrial Development Bank, the establishment of which is under way, is to provide concessional loans with long repayment and grace periods to promote both new and existing small- and medium-scale industrial enterprises and projects. This is considered to be vital for the development of light and small-scale industries. The authorized capital of the Bank has recently been declared to be 25 million dinars (approximately $66 million at the time of writing).

The Government in Bahrain is planning to establish an industrial development directorate divided into five key sectors to coordinate operations with the aim of stimulating further growth in these areas. The key sectors are petrochemicals and plastics, pharmaceutical and medical equipment, aluminium, engineering industries and craft industries.

In Oman, the Government will try to induce private investment in the development of industrial minerals. Local supplies of marble, limestone, dolomite, gypsum, silica, clays, laterite, asbestos and other materials are reported to offer good prospects for the domestic construction sector and for exports. The outlook for joint ventures between the private and the public sectors, or between domestic and foreign companies seems promising.

In Turkey, the manufacturing sector is expected to lead the economy, as has been the case over the past decade. Increasing demand for Turkish manufactures by countries in the region is likely to continue, providing a major impetus to industry (see table II.50). Chemicals, iron and steel and electrical products are doing well. Additional export demand could also arise from the newly independent States of Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

Table II.50. Commodity exports of Turkey, 1984-1989[a/]
(Millions of dollars)

Commodity	1984	1985	1986	1987	1988	1989
Industrial crops and forestry products, of which	492	659	495	431	696	672
Cotton	168	170	139	20	141	160
Tobacco	216	330	270	314	266	480
Live animals and sea products	343	265	325	356	337	329
Mining and quarrying products	240	244	247	272	377	413
Industrial products	5 144	5 995	5 324	8 065	8 944	9 088
Processed agricultural products	808	647	667	954	885	918
Manufactured products, of which	4 336	5 348	4 657	7 111	8 059	8 170
Textiles and clothing	1 875	1 790	1 851	2 707	3 201	3 505
Hides and leather	401	484	345	722	514	604
Chemicals	173	266	350	527	734	774
Petroleum products	409	372	178	232	331	254
Glass and ceramics	146	190	158	205	233	258
Iron and steel	576	969	804	852	1 458	1 349
Metal products and machinery	134	450	263	788	383	219
Electrical equipment and products	100	119	130	293	294	234
TOTAL	7 133	7 958	7 457	10 190	11 662	11 627

Source: OECD, *Economic Survey of Turkey* (Paris, 1990).

a/ Excluding transit trade.

2. *Long-run prospects*

Industrial growth prospects seem essentially good. The region as a whole has abundant capital resources, especially oil, a huge and growing domestic market for manufactured goods, and Governments willing to diversify the economy and make it more efficient, if necessary through greater emphasis on the private sector.

One of the greatest challenges facing the region, however, is the task of closing the gap in wealth and industrialization between the oil and non-oil producers. The industrial growth of the former has been remarkable as in the case of Saudi Arabia. The oil producers are expected to forge ahead towards further industrialization through upstream and downstream investments based on oil. This usually involves highly capital-, energy- and technology-intensive industries. The diversification efforts are accompanied by powerful incentive provisions such as free trade zones, zero-interest loans, low costs of water, electricity and other forms of energy, of feedstock from petroleum derivatives and of smelter input materials, as well as industrial sites and modern infrastructure, including telecommunications, transport, and harbour and airport facilities. Furthermore, relatively cheap labour from neighbouring countries could be employed.

Non-oil producers in the region, in contrast, are usually over-populated with limited natural resources, low productivity and wages (see table II.51). In 1990, for instance, labour productivity (MVA divided by number of workers) in Egypt was $7,122 compared with $55,973 in Kuwait. Unless concerted efforts are made, the gap could widen and peace and security in the region could be further jeopardized.*

For the region as a whole, labour productivity has been declining relative to the North American level (see table II.52). The relative productivity index dropped to 18.7 per cent in 1990 from 32.3 per cent in 1970. All industries recorded significant drops, the lone exception being non-ferrous metals, which benefited from aluminium smelting activities and cement production. The iron and steel industry fell sharply from 35.2 per cent in 1970 to 20.4 per cent in 1990. Future trends should be closely followed to prevent further decline.

However, the situation is not hopeless, because countries poor in natural resources could extricate themselves from low-equilibrium growth by the long-run accumulation of human capital. Indeed, in terms of literacy rates, school enrolment ratios etc. (see table II.53), the region seems to have done better than Tropical Africa, without matching the performance of the NICs. In fact, by 1990 many countries in the region had achieved over 80 per cent, or even 90 per cent, of the North's average school enrolment ratio for primary and secondary schools combined (even though education of women is not encouraged in some countries of the region). The corresponding figure for

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*Some observers have linked the Persian Gulf crisis to tensions created by the income gap. For instance, "Iraq's invasion of Kuwait in August 1990 is the most striking example of the political pressures that have been unleashed by the recent economic difficulties in the Arab world". See [40].

Table II.51. North Africa and Western Asia: labour productivity and average wage earnings in manufacturing, 1980 and 1990
(In constant 1985 dollars)

Country	MVA 1980 (million dollars)	MVA 1990 (million dollars)	Number of workers in manufacturing 1980 (thousands)	Number of workers in manufacturing 1990 (thousands)	MVA per worker 1980	MVA per worker 1990	Wage per worker 1980	Wage per worker 1990
Algeria	4 303	6 775	312	518	13 796	13 081	7 704	8 444
Bahrain	..	..	..	..	..	..	..	..
Egypt	4 328	7 697	868	1 081	4 987	7 122	2 842	2 768
Iran (Islamic Republic of)	10 960	15 119	470	796	23 311	18 995	[illegible]	7 765
Iraq	2 243	4 672	177	192	12 659	24 328	4 582	6 042
Jordan	399	901	25	44	16 172	20 258	4 343	4 788
Kuwait	1 955	2 934	43	52	45 546	55 973	10 088	13 049
Lebanon	..	..	..	..	..	..	..	..
Libyan Arab Jamahiriya	477	969	18	26	26 092	36 565	11 092	12 570
Morocco	1 038	1 095	191	367	5 447	2 984	2 789	1 898
Oman	..	..	..	..	..	..	..	..
Qatar	..	..	..	..	..	..	..	..
Saudi Arabia	5 819	14 361	.	..	..	..	.	..
Syrian Arab Republic	1 640	1 492	195	134	8 425	11 110	2 335	2 570
Tunisia	720	1 604	125	221	5 781	7 254	2 682	3 170
Turkey	7 973	17 305	787	961	10 131	17 728	3 113	2 468
United Arab Emirates	400	538	28	40	14 140	13 542	6 435	5 614
Yemen	109	206	7	11	15 538	18 690	3 609	

Source: UNIDO database.

Table II.52. Labour productivity and wage earnings per worker in North Africa and Western Asia as a percentage of the North American level, 1970, 1980 and 1990

(In constant 1985 dollars)

Industry	Labour productivity			Wage per worker		
	1970	1980	1990	1970	1980	1990
Food products	22.63	17.49	13.80	20.05	22.76	19.21
Beverages	27.65	19.89	13.13	21.57	24.77	19.62
Tobacco products	30.37	10.43	9.61	27.28	20.97	14.72
Textiles	23.32	25.68	20.06	19.70	27.37	23.11
Wearing apparel	40.00	31.10	22.61	35.48	33.22	24.90
Leather and fur products	40.55	40.49	35.72	22.41	30.51	23.76
Footwear, excluding rubber or plastic footwear	62.96	35.83	36.17	29.02	37.69	36.94
Wood and cork products	34.89	29.50	29.15	21.22	31.18	31.28
Furniture and fixtures	29.74	32.70	30.66	22.43	25.15	26.87
Paper and paper products	24.30	20.94	15.93	19.14	27.69	21.45
Printing and publishing	23.25	19.80	21.86	20.52	25.75	24.05
Industrial chemicals	18.68	14.59	13.37	23.61	20.32	16.10
Other chemical products	15.64	14.98	15.37	15.46	24.13	20.95
Petroleum refineries	265.65	57.21	99.26	33.61	38.49	37.12
Miscellaneous petroleum and coal products	33.27	32.82	23.30	20.43	16.31	16.87
Rubber products	26.24	32.41	23.27	19.79	30.53	28.93
Plastic products n.e.c.	61.92	49.02	47.08	18.29	32.47	21.12
Pottery, china and earthenware	29.45	25.96	27.89	17.54	25.60	18.60
Glass and glass products	20.70	20.82	20.80	16.05	24.42	20.34
Other non-metallic mineral products	29.53	26.52	27.67	21.05	27.63	26.69
Iron and steel	35.15	21.29	20.37	20.67	21.93	17.83
Non-ferrous metals	21.26	15.19	33.82	14.86	17.26	19.03
Metallic products excluding machinery	28.16	23.31	28.43	19.83	25.11	23.89
Non-electrical machinery	23.51	21.41	21.71	16.93	22.38	21.70
Electricial machinery	39.91	28.42	22.37	22.48	30.40	19.35
Transport equipment	32.37	19.58	15.85	18.92	24.89	14.81
Professional and scientific goods	22.13	21.57	12.83	25.22	33.61	16.84
Other manufactures	21.18	27.02	26.27	13.26	22.69	22.41
Total manufacturing	32.33	24.85	18.65	24.15	19.98	19.98

Source: UNIDO database.

Table II.53. North Africa and Western Asia: human capital indicators, 1970-1990

Country	Population (millions) in 1990	Mean years of schooling in 1990	Scientists and technicians per 1,000 people in 1985-1989	R & D scientists and technicians per 10,000 people in 1985-1989	Tertiary graduates as percentage of age group in 1986-1988	Adult literacy rate in 1990	Combined primary and secondary school enrolment ratio[a/]	
							1970	1988-1989
Kuwait	2.1	5.4	64.4	10.2	4.2	73	77	97
Qatar	0.4	5.6	26.6	7.9	4.3	82	..	..
Bahrain	0.5	3.9	43.3	..	2.3	77	95	100
United Arab Emirates	1.6	5.1	..	..	1.7	55	72	94
Saudi Arabia	14.9	3.7	..	..	2.5	62	35	65
Turkey	56.5	3.5	27.5	3.3	2.1	81	77	82
Syrian Arab Republic	12.1	4.2	3.6	..	4.0	65	70	88
Libyan Arab Jamahiriya	4.5	3.4	11.6	5.7	..	64	..	..
Oman	1.5	0.9	6.6	..	..	35	29	81
Iraq	19.0	4.8	3.6	..	..	60	56	77
Jordan	4.0	5.0	..	1.1	5.6	80	..	..
Tunisia	8.2	2.1	1.4	..	0.9	65	73	81
Lebanon	2.7	4.4	..	0.7	2.9	80	88	95
Iran (Islamic Republic of)	54.6	3.9	8.5	0.9	0.9	54	60	82
Algeria	25.0	2.6	..	..	2.2	57	53	81
Morocco	25.1	2.8	..	..	1.1	50	37	52
Egypt	53.2	2.8	..	5.4	3.8	48	63	92
Yemen	11.3	0.8	0.2	..	0.2	39	..	..

Source: United Nations Development Programme, *Human Development Report 1992* (New York, Oxford, 1991)

a/ Index North = 100. North refers to OECD countries

Tropical Africa is approximately 47 per cent. (For further comparisons see section F on Tropical Africa). Nevertheless, a recent study concluded that the GCC countries need substantial additional personnel in skilled and semi-skilled occupations as well as well trained managers [41]. Saudi Arabia, for instance, had 11,599 students enrolled in technical education in the 1985/86 school year, whereas the country needed an estimated total of 124,498 additional personnel in all skill categories.

H. Indian Subcontinent

1. Short-run outlook

The immediate industrial outlook is for substantial recovery with 6.1 per cent MVA growth in 1992 and 8.0 per cent in 1993, compared with a fall to 2.3 per cent in 1991 from 8.1 per cent in the previous year (see figure II.9 for GDP and MVA patterns of growth in recent years and also for the pattern of structural change in industry). This forecast was based on the assumption that a bad monsoon would not hit the agricultural sector, of which the demand for manufactured goods is a major force in aggregate demand. But the possibility remains that, after four consecutive years of good weather, a bad monsoon would be devastating. The recovery of industry is also predicated upon an adroit management of the balance-of-payments crisis triggered by the Persian Gulf war and the disappearance of remittances coupled with the loss of trade with the former USSR. Furthermore, the new industrial policy package adopted by the Government of India in 1991 is expected to give a considerable boost to industry.

(a) Impact of the situation in Western Asia

However, growth in the region is sensitive to what happens in Western Asia. In 1991 the economies of Bangladesh, India, Nepal and Pakistan were particularly hard hit by the fall in remittance levels of their nationals in the Persian Gulf States, especially Kuwait, and the costs of evacuating their nationals from the war region. These economies are yet to recover from the war-augmented balance-of-payments deficit and high inflation rates.

The crisis was of special significance to Bangladesh given the country's heavy dependence on the Persian Gulf States for labour exports, merchandise trade and energy supplies. Workers' remittances accounted for 35 per cent of the total foreign exchange earnings of Bangladesh on current account. Remittances originating from Kuwait and Iraq, about 13 per cent of the total, were lost in 1991 as a result of the war. The outflow of Bangladeshi migrant labour has averaged about 70,000 per annum in recent years. Workers' remittances depressed during 1991 are likely to recover in 1992 as new opportunities for construction and rehabilitation jobs in Kuwait and Iraq open up for Bangladeshi workers. A steady increase in workers' remittances, rapid and diversified growth of non-traditional exports, and limited growth in import demand would reduce current account deficits.

In addition to the momentous events taking place in Western Asia, shifting constellations in the former USSR in 1991 prompted Pakistan to position itself as a strategic player between energy-rich Central and Western Asia and energy-poor South Asia. Pakistan is running out of domestic oil and gas resources, and by 2003 will be using four times more oil and petroleum products than at present. In face of the severe energy shortage that threatens Pakistan's ambitious development plans for an economic growth rate of over 7 per cent by 1993, the Government and private sector are seeking to take advantage of the multiple market opportunities and the energy supplies and other resources of the newly independent States of the former USSR, in particular Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. In 1991/92, Pakistan signed economic and trade arrangements involving energy, food and consumer goods, medicines, telecommunications and banking. In collaboration with the Islamic Republic of Iran, Pakistan finalized in 1991 a joint-venture project with the Iranian National Oil Company for the building of a refinery with a capacity of 120,000 barrels per day. It will supply 30 per cent of oil and petroleum products to the Islamic Republic of Iran and 70 per cent to Pakistan. At current oil prices, this could save Pakistan up to $3,000 million annually. In collaboration with the former USSR and the Islamic Republic of Iran, Pakistan would like to invest in terminal pipelines, and infrastructural projects that will enable it to become a leading producer of oil and petroleum products.

(b) Liberalizing industry and trade

In India, the reform of industrial policy, which continued on the lines of earlier policy initiatives, was incorporated in the new industrial policy announced by its Government in July 1991. Its objective was to consolidate the gains of the past policy by further deregulation of industry to promote a more efficient and competitive industrial economy. The principal elements of the policy are as follows:

(a) Abolition of industrial licensing in all but 18 industries, thereby putting 80 per cent of industry outside the licensing framework;

(b) Removal of limits on capacity expansion and diversification to enable firms to become large enough to compete on global markets;

(c) Reducing areas reserved for the public sector from 17 to 8, mainly comprising those involving strategic or security concerns;

(d) Removal of government clearance for location of projects, with a few exceptions;

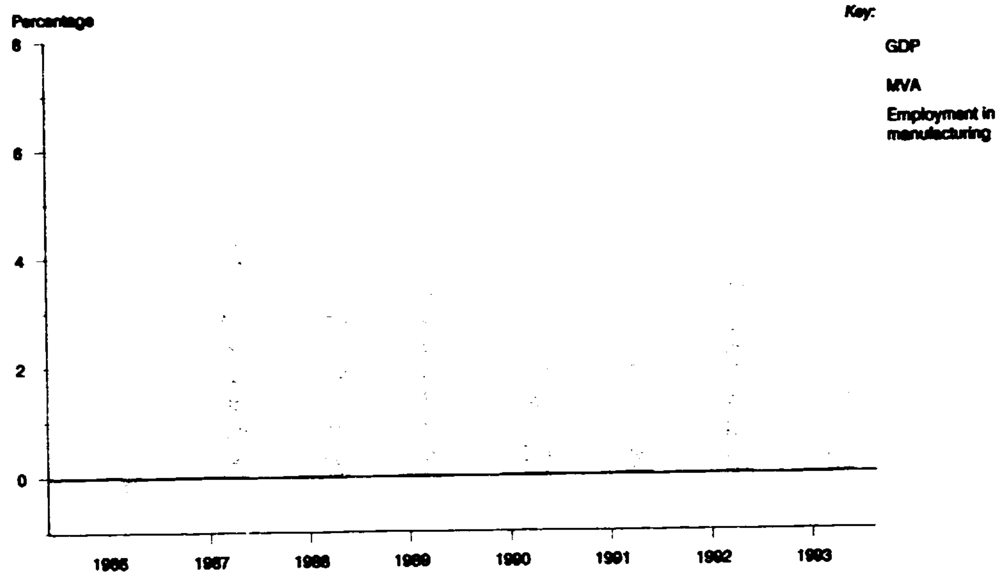
(e) Withdrawal of the right of financial institutions to convert loans into equity in respect of privately managed firms;

(f) Creation of a National Renewal Fund to provide a safety net for retrenched workers and to finance their retraining.

In addition, a major component of the new policy related to direct foreign investment. It is now provided that:

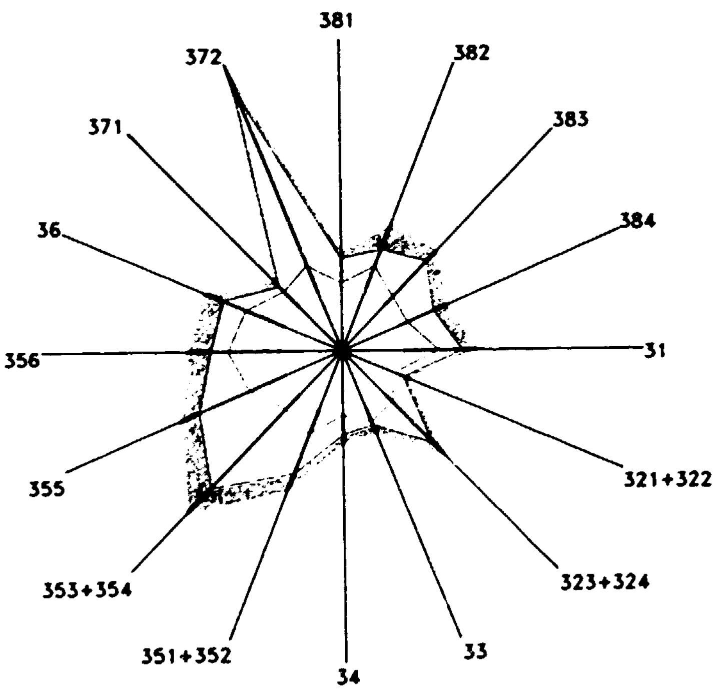
(a) The limit of foreign equity holding should be raised from 40 to 51 per cent in a wide range of priority

Figure II.9. Growth rates of GDP, MVA and manufacturing employment, 1986-1993, and industrial structural change, 1980-1993: Indian Subcontinent



Industrial structural change

(Index of value added: 1980 = 100)



g = 5.07, θ = 17.83

Key:

Deflated prices of 1985

g = Average annual growth rate, 1980–1993 (percentage)

θ = Index of structural change, 1980–1993

ISIC code	(industries):
31	(Food products)
321, 322	(Textiles)
323, 324	(Leather)
33	(Wood and furniture)
34	(Paper and printing)
351, 352	(Chemicals)
353, 354	(Petroleum and coal)
355	(Rubber products)
356	(Plastic products)
36	(Non-metal mineral products)
371	(Iron and steel)
372	(Non-ferrous metals)
381	(Metal products)
382	(Non-electrical machinery)
383	(Electrical machinery)
384	(Transport equipment)

1990–1993 forecast

1985–1990

1980–1985

Source: UNIDO database; estimates and forecasts by UNIDO/PPD/GLO.

industries, provided that outflow on account of dividends on additional equity is balanced by export earnings;

(b) Foreign equity participation up to 51 per cent should be automatically approved;

(c) A foreign investment promotion board should negotiate with large international firms for equity participation in non-priority industries as well as considering individual cases for equity participation exceeding 51 per cent;

(d) Technology imports for priority industries should be automatically approved for royalty payments of up to 5 er cent of domestic sales and 8 per cent of export sales.

In the central budget for 1992/93 some further measures relating to industry were announced. Firms with foreign equity participation which are currently governed by the provision of the Foreign Exchange Regulation Act are subjected to a good deal of administrative control. It is now proposed to radically diminish this control. Government control over capital issues through the Controller of Capital Issues is now abolished. Companies can now approach the market directly. Finally, reputable foreign institutions will be permitted to buy shares in the Indian stock market. This privilege is also extended to all non-resident Indians.

The impact of these policy measures will exhibit itself in industrial growth with a certain time lag. But a larger number of investment proposals were cleared in 1991 than in 1990. There was also an increase in foreign technology import agreements. With respect to foreign direct investment, 244 cases of foreign equity participation with an equity investment of $504 million were approved in 1991, as compared with an average of $88 million in the previous years.

(c) Public sector

The public sector has been dominant in the development and diversification of industry in India. It has failed in the generation of internal resources for further expansion. It is now clear that continued and excessive reliance of public sector enterprises on budgetary support cannot continue. The policy currently aims at improving the performance of the public sector so as to raise its productivity and profitability. With this end in view the intention is to expose it to competition, on the one hand, and to make it more fully responsible and accountable on the other. The former is being achieved by opening up for private investment areas that were earlier reserved for the public sector. With respect of the latter, besides administrative measures, a part of public sector equity is being disinvested in selected enterprises, which would introduce an element of public accountability.

The Bureau of Industrial and Financial Rehabilitation, which was hitherto responsible for dealing with sick private sector industrial units, has now been asked to deal with sick units in the public sector as well. The Bureau, after detailed scrutiny, decides whether a unit is terminally "sick" and must therefore be closed down, or can be restructured and rehabilitated. The subjection of sick public sector units to this discipline would mean that some will be closed down while others will be rehabilitated.

Many public sector units carry a workforce that is in excess of requirements. Rationalizing the workforce would be an important part of the process of improving productivity, but this awaits the announcement of an exit policy (closure, bankruptcy etc.), which the Government has promised.

(d) Trade policy reforms

Policy reforms in the area of trade were designed to make Indian industry more competitive globally and to stimulate exports. The principal components of the initial policy initiatives were as follows:

(a) Devaluation of the rupee by 18 per cent;

(b) Replacement of a large part of administered licensing of imports by import entitlement linked to export earnings. Import entitlements were to be called Eximscrips and would be freely tradeable and to attract a premium in the market. For most exports 30 per cent of the earnings were made available in Eximscrips, which could be used to import any item from a specified list;

(c) Simplification of the advance licensing system to improve access of exporters to imported inputs;

(d) Further liberalization of the import of capital goods;

(e) Granting or permission to established exporters to maintain foreign currency accounts and to raise external credit to finance their trade transactions.

These measures were aimed at improving the access of industry to imports and providing a stimulus to exports. Both formed a part of the strategy for the programme called the globalizing of Indian industry. The Eximscrip was meant to provide a self-regulating mechanism for balancing imports and exports. However, the operation of the mechanism did not prove entirely efficient on account of bureaucratic involvement. In the 1992/93 budget, it was replaced by a scheme of partial convertibility of the rupee, whereby the exchange rate for 60 per cent of export earnings would be determined by the market, while for the remaining 40 per cent the official rate would apply. This change not only signified that a larger proportion of export earnings would be available freely at a market determined exchange rate, it was also accompanied by a substantial increase in the items that could be imported freely.

Despite these policy initiatives, the Government was constrained by balance-of-payments problems to continue to compress imports. It was only later in the fiscal year 1991/92, when the position had significantly improved, that the import restrictions were progressively removed. By February 1992 reserves had risen to a comfortable level of $4.4 billion, which enabled the Government to completely remove all import licences, except for some strategic items. As a consequence of the compression of imports during most of 1991/92, industrial growth as well as exports were adversely affected. Industrial growth was further constrained by the restrictions imposed on government expenditure, especially investment. As a result, there was practically no growth in industrial production in 1991/92. Export growth was also stifled, but only partly because of import compression. The major reason was the dissolution of the former USSR and a decline by more than half of the exports to that country. Though there was positive growth in exports to countries with freely convertible currencies, exports were expected to show only a modest 2 to 3 per cent increase. However, with the access to imports greatly improved and a further devaluation of the rupee through its partial convertibility as well as other export incentives, exports are expected to grow by about 12 per cent in dollar terms in 1992/93.

For most of 1991/92, external resources that the Government succeeded in mobilizing went into building up reserves, so that not much was available to relax the compression on imports. The year therefore ended with not much to show from policy reforms. However, now that reserves have been built up and constraints on imports removed, a rise in exports can be expected. This would be necessary not only for sustaining a comfortable balance-of-payments position, but also for supplementing domestic demand, which is likely to be constrained due to the need to restrict government expenditure. In addition to exports, an improvement in the growth of industry in 1992/93 can also be expected.

A growth orientation is also observable in some salient modifications in the budget for 1992/93. The striking features of this budget are as follows:

(a) The rupee is now made partially (60 per cent) convertible;

(b) Most imports are put on open general licence, that is, made free of regulatory control;

(c) Custom tariffs are reduced and rationalized;

(d) Income tax rates are reduced and there is a major change in wealth and capital gains taxes;

(e) The floor interest rate is lowered by 1 per cent;

(f) A package of measures for better functioning of the stock market is introduced;

(g) Import of up to 5 kilograms of gold is permitted;

(h) Control on capital issues is removed;

(i) The National Renewal Fund is expanded.

The budget also provides for a further reduction in the revenue, budget and fiscal deficits, the later to come down to 5 per cent of GDP.

2. *Long-run prospects*

The industrial policy reforms adopted in the region, particularly those of India, appear destined to have positive growth effects throughout the 1990s. But the outcome will depend on how quickly and effectively the reform measures are implemented. Herein lies the real test of the government bureaucracy—a challenge to change long-entrenched habits formed during the regulatory regime before 1985.

Nevertheless, there are some encouraging signs that habits are changing and successes are being reaped through a slow process of learning by doing. The Indian computer industry provides an example. In the 1970s the Government of India effectively banned entry into the industry by domestic or foreign enterprises in order to support its public enterprise. But upon finding that the industry could not compete in terms of prices and technology, the Government decided to invite both domestic private and foreign enterprises to cooperate and compete under a new incentive system designed to cope with market failures. A recent study of the industry concludes:

> "These successes can be attributed to a considerable extent to government policies changing the incentive structure for computer firms. India has so far been able to attract the human skills necessary for the growth of its computer industry. Still, governmental support for human resource development has been less than consistent and comprehensive, and its support for the scientific and institutional infrastructure is needed to rectify market failures in the supply of firm-level technologies capacities that has remained insufficient and at times inappropriate." [42]

Creating and nurturing new industries like the computer industry and maximizing employment creation in conventional unskilled labour-intensive industries are crucial to industrialization. New industries aim at higher levels of value added through developing and mastering technology, as well as upgrading the skill content of human resources. Mere continuation (expansion) of unskilled labour-intensive manufacturing activities would not help raise the low level of labour productivity of manufacturing in the region (see table II.54). For example, in 1990 MVA per worker was $2,181 MVA in Bangladesh and $2,823 in India.* In other words, labour productivity in the region amounted to only 5.1 per cent of the North American Level in 1970 and 4.5 per cent in 1990 (see table II.55). The low relative figures are pervasive across all manufacturing industries and are generally not improving. But there are a few notable exceptions, including significant improvement in wearing apparel, footwear, rubber products and other manufacturing. These figures reflect in part the prevalence of small-scale (or cottage) industries with rudimentary or out-of-date technologies, and also "sick industries" that have been propped up by subsidies and protected for decades.

The modernization of the manufacturing sector in the long-run will require a fundamental policy shift with regard to upgrading human resources. Currently, the adult literacy rates for Bangladesh (35 per cent), India (48 per cent) and Pakistan (35 per cent) are among the lowest in the developing world (see table II.56). The same applies for average years of schooling. It therefore seems obvious that more resources should be devoted to the eradication of illiteracy, the promotion of primary and secondary education and tertiary science, increasing the number of technology graduates etc. Although it is not easy to precisely quantify the societal benefits of spending in education, available evidence suggests that illiteracy eradication and primary education should receive the first priority. There are high rates of return on education in India (see table II.57), with primary

*For comparison, the average labour productivity in manufacturing for Tropical Africa was $7,336 in 1990 and $6,212 in 1980.

Table II.54. Indian Subcontinent: manufacturing labour productivity and average wage earnings per worker, 1980 and 1990
(In constant 1985 dollars)

Country	MVA 1980 (million dollars)	MVA 1990 (million dollars)	Manufacturing employment 1980 (thousands)	Manufacturing employment 1990 (thousands)	Labour productivity 1980	Labour productivity 1990	Annual average wage earnings 1980	Annual average wage earnings 1990
India	12 110	20 767	6 992	7 356	1 732	2 823	878	1 303
Pakistan	2 216	4 389	412	551	4 903	7 962	1 026	1 687
Bangladesh	804	1 007	412	462	1 951	2 181	611	692
Sri Lanka	330	827	163	235	2 026	3 523	523	536
Nepal	90	199	56 a/	140 b/	1 070 a/	1 323 b/	261 a/	342 b/

Source: UNIDO database.
a/ 1977 data.
b/ 1988 data.

Table II.55. Labour productivity and wage earnings per worker in the Indian Subcontinent as a percentage of the North American level, 1970, 1980 and 1990
(In constant 1985 dollars)

Industry	Labour productivity 1970	Labour productivity 1980	Labour productivity 1990	Wage per worker 1970	Wage per worker 1980	Wage per worker 1990
Food products	3.68	1.70	3.02	2.96	2.07	4.20
Beverages	6.43	3.75	4.72	4.26	3.20	4.40
Tobacco products	3.69	1.30	0.64	2.73	1.37	1.36
Textiles	6.06	5.94	4.64	5.65	5.71	6.86
Wearing apparel	5.22	5.19	9.10	4.08	5.47	5.71
Leather and fur products	7.42	8.82	6.64	4.22	5.23	5.25
Footwear, excluding rubber or plastic footwear	7.66	6.06	9.57	5.65	8.50	9.02
Wood and cork products	3.40	3.16	3.48	2.96	2.68	3.63
Furniture and fixtures	5.02	4.18	4.57	3.22	4.20	5.29
Paper and paper products	6.56	3.92	2.84	4.64	4.31	4.87
Printing and publishing	3.68	3.70	3.77	4.47	4.98	6.38
Industrial chemical products	7.70	4.03	5.53	6.39	6.04	7.32
Other chemical products	5.14	3.78	3.61	4.68	4.99	6.33
Petroleum refineries	19.51	6.03	20.99	9.84	4.47	8.63
Miscellaneous petroleum and coal products	5.68	7.69	5.16	6.06	5.80	6.51
Rubber products	7.44	5.69	9.62	6.02	5.75	6.58
Plastic products n.e.c.	4.79	5.14	6.12	4.15	4.45	5.80
Pottery, china and earthenware	3.48	4.11	4.30	3.65	4.23	5.04
Glass and glass products	2.60	2.50	3.72	3.07	2.77	4.37
Other non-metallic mineral products	4.34	3.65	4.72	3.29	3.39	4.43
Iron and steel	6.21	5.26	4.09	5.45	4.52	6.13
Non-ferrous metals	11.18	2.30	9.07	5.98	5.36	8.04
Metal products	4.67	4.47	5.46	4.20	4.53	5.44
Non-electrical machinery	4.81	4.95	5.99	4.47	5.06	6.95
Electrical machinery	6.94	6.57	7.10	6.03	6.35	7.74
Transport equipment	3.77	4.07	4.90	4.92	4.85	7.04
Professional and scientific goods	3.93	3.73	3.96	4.42	5.15	5.29
Other manufactures	6.21	7.04	8.33	5.93	6.28	7.35
Total manufacturing	5.09	4.12	4.48	4.45	4.23	5.49

Source: UNIDO database.

Box II.8. Success of Bangladesh with garment exports:

In recent years, Bangladesh has achieved resounding success with garment exports. This success has been a bright spot for a country that has among the lowest per capita incomes in the world. The degree of success of Bangladesh can be seen in terms of the growth of garment exports relative to other overseas trade, employment generated and related gains in social welfare, and the increase in confidence within the business community.

Both the public and private sectors in Bangladesh were particularly interested in the garment business as they were aware of a failure to exploit the country's great potential for garment exports. This potential stemmed from the low wages in Bangladesh and its potential for exporting to major markets such as the United States without binding restrictions under the Multi-Fibre Arrangement. Bangladesh was not exporting garments because of a total lack of domestic production technology and marketing know-how, and no apparent means of acquiring them from overseas. For example, no domestic entrepreneurs seemed ready to seize the initiative.

Fortunately, a catalyst did emerge in 1978 in the form of the Desh Garment Company. The man who was to found Desh, Noorul Quader, had been exposed to the foreign business world as a senior official in the previous Government. He was also an agent for a project funded by a foreign Government. During an official visit to France, Quader happened to visit the Paris branch of Daewoo. Quader expressed a desire to collaborate with Daewoo in a new garment venture in Bangladesh. The idea became the Desh Garment Company, established in 1979 after Quader and Daewoo signed a collaboration agreement.

The collaboration agreement

Quader and Daewoo opted not to enter into a joint venture. Instead, they signed an agreement to collaborate—in specific ways—in the areas of technical training, purchases of machinery and fabric, plant start-up and marketing. The collaboration agreement, which was to run five years, involved the following key elements: six months of training for Desh workers in the Republic of Korea; start-up activities to involve certain purchases of machinery by Desh from Daewoo, which would then handle the installation, supervise and advise on the actual start-up; production, to be managed by Desh with consultation and supervision provided by Daewoo; and marketing, which was to be handled by Daewoo. Desh was to make royalty payments to Daewoo for the technical training and supervision equal to 3 per cent of its sales (based on ex-factory costs), as well as a sales commission for marketing services of 5 per cent of the sales value during the five-year contract period. It should be noted that the agreement did not include any investment capital transfer in the form of a loan or foreign direct investment, except for fabric and other intermediate inputs purchased on credit.

The cadre of trainees

Desh recruited 130 workers for training at Daewoo's Pusan plant (see table II.58). They would eventually fill four management positions, 97 production supervisory positions, and 29 actual production slots. The intention was that these personnel should complete the training with the capacity not only to handle their jobs effectively, but also to train Desh employees in the future. The 130 trainees had no previous experience with garment manufacturing. English was required for purposes of communication during the training, as was the equivalent of at least a junior college education. A very noteworthy feature of the cadre of trainees is that 14 were women. Muslim tradition had precluded females from working in factories in Bangladesh. However, Quader had been

education achieving the best results, and generally falling rates for higher levels of education. It should be cautioned, however, that such calculations do not include spillover intangible benefits.*

Nevertheless, there appears to be an increasing awareness that poverty is strongly linked to lack of education and training (see box II.8). Educational expenditures for the poor therefore provide a powerful tool. Bhagwati observes:

> "More is known now, therefore, to wean us away from the fear that such educational and health expenditures are necessarily at the expense of growth. What is equally pleasurable is the fact that many of these arguments apply with yet greater force when the expenditures are addressed to the poorer segments of the population. The case for undertaking more such expenditures, with focus on the poor, consistent with being engrossed in the growth strategy, is therefore now seen to be stronger than ever before. I think we have learned that, within reasonable margins, we may then be able to eat our cake and have it too. Social expenditures could improve the welfare of the poor directly and also indirectly through growth which in turn would have an impact on poverty. But beyond these margins, the trade-off remains an issue." [44]

Such awareness notwithstanding, there seems to be some resistance to universal, compulsory primary education. It has been reported that the forces in favour of maintaining the existing system of social

*Unfortunately, economic science has failed so far to develop theories and measurements of returns on education useful for policy-making.

so impressed by the efficiency and sheer numbers of women at Daewoo and other garment factories in the Republic of Korea that he persuaded the Government of Bangladesh to support female trainees, and then obtained permission from the parents and guardians of the 14 women.

The training at Daewoo

The 130 Desh workers were sent to the Daewoo Pusan Plant, where they receive some of the most intensive on-the-job training in garment production ever given in a developing country. The trainees actually spent seven months at Pusan, from 1 April 1979 to 30 November 1979, one month more than anticipated because of expanded training tasks. As agreed, Daewoo paid all living expenses, including a recreational allowance, while Desh covered the airfare.

The training programme was carefully organized so that the trainees, despite their lack of knowledge and experience with garment production, would emerge as fully qualified workers and supervisors able to produce exportable products. The emphasis was on providing actual experience with running a factory that produced world-quality, exportable goods. The fact that Daewoo prepared an English manual for garment manufacturing geared to the Desh trainees shows how seriously it took the training programme. Moreover, every two trainees had a separate machine to practise with and Daewoo used the actual production lines at the factory for on-the-job training, an indication of the importance it attached to practical work.

It is unlikely that any garment training institute could have provided such extensive factory training with such rich facilities, resources and product varieties. This programme may be the only one from which 130 trainees with no prior garment industry experience emerged able to produce export-quality products as a team after just seven months training. It was also probably not anticipated that the training would yield not just managers, supervisors and production for the Desh factory, but also the future managers of much of the Bangladesh garment export industry.

The extended value of training

In addition to the in-depth, excellent skills training they received, Desh workers got an education of expanded value; a look at the entire operations of a highly successful, multifaceted transnational company and the corporate culture that created and supported its superior performance. That part of the educational process can perhaps best be understood by looking at a statistical summary of the performance of Daewoo in textile, garment and overall exports in the last 20 years. This record was in large measure what Daewoo was passing on to the 130 Desh workers. Had the training been conducted in Bangladesh or textile training institutes in developed countries, the Desh workers might not have acquired the know-how and skills embodied in Daewoo's system of management and dynamic, effective corporate culture.

Desh workers learned not only narrowly defined production skills, but also the whole system of production, marketing and management that Daewoo had developed or accumulated over the preceding 10-12 years through its pioneering activities to enter international markets. As future managers of an entire garment industry, beyond the confines of the Desh factory production line, this broad experience was invaluable to the Desh trainees and to Bangladesh.

Source: Yung Whee Rhee, "The catalyst model of development: lessons from Bangladesh's success with garment exports", *World Development*, vol. 18, No. 2 (1990), pp. 333-346.

Table II.56. Indian Subcontinent: human capital indicators, 1970-1990

Country	Population in 1990 (millions)	Mean years of schooling in 1990	Scientists and technicians per 1,000 people in 1985-1989	R & D scientists and technicians per 10,000 people in 1985-1989	Tertiary graduates as percentage of age group in 1986-1988	Adult literacy rate in 1990	Combined primary and secondary school enrolment ratio [a] 1970	Combined primary and secondary school enrolment ratio [a] 1988-1989
Sri Lanka	17.1	6.9	..	2.0	1.4	88	81	91
Myanmar	40.8	2.5	..	..	..	81	62	63
Pakistan	112.1	1.9	4.1	1.3	..	35	30	30
India	828.1	2.4	3.6	2.3	..	48	56	69
Bangladesh	112.9	2.0	0.5	..	0.6	35	42	42
Nepal	18.9	2.1	0.6	0.2	0.3	26	22	62

Source. United Nations Development Programme, *Human Development Report 1992* (New York, Oxford, 1991).

Note. Countries listed according to rank in terms of UNDP human development index.

[a] Index North = 100. North refers to OECD countries.

Table II.57. Summary of calculations on the rates of return on education in India, 1957-1981

Educational level	Herberger[a/] 1957	Nallagoundan[a/] 1960-1961	Selowsky[a/] 1960-1961	Kothari[a/] 1965-1966	Hussains[a/] 1950-1954	Blaug[a/] 1960-1961	Pandit[a/] 1972	Tilak[a/] 1980	Sailabala[a/] 1980-1981
Sample size	2 895	8 650	8 650	19 301	6 148	28 650	2 203	1 000	..
Social rates of return									
Primary	-	17.0	23.5	-	-	15.2	7.6	7.0	-
Middle	-	11.8	17.7	-	-	14.2	14.0	6.3	-
Secondary	11.9	10.3	16.4	20.0	37.0	10.5	5.0	-	-
Intermediate	-	-	-	-	-	-	5.0	1.6	-
I degree (general)	-	7.0	11.6	10.0	4.0	8.9	5.0	6.3	-
II degree (general)	16.9	-	14.7	-	3.0	-	5.0	7.2	9.5
Higher (professional)	-	9.8	-	22.0	3.0	12.5	5.0	-	-
Engineering graduate	-	-	-	-	-	-	-	-	5.3
Medical graduate	-	-	-	-	-	-	-	-	4.0
Agricultural graduate	-	-	-	-	-	-	-	-	5.8
General postgraduate	-	-	-	-	-	-	-	-	5.9
Private rates of return									
Primary	-	23.0	-	-	-	18.7	9.5	7.8	-
Middle	-	13.0	-	-	-	16.1	17.3	8.5	-
Secondary	-	10.0	-	-	48.0	11.9	5.0	-	-
Intermediate	-	-	-	-	-	-	5.2	2.4	-
I degree (general)	-	8.1	-	14.0	12.0	10.4	9.2	6.8	-
II degree (general)	-	-	-	-	10.0	-	6.7	7.2	11.5
Higher (professional)	-	13.5	-	25.0	9.0	15.5	5.6	4.7	-
Engineering graduate	-	-	-	-	-	-	-	-	6.1
Medical graduate	-	-	-	-	-	-	-	-	4.3
Agricultural graduate	-	-	-	-	-	-	-	-	6.4
General postgraduate	-	-	-	-	-	-	-	-	6.1

Sources: G. K. Suri, Rajendra Prasad and A.K. Barman, "Survey report - India", in *Educated Unemployment in Asia*, Hiromitsu Muta, (ed.) (Tokyo, Asian Productivity Organization, 1990), p. 140; A.C. Herberger, "Investment in men versus investment in machines: the case of India", in *Education and Economic Development* by C.A Anderson and M.J. Bowman, eds. (Chicago, Aldine, 1965); A. M. Nallagoundan, "Investment in education in India", *Journal of Human Resources*, vol. 2, No. 3 (1967); M. Selowsky, "Education and economic growth: some international comparisons", *Education Development Report*, No. 83 (Cambridge, Harvard University, 1967); V. N. Kothari, "Factor cost of education in India", *International Economic Journal*, vol. 13 (April-June 1966), p. 631-46; I.Z. Hussains, Returns to education in India" in *Education as Investment*, B. Singh, ed. (Meerut, Meenakshi Prakasha, 1967); M. Blaug, P.R.G. Layard, and M. Woodhall, *The Causes of Graduate Unemployment in India* (London, Allen Lane and Penguin, 1969); M. Blaug, "The unemployment of the educated in India", in *Third World Employment Problem and Strategy*, R. Jolly and others, eds. (London, Penguin, 1983); V.N. Pandit, "Effectiveness and financing of investment in education in India, 1950-51 to 1965-66", unpublished Ph.D. thesis presented at Delhi University in 1972; J.B.G. Tilak, "Inequality in the returns to education, unpublished Ph.D. thesis presented at Delhi University in 1980; Devi Sailabala, "Cost-benefit analysis of higher education: a case study of Orissa" unpublished Ph.D. thesis presented at Ulkal University in 1982.

a/ Included in sources.

Table II.58. Training curriculum at Daewoo's Pusan Garment Factory[a]

Sequence	Subject	Training methods	Weeks
1	General orientation	Lectures	1.5
2	Introduction to machine operations	One machine per 20 trainees	2.0
3	Practice of machine operations	One machine per two trainees	2.0
4	Introduction to garment manufacturing	Morning session: lectures in afternoon session; exercises using four machines per trainee	1.0
5	Specialized training	Four specialized areas: cutting, sewing, finishing and machining	4.0
6	Specialized on-the-job training	On-the-job training in the four specialized areas	4.0
7	In-depth, on-the-job training and actual production	Production of various types of finished garments on actual factory production lines	13.0
8	Evaluation	Evaluation of the training	0.5

Source: Yung Whee Rhee, "The catalyst model of development: lessons from Bangladesh's success with garment exports", *World Development*, vol. 18, No. 2 (1990), pp. 333-346.

[a] 1 April 1979 to 30 November 1979.

stratification reflect the possible impact of "excessive" and "inappropriate" education for the poor.* Furthermore, in many areas, child labourers are providing supplementary income for poor parents, and hence the latter would not be interested in sending their children to school. In short, policy makers are confronted with a dilemma that will require bold new approaches and insights if it is to be tackled successfully.

I. East and South-East Asia

1. Short-run outlook

Despite the recession and growth slow-downs in other regions, the East and South-East Asian region has been maintaining respectable GDP and MVA growth. Both short- and long-run prospects of industrial growth seem promising, although country- and area-specific problems abound, such as the threat of double-digit inflation (Hong Kong, Indonesia and the Republic of Korea), and overloading of infrastructure facilities (shortages of electricity, transport and communications facilities). Furthermore, numerous countries of the region show signs of shortages of both skilled labour and well-trained managers. Nevertheless, these problems offer challenges and at the same time opportunities for policy makers to tackle. Overcoming them provides a new thrust for human and physical capital formation—a long-term process of central importance to industrialization and technical progress. In addition, new transnational economic links are being forged, for example in the Mekong Delta and Tumen Delta regions, and in the triangle formed by southern China—Hong Kong and Taiwan Province.

The region as a whole is expected to achieve 7.5 per cent and 7.8 per cent MVA growth in 1992 and 1993, respectively, supported by 6.9 per cent GDP growth in both years. This performance represents a small improvement over the 1990-1991 period, when MVA grew by 7.2 per cent and 8.3 per cent, and GDP by 7.0 per cent and 6.6 per cent, respectively. In view of the problems of overheating in the growth-leading countries, overall restraints in growth-oriented policy would appear prudent. Malaysia, Thailand and the Republic of Korea, for example, are using fiscal and monetary brakes to slow their economies (see table II.59).

Industrial growth rates in the region show a rather uneven pattern. For example, in 1991 the Philippines suffered from negative growth (−3.3 per cent) partly because of a natural disaster (the Mount Pinatubo eruption) and partly because of the failure to provide industrial infrastructure services (electricity, water, transport, communications, etc.). In general, long-run industrial growth has been slower then in neighbouring countries in spite of rich natural resources and the supply of an apparently superior level of educated manpower (see table II.60). Philippine policy makers and researchers are thus confronted with the challenge of determining what has gone wrong (see figure II.10 for GDP and MVA growth in recent years and also for the pattern of structural change in industry).

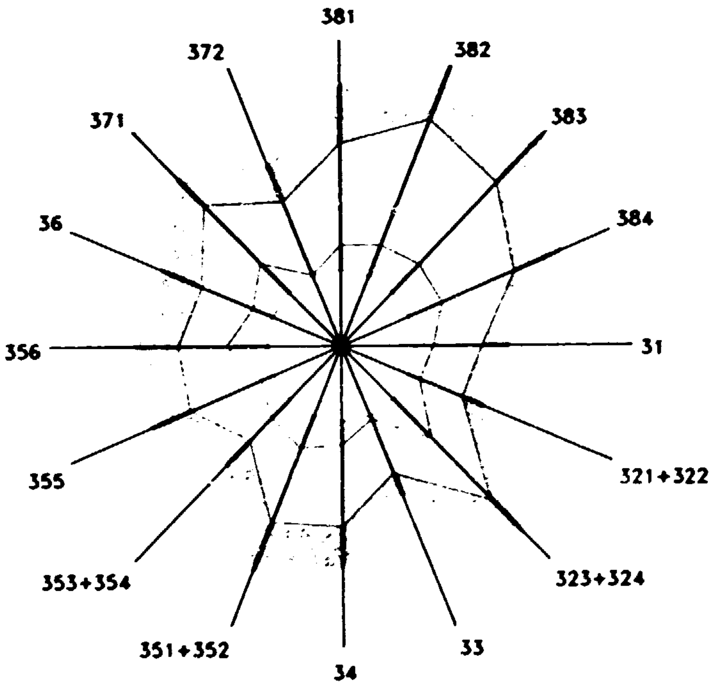
By contrast, a 29.8 per cent industrial growth was recorded for the Lao People's Democratic Republic in

*Myron Weiner sees "the neglect of primary education as based on the fear by the higher castes that excessive and inappropriate education for the poor would disrupt existing social arrangements. Rhetoric notwithstanding, India's policy makers have not regarded mass education as essential to India's modernization. They have instead put resources into élite government schools, state-aided private schools and higher education." ([45], p. 10)

Figure II.10. Growth rates of GDP, MVA and manufacturing employment, 1986-1993, and industrial structural change, 1980-1993: East and South-East Asia

Industrial structural change

(Index of value added: 1980 = 100)



$g = 7.85, \theta = 13.85$

Key:

Deflated prices of 1985

g = Average annual growth rate, 1980–1993 (percentage)

θ = Index of structural change, 1980–1993

ISIC code	(industries):
31	(Food products)
321, 322	(Textiles)
323, 324	(Leather)
33	(Wood and furniture)
34	(Paper and printing)
351, 352	(Chemicals)
353, 354	(Petroleum and coal)
355	(Rubber products)
356	(Plastic products)
36	(Non-metal mineral products)
371	(Iron and steel)
372	(Non-ferrous metals)
381	(Metal products)
382	(Non-electrical machinery)
383	(Electrical machinery)
384	(Transport equipment)

1990–1993 forecast

1985–1990

1980–1985

Source: UNIDO database; estimates and forecasts by UNIDO PPD GLO

Table II.59. East and South-East Asia: growth rate of value added in industry, 1989-1993
(Percentage per annum)

Economic grouping, region, country and area	1989	1990	1991	1992	1993
Republic of Korea	6.0	11.1	8.6	7.4	7.2
Singapore	8.3	9.2	6.0	4.6	6.0
Taiwan Province	4.5	1.3	6.4	6.8	7.1
Indonesia	8.2	9.5	7.5	7.1	7.1
Lao People's Democratic Republic	34.4	15.7	29.8	12.2	11.0
Malaysia	11.0	14.5	12.5	11.2	9.2
Philippines	8.2	1.8	-3.3	3.1	5.5
Thailand	16.2	15.6	9.2	9.0	9.5
Viet Nam	-7.2	3.7	4.9	4.9	4.8
Fiji[a/]	11.9	6.5	6.1	6.3	6.2
Papua New Guinea	-14.1	-3.2	24.8	7.0	30.0
Solomon Islands[a/]	4.9	7.5	5.0	5.5	5.7
Tonga	4.8	1.0	1.0	1.0	2.0
Vanuatu	10.3	8.1	9.3	10.7	4.5
Western Samoa	..	..	..	..	..

Source: Asian Development Bank.
Notes: Data for Tonga are on a fiscal-year basis. Industry includes mining, manufacturing and public utilities (electricity, gas and water).
a/ Based on constant factor cost.

1991. No doubt this reflects a low initial industrial base. Nevertheless, it foreshadows what may happen when political constraints in the whole Mekong Delta subregion loosen up. It is encouraging to observe, for instance, that Taiwan Province and Hong Kong have emerged as leading contenders to help Viet Nam become regionally integrated (see table II.60). They together have what Viet Nam urgently needs—capital, technology and industrial and marketing network services. But others are also interested: "Over 10,000 foreign businessmen visited the Hanoi Chamber of Commerce in 1991" [46].

Table II.60. Foreign investment approvals by Viet Nam[a/]

Investing country and area	Million dollars	Number of projects
Taiwan Province	743	56
Hong Kong	515	103
France	391	30
Australia	292	22
Netherlands	253	5
USSR	169	37
United Kingdom	149	10
Canada	115	12
Japan	103	23
Republic of Korea	90	13
TOTAL	2 820	311

Source: Viet Nam State Committee for Cooperation and Investment, as reported by Murray Hiebert and Carl Goldstein, in "Vietnam opening: Hong Kong vies to become gateway", *Far Eastern Economic Review* (28 May 1992), p. 50.
a/ Cumulative to 15 May 1992.

The industrial thrust of the region is expected to originate mainly in investment and trade, particularly intraregional trade. Compared with other regions, the relative level of investment has been, and is expected to remain high (see table II.61). Indonesia, Malaysia, Republic of Korea, Singapore and Thailand, all fast performers in the industrialization race, have achieved a 35 to 40 per cent rate of investment (as a percentage of GDP), and are expected to do the same in the next couple of years. These activities will provide not only the Keynesian demand force but also technology newly embodied in machines, equipment and new infrastructure. This process helps to upgrade the industrial base one step further. For instance, the computerization ratio in small- to medium-scale enterprises in the Republic of Korea increased to 54 per cent in 1991 from 25 per cent in 1989. Another example comes from Thailand, which has been diversifying and upgrading with Japanese investment:

> "... there is evidence that the Japanese are increasingly using Thai producers for simpler plastic and metal parts, and teaching these suppliers how to upgrade their quality. While plastic mould-making has also advanced, the Thai government and local industry have neglected production of metal moulds and dies." [47]

The high rate of investment has been accompanied by a high rate of growth of trade in the region. While world trade grew by only 3 per cent in 1991, regional exports grew by 13 per cent (including intraregional exports) and imports 17 per cent (including intraregional imports). These trade activities reflect in part the vertically integrated nature of the region through intra-industry cross-country investments which have

Table II.61. Gross domestic investment in East and South-East Asia, 1989-1993
(Percentage of GDP)

Economic grouping, region, country and area	1989	1990	1991	1992	1993
Hong Kong	27.5	38.5	29.9	30.8	32.3
Republic of Korea	33.4	37.0	39.3	39.9	40.0
Singapore	34.5	38.7	38.2	39.9	40.0
Taiwan Province	22.8	22.4	23.0	24.1	24.8
Indonesia	35.2	36.9	35.0	34.5	35.5
Lao People's Democratic Republic	14.5	14.5	12.7	14.0	15.1
Malaysia	28.8	32.3	35.7	36.2	36.0
Philippines	21.8	22.5	20.0	22.0	22.6
Thailand	31.5	36.8	35.7	36.0	38.0
Viet Nam[a/]	4.4	6.9	5.8	5.7	5.9
Fiji[b/]	14.7	19.3	17.3	17.2	17.5
Papua New Guinea	23.2	24.6	31.1	33.0	35.0
Solomon Islands	31.9	32.1	32.5	33.0	32.7
Tonga	21.5	22.5	24.2	22.2	23.7
Vanuatu	37.2	43.6	35.0	36.0	36.0
Western Samoa	27.3	27.0	29.0	..	..

Source: Asian Development Bank.
Notes: Data for Tonga are on a fiscal-year basis. Industry includes mining, manufacturing and public utilities (electricity, gas and water).
a/ Gross fixed investment in the public sector only.
b/ Based on constant factor cost.

intensified since the mid-1980s (see table II.62). The pattern of industrial integration tends to intensify intra-industry trade and to transmit industrial growth more directly through input-output, demand-supply relations even without transactions in finished products.

One major problem to have emerged is due to specific regional integration patterns coupled with the technological dominance of Japan. Virtually all countries in the region except Indonesia have become dependent upon the Japanese supply of machines and parts and intermediate inputs. Often the finished goods are sold to the United States or Europe, and not to Japan. A consequence of this arrangement turns out to be chronic balance of trade deficits *vis-à-vis* Japan. Furthermore, the higher the industrial growth and exports, the greater the deficits. It is a structural problem, not easily amendable to solution by shifts in the exchange rate.

One possible solution of the problem may be to acquire and master new technologies that make possible the domestic production of intermediate

Table II.62. Intra-Asia foreign direct investment approvals, cumulative total in East and South-East Asia, 1980-1988

Investment by	Investment in million dollars: Republic of Korea	Taiwan Province	Indonesia	Malaysia	Philippines	Thailand
Japan	2 070.3	1 843.6	1 209.8	512.6	302.7	1 245.3
Hong Kong	155.2	400.5	932.9	123.1	81.7	359.7
Republic of Korea	..	..	212.3	19.8	4.4	14.4
Singapore	Negative	67.9	410.5	250.8	13.7	170.3
Taiwan Province	..	..	117.5	75.4	122.0	49.8
Asia	2 264.6	2 320.7	3 759.4	918.7	630.3	1 999.2
World	4 108.2	5 464.8	9 374.0	2 213.7	2 095.4	3 331.7

Source: Taiwan Province: Ministry of Economic Affairs; Republic of Korea: Ministry of Finance; Malaysia: Ministry of Finance; Thailand: Bank of Thailand; Philippines: Board of Investments; and Indonesia: Central Bureau of Statistics, *Statistical Bulletin* (November 1989). As quoted in James Riedel, "Intra-Asian trade and foreign direct investment", *Asian Development Review*, vol.9, No.1 (1991), p. 142.

inputs, thereby reducing imports and increasing the value-added domestic content of exports. But often the higher-level technologies are not easily obtainable from Japanese firms. The assembler-producers are thus compelled to invest in technology development, or to attempt to purchase from non-Japanese sources. There seems to be no short-cut to technological mastery, which can be achieved only by climbing the technological ladder step by step.

2. *Long-run prospects*

By any standard, industries in the region have been performing admirably. Some indicators are provided in table II.63. With the exception of the Philippines, all countries and areas increased their MVA, total employment, labour productivity and wage earnings per worker between 1980 and 1990. The differences in labour productivity and wage earnings between countries are, however, striking. Singapore registered the highest per-worker MVA ($26,849) and wage earnings ($7,892) in 1990. The lowest figures were recorded by Indonesia.

Table II.64 gives labour productivity and wage earnings data as a percentage of the North American level for 28 manufacturing industries. A catching up process is indicated by the labour productivity figures, rising on average from 12.2 per cent in 1970 to 17.7 per cent in 1990.* Likewise, wage earnings rose from 6.8 per cent in 1970 to 16.2 per cent in 1990. Industry data confirm that the catching-up process is taking place in almost all product categories.

The differences in wage rates, however, offer opportunities for investment and plant migration from high-wage economies to low-wage ones for labour-intensive industries. Thus, for example, as wage rates rose in the 1970s, apparel enterprises from the Republic of Korea and Taiwan Province moved to Thailand and Indonesia. In turn, skill-intensive industries such as semiconductors, automobile parts, electrical appliances and numerically controlled machines moved to the higher-wage countries in the region from Japan and the United States. This process of product diversification in the industrial structure and trade composition of the region enabled it to avoid the consequences implied by the trade-pessimism hypothesis (namely, that the world market for labour-intensive goods would be limited if all developing countries emulated the NIC strategy of export-led growth).*

*The Republic of Korea recorded 25 per cent of the North American level of labour productivity in 1990.

The important question is whether the industrial dynamism of the region can be expected to continue through the 1990s and beyond. James Riedel, having analysed trade and investment behaviour, concluded:

> "Will intra-Asian international trade and foreign direct investment continue to expand as rapidly as they have in the recent past? There are good reasons to expect they will. First, as long as the Asian countries continue to liberalize unilaterally their trade policies and to maintain current high levels of investment, the Asian market will continue to outpace growth in other major export markets, principally North America and Europe.
>
> It is also likely that real wages in Japan and the Asian newly industrializing economies will continue to increase faster than elsewhere in Asia, and that as a result the flow of direct investment from the higher-wage Asian countries to the lower-wage Asian countries will be maintained for some time to come. Since intra-Asian direct investment appears to complement and reinforce intra-Asian trade, the bias which was observed in favour of intraregional over interregional trade is likely to grow stronger." [49]

But the explanation above appears incomplete. Nothing has been said about the role of human and institutional capital formation, which seems to be instrumental in bringing about changes of comparative advantage via changes in technological capabilities.** The Asian dynamism seems to be stimulated as much by technology mastering and innovation as by trade and investment. Though a comprehensive review of human and "institutional capital" formation cannot be conducted in this space, the following coments may

*See, for instance, [48].

**Traditionally, trade theorists have tended to ignore dynamic factors such as nurturing technological capabilities. Hence they seem unable to explain the Asian experience, including the case of Japan in the 1950s.

Table II.63. Industrial performance indicators in East and South-East Asia, 1980 and 1990
(In constant 1985 dollars)

Country and area	MVA 1980	MVA 1990	Manufacturing employment 1980	Manufacturing employment 1990	Labour productivity[a] 1980	Labour productivity[a] 1990	Wage per worker 1980	Wage per worker 1990
	(million dollars)		(thousands)					
Republic of Korea	18 822	55 125	2 015	3 292	9 342	16 744	2 735	4 733
Taiwan Province	16 488	32 153	1 997	2 419	8 258	13 291	2 962	5 936
Thailand	8 773	17 487	1 549	2 266	5 665	7 717	1 342	1 528
Indonesia	3 976	13 289	963	2 262	4 128	5 875	676	1 065
Hong Kong	7 277	9 788	737	0 875	7 769	11 185	4 043	6 264
Singapore	4 568	9 416	285	0 351	16 023	26 849	4 757	7 892
Malaysia	4 194	7 648	518	0 661	8 091	11 579	2 273	2 901
Philippines	4 678	4 546	949	0 748	4 931	6 077	1 085	1 624

Source: UNIDO database.
[a] MVA divided by number of employees in manufacturing.

help to shed some light on what is happening in the region.

The rapid rise of the Asian NICs, following the example of Japan, bears special significance. These countries do not possess natural resources, except human resources in abundance. Yet a rapid transformation of an agrarian economy into an industrial one is made possible by investing in human resources, upgrading their quality and thereby increasing the economy's technological capability.* It is not possible to reduce many facets of human capital into a single index. Nevertheless, selected indicators shown in table II.65 are informative. The Asian NICs show a higher level of average years of schooling, a greater number of scientists, technicians and R and D personnel per 10,000 people etc. than other countries.

The case of the Philippines, however, should be carefully studied. It has achieved 7.4 mean years of schooling, close to that of the Republic of Korea, a high literacy rate (almost 90 per cent), and a 100 per cent combined primary and secondary enrolment ratio; and yet its GDP per capita ($710 in 1989) is far lower than that of the Republic of Korea ($4,400 in 1989). Well-educated human resources are obviously waiting to be employed and effectively organized, ultimately to raise productivity and industrial growth.

Table II.65 does not include data for Taiwan Province, but an independent study provides telling information on its educational achievements (see table II.66). The study claims that "the education system was planned to grow in a manner that closely matched the changing requirements of the growing economy. The compulsory basic education was raised from six to nine years; the secondary level curriculum was shifted more toward vocational fields; the supply of university graduates was strictly limited, and the university curriculum changed to emphasize science and engineering subjects." [53]

Similarly, the education system of the Republic of Korea seems to have produced an abundance of educated workers.* But the available evidence indicates a glaring mismatch between supply and demand for college graduates—a chronic oversupply for more than 20 years since 1965. This phenomenon has been attributed to the following influences: the emphasis on a high level of education in Confucian culture; the preference for white-collar occupations which are conferred only on college graduates; and the high level of remuneration in white-collar occupations:

> "For example, in 1986 college graduates' average wage was 2.2 times that of high-school graduates, and the average entry wage of high-school graduates tended to be below 70 per cent that of college graduates." [56]

The question whether the oversupply of college graduates represents mismanagement of capital resources in the long-run remains controversial. In spite of this oversupply, the estimated social rate of return was, for instance, 13.8 per cent in 1977 compared with 9.9 per cent for high-school graduates and 2.8 per cent for middle-school graduates. In the same year, the employment of college graduates totalled 22,087, while the universities and colleges produced 37,374—an excess supply of over 15,000, indicating a degree of labour market disequilibrium and imperfection. The excess supply situation disappeared only after the mid-1980s, and according to recent projections, a shortage of college-educated manpower is expected to occur in the 1990s (see table II.67). Nevertheless, it could be argued that the abundance of college graduates and human capital in general has been a crucial factor enabling the economy to climb the technological ladder at a rapid pace, and hence ultimately to achieve productivity growth.** Moreover, to complete the analysis, it would be necessary to describe how these educated workers are organized.

Studies on institutional characteristics and performance are scarce, especially those comparing the organizational differences between economies (of Hong Kong, Republic of Korea, Singapore, Taiwan Province etc.). But what is available seems to suggest, not surprisingly, that there are similarities and differences, and the latter reflect the specific heritage of each country and area of the region in their culture, politics, social values, morality and historical paths. The task of building economic and non-economic institutions with a view to motivating workers to higher levels of efficiency would seem to require "the art" of using the specific unique heritage of those involved. Thus, for instance, studies ([57] and [58]) on Korean Chaebols identify the following characteristics: clan management; top-down decision-making; flexible lifetime employment; a Confucian work ethic; paternalistic leadership; loyalty; compensation based on seniority and merit rating; bureaucratic conflict solution; a very bureaucratic yet low degree of formality and a standardized system; close government-business relationship; and expansion through conglomeration (that is, acquisi-

*"The central point of interest from the standpoint of this analysis is that, in the immediate post-war period, after an intense debate, Japan specifically rejected a long-term development strategy based on the traditional theory of comparative advantage. This was apparently at that time being advocated by economists in the Bank of Japan and elsewhere who subscribed to the free-trade doctrines of the classical school. They had advocated a 'natural' path of industrial development, based on Japan's relatively low labour costs and comparative advantage in labour-intensive industries such as textiles. One of the central points at issue was whether Japan could hope to compete in the automobile industry and whether special steps should be taken to encourage its growth, but the debate affected industrial and trade policy in its entirety. In the early days, the views of the Bank of Japan had some influence. But on the whole the bureaucrats and their advisers at MITI prevailed. They repudiated the view that Japan should be content with a future as an underdeveloped country with low productivity and income per head." [50]

Fritz Machlup explains how education enhances human technological capabilities through the following set of abilities:

> "... the capacity to learn and perform tasks that demand cognitive aptitudes and moral attitudes of a higher order ...
>
> ... mathematical ability, verbal ability, alertness— also enterprising spirit, moral courage, creativity – resourcefulness, imaginativeness, inventiveness, ambition drive, resolution, diligence – industry, working intensity, perseverance – enduring dedication, constancy, from endowment and investment to ability, from ability and attitudes to capacity, from capacity and its utilization to performance, and from performance at selling price times hours per year to earnings" [51]. Empirical support for these views is mounting. Recent evidence includes the work of Gregory D. Woznick [52].

*See, for example, [54] and [55].

**Theodore Schultz advances the idea that human capital has external effects:

> "These effects spill over from one person to another. People at each skill level are more productive in high than in low human capital environments. Human capital enhances the productivity of both labour and physical capital ..." [43]

Table II.64. Labour productivity and wage earnings per worker in East and South-East Asia, as a percentage of the North American level, 1970, 1980 and 1990
(In constant 1985 dollars)

Industry	Labour productivity 1970	Labour productivity 1980	Labour productivity 1990	Wage per worker 1970	Wage per worker 1980	Wage per worker 1990
Food products	12.02	12.13	11.00	6.68	8.77	10.10
Beverages	22.65	21.29	20.22	9.24	13.63	17.09
Tobacco products	8.30	9.77	4.92	4.94	4.28	4.44
Textiles	10.95	17.57	21.91	7.72	13.16	19.72
Wearing apparel	15.45	20.44	26.51	10.33	20.93	27.82
Leather and fur products	9.18	19.46	31.37	7.45	16.14	27.25
Footwear, excluding rubber or plastic footwear	11.22	16.29	23.76	7.23	15.93	25.06
Wood and cork products	14.77	15.29	14.04	13.04	11.09	10.54
Furniture and fixtures	14.89	14.27	15.66	9.65	12.37	16.42
Paper and paper products	12.79	13.92	15.11	7.81	11.96	16.29
Printing and publishing	11.93	18.78	22.01	8.49	16.52	23.16
Industrial chemical products	13.53	14.69	19.34	7.99	12.94	18.59
Other chemical products	11.09	12.31	13.62	7.74	11.53	17.25
Petroleum refineries	11.80	7.48	8.81	20.48	22.53	35.35
Miscellaneous petroleum and coal products	22.74	52.57	42.60	8.74	17.77	27.58
Rubber products	10.59	14.44	13.46	7.05	9.91	12.10
Plastic products n.e.c.	9.09	14.57	19.47	8.27	15.31	22.96
Pottery, china and earthenware	10.26	15.13	20.39	7.77	10.50	16.98
Glass and glass products	12.13	15.97	24.46	7.96	11.60	18.95
Other non-metallic mineral products	14.40	19.42	24.74	8.15	12.29	18.21
Iron and steel	17.31	29.18	39.76	6.13	12.29	20.72
Non-ferrous metals	13.60	17.10	24.30	8.86	11.18	15.70
Metal products	9.69	13.34	19.66	6.41	13.57	22.66
Non-electrical machinery	8.93	14.12	20.24	6.74	13.29	19.90
Electrical machinery	11.45	14.41	20.38	5.32	12.39	19.68
Transport equipment	14.87	16.95	20.86	9.07	12.26	18.33
Professional and scientific goods	6.44	11.63	13.89	5.70	14.05	17.36
Other manufactures	10.91	19.87	26.26	4.63	12.88	22.13
Total manufacturing	12.20	14.87	17.66	6.78	11.26	16.18

Source: UNIDO database.

Table II.65. East and South-East Asia: human capital indicators, 1970-1990

Country and area	Mean years of schooling in 1990	Scientists and technicians per 1,000 people in 1985-1989	R & D personnel per 10,000 people in 1985-1989	Tertiary graduates as percentage of age group in 1986-1988	Adult literacy rate in 1990	Combined primary and secondary enrolment ratio 1970	Combined primary and secondary enrolment ratio 1989
Republic of Korea	8.8	47.3	21.6	..	96.3	87	100
Hong Kong	7.0	41.0	..	6.7	90.0	80	90
Singapore	3.9	23.6	..	5.8	88.0	88	90
Brunei Darussalam	5.0	27.0	5.6	..	86.0	..	..
Malaysia	5.3	..	3.7	1.4	78.4	71	79
Thailand	3.8	1.2	1.5	5.0	93.0	66	60
Philippines	7.4	..	1.1	6.7	89.7	97	100
Indonesia	3.9	10.1	1.7	0.6	77.0	56	86
Viet Nam	4.6	..	..	..	87.6	79	71
Lao People's Democratic Republic	2.9	..	..	0.5	..	33	70
Cambodia	2.0	..	..	..	35.0	..	..

Source: United Nations Development Programme, *Human Development Report 1992* (New York, Oxford University Press, 1992), pp. 127-139.

Table II.66. Enrolments and average annual increase in enrolment in Taiwan Province 1950-1986
(Number of students)

Academic year	Total	Primary	Junior high[a]	Senior high	Senior vocational[b]	Junior college	College and university and above
1950	1 033 651	906 950	89 944	18 866	11 226	1 286	5 379
1955	1 475 624	1 244 029	162 235	30 169	21 186	4 545	13 460
1960	2 279 117	1 888 783	253 145	57 512	44 617	7 888	27 172
1965	3 006 828	2 257 720	473 442	116 197	74 114	29 543	55 812
1968	3 465 707	2 383 204	652 083	152 877	116 206	79 456	81 881
1969	3 641 008	2 428 041	729 651	161 459	137 642	95 988	88 227
1970	3 803 467	2 445 405	800 402	178 537	175 650	108 328	95 145
1972	4 034 054	2 459 743	909 197	197 151	216 905	138 310	112 748
1975	4 160 389	2 364 961	1 036 357	185 181	284 455	150 226	139 209
1980	4 181 801	2 233 706	1 075 532	180 665	349 370	183 134	159 394
1982	4 266 038	2 226 699	1 082 358	187 015	394 270	203 722	171 974
1985	4 429 043	2 321 700	1 062 226	194 757	421 784	236 824	191 752
1986	4 498 602	2 364 438	1 052 993	200 599	437 924	244 482	198 166
Average annual percentage increase							
1953-1959	9.1	8.5	11.5	14.7	16.2	9.2	20.4
1960-1969	5.5	3.2	12.7	11.6	13.1	33.9	13.9
1970-1979	1.4	-0.7	4.1	1.3	9.3	6.3	5.8
1980-1986	1.1	0.7	-0.4	1.5	4.2	4.9	3.6
1953-1986	4.1	2.6	7.2	7.1	10.8	14.7	10.7

Source: Jennie Hay Woo, "Education and economic growth in Taiwan: a case of successful planning", *World Development*, vol. 19, No. 8 (1991), p. 1032.

[a] And junior vocational and normal before 1973.

[b] And normal 1973 and after.

Table II.67. Population by level of education in the Republic of Korea: 1980-2000

Item	1980	1990	2000
Population aged 14 and over	24 848 (100)	32 385 (100)	37 823 (100)
High-school graduates	4 383 (17.6)	8 174 (25.2)	11 102 (29.3)
College students	721 (2.9)	1 787 (5.5)	2 213 (5.9)
College graduates	1 329 (5.4)	3 877 (12.0)	7 511 (19.9)
High-school and college graduates	6 433 (25.9)	13 838 (42.7)	20 826 (55.1)

Source: Se-il Park, "Labour issues in Korea's future", *World Development*, vol. 16, No. 1 (1988), p. 104.

tions and mergers). These characteristics could be viewed as a product of influences from Japanese occupation (1910-1945), United States occupation (1945-1948), and indigenous elements. A comparison of management systems in the light of these characteristics is given in table II.68.

J. China

1. *Short-run outlook*

Both the short- and long-term outlook for industrial growth seem promising. Inflation has apparently been tamed thanks to the austerity programme imposed since 1989, and trade surpluses since 1990 are providing policy makers with greater room for manoeuvre.

Domestic savings and investment are keeping pace with the high levels maintained by the neighbouring NICs, and inflows of foreign direct investment have accelerated. Industrial reform and restructuring have been progressing rapidly, though amid some confusion about the final shape of "market socialism with a Chinese character". The greatest challenge remains, however, in meeting the ever-increasing demand for high-quality managers, engineers and scientists to help push Chinese industry towards higher levels of technology content.

Short-term prospects are good for 1992 (according to government forecasts). GNP is expected to grow by 7.9 per cent compared with 6.8 per cent in 1991 and 5.0 per cent in 1990. Non-government observers, however, are predicting up to 9 per cent growth, with the threat of overheating of the economy. Demand forces appear strong: consumption is expected to grow at

Table II.68. Comparison of personnel management systems

Issues	Republic of Korea	United States	Japan
Employee classes	Core, basic, temporary	Basic, temporary	Core, basic, some temporary
Recruitment criteria	Reference check and written test; preference given to new college graduates	Reference check and interview; prefer experience	Interview; preference given to new college graduates
Job assignment	Élites assigned to important departments	Assignment based on the job	Assignment to field site or initially to shop-floor in-house
Training and education	Uniform, on-the-job training, non-systematic	Knowledge and technical on-the-job training, university	On-the-job training, job rotation, informal groups
Job rotation	Ad hoc basis	Aimed at specialists	Regular, periodic; aimed at generalists
Evaluation	Non-systematic, past-oriented	Systematic, present-oriented	Continuous, future-oriented
Promotion	Seniority	Performance	Combination
Salary criteria	Education level and seniority	Education level and performance	Education level, age and performance
Incentive system	Seasonal bonus (uniform)	Performance-based incentive	Performance-based incentive
Welfare	No	Yes	Yes
Employees lay-offs	Less important departments first	Temporary staff and less important departments first	Concentration on temporary staff only
Retirement	Age of 55 (inflexible)	Age of 65 (flexible)	Age of 55-60 (flexible)
Labour relations	Principles of harmony; no strikes	Contract-oriented; strikes used as a last resort	Principle of "wa"; labour disputes start with strike
Job assignment	No systematic assignment	Individual assignment with detailed job descriptions	Group assignment, job descriptions not detailed
Structure	People-oriented	Work-oriented	Combination
Decision-making	Top-down	Top-down	Bottom-up

Source: Yookeun Shin, *Structure and Problems of Korean Enterprises* (Seoul, Seoul National University Publishing, 1985), pp. 331-359, as quoted in Sangjin Yoo and Sang M. Lee, "Management style and practice of Korean Chaebols", *California Management Review*, vol. 29, No. 4 (Summer 1987), p. 107.

13.1 per cent in 1992, compared with 12.2 per cent in 1990 and a mere 3.3 per cent in 1991; investment will grow by 11.2 per cent in 1992, compared with 7.6 per cent growth in 1990 and 18.6 per cent in 1991 (see table II.69).

As usual, the industrial sector will be leading the growth of other sectors with a rate of 10.0 per cent in 1992. This figure compares with 14.2 per cent industrial growth in 1991 (at double the planned target) and 7.6 per cent in 1990. The leadership of the industrial sector will be supported by the favourable trade surpluses recorded in 1991 ($8.1 billion) and 1990 ($8.7 billion) (see table II.70). A trade surplus of $7 billion is expected for 1992, providing sufficient room for policy makers to manoeuvre with respect to importing industrial inputs and technology. The availability of the latter determines industrial growth in a special way.

Opening up the economy since 1978 has permitted soaring export growth in labour-intensive goods such

Table II.69. Major indices of economic performance in China, 1989-1992

	Item	Annual growth rate			
		Actual			Forecast
		1989	1990	1991	1992
1	GNP	3.6	5.0	7.0	6.5
2	Industry	8.5	7.6	14.2	10.0
3	Agriculture	3.1	6.9	3.0	3.3
4	Exports	10.7	18.1	15.8	10.0
5	Imports	7.0	-9.8	19.5	13.0
6	Investment	-8.0	7.6	18.6	11.2
7	Consumption	10.8	3.3	12.2	13.1
8	Total retail sales	8.9	1.2	13.2	12.0
9	Inflation	17.8	2.1	2.9	4.5
10	Consumer price index	17.5	2.4	3.4	4.8

Source: Economic Research Center, Chinese State Planning Commission.

Note: Items 1, 2 and 3 based on 1980 prices; items 6, 7 and 8 in current prices; items 4 and 5 in current United States dollars. Item 2 includes the production value in village-level industries.

Table II.70. International trade of China, 1989-1992
(Billions of dollars)

Item	Actual			Forecast
	1989	1990	1991	1992
(a) International trade	111.6	115.5	135.7	151.2
(b) Exports	52.5	62.1	71.9	79.1
(c) Imports	59.1	53.4	63.8	72.1
(d) Trade balance	-6.6	8.7	8.1	7.0
(e) GNP	302.5	333.3	349.6	372.3
(f) (a)/(e) (percentage)	36.9	34.6	38.8	40.6

Source: Economic Research Center, Chinese State Planning Commission.

as cotton cloth, fabrics, shoes, carpets, bicycles and canned fruits. It has also enabled the economy to import producers' goods such as steel products, machine tools, trucks and chemicals, much needed for industrial restructuring and technical progress. This process, characteristic of the Asian NICs, has been providing the basic driving force for industrial vitality, and will continue to do so in the short- and medium-term. The degree of openness ((exports + imports)/GNP) is expected to exceed the 40 per cent mark in 1992 (much higher than that of Japan or the United States) (see table II.70, row (f)).

An additional source of industrial vitality so provided by two factors, namely, township-village-based community enterprises and foreign direct investment. Both operate freely on the basis of market forces and competition in purchasing inputs and selling outputs, unlike the State-owned enterprises. Industrial output from township-village-based community enterprises grew by over 15 per cent in 1989 and 1990, when an austerity programme was imposed on the entire economy in order to fight run-away growth and inflation (see table II.71).

In 1978, the number of township-village-based community enterprises totalled 1.5 million employed 28.3 million workers, and produced 49.3 billion yuan renminbi worth of industrial output (see table II.72). In 1989, the number soared to 18.7 million units, with employment reaching 93.6 million workers and output surpassing the value of total agricultural output by 22 per cent.

The output of township-village-based community enterprises grew by an annual average rate of 29.4 per cent between 1978 and 1989. This compares with the growth of total Chinese industrial output at an average rate of 16.2 per cent. Such enterprises are a unique feature of the Chinese industrial sector, without a parallel in Eastern Europe or the former USSR. The

Table II.71. Selected performance indicators of township and village enterprises, 1983-1990
(Percentage)

Item	1983	1984	1985	1986	1987	1988	1989	1990
Output								
Rural non-agricultural output	19.20	68.16	59.57	29.78	33.95	36.95	14.36	13.91
Industrial output value	17.19	64.49	46.72	32.08	34.40	39.65	15.78	15.37
Number of firms								
Township-village-based community enterprises (TVCEs)	-1.15	22.52	-4.88	-3.29	4.04	0.72	-3.42	-5.32
Industrial TVCEs	-0.68	21.12	-5.15	2.68	10.45	2.90	-1.43	-4.78
Employment								
TVCEs	3.91	18.97	7.90	5.77	7.08	4.07	-3.55	-2.71
Industrial TVCEs	4.60	17.56	9.15	9.32	9.79	0.34	3.03	-1.47
Financial indicators[a/]								
Gross revenues	20.61	36.55	44.10	21.68	31.96	44.24	13.93	8.23
Taxes	30.84	34.39	37.22	26.86	22.03	40.71	15.22	1.08
Profits	1.57	9.25	33.14	-6.04	16.59	38.05	-7.36	-3.08
Wage bill	14.91	36.11	25.97	17.94	20.30	26.54	7.30	4.49
Fixed assets (year-end)	10.87	20.89	31.02	25.67	29.56	29.16	21.23	14.65
Bank loans	19.15	102.62	40.33	46.96	41.37	26.90	18.14	22.06

Source: State Statistical Bureau of China, *Statistical Yearbook of China*, and *China Rural Statistical Yearbook* (various issues).

a/ For township-village-based community enterprises only.

Table II.72. Selected indicators on township-village-based enterprises in China, 1978-1989

Year	Number of enterprises (thousands)	Total employment (thousands)	Total output value (million yuan renminbi)
1978	1 524.2	28 265.6	4 930.7
1979	1 480.4	29 083.4	5 484.1
1980	1 424.6	29 996.7	6 569.0
1981	1 337.5	29 695.6	7 453.0
1982	1 361.7	31 129.1	8 530.8
1983	1 346.4	32 346.4	10 168.3
1984	6 065.2	52 081.1	17 098.9
1985	12 224.5	69 790.3	27 283.0
1986	15 153.1	79 371.4	35 408.7
1987	17 446.4	87 764.0	47 431.0
1988	18 881.6	95 455.0	64 956.6
1989	18 686.0	93 662.0	84 028.0

Source: David Zweig, "Internationalizing China's countryside: the political economy of exports from rural industry", *China Quarterly*, No. 128 (December 1991), p. 720.

arrangement relieves the central Government of much of the effort required to curb the urbanization pressures and associated costs often seen in other countries (such as the Republic of Korea).

Furthermore, many township-village-based community enterprises serve not only domestic but also overseas demand. In 1984-1985, the share of such enterprises in the total foreign exchange earnings of China was only 4.5 per cent, but it soared to 20.8 per cent by 1990 (see table II.73). This development has created new rural linkages in the flow of goods, services, capital and technologies from abroad.

The strategy of giving more autonomy to enterprise managers and local governments seems to have provided strong incentives—such as control over foreign exchange, raw materials, import and export licences, new equipment and market information—to take risks in innovation, investment and international market penetration.

Foreign direct investment has also added to the dynamic force of Chinese industry. The growth record of such investment in China might seem startling, especially when compared with that of Eastern Europe and the former USSR. The number of foreign-direct-investment projects jumped from 470 (worth $1.7 billion) in 1983 to 7,273 (worth $6.6 billion) in 1990 (for details see table II.74). The lure of the huge potential market and the supply of hard-working, even if unskilled, labourers would appear to have been sufficient to overcome the uncertainty created by internal unrest.

Table II.73. Foreign exchange earnings from township-village-based community enterprises in China, 1984-1990
(Billions of dollars)

Year	Total earnings	China's total export earnings	Percentage of total exports
1984-1985	2.4	53.7	4.5
1986	4.5	31.4	14.3
1987	5.1	39.5	12.9
1988	8.0	47.7	16.8
1989	10.1	52.5	19.3
1990	12.5	60.1	20.8

Source: David Zweig, "Internationalizing China's countryside: the political economy of exports from rural industry", *China Quarterly*, No. 128 (December 1991), p. 720.

The unrest led to a decline in the flow of foreign investment. The value of negotiated investment reached $2.351 billion in the first half of 1990, representing a 22 per cent drop from the previous year. China approved the establishment of 2,784 foreign-funded enterprises in the first half of 1990, down by 8 per cent from the same period in 1989. Of the 2,784 enterprises, there are 1,569 joint ventures, 570 cooperative enterprises and 645 solely foreign-owned enterprises. The contracted value of foreign direct investment in 1990 stood at $6.6 billion, while only $3.5 billion was actually utilized in that year.

The largest single category of direct investment hitherto has been corporate joint ventures, accounting for almost half of the contracted value. Guangdong continues to be by far the most popular site, and investors from Hong Kong and Macao are the most active. The proximity of Guangdong to the services offered by Hong Kong and the ease of monitoring investment just across the border are major reasons. Besides Hong Kong and Macao investors, only firms from the United States and Japan have contracted to invest more than $1 billion. None of the other investments exceeds $500 million. Investor interest in full-ownership operations is increasing, and now accounts for 6 per cent of direct investment.

2. *Long-run outlook*

The process of introducing market mechanisms has been uneven, with a "stop-go" pattern of policy pronouncements, as evidenced by the shifting emphasis of the debate between the conservatives and reformists during the past three or four years. Nevertheless, the available evidence provides encouraging signs concerning the long-run development of the process.

For instance, the proportion of steel supplies that has been distributed through the State central planning apparatus has declined steadily, as follows:

Fifth Five-Year Plan (1976-1980): 81.6 per cent
Sixth Five-Year Plan (1981-1985): 52.4 per cent
Seventh Five-Year Plan (1986-1990)
1986: 45.8 per cent
1987: 33.6 per cent
1988: 28.4 per cent

Furthermore, the number of industrial materials distributed solely by the State plunged from 279 items in 1979 to 24 in 1987. The transition to market-driven allocation from State-planned distribution involves the use of multiple prices (see box II.9). This gradualist approach is in stark contrast to the "big-bang approaches" observable in some countries of Eastern Europe and the former USSR.

Table II.74. Type of foreign direct investment in China, 1979-1990
(Billions of dollars and number of units)

Item	1979-1982	1983	1984	1985	1986	1987	1988	1989	1990
Contracted direct investment									
Value	4.608	1.731	2.650	5.931	2.834	3.709	5.297	5.600	6.596
Number of projects, of which	922	470	1 856	3 073	1 498	2 233	5 945	5 779	7 273
Equity joint ventures									
Value	0.127	0.188	1.067	2.030	1.375	1.950	3.134	2.659	2.704
Number	83	107	741	1 412	892	1 395	3 909	3 659	4 091
Cooperative joint ventures									
Value	2.727	0.503	1.484	3.496	1.358	1.283	1.624	1.083	1.254
Number	793	330	1 089	1 611	582	789	1 621	1 179	1 317
Fully foreign owned									
Value	0.332	0.040	0.100	0.046	0.020	0.471	0.481	1.654	2.444
Number	33	15	26	46	18	46	410	931	1 860
Joint oil exploration									
Value	1.422	1.001	..	0.360	0.081	0.005	0.058	0.204	0.194
Number	13	18	..	4	6	3	5	10	5
Other foreign investment [a]									
Value	0.927	0.185	0.224	0.402	0.496	0.610	0.894	0.694	0.390
Utilized direct investment, of which	1.168	0.635	1.258	1.658	1.875	2.314	3.194	3.393	3.487
Equity joint ventures	0.100	0.074	0.255	0.580	0.804	1.486	1.975	2.037	1.886
Cooperative joint ventures	0.531	0.227	0.465	0.585	0.749	0.620	0.779	0.752	0.674
Fully foreign owned	0.040	0.043	0.015	0.013	0.016	0.025	0.226	0.371	0.683
Joint oil exploration	0.479	0.292	0.523	0.481	0.260	0.183	0.213	0.232	0.244
Other foreign investment [a]	0.832	0.281	0.161	0.298	0.369	0.333	0.546	0.381	0.268

Source: State Statistical Bureau of China.
a/ Including international leasing, compensation deals and processing assembly.

Likewise, investment funds that the government budget provides to State-owned enterprises declined in proportion of total investment (see table II.75). For the economy as a whole, government-financed investment fell from 36 per cent in 1981 to 18.5 per cent in 1988. For the State-owned enterprises the figure fell from 44 per cent in 1981 to 15 per cent in 1988. By contrast, bank loans rose from 14 per cent to 24 per cent in the respective years. The rapid increase of foreign investment to 9 per cent in 1988 from a mere 2 per cent in 1983 is noteworthy. But all these financial changes do not imply a meaningful beginning for a financial market. Such a market with a Chinese character is, however, slowly emerging, as exemplified by the embryonic stock markets in Shanghai, Shenzhen and elsewhere.

In spite of the declining proportion of budget-supported investment, total investment for the whole economy as a percentage of GNP has been maintained at a high level (see table II.76). Throughout the years since the reform movement started in 1978, the investment ratio (investment/GNP) has shifted between a low of 28.3 per cent (in 1981) and a high of 35 per cent (in 1985). These are remarkably high levels by international standards. In some sense, the economy is following an investment-led growth path as well as an export-led one.

The first column of table II.76 also reveals that the ratio of investment to value added for State-owned enterprises has been rising rapidly. This is an indication of efforts to restructure and upgrade State-owned enterprises. Many of the latter have been plagued by labour redundancies, accumulation of unsalable inventories due to low quality, unutilized capacity, loss-making instead of profits, and not least managerial rigidities. By injecting new investment, and thereby more advanced technology and enterprise reorganization, the State enterprise sector has endeavoured to become more efficient and competitive.

Strong and systematic evidence of improvement is hard to obtain. But scattered evidence points to some progress, though as yet one third of State-owned enterprises have been reported to be loss-makers. Table II.77 provides some indication of labour productivity by industrial branch. It shows, in particular, that all branches achieved increasing productivity between 1987 and 1990, and also that the engineering-technology-intensive industries (such as metal products, machinery, transport equipment, electrical equipment, electronics and measuring equipment) performed better than the traditional industries (such as food, textiles and paper products).

Other observers appear to concur, as in the following quotation [59]:

"There had been a marked improvement in investment efficiency during 1978-1986. Total factor productivity growth, which had been negative during

Box II.9. The Chinese market mechanism

China's economic reforms started in 1979 and are still in the initial stage. For the reforms to succeed, China needs to make improvements in its economic policies and strategies and to learn from the experiences of economic reform carried out in other countries. The lessons and knowledge of such experiences must then be combined with China's own conditions to better assimilate the necessary changes.

At present, the market mechanism in China is imperfect. Along with the forwarding of economic reforms, China's economic system should be accompanied by a series of applicable policies. The changes required involve three aspects:

(a) Decentralization, which in China is called "simplifying the administration and giving more decision-making powers to the local governments and local enterprises";

(b) Promoting the commodity economy and invigorating production and circulation activities;

(c) Open-door policies.

To bring about the changes in these three aspects and to attain good results, the country must bring the market mechanism into full play and let economic levers play a role in development.

In China, the market mechanism operates jointly with three State policy measures to guide resource allocations towards a certain goal. The first measure is taxation. It is necessary to readjust taxation methods and increase taxation categories to support the production of certain goods, exports and imports, or to restrict them when necessary. By using credit policy measures as a second mechanism, the central Government can guide and direct capital flow and its use through financial credit activities involving interest rates and the provision of credit without interest. As a third measure, the distribution of materials provides important production incentives for enterprises. Before the reforms, the distribution of material supplies was centralized and was done in accordance with the State plan. After the reforms, the sources of the material supplies began to diversify, and enterprises were given some autonomy to retain the products that were manufactured with permission of the State, but which were not included in the State plan. This encouraged the emergence of a multi-channel distribution system and what is now called the "two-track price system".

There are actually several types of market prices for products. One is the State-allocated price (also called the normal price), which is fixed annually under the State plan by which materials are allocated and products purchased by the State. The "negotiated price" is determined by the suppliers and demanders in accordance with the market situation. This kind of pricing is applicable for those products retained by the enterprises when they have production in excess of the State plan. To control the quantities and scope of such negotiated-price products, the State purchases some of them at prices higher than the allocated price (normal price) and lower than the "negotiated price". This is termed the "semi-allocated, semi-negotiated price", which is controlled by the State and used for those goods allocated by the State.

The differences between these three prices is more or less as follows: if the State sets a normal price at 100, the semi-allocated, semi-negotiated price is usually 130 to 140, and the negotiated price is then 180 to 200. According to the availability of material supplies, the State allocates materials purchased at the normal price to the different State-owned enterprises and various developed and developing regions to enhance the economic development of the whole country and guarantee the completion of mandatory State plans.

Source: Economic and Social Commission for Asia and the Pacific, *China's Experience in Economic Development and Reforms*, Development Papers No. 7 (Bangkok, 1989), pp.19-20.

Table II.75. Sources and shares of government investment in total investment funds in State-owned enterprises in China, 1981-1988
(Percentage)

Year	Ratio of government-financed to total investment in the economy	Source of investment funds in State-owned enterprises: Government budget	Bank loans	Foreign investment	Own funds	Other[a]
1981	36.0	44	14	-	42[b]	
1982	29.9	39	16	-	45[b]	
1983	25.0	41	14	2	43[b]	
1984	26.9	39	15	2	39	4
1985	27.2	26	23	3	40	7
1986	22.2	24	23	5	38	10
1987	23.0	21	25	7	38	9
1988	18.5	15	24	9	40	12

Source: Athar Hussain and Nicholas Stern, "Effective demand, enterprises reforms, and public finance in China", *Economic Policy*, vol. 12 (April 1991), p. 156.

[a] Other includes government funds not included in the budget and investment funds provided by other enterprises.

[b] Average figure for "own funds" and "other".

Table II.76. Investment as a percentage of value added in China, 1971-1988

Year	State-owned enterprises	Whole economy
1971-1977	55.4	32.6
1978-1983	55.8	31.6
1984-1988	83.4	33.9
1978	57.9	36.5
1979	54.7	34.6
1980	54.4	31.5
1981	48.5	28.3
1982	58.3	28.8
1983	60.8	29.7
1984	68.2	31.5
1985	81.9	35.0
1986	88.9	34.7
1987	90.3	34.2
1988	87.9	34.1

Source: Athar Hussain and Nicholas Stern, "Effective demand, enterprises reforms, and public finance in China", *Economic Policy*, vol.12 (April 1991), p.156.

Note: Value added for the State-owned enterprises is estimated by multiplying the value added in the industrial sector by the share of State-owned enterprises in gross industrial output.

1957-1965 and zero during 1965-1977, increased to 3.8 per cent per annum during 1978-1986. However, a close look at the performance and efficiency of State-owned large-scale heavy industries and other categories of enterprises reveals mixed trends."

To quote another observer [60]:

"There occurred a remarkable improvement in economic efficiency in the 1980s: the increase in national income per 100 yuan of accumulation rose from 16 yuan in 1972 to 1975 to 41 yuan in 1981 to 1985, suggesting a rough fall in the ICOR (incremental capital output ratio) from 6.3 to 2.4 in the same period."

Nevertheless, the challenge still remains to complete the reform, to make all State-owned enterprises independent, and to eliminate subsidies propping up loss-makers. A warning comes from the increasing proportion of government expenditures allocated to cover enterprise losses. The proportion jumped from 2.9 per cent in 1978 to 15.1 per cent in 1989 (see table II.78). Along with the price subsidies, such expenditures seem to add inflationary pressures to an economy already over-burdened with rapid structural changes and an embryonic financial market mechanism.

3. *R and D and organizational restructuring issues*

The long-run challenges remain the need to make State-owned enterprises more efficient through judicious doses of R and D and factory reorganization. Technological upgrading seems to hold the key to success. But, the following has been reported [61]:

"Hitherto, most factory managers have been insensitive to the potential role of technology in both the process and product dimensions of manufacturing. ... In spite of current reforms enterprises lack the resources, drive and ability to pursue technological progress. Moreover, market demand sends out only feeble signals to stimulate technological progress ... Approximately 24 per cent of the government-led R and D units above county level have established sustained ties with enterprises and 22 per cent have established consulting relationships."

In addition to the task of linking more closely the science and technology community (see table II.79) to production activities, there is the complementary task of educating and training new crops of engineers, technicians and managers. Currently, these bottlenecks are being partially mitigated through ad hoc arrangements with joint venture partners and makeshift training programmes assisted by foreign aid. The latter include the following:

- *Australian programme*
  China-Australia Non-ferrous Metals Industry Management Training (Beijing); and Australia-China Iron and Steel Training Center (Wuchuan)
- *Canadian programme*
  China Enterprise Management Training Center (Chengdu); and Management Development Center of the Anhui Economic Management Cadre Training Institute (Hefei)
- *French programme*
  University of International Business and Economics Management Programme (Beijing)
- *German programme*
  Shanghai International Training Centre for Management
- *Japanese programme*
  Enterprise Management Center (Tianjin)
- *Netherlands programme*
  Chinese Enterprise Management Training Development Programme
- *United Kingdom programme*
  Master-of-Business-Administration scholarship programmes funded by the United Kingdom Overseas Development Administration, involving the University of Stirling and the University of Lancaster
- *United States programme*
  Dalian Management Centre, China Master-of-Business-Administration Programme with the State University of New York at Buffalo

These programmes usually train 30 to 40 students on short-term courses (a few months) or on two-year courses leading to a degree of Master of Business Administration. Considering the size of the economy, a system of large-scale education and training seems desirable, especially in order to overcome the debilitating effects of the Cultural Revolution on higher learning and human resources development. Although great strides have been achieved in the early

Table II.77. Overall labour productivity by industrial branches with independent accounting systems, 1987-1990
(In yuan renminbi per person per year, at constant 1980 prices)

Industry	1987	1988	1989	1990
Food products	20 167	22 130	22 506	23 586
Grains processing	34 900	37 234	36 838	36 676
Beverages	14 013	15 974	18 438	17 212
Tobacco products	81 589	90 483	92 797	99 218
Fodder products	40 813	51 017	49 087	47 900
Textiles	16 417	17 223	17 267	17 857
Cotton textiles	18 199	18 559	18 303	18 656
Woollen textiles	17 209	18 707	17 550	17 428
Silk textiles	13 195	13 957	14 809	16 759
Leather and fur products	10 741	12 175	13 266	15 311
Timber-processing, bamboo, cane, palm fibre and straw products	7 253	8 321	8 333	8 212
Furniture manufacturing	8 702	10 814	11 786	11 944
Paper-making and paper products	13 322	14 758	15 839	16 559
Printing	10 051	11 519	12 487	13 416
Cultural, educational and sports articles	12 162	13 491	14 399	15 512
Arts and craft articles	8 111	10 214	11 910	12 985
Power generation, steam and hot water productivity and supply	23 775	24 293	24 877	25 015
Petroleum processing	73 862	74 541	77 866	77 317
Coking gas and coal-related products	11 369	11 786	11 798	13 365
Chemical and allied products	18 706	20 589	21 331	22 669
Basic raw chemical materials	13 949	15 254	15 929	16 510
Organic chemical products	27 398	30 030	30 987	33 159
Consumer chemical products	26 090	29 159	29 650	33 700
Medical and pharmaceutical products	30 029	34 743	33 897	37 961
Chemical fibres	43 234	48 373	53 124	59 808
Rubber products	21 200	23 161	25 111	26 129
Plastic products	15 309	18 963	19 644	20 979
Building materials and other non-material minerals	6 010	6 864	7 268	7 916
Cement manufacturing	6 623	7 334	7 171	7 683
Smelting and pressing of ferrous metals	19 160	19 607	19 382	20 475
Smelting and pressing of non-ferrous metals	25 949	25 759	26 966	26 709
Metal products	11 082	12 693	14 021	15 009
Consumer metal products	12 570	14 418	14 776	16 508
Machine-building industry	12 001	14 136	14 629	14 522
Industrial machinery	11 491	13 680	14 389	14 264
Consumer machinery	22 046	23 279	22 888	22 575
Transport equipment	13 368	16 734	18 104	18 797
Electrical equipment and machinery	19 071	22 897	25 050	24 899
Consumer electrical equipment	33 252	47 523	51 554	50 181
Electronic and telecommunications equipment	28 604	38 235	38 193	41 132
Consumer electronic appliances	60 865	86 177	78 485	75 293
Instruments, metres and other measuring equipment	10 867	12 949	13 571	13 485

Source: State Statistical Bureau of China.

1980s (see tables II.80 and II.81), higher education still has a "Long March" to make if it is to serve the modernization needs of industry and improve the livelihood of over 1 billion people.*

*For instance, in 1985 the number of students enrolled at the college level per 100,000 inhabitants was only 168. This figure compares with 776 for India (1980 figure), 1,998 for Thailand (1985 figure) and 3,672 for the Republic of Korea (1985 figure)

K. Concluding remarks

The abandonment of central planning in Eastern Europe and the former USSR along with market liberalization movements in other parts of the world have engendered new appreciation for an old institution—the market mechanism. It has become increasingly clear that functioning market institutions

Table II.78. Composition of government expenditure in China, 1978-1989 (Percentage)

Year	Ratio of government expenditure to national income	Current expenditure: Total	Price subsidies	Enterprises losses	Capital expenditure
1978	41.2	56.5	6.4	2.9	43.5
1979	43.8	58.7	10.9	2.4	41.3
1980	39.6	67.7	16.4	2.3	32.3
1981	37.0	74.2	22.7	2.9	25.8
1982	34.6	76.3	21.6	3.5	23.7
1983	35.5	74.8	18.9	6.2	25.2
1984	34.0	71.2	16.7	4.4	28.8
1985	31.0	72.3	14.1	7.7	27.7
1986	30.9	71.3	9.2	12.3	28.7
1987	27.1	73.3	10.4	13.3	26.7
1988	26.6	74.6	9.8	13.9	25.4
1989	25.5	77.7	11.8	15.1	22.3

Source: Athar Hussain and Nicholas Stern, "Effective demand, enterprises reforms, and public finance in China", *Economic Policy*, vol. 12 (April 1991), p. 156.

Note: Price subsidies largely consist of those on grain, cooking oil and fertilizers.

Table II.79. Government R and D institutes, including social sciences institutes, in China

Type of institute	Number	Number of employees: Total	Scientists and engineers	Technical	Revenues	Expenditures
					(thousands of yuan renminbi)	
County	3 360	78 335	6 172	17 013	214 587	214 587
National[a]	7 047	1 040 830	336 432	206 466	11 229 358	10 934 920
Local[b]	4 706	449 089	122 432	100 753	4 085 906	4 006 874
Ministerial	932	516 843	175 939	95 636	6 247 828	6 050 714
Chinese Academy of Sciences	122	70 510	34 989	9 540	866 316	850 702
Chinese Academy of Social Sciences	33	4 388	3 072	537	29 308	26 630
TOTAL	9 153	1 119 165	342 604	223 479	11 443 945	11 149 507

Source: Denis Fred Simon, "China's drive to close the technological gap: S & T reform and the imperative to catch up", *China Quarterly*, No. 119 (September 1989).

a/ Government institutes above county level.

b/ Government institutes above county level, excluding those directly under the State Council, administered by local government.

cannot be created overnight by decree, that bankers must be trained to recognize the potential profitability of projects and to take risks rationally, that engineers should be retrained to be cost-conscious in combining intermediate inputs, that enterprise managers should be trained in marketing skills in order to compete in the market-place etc.

Not surprisingly, the many sick and insolvent industries in Tropical Africa, the Indian Subcontinent and Latin America appear to confront quite similar problems of incompetence and the shortage and mismatching of skills. By contrast, the industrial dynamism of East Asia has been sustained by its rapidly growing numbers of educated workers and its mastering of new skills (under intensive education and training programmes), that is, through its aggressive and ceaseless efforts to upgrade the technological capabilities of its human resource base. This process has enabled industry to overcome the disadvantage of poor natural resource endowments.*

The brief review of human capital availability in this chapter has highlighted regional differences which have been suggested as an explanation (among other factors) of differences in industrial labour productivity. A caveat should, however, be added. The education-productivity growth nexus does not appear to be such a simple matter;** the skilful organization of educated

*For a concise summary of this thesis and a survey of supporting evidence, see [62] and [63]. For the efforts of economists to theorize with human capital as the centre-piece, see [43] (especially chapter 17) and [64]. For theories taking knowledge as the centre-piece, see [65].

**The Philippines have been shown to possess a higher level of human capital stock compared to its neighbours, but its productivity growth has lagged behind

Table II.80. Selected indicators of higher education in China, 1980-1985
(College level)

Item	1980	1985
Number of institutions	675	1 016
Institutions enrolling postgraduates	316	388
Number of teaching staff, of which	247 000	344 000
Engineering	..	96 046
Agriculture and forestry	..	19 010
Medicine	..	29 184
Natural sciences	..	79 613
Number of postgraduates enrolled	21 604	87 331
Number of students enrolled, of which	1 144 000	1 703 000
Engineering	383 520	580 168
Agriculture and forestry	82 175	106 034
Medicine	139 569	157 388
Natural sciences	83 651	97 707

Source: R.J. Conroy, "The role of the higher education sector in China's research and development system", *China Quarterly*, No. 117 (March 1989), p. 42.

Table II.81. Selected educational indicators of China, 1975 and 1985

Level	1975	1985
Education at first level		
Duration a/	5	5
Official age range	7 to 11	7 to 11
Gross enrolment ratio b/	122	124
Pupils enrolled (millions),	150.9	133.7
of which female b/	45	45
Teaching staff (millions)	5.2	5.4
of which female b/	36	40
Pupils repeating b/	..	..
Pupil to teacher ratio	29	25
Education at second level		
Duration, general education a/	5	5
Official age range, general education	12 to 16	12 to 16
Gross enrolment ratio b/	46	39
Pupils enrolled (millions),	45.4	50.9
of which female b/	39	40
Teaching staff (millions),	2.2	3.0
of which female b/	..	28
Pupils repeating, general education	..	..
Education at third level		
Students per 100,000 inhabitants	54	168
Students enrolled (millions),	0.5	1.8
of which female b/	33	30
Students in scientific or technical fields b/	70	56
Foreign students c/	..	3 250
Teaching staff c/	155 723	344 262

Source: UNESCO, *Statistical Digest 1987* (Paris, 1987), p. 188.
a/ Years.
b/ Percentage.
c/ Number.

human capital seems crucial to the achievement of higher productivity. Organizational differences at the firm level are exemplified by a comparison of incentive structures in the United States and Japan. The possibility of "worker participation" in some aspects of decision-making is thus shown to lead to substantial increases in productivity, motivation and efficiency.*

The important point here is to recognize the need to design corporate (and also market) institutions for each country according to its own "local materials", including the specific characteristics of its human resources, values and political culture. For instance, the extent to which corporate institutions should protect the interest of workers at the expense of shareholders, or vice versa, is an issue that each individual country should solve. It has been noted in this chapter that the Japanese corporate system is quite different from the Anglo-Saxon system in this respect.

Likewise, the German system offers still another variation. Sooner or later the Russian Federation will be faced with the task of formulating and developing its own system. So also will the countries of Tropical Africa. The corporate system seems to be a crucial institutional variable determining long-run productivity and hence industrial survival and growth.** But in the final analysis the building blocks of the corporate system are the human resources that make up its workforce.

The survey presented in this chapter as well as other studies have shown that Tropical Africa and the Indian Subcontinent have been less successful in accumulating human capital than other regions of the world.* It seems clear that unless this human capital imbalance is corrected, a reversal of the widening productivity gap cannot be expected even well into the twenty-first century.** Yet, a reasonably efficient human-capital market does not exist in all countries. Governments and international communities therefore appear to confront a herculean tasks of surrogating the non-existent market in virtually all regions.

*"White collarization of blue-collar workers" is the Japanese approach. See Box II.2. There are many examples and variations of worker participation. See [66]-[73].

**It has been argued that the firm carries "habits and routines" which act as repositories of knowledge and skills, and they represent "organized memory" of the firm. These determine interfirm difference of productivity growth as well as international difference. See [74], particularly chapter 4.

*See, for instance, [75].

**An African scholar's comment aptly sums up the long-run priority: "First, what Africa needs most of all at the moment is intellectual aid, not the ad hoc economic aid that has become standard between the developed countries and the underdeveloped world. The benefits of economic aid have been at best ambiguous. The effects of intellectual aid, based on a new understanding of knowledge as a common heritage of mankind, will be more enduring." See [76].

III. Structural change, interindustry linkages and employment generation

In recent years, ever-increasing attention has been focused on the pervasive problems of poverty in general and on the eradication of its worst aspects in developing countries in particular. As a result, a number of antipoverty strategies and programmes have been formulated and implemented. A few well-known examples are the basic needs strategy to meet the minimal needs of the poorest people, and direct public interventions to provide basic social infrastructure such as water, electricity, sewerage and sanitation.

It seems evident, however, that the fundamental solution to poverty in developing countries is through the creation of productive employment. Employment generation, where feasible, may be preferred to income redistribution as a policy instrument for alleviating poverty and reducing inequality in many respects. Employment policy would be less susceptible to conflicts among various vested-interest groups of the economy than drastic redistribution policy measures. It would be less administratively unwieldy. Above all, the issue of employment touches directly the question of human dignity and hence warrants special treatment [1].

It is in this context of employment generation and consequent poverty-alleviating significance that the nature and evolution of linkages between manufacturing and other sectors of the economy are examined, with special reference to services at different stages of industrialization. In this regard, it should be noted that the contribution of manufacturing to employment generation stems not only from its direct employment effects, but more importantly from its indirect effects through its extensive linkages with the remaining sectors of the economy including the service sector, and through income-induced demand for services as per capita incomes rise.

Broadly speaking, there are two types of linkages, consumption (or income-induced) linkages and production linkages. Consumption linkages arise from the demand for output of another sector created by incomes generated from productive activity in a given sector. Production linkages are typically further categorized by two types; backward linkages which describe the input requirements from other sectors resulting from productive activity in a given sector, and forward linkages in which the production of output in one sector gives rise to a supply of inputs to other sectors. In fact, both backward and forward linkages are two different sides of the same coin, namely a forward linkage of one sector being regarded as a backward linkage of another. But in practice, it is important to know which sector is a catalyst for developing linkages. In this regard, backward linkage is likely to be more important than forward linkage, since the former represents the demand of inputs from other sectors necessitated by productive activity of one sector, while the latter provides an inducement to productive activity of other sectors by making available supplies of a commodity. For instance, an investment decision may inevitably lead to input purchases from various sectors, but the availability of certain inputs alone may not necessarily activate investment activities.

A better understanding of the evolution of intersectoral linkages at different stages of industrialization is important because the nature and extent of intersectoral linkages affect not only the overall growth rate, but also determine the structural balance and international competitiveness of the economy. It should be noted, however, that not all linkages are desirable *per se*; contraction may be preferable to expansion in certain cases. The desirability of linkage depends, among other things, on policy objectives such as employment generation, foreign exchange earnings, technology diffusion, and increasing domestic content.

The sequence of this study is as follows. In section A, the recent performance of manufacturing industry in generating employment in both developing and developed countries is reviewed, with a discussion of structural change in general, the evolution of intersectoral relationships in particular, and the implications of both for employment generation. In section B, the nature and extent of intersectoral linkages of manufacturing industry with other sectors of the economy over time at the aggregate level are examined in the context of selected developing and developed countries. Section C focuses on a more detailed examination of intersectoral relationships between manufacturing and services on the basis of more disaggregated country input-output tables. Various interindustry relationships are examined in greater detail in section D. Some major inferences and their policy implications are presented in section E.

A. Industrialization and employment generation

It has been argued that employment growth in the manufacturing sector has been lagging not only behind its own output expansion, but also behind the growth rate of the urban population, and even behind the growth rate of the total population. The manufacturing sector has thus failed to provide productive employment opportunities for surplus labour in the agricultural sector and other sectors of the economy. As a result, agriculture and services have borne the brunt of surplus labour absorption.*

*For some of the views stressing unsatisfactory employment growth associated with industrialization, see, for example, W. A. Lewis [2], W. G. Tyler [3] and D. Morawetz [1].

Table III.1, which is based on table III.31 in annex II to this chapter, permits an international comparison of the growth rate of MVA with that of manufacturing employment and other relevant variables such as service employment, urban population, total employment and general population in the period 1975-1985. What is most remarkable is not only the marked North-South differences, but also equally significant differences within the South, particularly between Asia and Africa. Both manufacturing employ-

Table III.1. Growth rates of industrialization and employment, 1975 to 1985
(Percentage)

Region, country and area	Average annual growth rates							
	Total population	Urban population	Total employment	Agricultural employment	Service employment	Manufacturing employment	MVA	GDP
Africa								
Burundi	2.54	2.54	4.60	-9.23	15.20	7.67	4.66	4.82
Côte d'Ivoire	3.94	6.39	3.42	0.55	9.43	-0.42	3.79	4.26
Ghana	2.70	2.70	0.44	-1.17	2.53	-3.91	-4.59	0.26
Kenya	3.87	9.32	3.67	0.01	5.13	4.66	7.77	4.43
Sierra Leone	2.26	4.06	1.25	1.90	0.38	3.38	-0.96	1.62
Zambia	3.76	7.41	-0.84	-0.29	0.66	0.90	0.64	0.20
Zimbabwe	3.03	5.86	-0.15	-3.21	2.32	0.71	1.16	2.15
Average[a/]	3.19	5.92	1.37	-1.43	3.63	1.05	1.98	2.46
Asia								
Hong Kong	2.19	2.52	6.61	..	9.59	3.07	7.59	8.89
India	2.17	3.96	2.25	1.25	2.49	1.88	6.37	4.45
Pakistan	3.28	4.42	2.82	1.99	3.67	2.85	8.48	6.68
Philippines	2.62	4.04	3.69	2.82	5.48	2.22	2.21	2.77
Republic of Korea	1.47	4.21	2.38	-3.67	6.31	4.74	11.04	7.66
Singapore	1.24	1.24	3.31	-7.36	3.08	3.02	6.08	7.34
Sri Lanka	1.71	0.36	17.78	17.41	22.02	13.12	2.85	5.30
Thailand	2.24	4.84	2.91	1.49	5.67	5.34	7.18	6.78
Average[a/]	2.26	3.96	3.21	1.77	4.55	3.26	7.21	5.57
Latin America								
Bolivia	2.67	6.68	0.86	0.72	2.30	-0.60	-3.59	0.14
Chile	1.59	2.09	3.20	2.52	4.49	0.80	2.94	3.49
Colombia	2.22	2.37	3.74	1.87	4.14	2.85	2.85	3.79
Cuba	0.80	2.01	2.83	-2.29	4.59	3.94	7.45	5.68
Guatemala	2.83	3.89	1.48	-5.19	16.09	1.01	2.69	2.24
Jamaica	1.39	2.84	1.33	1.91	1.00	2.97	-2.65	-1.57
Panama	2.24	2.04	3.12	2.29	3.93	4.11	2.01	4.56
Trinidad and Tobago	1.54	13.51	1.67	-1.26	2.54	-1.45	0.52	2.64
Venezuela	3.18	3.80	3.84	1.69	4.57	3.91	3.46	1.07
Average[a/]	2.19	2.94	2.97	0.36	4.30	2.65	3.89	2.56
Eastern Europe and USSR								
Bulgaria	0.21	1.65	1.08	1.00	1.29	0.85	6.64	4.49
Czechoslovakia	0.46	1.59	1.65	-1.09	3.18	1.05	2.85	2.65
German Democratic Republic	-0.12	0.01	0.69	1.02	0.94	0.53	5.17	4.34
Hungary	0.11	1.07	0.06	-0.45	0.83	-1.56	2.84	2.50
Poland	0.90	1.97	0.76	0.25	1.64	0.45	0.66	0.21
Romania	0.68	2.17	0.42	-2.31	1.77	2.36	7.06	5.78
USSR	0.87	1.67	1.07	-0.29	1.70	1.97	4.48	4.05
Yugoslavia	0.80	2.52	3.17	2.13	3.35	3.43	4.71	3.07
Average[a/]	0.77	1.64	1.05	-0.37	1.75	1.64	4.41	3.82

Region, country and area	Total population	Urban population	Total employment	Agricultural employment	Service employment	Manufacturing employment	MVA	GDP
	Average annual growth rates							
OECD[b]								
Australia	1.46	1.35	1.34	0.43	2.44	-1.25	1.70	2.93
Austria	-0.03	0.52	-3.11	12.70	-4.97	-3.11	2.97	2.40
Belgium	0.06	3.13	-0.60	-2.17	0.89	-3.06	2.54	1.86
Canada	1.11	0.98	1.91	0.19	2.65	0.47	2.83	3.39
Denmark	0.12	0.60	0.91	-2.94	2.09	-0.25	2.77	2.58
Finland	0.40	0.91	0.65	-3.28	2.46	-1.00	3.92	3.00
France	0.46	0.19	0.17	-3.06	1.96	-1.76	1.22	2.30
Germany, Federal Republic of	-0.13	0.22	0.52	-3.34	1.86	-0.62	1.91	2.24
Ireland	1.12	1.48	0.25	-3.22	2.22	-0.92	5.71	3.39
Israel	2.05	2.40	1.95	0.07	2.89	1.00	2.42	2.85
Italy	0.30	0.30	1.05	-2.52	4.48	-2.49	4.31	3.17
Japan	0.81	0.94	1.07	-2.58	1.95	0.77	7.49	4.44
Netherlands	0.59	2.08	1.03	0.19	2.11	-1.56	2.45	1.81
New Zealand	0.52	0.52	0.93	1.23	1.45	0.69	1.74	1.34
Norway	0.36	4.87	1.67	-0.78	3.25	-1.65	0.45	4.09
Portugal	1.11	2.15	1.37	-2.15	4.27	0.99	2.69	3.15
Spain	0.81	1.63	-1.75	-3.55	0.52	-3.33	1.19	1.56
Sweden	0.19	0.31	0.57	-2.32	1.88	-1.49	0.84	1.56
Switzerland	0.21	0.90	1.06	-1.55	2.46	1.61	1.59	1.52
Turkey	2.32	3.01	3.64	..	4.33	3.16	4.57	3.78
United Kingdom	0.07	0.29	-0.07	-0.94	1.29	-3.20	-0.11	1.88
United States	1.03	1.59	2.24	-0.49	2.79	0.71	3.75	3.05
Average[a]	0.76	1.09	1.12	-2.10	2.31	-0.52	3.38	2.89

Sources: International Labour Organisation, *Yearbook of Labour Statistics*, various issues; World Bank, *World Development Report*, various issues; and UNIDO database.

[a] Weighted group average.

[b] Including Israel.

ment and MVA for selected Asian developing countries as a whole increased at a remarkable rate, although the former (3.26 per cent) lagged considerably behind the latter (7.21 per cent) during the period in question. But the growth rate of manufacturing employment was considerably behind that of service employment (4.55 per cent), and also slightly behind that of the urban population (3.96 per cent). On the other hand, manufacturing employment grew much faster than agricultural employment (1.77 per cent) and even total population (2.26 per cent).

In sharp contrast, selected developing countries in Africa as a whole registered a meagre growth rate for both MVA (1.98 per cent) and manufacturing employment (1.05 per cent), while urban population and total population grew at a rapid rate of almost 6 per cent and 3.2 per cent per year, respectively, accompanied by an average annual decline of agricultural employment by nearly 1.5 per cent. The fastest-growing sector in employment was the service sector (3.63 per cent), absorbing most of the impact of shocks resulting from rural-urban migration and rapid population increase. Employment growth in Latin America appears to lie between the extreme cases of Asia and Africa. Manufacturing employment for the selected developing countries in Latin America as a whole grew at a satisfactory rate of 2.65 per cent per year, ahead of the growth rate of agricultural employment (0.36 per cent) and even total population growth (2.19 per cent), but slightly behind urban population growth (2.94 per cent). But employment growth was the most rapid again in the service sector, at a rate of 4.3 per cent per annum.

By sharp contrast, in the OECD countries as a whole, manufacturing employment actually declined by slightly less than 1 per cent per year, while MVA grew by almost 3.4 per cent per year. Meanwhile, the decline in agricultural employment accelerated at a rate of around 2 per cent per year, while service employment continued to increase at an annual rate of 2.3 per cent, well ahead of total population growth (0.76 per cent) and urban population growth (1.1 per cent). Thus, statistical evidence seems to support the hypothesis of the "deindustrialization" phenomenon spreading throughout the industrialized world with a marked shift in employment creation away from manufacturing and agriculture towards the service industries.

However, this massive restructuring of the labour market towards the service sector could be better understood in the broader context of structural change that has been going on during the past several decades all over the world. It is a stylized economic paradigm that the share of agriculture in total output and employment dominates in the early stages of economic development, but rapidly declines after the initial phases of industrialization, while that of industry expands at the expense of agriculture. Less certain is the pattern of growth in the service sector and its linkages to industry. In fact, Clark and Fisher predicted the emergence of the service economy and deindustrialization in the post-industrial society more than five decades ago ([4] and [5]). They argued that countries could be expected to follow a sequence of primary, secondary and service production in the course of development. Because of the high income elasticities associated with many service activities, the service sector becomes dominant only after the basic needs of the primary sector are met and most demands for manufactured goods are satisfied. This process has become known as the Clark-Fisher hypothesis.

However, the Clark-Fisher hypothesis appears to be inadequate in explaining an important phenomenon occurring in developing countries, namely, the persistent presence of the informal sector. The rapid growth of the informal sector in developing countries makes it difficult to delineate the patterns of structural change over time in the service sector *vis-à-vis* other sectors of the economy. In the early stages of economic development, where agriculture dominates both output and employment, the bulk of new urban migrants pushed out by rural poverty is likely to be absorbed by the informal sector due to the limited capacity of the manufacturing sector to expand employment, and the majority of them may end up in service activities in the informal sector, although some may be involved in unskilled manufacturing.

Obviously, the nature and structure of sectoral output and employment change over different phases of industrialization. At the risk of oversimplification, a stylized model of industrialization is generally characterized by the following three interrelated stages of industrialization: natural-resources- and/or labour-intensive-industrialization, specializing in agroprocessing and light manufacturing; physical-capital-intensive industrialization, producing a wide range of basic industrial materials; and technology- or human-capital-intensive industrialization, focusing on skill-intensive high-technology production with increasing information content.

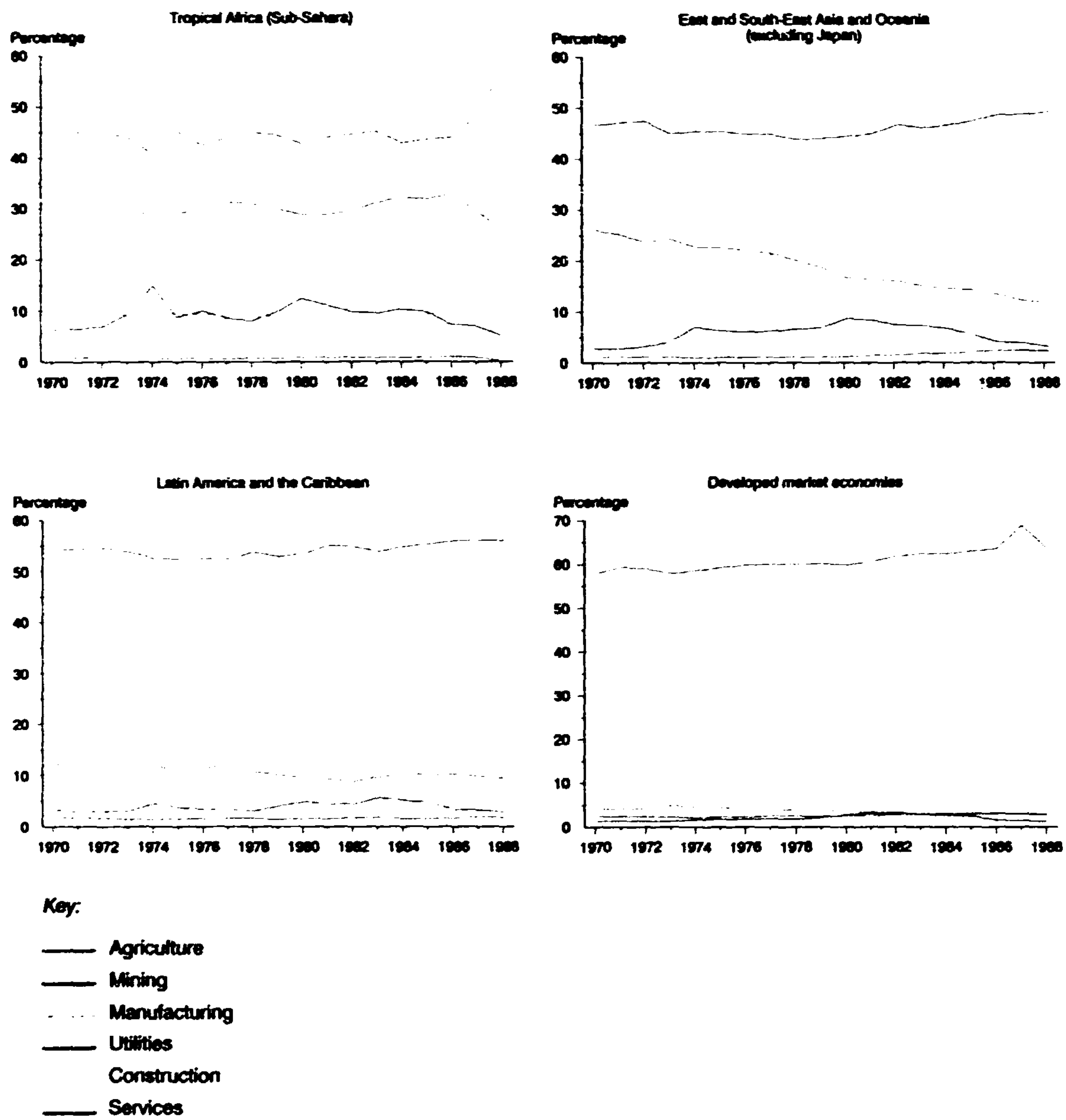
Generally speaking, at the embryonic stages of industrialization, where agriculture dominates both output and employment, service sector employment tends to grow faster than the manufacturing sector, mainly as a result of rapid rural-urban migration, while agricultural employment begins to decline. At the intermediate stages of industrialization, where a network of interindustry linkages begins to take root and industrial output expands, manufacturing employment increases rapidly, although not as fast as its own output. Service employment may increase at a slower rate than manufacturing employment. When the economy attains industrial maturity and moves into the phases of the knowledge-intensive post-industrial society, the service sector again dominates and the manufacturing share of output and employment eventually begins to shrink.

The broad pattern of structural change at the different stages of industrialization described above is more or less reflected in changes over time in the sectoral shares of GDP in different regions of the world as shown in figure III.1 (see table III.32 in annex II of this chapter). In sub-Saharan Africa, where industrial development is still at its early stage, the service share of GDP dominated during the 1970s and 1980s, remaining at about 45 per cent, but rising sharply to a 60 per cent level in recent years, while the agricultural share continued to dip during the same period. Meanwhile, the manufacturing share remained at a low level of slightly less than 10 per cent. Statistical evidence seems to point to a marked shift in output from agriculture to services. At the other end of the development spectrum, output in developed market economies is also dominated by the service sector, steadily rising from 58 per cent in 1970 to above the 60 per cent level in recent years, accompanied by a steady decline in the manufacturing share from around 28 per cent in 1970 to 22 per cent in 1988 and a very small agricultural share of GDP, below the 4 per cent level. Statistical results in both sub-Saharan Africa and developed market economies tend to support the hypothesis that the growth path of the service sector is U-shaped, high at both ends of the development trajectory and slightly declining at the intermediate range. In East and South-East Asia, a sharp increase in the manufacturing share coupled with an equally sharp drop in the agricultural share is quite notable, while both shares remained more or less constant in Latin America during the period considered.

Sectoral employment shares in 1975 and 1985 in various groups of countries as given in table III.2 also tend to corroborate the patterns of structural change described above. Service employment accounted for a relatively large share of total employment at both ends of the development spectrum, namely in Africa at the early stages of industrialization and in the OECD group at advanced stages. A smaller share of service employment was observed for Asia and the formerly centrally planned economies of Eastern Europe and the USSR, and a somewhat larger share for Latin America; all these regions are roughly situated at the intermediate stages of industrialization. More importantly, the share of service employment in total employment increased between 1975 and 1985 in varying degrees for all these country groups. By contrast, the share of agricultural employment fell between 1975 and 1985 in all cases. Not surprisingly, the agricultural employment share in developing countries is generally several times larger than that of OECD countries, whose weighted average share is estimated to have been around 6 per cent in 1985. Meanwhile, manufacturing employment maintained more or less its steady share of 14 to 17 per cent for different groups of developing countries between 1975 and 1985, while the same group average for OECD countries dropped from nearly 27 per cent in 1975 to 23 per cent in 1985, thus showing some signs of the deindustrialization phenomenon.

At this juncture, it seems useful to analyse the sources of employment growth and the shifting composition of employment in the service sector at successive stages of development. The nature and extent of linkages between manufacturing and services in the course of development would affect fundamentally the patterns of structural transformation in the service sector. For instance in the early phases of industrialization, various types of small-scale services in the informal sector dominate the service activities, mainly catering to the needs of low-income groups. As the economy progresses along the path of industrialization, the importance of the informal sector in generating employment steadily diminishes; however, service employment stimulated by interindustry demand for service inputs, particularly producer services, and income-induced final demand for personal and social

Figure III.1. Sectoral changes of GDP by economic grouping and region, 1970-1988



Sources: See table III.3

services expand rapidly. In particular, various institutionalized social services, such as education, health and welfare, would emerge only after the economy produces market surplus at a relatively advanced stage of industrialization. It would appear, therefore, that the employment share of the service sector tends to dominate at both ends of the trajectory of industrialization, as revealed in table III.2, but for entirely different reasons. At early stages, rapid urbanization, fed by accelerating rural-urban migration, swells service sector employment through the urban informal sector, which acts as the residual source of employment. In the intermediate stage of industrialization, service employment expands through linkages of services with manufacturing and other sectors of the economy and through rising per capita incomes, while the pool of informal services continues to shrink. Put differently, demand factors begin to dominate supply factors as a source of employment gains in the service sector, and the composition of service employment also changes drastically in response to structural change caused by industrialization.

At later stages of industrialization, and particularly in the post-industrial society, the service sector claims the lion's share of total employment, not only because it continues to provide increasing employment opportunities, but also, more importantly, because manufacturing employment declines in both absolute and

Table III.2. Sectoral employment share, 1975 and 1985
(Percentage)

Region, country and area	Agricultural employment		Service employment		Manufacturing employment		Other[a]	
	1975	1985	1975	1985	1975	1985	1975	1985
Africa								
Burundi	60.46	14.64	18.63	48.92	9.37	12.50	11.54	23.94
Côte d'Ivoire	21.66	17.29	39.19	61.60	21.46	15.86	17.69	5.25
Ghana	14.24	12.13	52.53	64.57	17.32	11.14	15.91	12.17
Kenya	29.37	20.51	52.01	59.80	12.29	13.52	6.32	6.16
Sierra Leone	8.04	8.57	59.23	54.36	9.53	11.73	23.20	25.34
Zambia	9.17	9.70	43.57	50.63	11.27	13.41	35.99	26.26
Zimbabwe	34.64	26.17	38.10	47.45	14.85	16.05	12.41	10.33
Average[b]	25.50	19.28	44.83	55.90	14.63	14.17	15.04	10.66
Asia								
Hong Kong	-	1.63	40.98	54.00	50.63	36.13	8.38	8.24
India	5.86	5.31	55.63	56.92	26.08	25.16	12.43	12.62
Pakistan	54.80	50.56	26.41	28.69	13.63	13.67	5.17	7.08
Philippines	53.97	49.61	30.82	36.55	10.93	9.48	4.28	4.36
Republic of Korea	45.86	24.94	30.38	44.26	18.64	23.41	5.12	7.40
Singapore	2.09	0.70	65.30	63.86	26.17	25.45	6.44	9.99
Sri Lanka	50.91	49.32	19.57	27.87	18.92	12.64	10.60	10.17
Thailand	72.98	63.50	18.04	23.51	7.46	9.41	1.52	3.58
Average[b]	44.84	38.97	33.01	37.55	16.14	16.21	6.02	7.27
Eastern Europe and USSR								
Bulgaria	22.05	21.86	33.03	33.71	35.27	34.46	9.65	9.96
Czechoslovakia	15.85	12.06	36.64	42.53	35.13	33.11	12.38	12.30
German Democratic Republic	4.04	4.17	42.84	43.89	45.70	44.97	7.42	6.96
Hungary	22.40	21.27	34.81	37.56	35.36	30.03	7.43	11.14
Poland	29.36	27.89	30.29	33.04	27.24	26.42	13.11	12.64
Romania	38.07	28.90	21.97	25.10	30.64	37.10	9.33	8.89
USSR	22.15	19.34	38.68	41.14	26.75	29.24	12.41	10.27
Yugoslavia	5.66	5.11	42.70	43.45	36.90	37.83	14.74	13.61
Average[b]	22.33	19.38	36.83	39.47	28.90	30.64	11.94	10.51
Latin America								
Bolivia	48.10	47.43	31.72	36.55	10.10	8.73	10.08	7.30
Chile	21.57	20.19	52.58	59.58	16.82	13.30	9.03	6.94
Colombia	1.63	1.35	66.61	69.24	23.96	21.97	7.81	7.44
Cuba	28.62	17.18	42.97	50.90	19.73	21.97	8.69	9.94
Guatemala	72.97	36.98	11.99	46.02	12.96	12.38	2.09	4.62
Jamaica	33.79	35.80	47.67	46.16	10.74	12.62	7.79	5.42
Panama	31.94	29.46	46.88	50.70	9.30	10.24	11.88	9.60
Trinidad and Tobago	14.44	10.79	51.50	56.12	20.19	14.79	13.87	18.31
Venezuela	19.94	16.18	54.89	58.87	15.37	15.48	9.81	9.47
Average[b]	24.93	19.28	49.40	56.15	16.69	16.18	8.98	8.40
OECD[c]								
Australia	6.81	6.22	59.66	66.45	21.62	16.68	11.91	10.66
Austria	1.77	8.04	52.02	42.85	33.91	33.91	12.30	15.20
Belgium	3.59	3.06	57.86	67.13	28.95	22.55	9.59	7.26
Canada	6.07	5.12	64.63	69.47	20.15	17.47	9.14	7.94
Denmark	9.76	6.61	58.25	65.41	22.67	20.18	9.33	7.80
Finland	16.91	11.35	47.75	57.10	26.64	22.59	8.69	8.96
France	10.33	7.45	51.12	61.06	27.74	22.84	10.81	8.65
Germany, Federal Republic of	7.01	4.74	47.59	54.32	35.63	31.80	9.77	9.14
Ireland	22.19	15.60	45.71	55.55	21.14	18.81	10.95	10.03
Israel	6.44	5.34	59.29	64.97	24.67	22.47	9.60	7.22
Italy	15.75	10.99	40.12	56.01	32.59	22.81	11.55	10.19
Japan	12.66	8.77	51.31	55.97	25.77	25.02	10.26	10.25
Netherlands	5.66	5.21	59.44	66.14	25.02	19.31	9.88	9.34
New Zealand	10.72	11.04	54.07	56.90	24.29	23.71	10.92	8.35

Region, country and area	Agricultural employment		Service employment		Manufacturing employment		Other[a]	
	1975	1985	1975	1985	1975	1985	1975	1985
OECD[c] (continued)								
Norway	9.31	7.30	56.24	65.64	24.08	17.28	10.37	9.78
Portugal	33.88	23.79	32.00	42.42	25.15	24.22	8.97	9.56
Spain	22.05	18.32	39.68	49.84	26.74	22.73	11.53	9.12
Sweden	6.47	4.84	57.36	65.27	27.70	22.52	8.47	7.37
Switzerland	7.87	6.06	50.83	58.32	33.74	35.62	7.56	-
Turkey	..	1.91	21.78	23.26	46.64	44.51	31.58	30.32
United Kingdom	2.74	2.51	56.72	64.93	31.04	22.58	9.49	9.98
United States	4.08	3.12	65.03	68.62	22.67	19.49	8.22	8.78
Average[b]	8.60	6.23	54.81	61.62	26.81	22.78	9.78	9.37

Source: Annex II, table III.31.

[a] Construction, mining and public utilities.

[b] Weighted group average.

[c] Including Israel.

relative terms. There are many plausible causes for the deindustrialization phenomenon, and for the consequent shift in the structure of employment away from manufacturing to services in the post-industrial society. Most of all, manufacturing is the most dynamic sector of the economy, characterized by rapid technological advances, potential for scale economies, and considerable scope for factor substitution and productivity gains. A substantial increase in labour efficiency and productivity would lead to lower labour input requirements. On the other hand, most service activities are constrained by rigid factor proportions of the labour-intensive type and rather inefficient production processes. For instance, Berry has stressed the paucity of technological change, lagging productivity and a rather narrow range of factor substitution possibilities as a major cause of the expansion of service employment [6].

Even in developing countries, where manufacturing employment is expected to increase rapidly, widespread factor price distortions may often considerably hinder the employment absorption capacity of the manufacturing sector. Wage rates in the modern manufacturing sector tend to be higher than the marginal social cost of labour, while capital is undervalued by credit subsidies (low interest rates) coupled with overvalued exchange rates and favourable treatment of imports of capital goods. All these distorted factor prices, which deviate substantially from their opportunity costs or scarcity values, have undoubtedly contributed to the adoption of more capital-intensive techniques of production in the manufacturing sector.

Moreover, at advanced stages of industrialization, dynamic comparative advantage shifts to high-technology and knowledge-intensive production. The traditional "smokestack industries" lose ground to NICs with cheaper labour costs. This factor alone explains a substantial part of the decline in the absolute number of those in manufacturing employment in many industrialized countries.

In this context, the role of the informal sector in employment generation in developing countries may warrant special attention, since it is a major source of income and employment for a large portion of the labour force in developing countries, and a considerable part of its activities are also related to manufacturing.*

A reliable estimate of the size of income and employment in the informal sector is hard to come by, since activities in the informal sector are unregistered and unrecorded in official statistics. According to a recent ILO estimate, around 30 million people are working in the informal sector in Latin America, and informal sector employment accounted for about 60 per cent of the urban labour force in Africa in 1985, and between 40 and 66 per cent in Asia during the 1980s. Total informal sector employment for developing countries is estimated to be around 300 million, contributing anywhere between 5 and 35 per cent of GDP ([7], p. 11]).

In theory, the importance of the informal sector progressively diminishes and eventually disappears as workers in the informal sector are continuously being absorbed into the formal sectors of the economy, which expand as a result of industrialization, as evidenced in most developed countries and even in a number of NICs such as the Republic of Korea, Singapore and Taiwan Province, which are now experiencing labour shortages. In reality, the problem of the informal sector is likely to persist for a long time to come in most developing countries, mainly due to the inability of manufacturing and other modern sectors to provide gainful employment opportunities to a rapidly increasing labour force. Even during the period of healthy

*Much confusion and ambiguity exists about the term "informal sector". For purposes of the present analysis, the ILO version of the definition is adopted, as follows: "very small-scale units producing and distributing goods and services, and consisting largely of independent, self-employed producers in urban areas of developing countries, some of whom also employ family labour and/or a few hired workers or apprentices; which operate with very little capital, or none at all; which utilize a low level of technology and skills; which therefore operate at a low level of productivity; and which provide very low and irregular incomes and highly unstable employment to those who work in it. They are informal in the sense that they are for the most part unregistered and unrecorded in official statistics. ..." ([7], p. 4). In this context, the underground economy of certain developed countries should not be treated as the informal sector. The underground economy in developed countries exists mainly to evade taxes and certain bureaucratic controls and regulations, and it is rarely generated by the necessity for survival strategies among the poor as in developing countries.

economic growth in the 1970s, employment in the informal sector in relatively industrialized Latin America is estimated to have increased by 3.7 per cent per year. Employment growth in the informal sector accelerated during the recession period of the 1980s, as adjustment policies forced many modern enterprises to downsize their employment. As a result, informal sector employment is estimated to have expanded by 56 per cent compared to a 30 per cent gain in non-agricultural employment in Latin America between 1980 and 1987, while average informal sector incomes declined by 8 per cent during the period. In sub-Saharan Africa, informal sector employment grew by 6.9 per cent per annum, absorbing about 75 per cent of new entrants to the labour market between 1980 and 1985 ([7], p. 10).

It must be recognized that the informal sector in developing countries is not a transitory phenomenon, but a permanent entity, and effective policy measures must be designed to ensure the maximum employment-generating capacity of this sector, and at the same time provide regulation and social safeguards to protect the interests of its workers. It is obviously beyond the scope of this study to deal with a whole host of policy issues related to the informal sector. The literature in this field is already voluminous and still rapidly expanding. However, the linkages between the modern manufacturing sector and the informal sector, mainly in the form of subcontracting work would be of great relevance to this study, since the strengthening of such linkages would not only facilitate the integration of the informal sector into the economy, but also enhance the productive capacity of the economy and employment generation in general.

The foregoing analysis appears to indicate that given the limited capacity of the manufacturing sector to generate employment, the service sector may have to bear the brunt of job creation. But, on closer examination, it can be argued that not only is the employment generating capacity of the manufacturing sector underestimated, but also the capability of the service sector to generate and sustain a high level of employment critically hinges upon its vital linkages with the manufacturing sector.

Recent empirical results related to regional income and employment multiplier analysis in industrialized countries, using input-output techniques, strongly suggest that the direct employment effect of industrial investment is small relative to its indirect effects resulting from the interindustry purchases of inputs and income-induced effects of private consumption. These secondary employment effects are not usually considered when industry is faulted for its inability to generate sufficient employment. Undoubtedly, at the initial stages of industrialization, when interindustry linkages are still weak and per capita incomes are low, the secondary effects may not be significant. However, as the industrial base broadens and becomes more integrated, both vertically and horizontally, the employment impact of industrial activities should also increase substantially.*

*For a comprehensive list of references to the regional multiplier analysis in developed countries, see H. W. Richardson [8] and also Se-Hark Park and others [9]. For the multiplier analysis of the manufacturing sector in developing countries, see W. Galenson [10], P. Mueller and M. Marfan [11], and F. Stewart and P. Streeten [12].

It is in this context of critical linkages between manufacturing and services that the employment strategy may have to be designed. However, the service sector represents heterogeneous activities. It would be essential, therefore, to disaggregate the service sector into more or less homogeneous groups of activities, and to examine separately the linkage of each disaggregated subsector with various manufacturing industries. Not only are both price and income elasticities expected to vary considerably among various service activities, but also, as discussed earlier, the provision of certain types of services, such as institutionalized social services and technology-intensive producer services, are a function of the stages of industrialization in which the economy finds itself. Such a disaggregated approach is adopted for this study.

B. Structural change and intersectoral linkages at the aggregate level

1. *Conceptual and technical issues*

The concept of interindustry linkages, pioneered by Hirschman [13], has received much attention from development economists and policy makers. Input-output tables lend themselves easily to the measurement of such intersectoral linkages. Usually, linkages are calculated to identify key sectors primarily for planning purposes, such sectors being defined as those having the most extensive linkages or highest degree of interdependence with other industries in the economy. Apart from methodological issues involved in the measurement techniques,* there are many serious conceptual limitations to the use of empirically derived linkages as a planning tool. Some of these limitations are discussed below, followed by estimates of simple interindustry linkages. Given these limitations, the empirical results should be interpreted with a great deal of caution.

On the technical level, some of the limitations in the analysis of interindustry linkages result directly from the simplifying assumptions of the input-output model. First, input coefficients are generally given in value terms, and hence may yield different linkage effects for the same physical interrelationships, depending on the structure of relative prices. Second, differences in input coefficients may often reflect differences in the product mix rather than in the production technology. Third, the assumption of linear homogeneous production in the input-output analysis precludes the possibility of scale economies in the interindustry linkage effects. Finally, the linkage measures are sensitive to the level of sectoral aggregation [16].

Equally serious problems exist also at the conceptual level. The implicit assumption underlying the linkage analysis is that a sector with high linkages would impart a growth stimulus to other industries. Many economic and institutional factors must be satisfied if these technological linkages are to be translated into actual growth impulses for other industries. For

*For more recent works on the methodological issues of linkage measures focusing on mathematically consistent measurement methods, see G. Cella [14], and B. J. Clements and J. W. Rossi [15].

instance, the following conditions must be met in order to bring about the desired response to the potential growth inducements implied by the linkage measures. First, the size of demand pressures in case of backward linkages and supply pressures in case of forward linkages should be large enough to provide a viable basis for the establishment of a new firm or the expansion of an existing firm. Secondly, the pool of entrepreneurs should be readily available to respond to these pressures at the right time. Thirdly, complementary factors of production such as skilled labourers, land, capital and raw materials should be readily available. Fourthly, easy access to credit and other financing mechanisms to expand output should be ensured. And finally, a whole host of supportive government policies should be designed and implemented to facilitate the growth of industries induced by high linkages. These policies include various government policy instruments such as taxes, subsidies, licensing, tariffs and other foreign trade controls [16]. Moreover, the relevance of the linkage approach as a criterion for the selection of key sectors in developing countries depends on the development objectives of a given country. Apart from rapid industrialization, they may include rapid increase in per capita income, maximizing employment generation, reducing income inequalities, efficient resource allocation and economic stabilization. Obviously, each of these objectives may require different criteria for selecting key sectors other than on the basis of linkage measures.

Input-output tables for selected countries of the Pacific region, constructed by the Institute of Developing Economies in Tokyo, with the collaboration of the countries concerned, were used to make a cross-country analysis of intersectoral linkages in 1975 and 1985. The countries chosen for the study were China (1985 only), Indonesia, Japan, Malaysia, Philippines (1975 only), Republic of Korea, Singapore and Thailand. Each country table with its own import matrix is aggregated to 6, 13 and 27 industries to facilitate a cross-country and intertemporal comparison. Complete references for the input-output tables used in this study are given in table III.3.

East and South-East Asia has been the most rapidly growing region of the world over the past two decades. For instance, table III.4 shows that the MVA growth rate in this region outpaced that of in other regions by a considerable margin in both the 1970s and the 1980s, except for the Indian Subcontinent in the 1980s. As a result, the structure of these economies as revealed by input-output tables for 1975 and 1985 may not be typical of developing economies in other parts of the world. Nevertheless, given the sufficiently differentiated stages of industrialization attained by the developing countries of East and South-East Asia, the study of this region permits a cross-country analysis of the different patterns of intersectoral linkages over time. Furthermore, current development in this region may be seen as a precursor of the future industrialization of less industrialized countries elsewhere in the world.

Table III.3. Input-output tables used in this study

Country	Year	Source tables by the Institute of Developing Economies, Tokyo
China	1985	*China Input-Output Table 1985* (March 1991)
Indonesia	1975	*International Input-Output Table Indonesia - Japan 1975* (March 1981)
	1985	*International Input-Output Table Indonesia - Japan 1985* (March 1991)
Japan	1975	*International Input-Output Table Japan - Korea 1975* (March 1981)
	1985	*International Input-Output Table Korea - Japan 1985* (March 1981)
Malaysia	1975	*Input-Output Table for Peninsular Malaysia, 1975* (March 1982)
	1985	*Input-Output Table for Malaysia, 1985* (March 1991)
Philippines	1975	*Input-Output Table for the Philippines, 1975* (March 1983)
Republic of Korea	1975	*International Input-Output Table Japan - Korea 1975* (March 1981)
	1985	*International Input-Output Table Korea - Japan 1985* (March 1981)
Singapore	1973	*Singapore Input-Output Tables 1973* (July 1978)[a]
	1985	*Singapore Input-Output Table 1985* (March 1990)
Thailand	1975	*International Input-Output Table Thailand - Japan 1975* (March 1981)
	1985	*International Input-Output Table Thailand - Japan 1985* (March 1991)

Sources: Institute of Developing Economies database and tables.
[a] By the Department of Statistics of the University of Singapore.

Table III.4. MVA annual growth rates by region, 1970-1990
(Percentage in 1980 constant prices)

Economic grouping and region	1970-1980	1980-1990
Developed economies	3.25	3.20
Japan	5.90	6.46
North America	2.85	3.27
Eastern Europe and USSR	6.86	2.84
Western Europe	2.88	1.97
Developing economies excluding China	7.02	3.94
East and South-East Asia	11.54	7.71
Indian Subcontinent	4.46	7.45
Western Asia	7.26	5.02
North Africa	6.44	4.83
Tropical Africa (sub-Sahara)	3.77	1.98
Latin America	6.31	1.07

Source: UNIDO database.

In section 2 of this chapter, an overview of intersectoral linkages between manufacturing and other sectors of the economy at the aggregate level, namely agriculture, mining, construction, public utilities, and services is provided and compared across countries and over time. In section 3, intersectoral relationships between manufacturing and services will be examined in greater detail at more disaggregated levels of industrial classification. In this regard, the nature of manufacturing linkages could be perhaps better understood in the context of the catalytic role that the manufacturing sector plays in the growth of other sectors of the economy through the multiple functions it performs in facilitating the output growth of these sectors. Specifically, the manufacturing sector processes raw materials, produces intermediate goods, and manufactures capital goods as well as a wide range of consumer goods. In performing all these functions, the manufacturing sector helps expand the supply capacity of the economy and hence accelerates economic growth. In particular, this supply-creating aspect of manufacturing activity appears to take on added importance, since one of the major constraints to economic growth in developing countries consists in supply-related bottlenecks such as a shortage of intermediate inputs and capital goods, which are likely to hamper the demand induced growth strategy.

2. *Sectoral dependency ratios*

The dependency ratio measures the degree of importance of an input relative to the total inputs required to produce an output.* Figure III.2 describes sectoral dependency ratios in 1975 and 1985 in selected countries of the Pacific region, and reveals a number of notable general characteristics about the nature and extent of intersectoral relationships in these countries.

(a) *Linkages between manufacturing and construction*

Despite considerable variations among sectors and countries, and with only a few exceptions, the dependence of the non-manufacturing sector on manufactured inputs as a percentage of the total input purchases of the sector was markedly and consistently higher than any other intersectoral measures in the years considered. This general dependence on manufacturing inputs was particularly strong in the construction industries in the selected developing countries of the region as well as in Japan, all of which had ratios exceeding 50 per cent, at the following levels: 78 per cent in 1985 for China; 53 per cent in 1975 and 59 per cent in 1985 for Indonesia; 61 per cent and 64 per cent for Japan; 79 per cent and 69 per cent for Malaysia; 70 per cent in 1975 for the Philippines; 72 per cent and 68 per cent for the Republic of Korea; 85 per cent and 76 per cent for Singapore and 63 per cent and 54 per cent for Thailand. The critical dependence of the construction industry on manufacturing could be readily seen in the vital complementary role that construction plays with the manufacturing sector in capital formation, by putting together manufactured construction materials and installing machinery and equipment in various sectors of the economy.

(b) *Linkages between manufacturing and services*

In general, services appear to be quantitatively the second most important source of inputs to productive activities in the economy, ranging anywhere between 10 and 60 per cent of the total input purchases of a given sector. For instance, the share of service inputs in the total input purchases of the manufacturing sector in all countries except for Japan ranged between 10 and 15 per cent and increased by varying amounts between 1975 and 1985. The same share exceeded the 20 per cent level for Japan. These results seem to confirm the growing importance of service inputs in step with the level of economic development as discussed earlier. However, it is worth noting an asymmetrical relationship, in terms of input requirements, between

*See annex I to this chapter for more precise mathematical definitions of various intersectoral linkage measures used in this study.

manufacturing and services in all the countries considered except Japan; specifically, the share of manufacturing inputs in the service sector seems to be two to three times larger than that of service inputs in the manufacturing sector. But this gap almost disappears in the case of Japan, again underscoring the strategic importance of service inputs to advanced, technologically sophisticated manufacturing. Also, it must be emphasized that a disproportionately large share of service inputs is required by the service sector itself, accounting for 50 to 60 per cent of total input purchases in most cases. This result appears to suggest a high degree of interdependence among various service activities, which will be articulated in greater detail in the next section.

(c) Linkages between manufacturing and agriculture

Equally important in the intersectoral analysis are the agriculture-industry linkages, particularly in the early stages of economic development. The literature is extensive in this field.* It is beyond the scope of this study to provide a comprehensive treatment of the subject. Only certain limited aspects of the linkages between agriculture and manufacturing, as revealed by input-output tables, are discussed in this paper.

*For a comprehensive bibliography, see UNIDO [17].

The importance of linkages between agriculture and manufacturing progressively diminishes as a country develops, although crucial at the initial stages of economic development. At early stages of development, agricultural growth stimulates domestic demand for industrial products and supplies food for industrial workers, raw materials for agro-based industries, and labour to meet the growing needs of industrial expansion. Most importantly, due to its sheer size in terms of output and employment at the early stages of development, agriculture, which is both the largest and the slowest-growing sector in a developing economy, makes a major contribution to the net flow of resources, such as rents, savings, taxes and foreign exchange, to the industrial sector, without which industrial development could not take root and grow. At the same time, industry provides agriculture with intermediate inputs such as chemical fertilizers and pesticides, and with producer goods such as farm implements, irrigation pumps and transport equipment. Furthermore, the acquisition of non-agricultural products become an essential incentive for raising agricultural productivity. However, as countries develop and industrialize and achieve rising household incomes, non-agricultural products account for an increasing proportion of total consumption. Trade provides an outlet for securing food and other agricultural products by exporting industrial goods, and more significantly,

Figure III.2. Input dependency ratios, 1975 and 1985

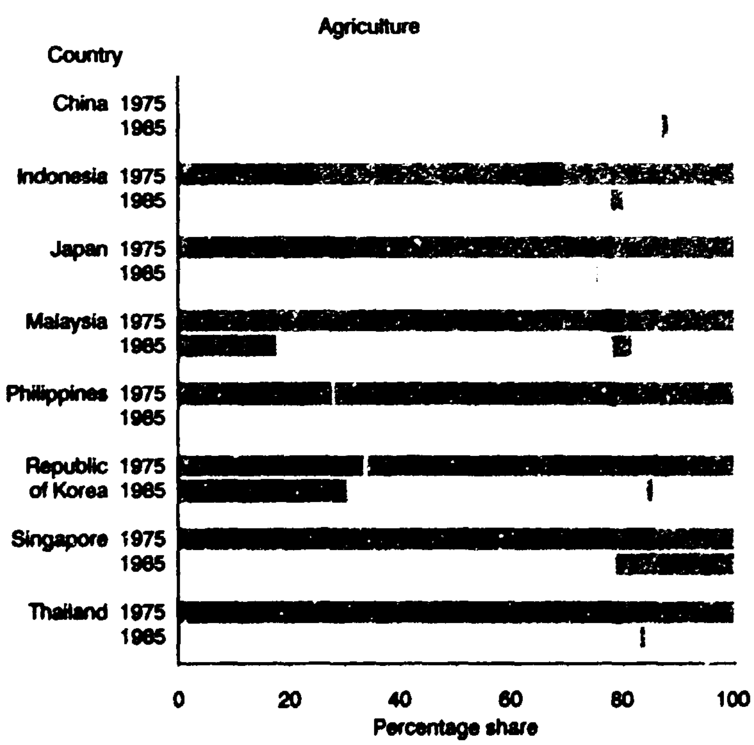
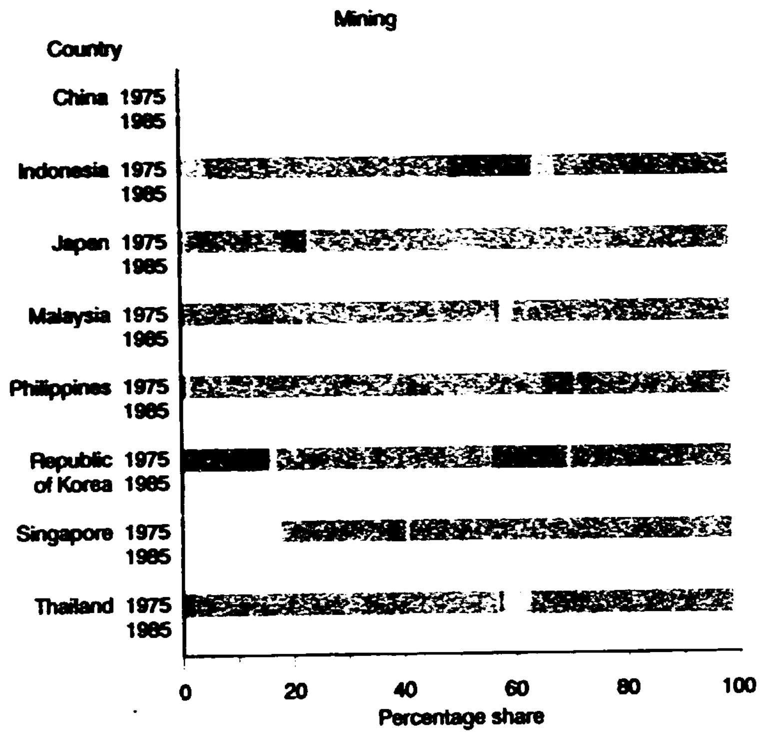
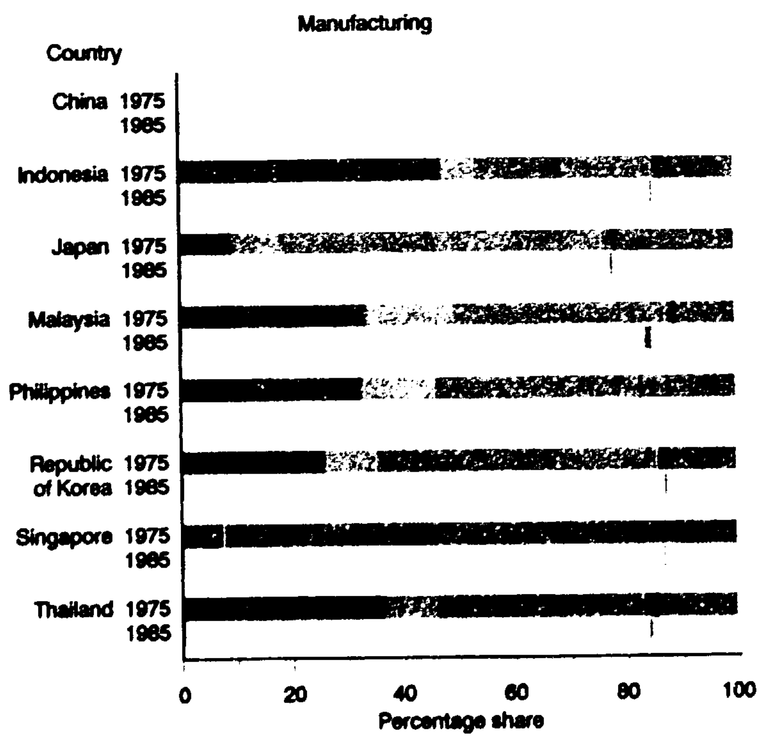
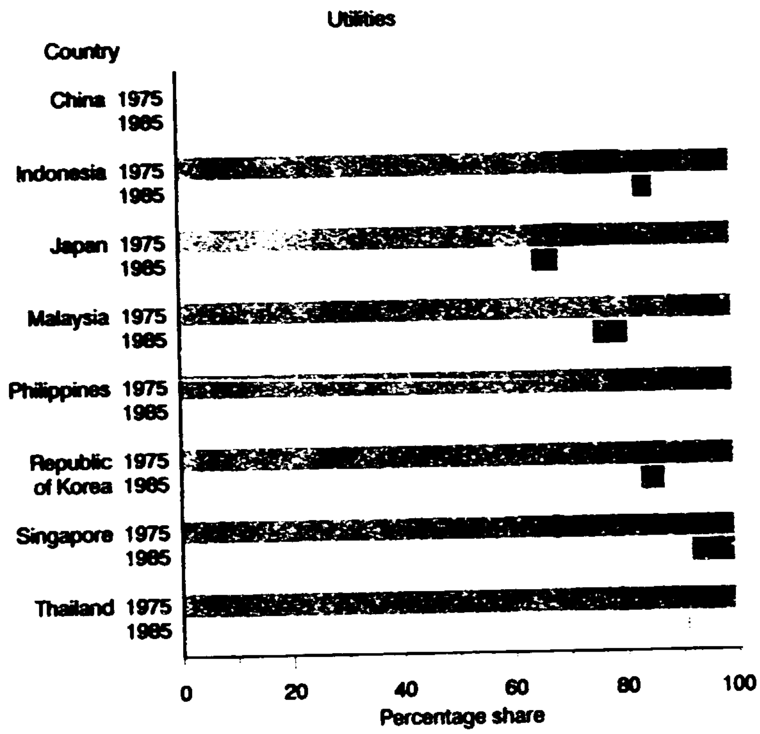


Figure III.2

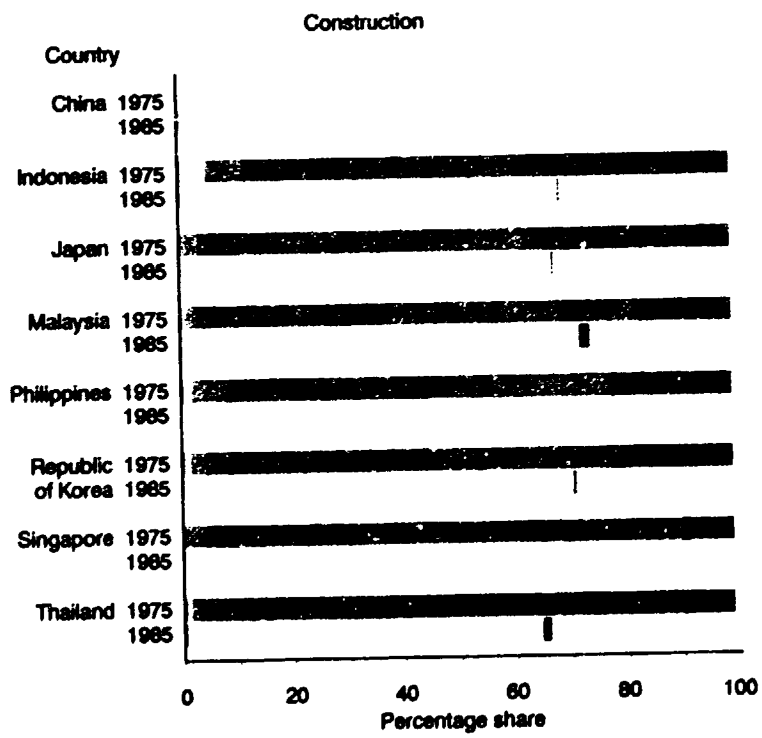

Mining
Country
China 1975
1985
Indonesia 1975
1985
Japan 1975
1985
Malaysia 1975
1985
Philippines 1975
1985
Republic of Korea 1975
1985
Singapore 1975
1985
Thailand 1975
1985
0
20
40
60
80
100
Percentage share


Manufacturing
Country
China 1975
1985
Indonesia 1975
1985
Japan 1975
1985
Malaysia 1975
1985
Philippines 1975
1985
Republic of Korea 1975
1985
Singapore 1975
1985
Thailand 1975
1985
0
20
40
60
80
100
Percentage share

(continued)

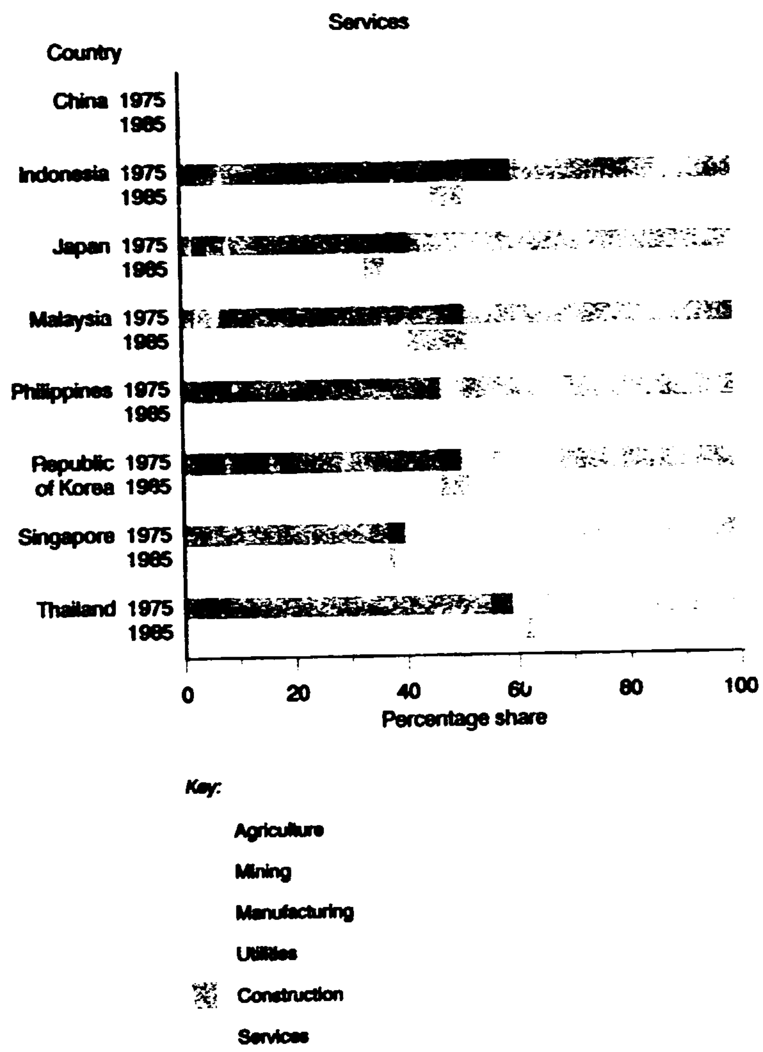


Utilities
Country
China 1975
1985
Indonesia 1975
1985
Japan 1975
1985
Malaysia 1975
1985
Philippines 1975
1985
Republic of Korea 1975
1985
Singapore 1975
1985
Thailand 1975
1985
0
20
40
60
80
100
Percentage share



Construction
Country
China 1975
1985
Indonesia 1975
1985
Japan 1975
1985
Malaysia 1975
1985
Philippines 1975
1985
Republic of Korea 1975
1985
Singapore 1975
1985
Thailand 1975
1985
0
20
40
60
80
100
Percentage share

Figure III.2 *(continued)*



Sources See table III 3

many of the essential resource transfer functions performed by agriculture, involving savings, taxes, foreign exchange etc., are performed by the industrial sector itself at the later stages of economic development.

Figure III.2 shows a relatively high degree of agricultural dependence on manufactured inputs, and this dependence is increased over time in many developing countries. The agricultural dependency ratio on manufacturing increased from 38 to 46 per cent between 1975 and 1985 in Indonesia, and from 47 to 54 per cent in Thailand. It remained about constant at the level of 52 per cent in the Republic of Korea, but declined considerably from 70 to 58 per cent in Malaysia, and from 45 to 37 per cent in Japan during the period under review. Meanwhile, manufacturing requirements of agricultural inputs dropped substantially in all these countries: from 47 to 39 per cent in Indonesia; from 26 to 14 per cent in the Republic of Korea; from 34 to 17 per cent in Malaysia; from 37 to 25 per cent in Thailand; and from 9 to 6 per cent in Japan, all between 1975 and 1985. This substantial reduction of agricultural inputs in manufacturing may reflect a marked structural shift away from light manufacturing and agro-processing industries to capital-intensive intermediate products and some of the more technologically sophisticated products such as transport equipment and electronics goods. Furthermore, it seems that the asymmetrical input dependence between services and manufacturing discussed earlier also holds for linkages between agriculture and manufacturing.

At the early stages of development, given these mutually supportive interactions between agriculture and industry, an unbalanced growth between the two sectors could be potentially damaging to both. If the growth in agricultural production lags considerably behind that of industrial output, imports of agricultural products will increase and divert scarce foreign exchange from the imports of capital and intermediate goods needed for industrial development. Furthermore, the rate of increase of non-agricultural employment, including that of industry, depends on the rate of growth of surplus food supplies from the agricultural sector. Also, as mentioned earlier, growth in agricultural productivity and income is a prerequisite for the growth of purchasing power necessary to sustain industrial expansion.

On the other hand, sustained agricultural development without concomitant industrial development may not materialize, because surplus labour in the agricultural sector will have no alternative outlet for productive employment, which will in turn continue to depress per capita farm incomes. More significantly, since the most important determinant of agricultural productivity, at the early stages of agricultural development, is the increased application of chemical fertilizers and pesticides, and, at its later stages, farm machines and tools, all of which are supplied by industry, agricultural development cannot be sustained without the vital support of manufacturing industries.

Given these vital linkages between agriculture and industry, it is furthermore important to distinguish between the productivity per unit of land and the productivity per farmer under conditions of surplus labour and under-employment, conditions which characterize the agricultural sector in most developing countries. This conceptual distinction is useful because it illuminates the reasons why the average income of farmers in developed countries tends to be strikingly higher than that of farmers in developing countries. Moreover, policy prescriptions for achieving the two objectives are quite different, requiring different adjustments in the agricultural sector and different policy responses from the industrial sector.

Central to this conceptual distinction is the notion that total output in agriculture is determined by the productivity of land, and the per capita agricultural income by the size of the agricultural labour force. It is clear, therefore, that an agricultural development strategy designed to raise agricultural productivity and the income of farmers will involve a two-pronged assault: increasing the productivity of land, and at the same time reducing agricultural employment, since the removal of redundant labour results in the growth of per capita income of the residual farmers under conditions of agricultural surplus labour.*

It has been amply documented in the literature that apart from the development of the full range of necessary institutional supports, such as land tenure reforms, agricultural credits and finance, marketing, extension services and correct pricing, the application of chemical fertilizers and pesticides is the most important determinant of the productivity of the land, and the basic cause of low productivity per unit of land in developing countries is the limited supply of fertilizers, domestically produced or imported.* On the other hand, introduction of farm mechanization is considered to be one of the most important contributing factors to productivity growth per farmer.

As described earlier, agricultural development requires not only a sufficient supply of intermediate inputs from the manufacturing sector to boost productivity per acre at the initial phase of its development, but also capital goods and particularly "capital deepening" through farm mechanization at later stages, with nearly all agricultural capital goods being produced in the manufacturing sector and installed through the construction sector.

(d) *Linkages within the manufacturing sector*

The dependency ratio of manufacturing on its own output sheds some light on the degree of industrialization achieved by various countries. The manufacturing sector uses an increasingly larger proportion of its own output, as the industrial base broadens by extending the range of manufactured goods and expanding a network of domestic supplies of numerous manufactured inputs and capital goods. The volume of interindustry transactions within the manufacturing sector may reflect the extent of linkages within the manufacturing sector and hence the degree of industrial maturity.

The interindustry transactions within the manufacturing sector seem to be relatively significant, having increased appreciably between 1975 and 1985 in all the sample countries except Indonesia: from 32 per cent in 1975 and 29 per cent in 1985 for Indonesia; from 50 to 60 per cent for the Republic of Korea; from 38 to 50 per cent for Malaysia; from 37 to 45 per cent for Thailand; from 81 to 84 per cent for Singapore; and from 58 to 62 per cent for Japan. The dependency ratio was 60 per cent for China in 1985, and 36 per cent for the Philippines in 1975. Moreover, these statistics are generally consistent with theoretical expectations that interindustry transactions within the manufacturing sector increase in step with the degree of industrialization achieved by a given country. Not only manufacturing dependence on its own output for its growth increased over time within a given country, but also a cross-country comparison in a given year shows a systematic variation in dependency ratios according to the degree of industrialization, with the dependency ratios of Japan and relatively more industrialized countries such as the Republic of Korea and Singapore being considerably higher than those of less industrialized countries such as Indonesia, Malaysia, Philippines and Thailand, with the exception of China. Similar empirical relationships between the magnitude of interindustry transactions within each sector and the stages of growth were not, however, observed in other sectors, except for the service sector.

There seems to be an inverse correlation between the importance of primary inputs (agriculture plus mining) to manufacturing and the stages of industrialization. In less industrialized countries of the region, such as Indonesia, Malaysia and Thailand, the manufacturing

*For a more detailed discussion of the theoretical underpinning of this particular agricultural development strategy and empirical evidence supporting this thesis, see S.S. Park ([18], chap. 5).

*For empirical evidence showing positive correlations between the productivity of crops per hectare of land and fertilizer consumption per hectare, see FAO [19].

sector purchased its inputs more from agriculture and mining combined than from its own sector in 1975, but the opposite was true in 1985, except for Indonesia, while the manufacturing share exceeded the primary share in both 1975 and 1985 in Japan and relatively more industrialized countries such as the Republic of Korea and Singapore. For instance, in Malaysia, the primary share decreased from 50 to 30 per cent between 1975 and 1985, while the manufacturing share increased from 38 to 50 per cent during the same period. In the Republic of Korea, the primary share dropped from 35 to 24 per cent, compared with a rise in the manufacturing share from 50 to 60 per cent. In Japan, manufacturing dependence on primary inputs fell from 18 per cent in 1975 to 12 per cent in 1985, compared with an increase in the manufacturing share from 58 to 62 per cent during the same period. Thus, the process of industrialization tends to diminish the importance of the primary sector to manufacturing and increase the dependence of manufacturing on its own output.

(e) *Import content of inputs*

The import contents of intermediate inputs used in production have varied remarkably over time and among sectors within a given country and across countries (see annex II, table III.33). Obviously, non-tradable inputs such as utilities and construction have nearly all come from domestic sources. Also, the import contents of inputs from agriculture and mining have been relatively negligible, with some important exceptions such as utilities in Japan depending on foreign sources for over 20 per cent of its mineral inputs. In general, manufactured inputs have accounted for the bulk of total imports of intermediate inputs by most sectors. Moreover, in some countries, this dependence on imported manufactured inputs increased appreciably between 1975 and 1985; for instance, the import share of manufactured inputs was up from 16 to 18 per cent in Indonesia, from 26 to 36 per cent in Malaysia, and from 20 to 23 per cent in Thailand. In others, dependence diminished during the period. The import contents of total manufactured inputs fell from 30 to 27 per cent between 1975 and 1985 in the Republic of Korea, and from 77 to 70 per cent during the same period in Singapore, perhaps reflecting the increased localization of manufactured intermediate goods in these countries. In sharp contrast, import contents of all inputs including manufacturing were very low in Japan, one major exception being utilities, which depend heavily on imported raw materials. This is hardly surprising in view of the capacity of Japanese industry to produce a wide range of technologically sophisticated intermediate goods as well as final products.

High import contents of the manufactured inputs may reflect scarcities of these inputs and unrealized production potential in various domestic industries in relatively less industrialized countries. Demand pressures created by backward linkages may not necessarily lead to a corresponding expansion of output by potential supplier industries, for a whole host of reasons including technical, socio-economic and institutional factors (to be discussed in the following section), but may instead result in imports of scarce inputs and leakages in domestic production. This problem seems to have emerged and worsened over time in countries such as Indonesia, Malaysia and Thailand, while the problem of import leakages has become less severe in the Republic of Korea and almost non-existent in Japan. It must be noted in this regard that policy measures designed to reduce the import of scarce inputs because of balance-of-payment problems may worsen the situation by sharply increasing the price of the scarce inputs in question, and causing capacity underutilization and slow growth as a result of input shortages in the sector that originally induced the backward linkages.

3. *Interindustry linkages*

A common measure of backward linkages is the traditional output multiplier, which is merely the column sum of the Leontief inverse matrix. The output multiplier represents the cumulative input requirements from other sectors and the given sector, resulting from a unit increase in final demand for the output of that sector. There are many variations of backward and forward linkage indices, such as those developed by Rasmussen [20] and Cella [14].

Aggregate multipliers for eight countries are calculated and presented in table III.5. They are the average of all sectoral output multipliers, namely $\Sigma_i\Sigma_j r_{ij}/n$ where r_{ij} are elements of the Leontief inverse. They represent the total value of production required from all sectors through the successive rounds of interindustry transactions to deliver one unit value of uniformly distributed final demand, that is, with equal weight assigned to each component of final demand. Therefore, any value exceeding unity by this measure shows the extent of interindustry transactions required to deliver one unit increase in final demand, and hence the extent of interindustry linkages.

In table III.5 the first column is derived from the inverse matrices of 27 sectors including imported inputs. These multipliers capture the extent of overall interindustry relations implied by the underlying production technology, and hence represent potential rather than actual linkages. The second column shows domestic multipliers calculated from the input-output matrices net of imported inputs. They represent the extent of linkages based on the domestic industrial production capacity. The last column shows the ratios of the domestic to the total multipliers, indicating the extent of overall domestic self-sufficiency in production, or the complement of this ratio being construed as the extent of overall import dependence in production.

Total multipliers in the first column show considerable variations across countries and over time in some developing countries. Multipliers for Japan and for relatively more industrialized developing countries such as the Republic of Korea and Singapore are considerably greater than those for the rest of the sample group, that is, China, Indonesia, Malaysia, Philippines and Thailand. However, interindustry linkages implied by the multiplier substantially increased between 1975 and 1985 in Indonesia, Malaysia and Thailand, reflecting rapid industrialization in these countries during that period.

On the other hand, the domestic multipliers in most developing countries as shown in the second column

Table III.5. Aggregate output multipliers in selected countries, 1975 and 1985[a]

Country	Year	Output multiplier[b] Total[c] linkages	Domestic[d] linkages	D/T[e] (percentage)
China	1985	2.1298	1.9505	92.33
Indonesia	1975	1.7089	1.4151	84.97
	1985	1.8499	1.5347	84.90
Japan	1975	2.3854	2.0578	87.23
	1985	2.3380	2.0317	87.51
Malaysia	1975	1.9173	1.4907	79.83
	1985	2.1744	1.4822	71.21
Philippines	1975	2.0141	1.5458	79.84
Republic of Korea	1975	2.3451	1.7043	75.74
	1985	2.3655	1.7872	77.43
Singapore	1973	2.5740	1.2834	56.58
	1985	3.0875	1.4711	53.16
Thailand	1975	1.8959	1.5477	83.58
	1985	2.0276	1.5962	79.94

Sources: See table III.3.

a/ 1973 and 1985 for Singapore.

b/ Average of sectoral multipliers, that is, $\sum_i \sum_j r_{ij}/n$, where r_{ij} is an element of the Leontief inverse.

c/ Calculated from total (domestic plus imported) input coefficients.

d/ Calculated from domestic input coefficients only.

e/ Ratio of domestic to total output multiplier.

are considerably lower than their total multipliers, except for China, showing a substantial gap between potential and actual output. The implication is that these developing countries built up an industrial structure nearly comparable to that of developed countries like Japan, heavily relying on imported inputs as shown in the domestic total ratios in the third column. For instance, import leakages of the output multiplier in the Republic of Korea was about 25 per cent. It is well-known that these countries pursued vigorously an export-led growth strategy with mounting imports of intermediate and capital goods financed by rapidly rising export earnings. Particularly, import dependence on intermediate goods is very high in Singapore, accounting for half of the potential output. The expected result occurred, given the nature of a relatively small entrepôt economy like that of Singapore, where the bulk of products is imported, processed and re-exported. By contrast, such import dependence in China was very low, at less than 10 per cent in 1985. The relatively low import dependence in China may reflect its emphasis on heavy industries and the consequent broadening of its industrial base at an early stage of development, which is typical of the growth path of most centrally planned economies. However, given economic liberalization, an emphasis on light manufacturing, and export promotion policies initiated after 1985, more recent data for China may show a greater gap between potential and actual output than was shown in 1985.

As expected, Japan showed the strongest domestic linkages with low import dependence, and the extent of linkages changed little between 1975 and 1985 The result is not surprising, since Japan grew rapidly after 1960 and the interindustry network of production and trade was firmly in place by 1970.

The relative strength of domestic interindustry linkages can also be inferred by comparing the ratios of domestic intermediate sales to final sales in different countries as shown in table III.6. The ratios tend to be

Table III.6. Average ratios of intermediate to final sales in selected countries, 1975 and 1985

Country	1975	1985
China	..	0.50
Indonesia	0.29	0.35
Japan	0.51	0.49
Malaysia	0.34	0.34
Philippines	0.38	..
Republic of Korea	0.43	0.46
Singapore	0.21[a]	0.31
Thailand	0.37	0.40

Sources: See table III.3.
a/ 1973.

correlated with the stages of industrialization across countries, and also increase over time within a given country, except for China and Singapore for the reasons given above. The ratio is highest in Japan, followed by the Republic of Korea, Thailand, Malaysia, Indonesia and Singapore, not counting China.

Broad sectoral multipliers for eight countries are depicted in figure III.3. In general, total sectoral multipliers tend to be higher in secondary industries, such as manufacturing, utilities and construction, than in primary industries, such as agriculture and mining, and in the tertiary sector, including services. The same holds for trade dependence on imported inputs. Singapore is again a major exception to this general pattern.

4. *Import contents of final demand and exports*

The difference between total (potential) and actual output indicates the extent of dependence on imported inputs in production, and this gap was substantial in most cases in the foregoing analysis. There remains the important question of where these imported intermediate inputs are used, for instance, in domestic final demand or in exports. In other words, it would be interesting to determine the total import content of domestic final demand and exports and the sectoral distributions of these imports.

The output multipliers derived earlier provide the linkage effects under the assumption of uniform sectoral distribution of final demand, or per unit increase in final demand for the sectoral output in question. However, any sectoral linkages calculated without considering the level and structure of final demand would often yield grossly misleading results. For instance, without considering final demand pressure, the import content of sectoral output for public utilities is considerable, as shown in figure III.3. But when the existing structure of final demand is taken into account, where the utility sector accounts for less than 3 per cent of total final domestic demand (see table III.7), the resultant import content is expected to be negligible. In a similar vein, both manufacturing and services claim the dominant share of total domestic final demand, as shown in table III.7, and hence a relatively high level of demand pressure in these sectors should be reflected in the high import contents of their output. Likewise, the net export earnings for the non-tradable sectors like construction and utilities should be almost nil. In short, when the linkage effects are based solely on intersectoral demands and neglect the final demand pressures, the relative importance of a sector for income and employment generation is not properly assessed, and hence may lead to the incorrect sectoral prioritization.

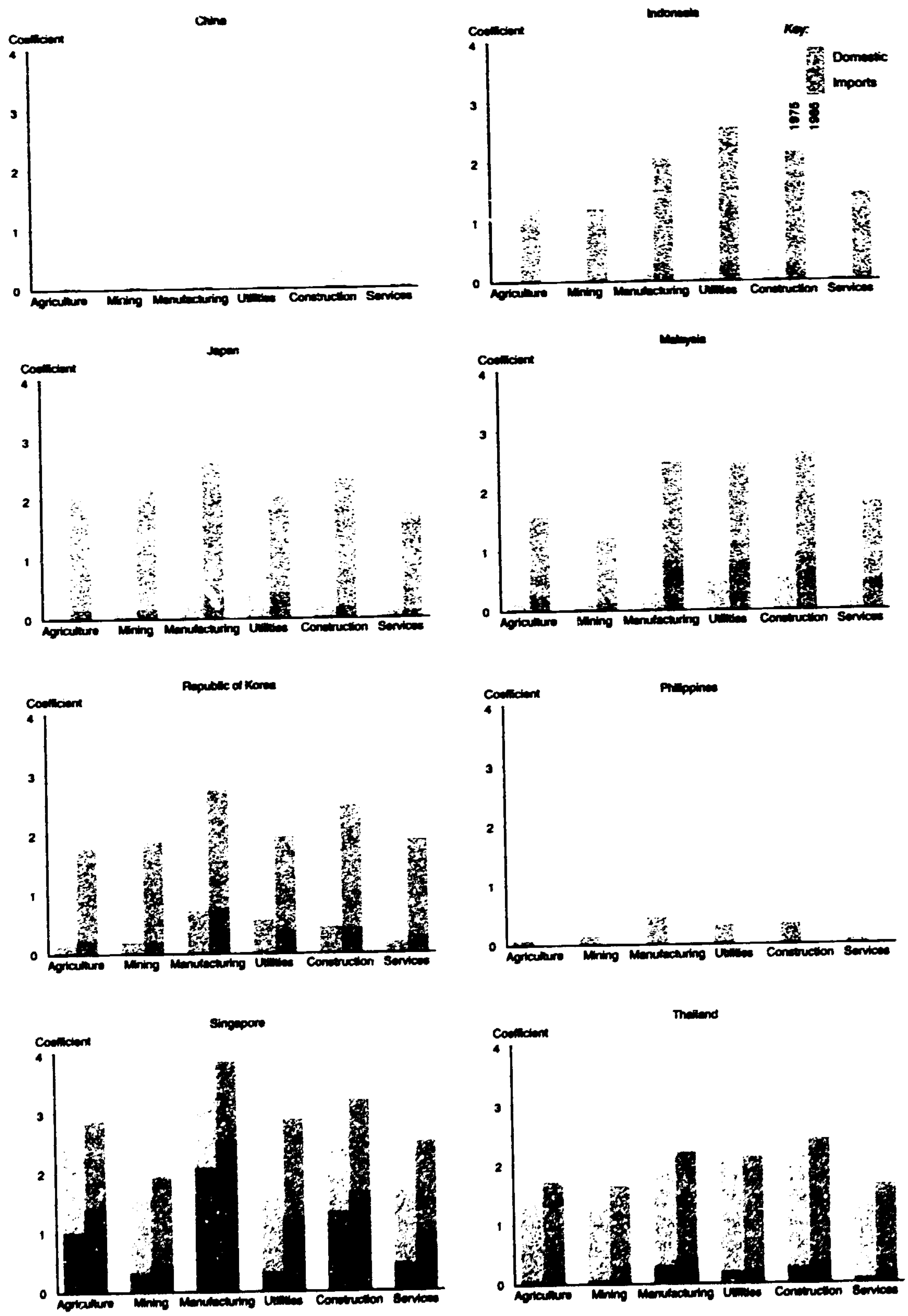
The total (direct and indirect) import content of sectoral output induced by the country-specific composition of final demand is given in table III.8. The import content of total output for the economy as a whole, as given in the last column of table III.8, shows marked intercountry variations. On the lower end of the range, the share of imported intermediate inputs used to meet domestic final demand was around 10 per cent in China and Indonesia, as well as in Japan, but for different reasons. The relatively low level of use of imported inputs in production in China and Indonesia may be attributable to the limited development of interindustry linkages, which is typical of the early

Table III.7. Sectoral distribution of domestic final demand and exports in selected countries, 1975 and 1985
(Percentage)

Country	Year	Agriculture	Mining	Manufacturing	Utilities	Construction	Services
				Domestic final demand			
Malaysia	1975	5.15	0.02	48.13	0.55	5.87	40.29
	1985	7.59	9.51	39.07	0.80	10.46	32.59
Republic of Korea	1975	8.18	0.24	43.07	2.27	12.04	34.20
	1985	6.93	0.07	31.44	1.15	18.17	42.25
Thailand	1975	11.50	0.11	33.04	0.69	11.24	43.43
	1985	6.89	0.29	31.04	1.54	13.15	47.10
				Exports			
Malaysia	1975	2.59	0.39	85.90	0.08	-	11.04
	1985	8.35	22.70	56.02	-	-	12.92
Republic of Korea	1975	6.91	1.02	73.16	-	0.22	18.67
	1985	2.14	0.15	77.49	0.01	0.63	19.51
Thailand	1975	16.52	1.86	60.50	0.19	-	20.94
	1985	6.75	0.54	61.66	0.01	-	31.04

Sources: See table III.3.

Figure III.3. Aggregate sectoral output multipliers, 1975 and 1985



Sources: See table III.3

Table III.8. Sectoral import contents induced by final demand[a] in selected countries, 1975 and 1985[b]
(Percentage)

Country	Year	Agriculture	Mining	Manufacturing	Utilities	Construction	Services	Total
China	1985	0.75	0.20	6.91	0.02	-	0.51	8.39
Indonesia	1975	0.81	0.09	8.02	-	-	0.96	9.89
	1985	0.71	1.18	6.81	-	-	1.23	9.94
Japan	1975	1.50	4.80	2.44	-	-	1.35	10.09
	1985	1.15	4.07	3.18	-	-	1.22	9.61
Malaysia	1975	0.86	4.05	10.24	-	-	0.23	15.37
	1985	0.97	2.36	19.60	0.03	0.10	3.90	26.96
Philippines	1975	1.00	5.59	8.16	-	-	0.09	14.83
Republic of Korea	1975	4.43	4.90	10.52	0.01	-	1.52	21.39
	1985	1.83	5.37	10.33	0.02	-	1.85	19.37
Singapore	1973	3.44	0.07	34.56	-	-	2.57	40.64
	1985	0.84	0.07	44.56	-	-	3.91	49.38
Thailand	1975	0.67	2.73	6.00	-	-	0.46	9.85
	1985	0.78	2.95	9.92	0.01	-	0.46	14.11

Sources: See table III.3.

[a] Sectoral imports of inputs induced by one unit value of total domestic final demand weighted by the existing structure of sectoral demand components.

[b] 1973 and 1985 for Singapore.

Table III.9 Sectoral net export earnings[a] in selected countries, 1975 and 1985[b]
(Percentage)

Country	Year	Agriculture	Mining	Manufacturing	Utilities	Construction	Services	Total
China	1985	11.87	8.36	45.97	-	-	25.94	92.13
Indonesia	1975	7.42	65.68	10.62	-	-	13.16	96.90
	1985	8.65	59.48	15.12	-	-	11.85	95.10
Japan	1975	-2.30	-8.38	74.79	-	-	19.96	84.06
	1985	-1.52	-5.87	76.73	0.04	-	17.34	86.73
Malaysia	1975	1.30	-5.81	73.26	0.01	-	10.86	79.69
	1985	7.15	19.60	36.93	-	-	10.80	74.44
Philippines	1975	20.56	4.52	42.02	0.02	0.03	17.48	84.63
Republic of	1975	0.84	-5.77	60.00	-	0.23	17.21	72.50
Korea	1985	-0.92	-8.75	62.76	0.09	0.63	17.94	71.75
Singapore	1973	-4.15	-	26.71	0.13	-	25.87	48.56
	1985	-0.55	-	21.43	0.57	0.01	22.65	43.72
Thailand	1975	15.54	-2.11	53.48	0.19	-	20.51	87.61
	1985	5.66	-3.89	50.86	-	-	30.64	83.28

Sources: See table III.3.

[a] Sectoral net export earnings induced by one unit value of exports weighted by the existing structure of sectoral exports.

[b] 1973 and 1985 for Singapore.

stages of industrialization, while the low import content in Japan may be explained by its being the world's leading net exporter of manufactured goods including intermediate inputs. An exceptional case in terms of the high level of import content is that of Singapore, with an import dependence of 40 to 50 per cent to deliver final goods. The Republic of Korea comes as a distant second, with an import content of around 20 per cent in both 1975 and 1985. Meanwhile, the import dependence of Thailand increased considerably from about 10 per cent in 1975 to 14 per cent in 1985, and there was a dramatic increase in Malaysia, up from 15 per cent in 1975 to 27 per cent in 1985. As far as the sectoral share of these imported inputs is concerned, the manufacturing sector claimed the bulk of the total imported inputs needed to meet final demand in the selected developing countries, whereas Japan is far less dependent on imported manufactured inputs.

A similar picture emerges for net export earnings, namely export revenues net of imported inputs used for the production of exportables. Sectoral contributions to net export earnings, given the country-specific level and structure of export demand, are shown in table III.9. First, it is not surprising to find that export earnings in non-tradables such as utilities and construction are zero or almost nil in all countries. Secondly, the last column in table III.9 represents net export earnings for the economy as a whole, with the import content of exportables being derived by subtracting net export earnings from unity. The results seem to confirm theoretical expectations that import contents depend on export orientation. In other words, as a developing country moves towards the export of more technologically sophisticated manufactured goods, such as consumer electronics and capital goods, the import contents tend to rise sharply, while countries specializing in the export of primary goods and light manufacturing, such as food processing, leather goods and textiles, are likely to require fewer imported inputs. Such a low import dependence, or high net export earnings, was shown in exportables of relatively less industrialized countries, such as China (92 per cent) and Indonesia (95 per cent), while net export earnings per unit of export were much lower in Singapore (less than 50 per cent) and the Republic of Korea (around 70 per cent), and to a lesser extent lower in the Philippines (85 per cent), Thailand (83 to 88 per cent), and Malaysia (74 to 80 per cent). Thirdly, the manufacturing sector contributed most to total net export earnings in all countries examined here, with the major exception of Indonesia, where mining or oil exports dominated total export revenues. Fourthly, the contribution of the service sector to total net export earnings was the second highest in most cases, ranging from around 12 per cent (11.85/95.10) in Indonesia to 53 per cent (25.87/48.56) of total net export earnings in Singapore. Lastly, although quantitatively insignificant, some exports resulted in negative net earnings, such as agricultural exports in Singapore and Japan, and mineral exports in the Republic of Korea and Japan. These negative results do not lend themselves to easy interpretation.

One of the major implications to be drawn from an examination of the import contents of exports and output induced by final demand is that all developing countries examined in this study generally pursued an export-led growth strategy and expanded their industrial capacity by relying heavily on imported capital goods and intermediate inputs, and particulary manufactured intermediate goods. Thus the empirical results tend to suggest that import dependence on manufactured inputs as well as machinery and equipment continues to increase with the progress of industrial development, until an economy reaches an industrial maturity characterized by the technological capacity to produce a wide range of its own capital goods and industrial inputs, as in Japan. In the language of the stage theory of development, most developing countries in East and South-East Asia are in the second phase of industrialization based on foreign technology, capital goods and components. They are developing local technological capabilities geared to the effective utilization and adaptation of imported technologies. Meanwhile, Japan is in the last phase of human capital-intensive industrialization, during which intersectoral linkages deepens with the emergence of sophisticated capital goods and engineering service suppliers. During this phase, other information-intensive service industries, such as advertising, finance, and insurance, which support international competition in differentiated products, also emerge.

To answer the question raised at the outset regarding the relative importance of imported intermediate inputs used to meet final demand and produce export goods, the total import contents of final demand and exports are calculated and compared for the countries listed in table III.10. The results show that the import contents of exports tend to be higher than those of domestic final demand in most of the countries examined, except for China and Indonesia. It must be noted, however, that the import contents of domestic final demand are also quite considerable and fairly close to the import contents of exports in most cases. This may imply that imported inputs are heavily used to produce for both domestic markets and exports at the same time. Even at an advanced stage of industrialization with a sophisticated technological base, as in the case of Japan, import dependence on intermediate inputs may not be avoidable, and in fact could be substantial, as intra-industry trade in similar but differentiated products, and particularly a large variety of parts and components, becomes increasingly important among trading partners of developed countries.

Table III.10. A comparison of the import contents of final demand and exports in selected countries, 1975 and 1985[a/]
(Percentage)

Country	Year	Final demand	Exports
China	1985	8.38	7.87
Indonesia	1975	9.89	3.10
	1985	9.94	15.94
Japan	1975	10.09	13.27
	1985	9.61	4.90
Malaysia	1975	15.37	20.31
	1985	26.96	25.56
Philippines	1975	14.83	15.37
Republic of Korea	1975	21.39	15.94
	1985	19.37	13.27
Singapore	1973	40.64	51.44
	1985	49.38	56.28
Thailand	1975	9.85	12.39
	1985	14.11	16.72

Sources: Table III.8 and table III.9.
[a/] 1973 and 1985 for Singapore.

On the other hand, data on developing countries that followed an import-substitution strategy may have shown a relatively small gap between potential and actual output, as measured by the difference between total and domestic linkages discussed earlier, and hence a low level of import content. Stated differently, due to the limited export growth and consequent shortage of foreign exchange, these countries may be forced to resort to the available domestic supply of intermediate goods, while the introduction of new technology and imports of intermediate inputs are kept to a minimum.*

5. *Structural change*

There is no commonly accepted method for measuring, testing and comparing the extent of structural change that has occurred over time in a given country. The most serious problem encountered in developing such a measurement method is the lack of a norm against which actual performance could be compared. In the field of development economics, the notion of optimal structure of production of an economy is not only conceptually elusive and extremely difficult to formulate, but also may vary over time and space as affected by a shift in the international division of labour and comparative advantage, thus making its empirical measurement impracticable.

*For empirical evidence, see Y. Kubo [21].

In the absence of a theoretically sound measurement method, an ad hoc approach based on certain "heroic assumptions" will be used. In particular, assuming that the structure of production implied in the 1985 table of input-output coefficients for Japan approximates to a desired, if not ideal, form of industrial structure, Japanese coefficients in 1985 are regarded as a benchmark against which those in other countries may be compared. The evaluation criterion used for this purpose is the inequality coefficient,* that is,

$$u = \left[\sum_i \sum_j (a_{ij} - a_{ij}^b)^2 / \sum_i \sum_j (a_{ij}^b)^2 \right]^{1/2}$$

where a_{ij}^b is an input coefficient of the benchmark economy of Japan, and a_{ij} is an input coefficient of an economy being compared to it.

The inequality coefficients of the manufacturing sector and the entire economy for the selected countries of the Pacific region in 1975 and 1985 are given in table III.11. They provide an overall indication of how close the structure of production of a given country in a given year came to that of the benchmark economy in 1985. It is obvious that the closer the structure of production of an economy examined to that of a benchmark economy, the smaller the coefficient is, and, (in the extreme case) it becomes zero if the two are identical.

Before discussing numerical results, it seems useful to describe briefly the salient features of structural change that occurred in Japan in the last decade. Natural resources constraints in Japan have been a dominant factor underlying its massive industrial restructuring, which has been based on resource-saving strategies and an industrial policy designed to facilitate the implementation of those strategies. Emphasis has been placed on miniaturization, a product mix using fewer imported inputs, and increasing the information content of products coupled with just-in-time inputs inventory management. All these factors contributed to greater efficiency and competitiveness in the manufacturing sector in Japan, with electronics playing a leading role. In this regard, high technology has been instrumental to structural change of the manufacturing industry in Japan. High technology was extensively applied not only to restructure declining industries, such as the materials industries, but also to further stimulate the growth industries, such as processing and assembly. Moreover, for capital goods industries, such as electrical and non-electrical machinery and precision instruments, high-technology products are produced both as an input and an output, thus strengthening both backward and forward linkages with other industries, and contributing to the rapid growth of their markets.

According to the *Global Report 1991/92*, the 1985 per capita GDP in 1980 constant dollars for the countries examined here was as follows: Japan, \$10,620; Singapore, \$6,182; Republic of Korea, \$2,206; Malaysia, \$2,005; Thailand, \$820; Philippines, \$621 and Indonesia, \$560. Apart from Japan, the Republic of Korea and Singapore are the most developed of their group, (excluding Japan) with a relatively b... industrialized base and a diversified structure of exports. Indonesia is the least industrialized, being a late starter in the industrialization race in the mid-1960s; it accelerated its drive to take-off during the 1970s, fuelled by its oil revenues. By 1985, Malaysia was fairly advanced along the path of industrialization, with a well-articulated industrial policy which guided a gradual transition to an export-led growth strategy

*For a detailed explanation of the use of the inequality coefficient method, see H. Theil and others [22].

Table III.11. A comparative measure of structural change relative to the industrial structure of Japan in 1985, selected countries, 1975 and 1985[a/]

		Inequality coefficient[b/]	
Country	Year	Economy as a whole	Manufacturing sector
China	1985	0.6298	0.5154
Indonesia	1975	0.6546	0.5281
	1985	0.6697	0.5479
Japan	1975	0.3160	0.2403
	1985	-	-
Malaysia	1975	0.7335	0.6663
	1985	0.7269	0.6570
Philippines	1975	0.6642	0.5622
Republic of Korea	1975	0.5905	0.5011
	1985	0.4795	0.3914
Singapore	1973	1.0691	1.1454
	1985	0.9487	0.9531
Thailand	1975	0.5665	0.4572
	1985	0.5480	0.4271

Sources: See table III.3.

a/ 1973 and 1985 for Singapore.

b/ $u = [\sum_i \sum_j (a_{ij} - a_{ij}^b)^2 / \sum_i \sum_j (a_{ij}^b)^2]^{1/2}$ where a_{ij} is an input coefficient of a sample country, and a_{ij}^b is an input coefficient of the benchmark economy, that is, Japan in 1985.

from the initial import-substitution strategy. The Philippines and Thailand also underwent a process of transition from an import-substitution to an export-led growth strategy, but only Thailand seems to have succeeded in the export-led industrialization drive so far. The continuing poor performance of the industrial sector in the Philippines and Indonesia appears to be explained partly by the protection of their economies from international competition. However, the four economies of Indonesia, Malaysia, the Philippines and Thailand share the following dominant characteristics: they are primarily resource-based; and the overriding objective of their industrialization is to broaden and diversify the structure of production so as to reduce their dependence on primary exports.

Among the countries compared in table III.11, the Republic of Korea yielded the smallest inequality coefficient, and at the same time registered the largest reduction in the coefficient between 1975 and 1985 for both the manufacturing sector and the economy as a whole. This result is not surprising in view of the rapid industrialization achieved by the Republic of Korea during that period, relying heavily on Japanese capital goods and industrial technology. By contrast, among the countries considered the structure of production in Singapore deviated most from that of Japan as measured by the inequality coefficient. This result also seems plausible, given the special characteristics of the island entrepôt economy of Singapore, with its critical dependence on foreign trade. For instance, in 1988, exports and imports as a percentage of GDP in Singapore were 165 and 205 per cent, respectively, compared with only 13 and 9 per cent, respectively, in Japan. More importantly, a substantial portion of the exports of Singapore consists of re-exports of a wide variety of products ranging from sophisticated electronic goods, such as integrated circuits and computer peripherals, colour television sets and video recorders, to industrial raw materials such as rubber and plywood. For instance, the total exports of Singapore amounted to 87,116 billion Singapore dollars in 1989, of which re-exports accounted for 37 per cent and domestic exports the rest. Refined fuels accounted for about a quarter of domestic exports. In fact, Singapore has become the world's third-largest oil-refining centre, although it does not itself produce any crude oil [23].

The rest of the countries in the sample group fall between the two countries described above. Few countries seem to have changed their structure of production as dramatically as the Republic of Korea. Most of them, in particular Malaysia, Indonesia, Philippines and Thailand, are richly endowed in natural resources, unlike the resource-poor Republic of Korea and Japan, and their human capital base, as well as various social-economic and institutional factors that shape the industrial structure, are vastly different from those of the Republic of Korea and Japan. All these factors may explain a significant difference in structural change between the Republic of Korea and the rest of the group. However, if a similar comparison is made using more recent data for the period since 1985, during which all these South-East Asian countries, except for the Philippines, have enjoyed faster economic growth than any other region in the world, the results might have shown much more rapid structural change in these countries. Nevertheless, the particular assumption that the Japanese model of industrialization should be followed may still be open to question. In this context, it is worth noting that structural change in Japan itself was greatest among the sample group, as measured by the inequality coefficient, which was reduced by 0.32 per cent for the economy as a whole, and by 0.24 per cent for the manufacturing sector, between 1975 and 1985, perhaps reflecting the massive industrial restructuring that occurred in Japan during that period.

C. Linkages between manufacturing and services

1. Sectoral disaggregation

Given the strategic importance of establishing a symbiotic relationship between manufacturing and services in order to achieve rapid industrialization, the relationships between those sectors will now be analysed over time and across countries in much greater detail than in the foregoing sections. Recently, Park [24] and Park and Chan [25] conducted a cross-country input-output analysis of intersectoral relationships between manufacturing and services at different stages of industrialization. Earlier studies suffered from two major shortcomings. First, they were based on cross-section input-output data, and hence liable to all the limitations, both conceptual and empirical, associated with the cross-section analysis in general. Second, all interindustry linkage measures were based on total input-output coefficients, including imported inputs. Thus, the computed linkage measures represented potential rather than actual capacities. As shown earlier, the gap between potential and actual linkages could be quite substantial in developing countries, and some knowledge about the degree of import dependence in production could be essential for a better understanding of intersectoral relationships. The present study attempts to remedy these limitations by focusing on an intertemporal as well as cross-country analysis of intersectoral relationships, by comparing input-output tables for two different years, 1975 and 1985, where available, and more importantly, by using separate import matrices for these tables to estimate the degree of import dependence required to achieve a certain level of interindustry linkages and a broader industrial base in the process of industrialization.

There is no agreed definition of what comprises services. Generally speaking, services include all economic activities other than agriculture, mining, manufacturing, construction and public utilities (electricity, water and gas), although the last item is often included as part of services in some studies. In terms of the International Standard Industrial Classification, services comprise trade and finance, transport and communication, public administration and defence, and other services.* Moreover, there seems to be no

*This "other services" category includes many important activities, such as education services, medical and other health services, legal services, religious organizations, welfare institutions, business services, motion picture production, distribution and projection, domestic services, restaurants, hotels and laundry services. For further reference, see UNCTAD [26].

commonly accepted topology of service activities. In this regard, the classification system developed by Gershuny and Miles seems the most conceptually sound and empirically useful among many different methods for analysing linkages between manufacturing and services [27]. Their classification system is therefore adopted for this study, with some modification. Service activities are categorized into two major groups, marketed services and non-marketed services, and further refined under each group heading as follows:

Marketed services

(a) Producer services. (i) finance, banking, credit, insurance and real estate; (ii) professional services: engineering, architectural and legal; (iii) other services: cleaning, maintenance and security;

(b) Distributive services. (i) transport and storage; (ii) wholesale and retail trade;

(c) Communications;

(d) Personal services (i) domestic services: laundry, barber-shops etc.; (ii) hotel, restaurant and catering etc.; (iii) repairs; (iv) entertainment and recreation.

Non-marketed services

(e) Social services. (i) health, medicine and hospitals; (ii) education; (iii) public welfare; (iv) public administration and legal and military services.

Communications are usually grouped as part of distributive services, but are here separated from the rest of service activities, given the critical role they play in expanding interindustry linkages, and particularly in developing and spreading new information technology, generating a whole new class of information-intensive service industries catering to both producers and consumers.

The five groups of service activities identified above are easily distinguished from one another by the nature of their activities and by different factors governing the supply of and demand for each group of services. For instance, it seems, prima facie, evident that the manufacturing sector develops a direct symbiotic relationship with producer services, communications and distributive services in the course of industrialization.

On the other hand, output and employment associated with personal services are not affected so much by their direct linkage with manufacturing as by the indirect income-induced effects of manufacturing activities, as suggested by the Keynesian income multiplier. More importantly, the character of personal services goes through fundamental changes in the process of industrialization. In the early phases, most personal services are provided in the informal sector through non-market transactions in the family and communal setting. The personal services provided are relatively labour-intensive, unsophisticated and undifferentiated, mainly catering to the rural poor and urban masses. As the economy moves up the ladder of industrialization, the range of personal services provided by the market expands, and products become increasingly specialized and sophisticated in response to discriminating consumer demand for such services, induced by high per capita incomes.

Likewise, the mode of provision of social services exhibits fundamental change at different phases of industrialization. In an agrarian society, most social services are provided through non-market mechanisms established by communal and tribal customs, and practices such as the provision by children of care for the aged. At advanced stages of industrialization, the provision of social services is institutionalized through the political process of budgetary allocation, which supersedes the market process mainly because of externality problems associated with social services. The provision of social services depends not only on the level of income, but also on the choice between private and public goods. Industrialization obviously increases the provision of social services, *ceteris paribus*, through rising per capita incomes, since social services are considered to be superior goods with high income elasticities.

In this regard, it would be difficult to overemphasize the importance of producer services, which emerges at the late advanced stages of industrialization, in enhancing manufacturing competitiveness in the global market. The rapid rise of producer services in developed countries may reflect a whole host of new demands brought on by a rapid change in the global economic environment, including the globalization of financial markets and certain product markets, particularly durable goods such as automobiles, consumer electronics products and semiconductors, and the intensification of global competition and deregulation. Not only are products differentiated to cater to special market niches with increasingly shorter life cycles, but also the production process itself become increasingly broken down into numerous differentiated subprocesses and subassemblies of parts and components, allowing a large number of firms to form vertical interfirm linkages, with each specializing in a few subprocesses or subassemblies.

This dramatic change in the global economy, characterized by internationalization of production, ever-increasing product differentiation, and the disintegration and dispersion of production processes, has created a wide range of new demands for specialized services, such as international trade law expertise, marketing services, plant location surveys, sourcing of parts and components, technical engineering and construction, accounting, recruiting specialized managerial talent and even janitorial services. The rapidly expanding range and complexity of new demands for such producer services has forced many enterprises to rely on outside service suppliers rather than providing them internally. This externalization of service functions may be prompted not only by the consideration of scale economies and the inability of a firm to provide ever-increasing specialized services economically, but also by the substantial cost savings to be derived from the outside purchase of such services, instead of a permanent commitment of resources to meet temporary increases in demand, or from the licensing or purchase of technology, instead of an independent R and D or marketing research effort.

Producer services are required when companies attempt to improve or diversify their products, and to enhance their competitiveness in traditional markets or to penetrate new markets. Producer services are rendered at various stages of production. For instance, an UNCTAD study has identified the service inputs required at the following stages in the production process ([28], p. 177):

(a) Up-stream: pre-production service inputs, such as pre-feasibility and feasibility studies, venture capital, product design and market research;

(b) On-stream: service inputs incorporated into production, such as quality control, equipment leasing, maintenance and repair;

(c) On-stream parallel: supportive service inputs required for the operation of a firm, such as accounting, human resource management, legal services, telecommunications and information networks, insurance, finance, real estate, security and cleaning;

(d) Downstream: post-production service inputs, such as after-sales services and maintenance, advertising, shipping and distribution.

It is apparent that service inputs at three different stages must be closely linked and coordinated to be effective in enhancing the competitiveness of a firm, and such an integrated feedback system within and outside a firm could be maintained only through advanced telecommunication systems and information networks. Information technologies play a crucial role in establishing a symbiotic linkage between manufacturing and services. In fact, recent advances in information technologies have not only increased the information content of products, but also have begun to blur the traditional distinction between tradables and non-tradables, and render increasingly tradable many of the previously non-tradable service activities. For instance, services are considered generally non-tradable because of the inherent nature of service activities, which may be characterized as follows: they are intangible; they are non-storable; and they must be consumed instantaneously at the time of delivery. But these characteristics can be partially or wholly modified by technological developments, such as computerized storage of data flows and remote delivery of services through modern communication networks.

It now becomes clear that the development of producer services is essential to building a competitive manufacturing sector in world markets. But in most developing countries producer services are inadequately developed, and hence often imported. Both demand and supply constraints hinder the development of producer services in developing countries. On the demand side, technologically sophisticated manufacturing, such as the production of advanced capital goods, which requires a whole range of producer services, is not yet developed in many developing countries, particularly at the early stages of industrialization. On the supply side, advanced telecommunications and information networks, a highly developed legal and educational infrastructure, and a sophisticated technological base supported by a skilled workforce are essential to the development of producer services, but most developing countries are seriously deficient in almost all of them.

Given the five broad categories of service activities, the number of permutations of each manufacturing industry with the five service industries multiplies exponentially as the level of disaggregation of the manufacturing sector increases. To make the study manageable, the manufacturing sector is therefore subdivided into three groups formed from two-digit ISIC industries, roughly along the line of progression of industrial processing. The manufacturing subgroups are as follows:

(a) Agrofood processing and light industries: ISIC 31, 32 and 33;

(b) Energy and basic industries: ISIC 34, 35, 36 and 37;

(c) Capital goods: ISIC 38.

2. *Dependency ratios of manufacturing to services*

(a) Manufacturing

The dependency ratio is used to measure the degree of dependency between manufacturing and various service activities, as dealt with earlier. The usual caveats apply when such measures are interpreted. In particular, some estimation errors may arise from the standardization of different input-output tables prepared by different classification methods; the input coefficients include only out-of-house services purchased. The proportion of in-house services, which are usually included as part of the output of the sector, could be substantial; statistics for certain services are weak and perhaps misleading, particularly for social services; like other output, the supply of services may be subjected to scale economies; and finally, the input-output table cannot show the qualitative importance of certain services, such as those associated with telecommunications and information technologies.

The results presented in table III.12 seem to suggest that three manufacturing groups depend on distributive services more than any other types of services in most cases. In Singapore, the share of producer services was greater than that of distributive services in both years for the energy and basic products and capital goods categories, but the share of distributive services exceeded that of producer services slightly for the agrofood processing and light industry group. In the Republic of Korea, the gap between the two service inputs was relatively large in 1975, but substantially narrowed by 1985, for instance the share of producer services for the capital goods group grew from 3.41 to 6.09 per cent between 1975 and 1985, compared to a decline in the share of distributive services from 12.86 to 9.4 per cent during the period.

Not surprisingly, the dependency ratios of manufacturing to social services and to personal services are consistently weakest across countries and manufacturing groups over time. Also, the linkages between manufacturing and communications are quantitatively rather insignificant, but may belie the qualitative importance of telecommunication services in industrial development. As expected, interindustry dependency within the manufacturing sector itself proved to be far more quantitatively significant than any intersectoral ratios between manufacturing and various service groups in all the countries examined. Also, import shares of manufactured inputs are substantial, while almost all the service inputs are domestically provided.

Table III.12. Dependency ratios of selected manufacturing groups, 1975 and 1985

Country and sector or industry	Agrofood processing and light manufacturing[a]				Energy and basic products[b]				Capital goods[c]			
	1975		1985		1975		1985		1975		1985	
China												
Total manufacturing	..		47.63	(3.97)	..		60.74	(10.01)	..		80.80	(32.94)
Distributive services	..		10.46		..		10.35		..		11.80	
Communications	..		0.09		..		0.11		..		0.12	
Producer services	..		1.57		..		1.43		..		2.17	
Personal services	..		1.04		..		0.64		..		0.87	
Social services	..		0.57		..		1.29		..		1.44	
Total services	..		13.74	(0.47)	..		13.82	(0.52)	..		15.68	(0.45)
Indonesia												
Total manufacturing	20.37	(3.99)	21.48	(3.52)	49.18	(19.24)	29.85	(17.39)	78.65	(57.89)	82.28	(54.77)
Distributive services	9.99		11.76		10.61		10.05		16.83		12.76	
Communications	0.11		0.10		0.23		0.33		0.17		0.19	
Producer services	1.03		1.45		2.73		2.57		1.94		2.33	
Personal services	0.46		0.59		0.54		1.99		0.69		0.70	
Social services	0.06		0.05		0.09		0.16		0.06		0.06	
Total services	11.65	(0.18)	13.94	(0.06)	14.21	(0.59)	15.09	(0.68)	19.69	(1.76)	16.04	(1.60)
Japan												
Total manufacturing	43.79	(4.28)	48.52	(4.17)	58.16	(2.81)	60.00	(5.10)	73.90	(2.57)	73.71	(2.85)
Distributive services	9.61		11.75		6.70		8.10		9.49		8.89	
Communications	0.37		0.33		0.55		0.41		0.67		0.48	
Producer services	7.52		6.74		5.63		6.07		7.93		7.54	
Personal services	0.02		0.03		-		-		-		0.02	
Social services	0.25		0.51		0.72		0.84		1.54		1.12	
Total services	17.76	(0.08)	19.36	(0.19)	13.61	(0.06)	15.43	(0.12)	19.64	(0.11)	18.05	(0.17)
Malaysia												
Total manufacturing	34.80	(12.48)	42.19	(16.97)	29.23	(10.89)	36.34	(20.45)	85.33	(40.52)	88.09	(69.30)
Distributive services	8.84		14.55		6.35		6.32		7.77		6.43	
Communications	0.12		0.40		0.05		0.30		0.24		0.29	
Producer services	3.07		7.29		1.59		4.80		2.45		2.45	
Personal services	0.42		0.96		0.38		0.75		1.87		0.71	
Social services	0.06		0.26		0.09		0.25		0.15		0.12	
Total services	12.52	(0.15)	23.46	(-)	8.46	(0.10)	12.41	(0.45)	12.49	(0.21)	10.00	(0.06)
Philippines												
Total manufacturing	31.46	(8.09)	..		33.90	(15.88)	..		71.70	(32.94)	..	
Distributive services	13.74		..		13.01		..		20.63		..	
Communications	0.08		..		0.11		..		0.16		..	
Producer services	1.78		..		2.07		..		3.37		..	
Personal services	0.60		..		0.93		..		0.76		..	
Social services	-		..		-		..		-		..	
Total services	16.20	(-)	..		16.11	(-)	..		24.87	(-)	..	
Republic of Korea												
Total manufacturing	41.78	(8.06)	51.33	(8.40)	55.06	(17.42)	58.20	(13.48)	78.05	(31.13)	79.14	(25.71)
Distributive services	6.71		5.61		9.16		5.85		12.86		9.40	
Communications	0.20		0.34		0.20		0.30		0.47		0.66	
Producer services	1.81		3.52		2.55		3.39		3.41		6.09	
Personal services	0.02		0.01		0.01		0.01		0.02		0.02	
Social services	0.10		0.21		0.11		0.22		0.10		0.38	
Total services	8.83	(0.54)	9.69	(0.48)	12.04	(0.87)	9.77	(0.50)	16.86	(2.61)	16.54	(1.20)

Country and sector or industry	Agrofood processing and light manufacturing[a]				Energy and basic products[b]				Capital goods[c]			
	1975		1985		1975		1985		1975		1985	
Singapore[d]												
Total manufacturing	60.99	(47.69)	74.21	(51.69)	91.69	(85.15)	85.30	(75.04)	84.31	(69.10)	85.16	(59.70)
Distributive services	6.64		6.88		2.23		3.30		5.38		5.17	
Communications	0.46		0.45		0.43		0.21		0.83		0.50	
Producer services	4.89		6.71		3.54		8.26		6.70		7.20	
Personal services	0.23		1.58		0.17		0.30		0.32		0.50	
Social services	0.17		0.18		0.14		0.07		0.25		0.13	
Total services	12.4	(-)	15.80	(0.38)	6.52	(-)	12.14	(0.22)	13.49	(-)	13.49	(0.44)
Thailand												
Total manufacturing	29.44	(4.79)	43.95	(7.71)	39.00	(14.96)	33.57	(15.14)	75.51	(34.79)	71.64	(33.83)
Distributive services	10.87		11.77		9.03		9.46		18.07		18.01	
Communications	0.32		0.48		0.53		0.40		0.40		1.05	
Producer services	0.88		2.03		1.60		1.57		0.75		2.51	
Personal services	0.72		0.53		1.30		0.55		1.10		1.08	
Social services	0.06		0.09		0.17		0.28		0.04		0.54	
Total services	12.85	(0.16)	14.91	(0.14)	12.63	(0.43)	12.27	(0.33)	20.36	(0.98)	23.18	(0.83)

Sources: See table III.3.

Note: Figures in parentheses are percentage shares of imported inputs.

a/ ISIC 31, 32, 33.

b/ ISIC 34, 35, 36, 37.

c/ ISIC 38.

d/ 1973 and 1985 ratios.

(b) *Distributive services*

Distributive services, which are comprised of transport and storage, and wholesale and retail activities, typically constitute the largest segment of the service sector, but, although essential to the production and distribution of goods and services in the economy, they are not a dynamic growth subsector like producer services. In developing countries, these activities tend to be labour-intensive, low-skilled, inefficient, and seriously underreported when a substantial part of them is carried out in the informal sector. As a result, the relative importance of distributive services tends to decline as per capita incomes rise.

Table III.13 summarizes the intersectoral ratios of distributive services. The results show, among other things, a high degree of dependence of these activities on manufactured inputs, ranging from 14 per cent in Singapore in 1973 to 62 per cent in Thailand in 1985. In general, the dependency ratio of distributive services to manufactured inputs dropped appreciably between 1975 and 1985 in all the countries considered except Thailand and Singapore. At the disaggregative levels, as expected, petroleum products and transport equipment are the two most important suppliers of manufactured inputs to distributive services.

The dependence of distributive services on service inputs ranged between 34 per cent in Thailand in 1985 and 82 per cent in Singapore in 1973, and at least equalled their dependence on manufactured inputs. Among various groups of service inputs, distributive services seem to depend most heavily on producer services and their own output as inputs to their production. In particular, over 40 per cent of total input requirements of distributive services in Singapore is provided by the distributive service industry itself. The result is not surprising in the entrepôt economy of Singapore. It is equally worth noting that the share of producer services in distributive services rose considerably between 1975 and 1985 in the Republic of Korea and Japan, from 10 to 15 per cent and from 25 to 37 per cent, respectively, perhaps reflecting the widening application of new technologies and consequent increased demand for producer services in this sector. However, such a discernible pattern of change over time is not observed in the other countries considered.

(c) *Communication services*

Manufactured inputs are essential to the provision of telecommunication services, but their dependence on manufactured inputs varied substantially from country to country. Despite individual variations, these statistics seem to point to a general discernible trend characterized by a decrease in the relative importance of manufactured inputs, and an increase in that of service inputs, as a country advances to a higher stage of industrialization. For instance, the manufactured inputs requirements of the communications industry in the Republic of Korea was sharply down to about 30 per cent in 1985, from 50 per cent of its total input requirements in 1975, while the industry's requirements of service inputs jumped from 25 to 50 per cent of its

Table III.13. Dependency ratios of distributive services in selected countries, 1975 and 1985[a/]

Country	Agrofood processing and light manufacturing	Energy and basic products[b/]	Capital goods[c/]	Total manufacturing[d/]	Distributive services	Communications	Producer services	Personal services	Social services	Total services[d/]
China										
1985	16.90	22.62 (11.03)	9.47 (4.14)	48.99 (0.32)	9.74	0.05	23.30	2.96	7.19	43.24 (-)
Indonesia										
1975	3.54	18.35 (16.65)	22.95 (22.11)	44.84 (11.06)	18.99	1.62	22.01	6.57	1.37	50.56 (5.42)
1985	2.35	24.40 (23.25)	3.30 (2.34)	30.05 (3.94)	19.96	2.76	15.92	24.91	0.57	64.11 (7.14)
Japan										
1975	3.08	18.85 (17.44)	14.22 (13.52)	36.14 (0.74)	24.90	2.37	25.09	0.01	0.67	53.04 (6.01)
1985	4.84	11.09 (9.12)	7.17 (6.40)	23.10 (1.55)	18.70	3.36	37.30	0.06	2.08	61.50 (5.78)
Malaysia										
1975	8.24	23.49 (18.51)	7.38 (6.82)	39.12 (13.08)	8.64	3.51	40.29	7.10	0.33	59.88 (1.49)
1985	4.15	17.89 (13.97)	5.91 (5.01)	27.95 (15.33)	30.04	2.36	25.24	4.18	1.28	63.09 (27.52)
Philippines										
1975	8.39	17.62 (13.44)	9.67 (8.71)	35.68 (3.58)	11.67	2.68	36.15	6.50	-	57.01 (-)
Republic of Korea										
1975	4.43	34.05 (29.40)	6.48 (4.91)	44.97 (4.70)	21.98	3.74	9.86	0.45	0.63	36.65 (5.52)
1985	3.47	32.52 (28.76)	6.08 (4.16)	42.07 (6.23)	19.82	7.51	15.30	0.06	1.47	44.16 (10.03)
Singapore										
1973	5.09	5.31 (3.55)	3.34 (2.81)	13.74 (5.45)	47.24	2.60	25.62	5.12	1.62	82.20 (19.43)
1985	3.71	13.61 (11.52)	8.26 (15.56)	25.59 (8.39)	41.67	2.70	21.04	6.65	0.54	72.61 (19.83)
Thailand										
1975	11.17	28.29 (24.96)	11.20 (10.14)	50.66 (3.53)	15.03	4.21	9.10	12.26	0.27	40.87 (0.46)
1985	10.49	39.27 (35.69)	12.62 (11.63)	62.38 (17.61)	13.59	2.80	8.82	8.53	0.19	33.93 (1.16)

Sources: See table III.3.

a/ 1973 and 1985 for Singapore.

b/ Figures in parentheses in this column represent dependency ratios of distributive services to petroleum products.

c/ Figures in parentheses in this column represent dependency ratios of distributive services to transport equipment.

d/ Figures in parentheses represent import shares.

total input requirements during the same period. The same drastic change also occurred in Malaysia and Indonesia, and to a lesser extent in Japan (see table III.14).

Not surprisingly, three manufacturing branches, namely printing and publishing, petroleum products, and machinery and equipment supplied the dominant share of manufactured inputs to the communications industry in the countries studied. Among service inputs, communication services depended heavily on three types of service inputs, namely distributive services, producer services and its own output. However, with some exceptions, the dependence of the industry on distributive services seems to diminish, in contrast to the increasing need for producer services, as a country industrializes, as was the case in Indonesia, Japan, Malaysia and the Republic of Korea. The Japanese case is particularly remarkable. The share of distributive services in total input uses of the communications industry nearly halved from around 21 to 11 per cent, while that of producer services nearly doubled from 23 to 37 per cent between 1975 and 1985. This dramatic increase in the use of producer services in the communications industry in Japan may reflect the rapid development of sophisticated information technologies, as the information content of both manufacturing and service outputs increased sharply during the period. For instance, many manufacturing branches needed sophisticated information technologies which revolutionalized the entire range of manufacturing operations, including feasibility studies, product design, automation of production processes, quality control, maintenance and inventory control, and marketing and distribution, as well as accelerating the computerization of administrative functions such as accounting, personnel operations, and general data processing. The development of such advanced information technologies and their integration into manufacturing processes has been a key factor in the successful efforts of Japanese manufacturing to gain a competitive edge in the global markets, a process which has attracted much worldwide attention in recent years.

Although communication services depend on their own output to a significant extent, the results in table III.14 generally bear no systematic relation to the level of industrial development of a particular country. In this regard, two statistical anomalies in the table may be worth noting, namely, huge intra-industry transactions in the telecommunications industry in Singapore in 1973 (67 per cent) and in Malaysia in 1985 (67 per cent). However, import statistics show massive intermediate imports in this industry, and hence such anomalies may reflect a development priority of those countries to build up the telecommunications industry, primarily on the basis of imported intermediate inputs and foreign technologies at that time.

(d) Producer services

Table III.15 summarizes the intersectoral relationships of producer services, and reveals, among other things, the following salient points. First, producer services required far fewer manufactured inputs than other services. For instance, the dependency ratio of producer services to manufacturing ranged from 10 to 20 per cent in all countries, except for China, while the same ratio for distributive services ranged from 20 to 60 per cent in various countries (see table III.13). The most important supplier of manufactured inputs to producer services is paper, pulp and printing, followed by fabricated metal products and chemical products.

Secondly, producer services depend collectively on various service inputs to a far greater extent than on manufactured inputs, roughly by a factor of 2 to 5. Above all, the intra-industry transactions within the producer services group seem to overwhelm its backward linkages with other service groups. As the complexity of business operations increases, so does the range of producer services demanded to support such operations. For instance, more than 300 different types of producer services are currently offered to support business operations in the industrial and service sectors in Japan, and their operations are highly specialized, including: legal and financial services; highly technical engineering and consulting services; rental and leasing services involving machinery and equipment, office space, cars and office equipment; manpower training; information and data dissemination; marketing surveys; maintenance and repairs; cleaning; and security services such as inspection, protection and the prevention of industrial accidents ([28], p. 156). In short, a host of specialized producer services are created to respond to the growing technological complexity and diversity of industrial society, with an increasing dependence on their own output as a source of input in expanding such producer services. Such a marked upward trend in the use by the producer services sector of its own output is particularly notable in Indonesia, Japan, Malaysia and Republic of Korea, as shown by a sharp increase in dependency ratios in these countries between 1975 and 1985 (table III.15).

Thirdly, although relatively small in absolute terms, the dependency ratios of producer services to communications are still considerably greater than the same ratios for other sectors. As mentioned earlier, telecommunications services provide much more vital inputs to other sectors of the economy than is recorded in the interindustry table, particularly as a key ingredient in the development and diffusion of information technologies in the production process. Producer services need advanced telecommunications and information networks to develop and offer sophisticated service inputs based on information technologies, in order to facilitate a shift towards an information-oriented way of producing or organizing activities within and between firms. The results may reflect the critical dependence of producer services on advanced telecommunications infrastructure in producing information-intensive services.

(e) Personal services

As discussed earlier, a substantial portion of personal services in developing countries, particularly at the early stages of development, is provided through the informal sector. Personal services provided through the informal sector include not only consumer services such as laundering, car washing, food preparation, tailoring, repairs and petty trade, but also intermediate inputs such as machine and equipment repairs, and minor transport and removal services. Therefore, to the extent that transactions in the informal sector remain unrecorded, the true magnitude of personal services is

Table III.14. Dependency ratios of communications services in selected countries, 1975 and 1985[a/]

Country	Agrofood processing and light manufacturing[b/]	Energy and basic products[c/]	Capital goods[d/]	Total manufacturing[e/]	Distributive services	Communications	Producer services	Personal services	Social services	Total services[e/]
China										
1985	27.63 (12.70)	13.93 (3.83)	33.25 (28.88)	74.81 (0.32)	8.25	0.10	0.19	7.39	3.98	19.90 (-)
Indonesia										
1975	12.87 (4.00)	5.07 (2.74)	10.76 (3.16)	28.53 (2.77)	13.66	1.23	13.13	3.20	7.47	38.69 (3.99)
1985	4.74 (3.00)	4.35 (3.52)	2.69 (2.56)	11.76 (0.64)	12.17	17.68	15.27	8.43	2.08	55.62 (7.15)
Japan										
1975	11.30 (7.48)	3.11 (0.57)	4.44 (4.38)	18.85 (0.40)	20.62	5.26	23.10	0.03	1.34	50.35 (0.96)
1985	8.59 (6.56)	2.46 (1.36)	3.49 (2.35)	14.54 (0.19)	11.36	7.35	37.02	3.65	7.74	67.13 (2.31)
Malaysia										
1975	4.40 (1.71)	22.20 (19.76)	11.83 (4.88)	38.43 (14.37)	9.61	20.60	6.13	3.20	0.01	39.56 (1.07)
1985	2.51 (2.30)	1.66 (1.02)	5.83 (4.95)	10.00 (4.17)	2.85	67.11	6.31	0.78	-	77.05 (64.03)
Philippines										
1975	6.10 (3.33)	12.85 (7.75)	13.60 (9.21)	32.[illegible]5 (3.65)	10.06	1.67	31.19	4.12	-	47.05 (-)
Republic of Korea										
1975	8.50 (6.02)	13.54 (9.62)	28.66 (26.99)	50.70 (9.53)	18.44	0.16	5.60	0.55	0.22	24.77 (0.49)
1985	4.21 (3.65)	8.26 (7.61)	18.49 (18.41)	30.96 (5.24)	7.85	32.07	8.45	0.07	1.05	49.50 (21.61)
Singapore										
1973	3.61 (1.45)	- (-)	5.30 (4.34)	8.92 (2.17)	4.58	66.99	10.60	3.86	0.24	86.26 (51.08)
1985	6.08 (4.89)	0.53 (0.02)	16.18 (15.72)	22.80 (6.90)	5.01	23.09	23.84	11.17	2.33	65.44 (4.21)
Thailand										
1975	12.51 (10.51)	7.21 (4.30)	4.99 (1.91)	24.71 (2.57)	21.70	20.68	18.06	5.55	0.75	66.73 (4.57)
1985	12.65 (8.43)	10.83 (6.87)	7.23 (4.94)	30.71 (7.60)	33.73	9.90	10.62	2.88	0.69	57.80 (1.49)

Sources: See table III.3.

a/ 1973 and 1985 for Singapore.

b/ Figures in parentheses in this column represent dependency ratios of communication services to printing and publishing.

c/ Figures in parentheses in this column represent dependency ratios of communication services to petroleum products.

d/ Figures in parentheses in this column represent dependency ratios of communication services to machinery and equipment.

e/ Numbers in bracket represents import shares.

Table III.15. Dependency ratios of producer services in selected countries, 1975 and 1985[a/]

Country	Agrofood processing and light manufacturing[b/]	Energy and basic products	Capital goods	Total manufacturing[c/]	Distributive services	Communications	Producer services	Personal services	Social services	Total services[c/]
China										
1985	11.06 (8.06)	31.32	15.66	57.97 (2.21)	13.97	5.09	3.81	8.17	3.31	34.34 (0.84)
Indonesia										
1975	3.62 2.10		3.16	8.88 (1.09)	7.01	4.65	13.21	16.60	3.25	44.72 (12.43)
1985	2.90 (2.59)	2.11	5.37	10.38 (4.14)	6.18	4.48	35.98	9.94	4.63	61.21 (12.30)
Japan										
1975	17.74 (17.39)	3.51	2.77	24.02 (0.34)	8.01	2.95	28.58	4.50	0.50	44.59 (0.10)
1985	15.68 (9.86)	3.15	2.98	21.81 (0.28)	4.91	3.59	41.07	5.09	1.91	56.58 (2.47)
Malaysia										
1975	8.99 (6.54)	5.80	7.90	22.69 (8.02)	6.67	2.43	17.91	20.33	1.22	48.56 (0.88)
1985	12.55 (9.89)	2.78	3.25	18.58 (7.46)	3.74	5.55	52.31	6.99	0.98	69.56 (25.76)
Philippines										
1975	12.00 (11.80)	8.31	4.27	24.59 (1.90)	8.87	5.23	44.74	10.16	-	69.00 (-)
Republic of Korea										
1975	17.78 (17.35)	6.13	4.48	28.39 (5.18)	7.52	3.94	19.00	9.25	0.65	40.36 (1.84)
1985	12.84 (7.70)	5.39	4.87	23.10 (1.00)	5.00	3.86	30.30	6.04	3.01	48.21 (2.37)
Singapore										
1973	9.40 (8.38)	1.57	4.49	15.46 (10.15)	8.46	5.32	54.14	4.28	2.02	74.23 (12.70)
1985	7.25 (6.04)	7.79	6.03	21.07 (9.10)	9.05	4.55	52.55	6.75	2.22	75.13 (8.47)
Thailand										
1975	12.01 (10.30)	6.13	4.13	22.27 (2.31)	9.80	11.90	14.33	9.96	0.88	46.87 (1.92)
1985	10.82 (8.26)	14.90	5.08	30.79 (4.08)	15.26	8.82	15.41	5.40	2.61	47.49 (4.97)

Sources: See table III.3.

a/ 1973 and 1985 for Singapore.

b/ Figures in parentheses in this column represent dependency ratios of producer services to paper, printing and publishing.

c/ Figures in parentheses represent import shares.

likely to be underestimated. With these data limitations in mind, the results presented in table III.15 may be highlighted as follows.

The dependency ratios of personal services to manufactured inputs are quite high at the early stages of development, often accounting for over a half of total input purchased by this service group, as was the case in Indonesia, Malaysia, Philippines and Thailand in 1975, and China, Indonesia and Thailand in 1985. But the same ratios in Japan and relatively industrialized countries such as the Republic of Korea and Singapore are substantially lower than in the other countries. More importantly, this dependency ratio is not only inversely related to the level of development, but also decreases over time for all the countries studied. Not surprisingly, a predominant portion of total manufactured inputs are from the food, beverages and tobacco industries, and there is little else from other manufacturing industries, except minor contributions of chemical, petroleum and fabricated metal products.

As a corollary of the above phenomenon, the share of input requirements of personal services from the service sector itself seems to be positively correlated with the level of industrialization, and also increased markedly between 1975 and 1985 in all the countries studied. However, two different patterns of input dependence of personal services emerged for two groups of countries. For those countries at relatively earlier stages of industrialization, such as China, Indonesia and Thailand, with the major exception of Malaysia, the quantitative importance of distributive services dominated that of producer services in terms of service input requirements for personal services, while the converse is true for those countries at relatively advanced stages of industrialization. For instance, in Thailand the dependency ratio of personal services to distributive services increased from 22 to 28 per cent between 1975 and 1985, compared to a small increase in the same ratio to producer services from 2 to around 4 per cent. By contrast, the dependency ratio of personal services to producer services in the Republic of Korea jumped from 15 to 39 per cent, while the same ratio to distributive services declined sharply from 12 to 5 per cent during the same period. It is worth noting that, although small relative to distributive services and producer services, the intra-industry transactions within the personal service group seem to be quite significant. Such a result is not surprising in view of the mutually supportive and complementary nature of various personal services activities which can be found among household services; hotel, restaurant and catering services; entertainment and recreation services, etc. Finally, as expected, the backward linkage of personal services with social services is shown to be weak, and with communications services slightly stronger in most cases.

The diminishing importance of manufactured inputs and increasing importance of producer services or distributive services in the provision of personal services in the course of economic development, as revealed in table III.16, may reflect a fundamental change in the way that personal services are provided over different phases of industrialization. At the early stages of industrialization, the bulk of personal services are technologically unsophisticated, labour-intensive, low in value added and undifferentiated, requiring equally simple and labour-intensive inputs mainly from transport and retail and wholesale trade services. Many personal services at this stage are provided in the informal sector, and hence remain seriously under-reported. On the other hand, at advanced stages of industrialization, personal services become highly differentiated and sophisticated through the incorporation of new technologies catering to the increasingly discriminating tastes of different consumer groups. In particular, the widespread application of information technology in the service sector gives rise to a whole new class of information-intensive service industries for households as well as producers, requiring a wide range of technologically sophisticated producer services as inputs. Some examples of these new services are home video and cable services; direct orders and purchases using personal computers and other electronic communication devices, obviating the need for retail and wholesale outlets; computer software for home entertainment; new home appliances replacing many traditional household services such as cleaning and repairs; and educational software for households. These new services critically depend on the development of an advanced telecommunications infrastructure. These are so-called "progressive services", where substantial productivity gains are made possible through standardization in the delivery and utilization of technology. But some of these new services may also suffer an eventual erosion of the productivity gained at the initial stage of application of computer and telecommunication technologies, as labour-intensive inputs such as scriptwriting and production of software and programmes begin to dominate the cost structure of the new services at the later stages of their life cycle [29].

(f) Social services

Social services as defined in this study comprise a group of heterogeneous activities, namely, health care, education, social welfare, public administration and military defence. All these services have one thing in common, the fact that they are public goods. Hence the amount to be produced is determined by a political process outside the market, but the production of each is governed by different production functions requiring different factor proportions and input requirements. As a result, individual country ratios are expected to be quite disparate, reflecting inter country differences in socio-political factors affecting both the allocation of resources to different categories of social services, and different production technologies. Bearing in mind these limitations, the following salient features can be deduced from the dependency ratios of social services given in table III.17.

In general, manufactured inputs accounted for a greater share of total input requirements of social services than any other inputs. The dependency ratio of social services to total manufacturing ranged from 40 to 66 per cent, compared to a range of 23 to 41 per cent for total services. Unlike other service groups, no single manufacturing subgroup seems to dominate the composition of manufactured inputs required for the provision of social services. Only further disaggregation of social services into more homogeneous groups of activities would make it possible to delineate the

Table III.16. Dependency ratios of personal services in selected countries, 1975 and 1985[a]

Country	Agrofood processing and light manufacturing[b]	Energy and basic products	Capital goods	Total manufacturing[c]	Distributive services	Communications	Producer services	Personal services	Social services	Total services[c]
China										
1985	49.92 (31.04)	5.06	2.37	57.35 (2.14)	10.72	0.52	0.42	4.96	1.36	17.97 (0.64)
Indonesia										
1975	39.81 (35.36)	7.82	2.97	50.60 (6.22)	13.29	0.57	5.40	7.88	0.24	27.38 (5.17)
1985	27.44 (23.62)	12.91	9.94	50.28 (7.03)	15.20	1.23	8.46	5.07	0.43	30.39 (2.86)
Japan										
1975	27.29 (24.34)	5.25	1.54	34.08 (1.82)	19.62	1.51	13.09	2.1[illegible]	0.63	36.99 (0.37)
1985	27.77 (24.10)	7.65	3.58	39.00 (2.23)	13.62	1.92	16.54	3.65	2.82	38.55 (0.46)
Malaysia										
1975	50.00 (46.47)	5.50	3.29	58.79 (13.46)	5.65	2.28	9.57	4.72	0.20	22.43 (0.11)
1985	16.35 (14.36)	6.96	9.91	33.22 (9.61)	6.41	2.84	18.21	8.12	1.50	37.08 (2.21)
Philippines										
1975	32.46 (27.46)	15.42	2.47	50.35 (5.66)	10.73	1.53	9.80	11.94	-	34.06 (2.74)
Republic of Korea										
1975	4.80 (1.32)	25.83	5.37	36.00 (5.18)	11.70	5.14	14.77	6.41	0.51	38.53 (1.84)
1985	3.37 (1.02)	16.80	4.61	24.79 (2.55)	4.79	5.00	38.57	2.95	1.23	52.55 (0.38)
Singapore										
1973	26.67 (21.04)	8.86	7.05	42.59 (18.44)	3.72	2.13	12.91	3.25	1.86	23.87 (-)
1985	28.01 (21.22)	7.45	3.20	38.65 (19.96)	9.82	2.32	20.13	8.73	1.37	42.37 (1.26)
Thailand										
1975	47.96 (44.62)	6.03	3.33	57.32 (3.20)	21.86	0.92	2.44	2.57	0.18	27.97 (0.20)
1985	43.20 (41.22)	5.50	0.93	49.73 (7.89)	27.21	1.90	3.75	0.05	0.02	32.93 (0.28)

Sources: See table III.3.

a/ 1973 and 1985 for Singapore.

b/ Figures in parentheses in this column represent dependency ratios of personal services to food, beverages and tobacco products.

c/ Figures in parentheses represents import shares.

Table III.17. Dependency ratios of social services in selected countries, 1975 and 1985[a]

Country	Agrofood processing and light manufacturing	Enegy and basic products	Capital goods	Total manufacturing[b]		Distributive services	Communications	Producer services	Personal services	Social services	Total services[b]	
China												
1985	14.10	26.5	13.00	53.65	(0.94)	14.95	2.50	0.22	14.57	6.61	38.85	(1.44)
Indonesia												
1975	28.44	19.34	4.67	52.34	(10.30)	17.20	1.04	3.62	5.75	0.71	28.32	(3.57)
1985	24.79	22.85	5.35	52.99	(6.71)	17.69	0.76	4.57	4.64	4.65	32.3!	(0.24)
Japan												
1975	11.18	23.32	5.91	40.40	(2.59)	16.07	1.72	20.72	0.54	0.46	39.52	(2.79)
1985	9.51	24.52	8.48	42.50	(2.81)	12.02	2.57	19.50	0.93	3.35	38.38	(0.48)
Malaysia												
1975	27.59	20.30	4.10	51.98	(15.60)	10.53	1.81	12.96	4.48	7.18	36.96	(1.08)
1985	8.53	6.91	31.68	47.13	(36.54)	4.16	1.61	10.93	5.80	4.39	26.88	(2.45)
Philippines												
1975	-	-	-	-	-	-	-	-	-	-	-	-
Republic of Korea												
1975	11.23	26.62	6.55	44.41	(6.63)	12.37	3.11	7.06	0.46	0.90	23.91	(0.71)
1985	5.02	21.90	24.45	51.36	(15.13)	8.56	2.08	11.15	0.18	1.03	23.01	(0.54)
Singapore												
1973	11.03	25.86	29.45	66.34	(51.75)	2.64	2.55	7.44	3.20	8.71	24.54	(5.97)
1985	7.07	23.22	33.16	63.45	(33.28)	5.88	0.86	14.20	3.09	2.23	26.26	(0.35)
Thailand												
1975	16.08	25.51	4.60	46.18	(8.72)	21.76	1.79	3.15	4.08	4.59	35.37	(0.13)
1985	16.03	16.49	9.07	41.59	(7.90)	25.09	6.56	5.14	1.86	2.71	41.38	(0.11)

Sources: See table III.3.

[a] 1973 and 1985 for Singapore.

[b] Figures in parentheses are import shares.

relative strength of their linkages with specific industry groups, which was not possible due to data limitations.

The dependence of social services on distributive services as a source of inputs is considerable, but the dependency ratio seems to be inversely related to income levels. For instance, the values of this ratio in Indonesia and Thailand in 1985 were 18 per cent and 25 per cent, respectively, much higher than those in Singapore and the Republic of Korea, 6 per cent and 9 per cent, respectively, in the same year. Furthermore, the quantitative importance of distributive services to social services seems to diminish over time in the course of development, as in the case of Japan, Malaysia and the Republic of Korea.

By contrast, the use of producer services in providing social services appears to be modest compared to the use of distributive services at the early stages of industrialization, but becomes quite significant, surpassing the importance of distributive services as a country achieves industrial maturity. For instance, the dependency ratio of social services to producer services in Indonesia and Thailand were around 5 per cent, far smaller than the same ratio to distributive services of 17 to 25 per cent. The ratio of social services to producer services in Japan was about 20 per cent, and, between 1975 and 1985, the same ratio increased from 7 to 11 per cent in the Republic of Korea, and from 7 to 14 per cent in Singapore. In fact, although small, the same ratio increased even in Indonesia and Thailand during that period. Malaysia was an exception, where the ratio declined slightly from 13 to 11 per cent.

The above empirical results are consistent with the earlier observation that at the initial stages of industrialization, most social services are provided in the family and communal setting requiring few producer services, but at advanced stages of industrialization, the provision of social services is institutionalized, requiring considerable specialized producer services, particularly managerial, financial, legal and technical services. Finally, the dependency ratios to social services to other service inputs do not seem to reveal any systematic pattern of change with regard to the levels of development.

D. Multiplier analysis

1. Output multipliers

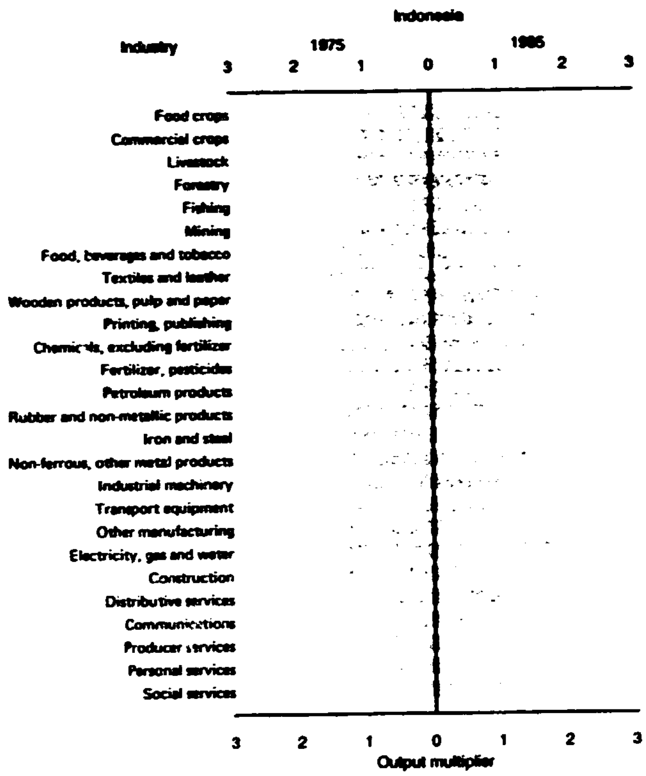
To assess the impact of any sectoral activity (output, income and employment) on the economy at large and on any specific sectors, the total (direct and indirect combined) effects of such an activity must be considered, whereas conventional cost-benefit analysis disregards such indirect linkages and the externalities arising out of them. This is because the production of each product requires direct inputs of various goods and services (backward linkages). Moreover, each of these inputs has its own sets of inputs, and this process continues in ever-decreasing magnitudes in successive rounds. Therefore, the multiplier effect of any sectoral activity should include not only the direct backward linkages, but also the sum of effects resulting from these linkages in successive rounds. This takes on added significance for manufacturing activities, because the direct income (or employment) effect of the manufacturing sector is generally known to be relatively small, but its indirect and income-induced linkages provide a strong stimulus for output and employment expansion in other sectors, including services. The output multiplier provides such a measure of backward linkages, which traces the cumulative effects of a unit increase in final demand for the output of a specific sector on the input requirements from all sectors. Mathematically speaking, the output multiplier is the column sum of the Leontief inverse.

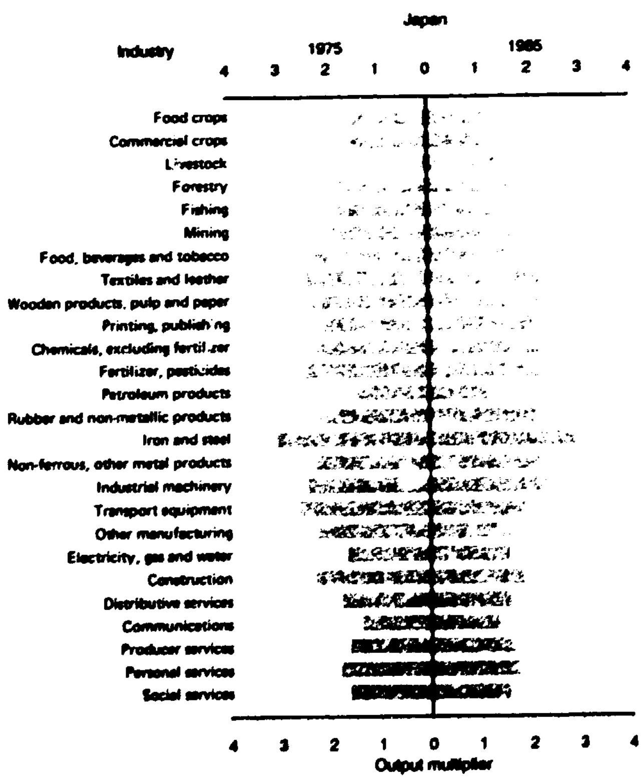
Estimates of output multipliers according to sectors of origin in the selected countries of the Pacific region in 1975 and 1985 are depicted in figure III.4 (see table III.34 in annex II to this chapter). The multiplier measured by the total length of a bar in the figure represents potential rather than actual effects, while the unshaded portion of a bar corresponds to actual production effects netting out the import leakages, which is represented by the shaded portion of the bar. The multiplier varies substantially from sector to sector and across countries over time. In general, as discussed earlier, sectoral multipliers tend to be higher in Japan and more industrialized developing countries such as the Republic of Korea and Singapore, than in less industrialized developing countries such as Indonesia, Malaysia, Philippines and Thailand, but all developing countries except for China show a considerable gap between potential and actual production effects compared to that in Japan, underscoring a heavy dependence of these economies on imported intermediate goods.

In table III.18, sectoral multipliers for each country are ranked in descending order to facilitate their international comparison over time. A number of interesting patterns seems to emerge from such a ranking. First, both primary sector industries (agriculture, forestry, livestock, fishery and mining) and service industries are mostly found in the lowest quintile in terms of both total and domestic output multipliers, with some exceptions. The result is not surprising in view of the expected relatively low backward linkages of these industries. A major exception is the livestock industry, the domestic multipliers of which ranked among the top five in many countries, including Japan, Malaysia, Republic of Korea, Singapore and Thailand. However, its first backward linkage is concentrated on a few sectors, particularly the processed-livestock-feeds industry, which in turn creates backward linkages with a much larger number of sectors than the first link, such as grain products, fisheries, animal and vegetable oils and fats, and wholesale and retail trade. Among service industries, only domestic multipliers for personal services ranked among the top 10 in many countries, including Indonesia, Malaysia, Philippines, Singapore and Thailand.

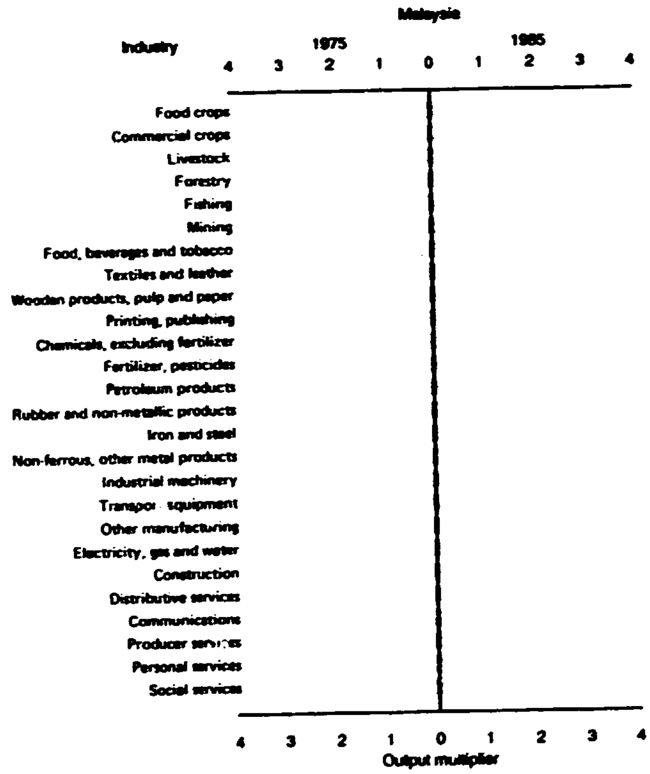
As expected, manufacturing industries tend to show stronger production linkage effects than those in the primary sector or the service sector. Manufacturing industries with relatively high multiplier effects included textiles, food manufactures, iron and steel, petroleum products, machinery and transport equipment, but each industry exhibited markedly different characteristics of production linkage effects across countries and over time. For instance, the iron and steel industry in Japan was shown to be strongest in

Figure III.4. Industry output





multipliers, 1975 and 1985



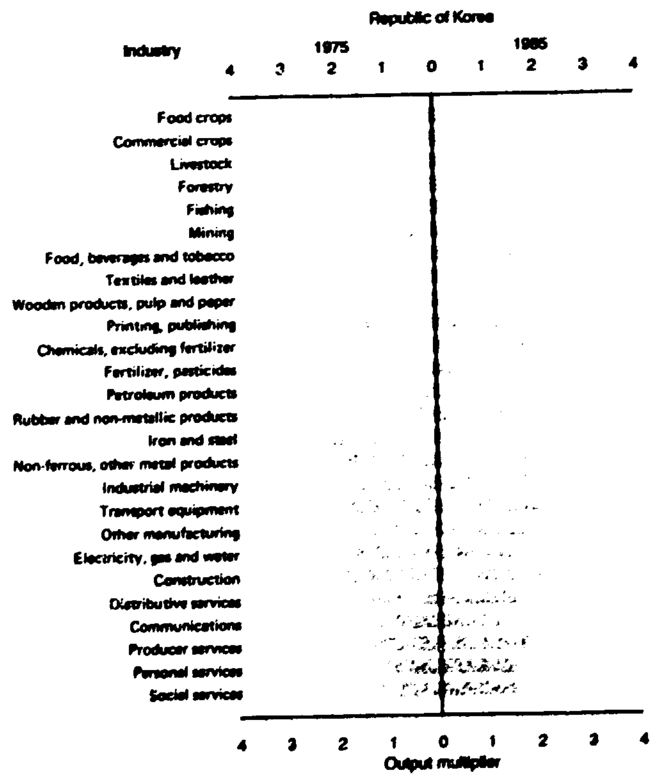
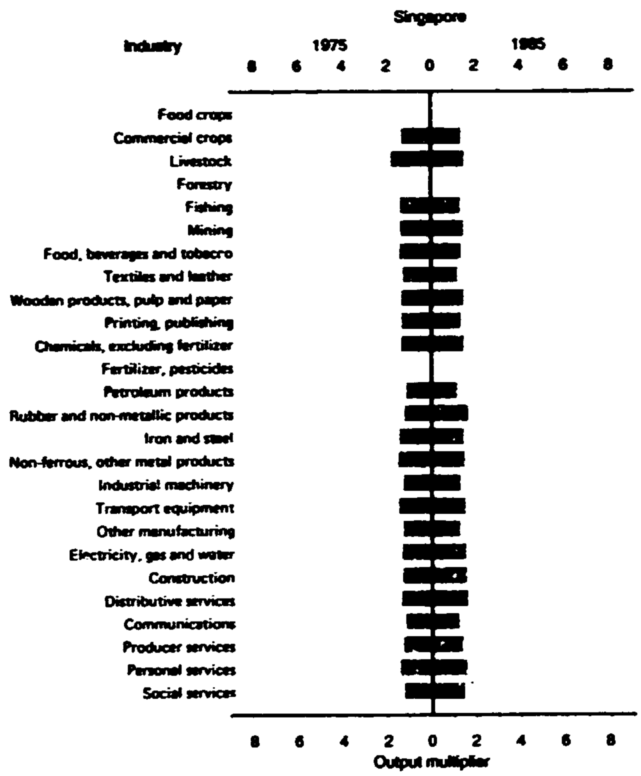
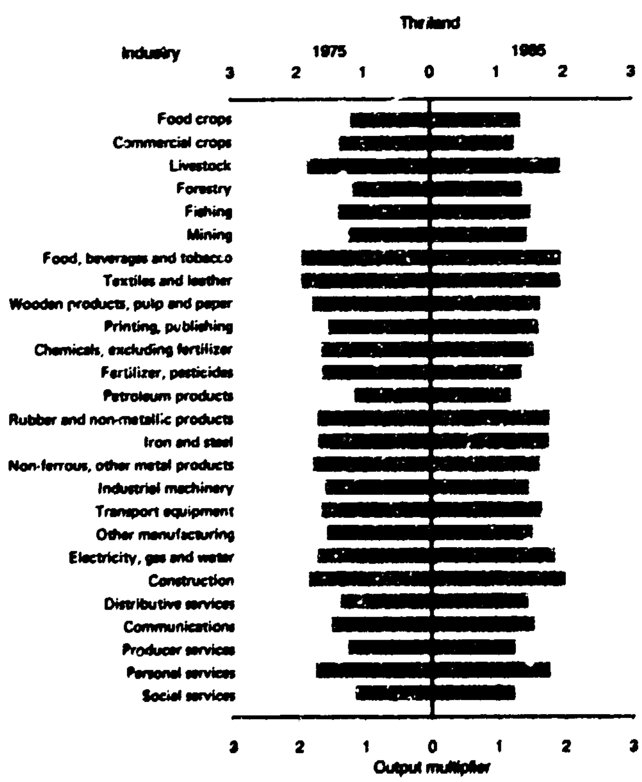
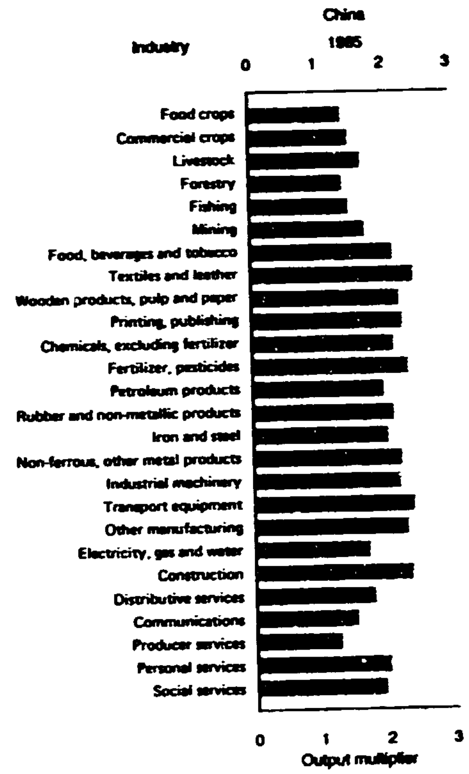


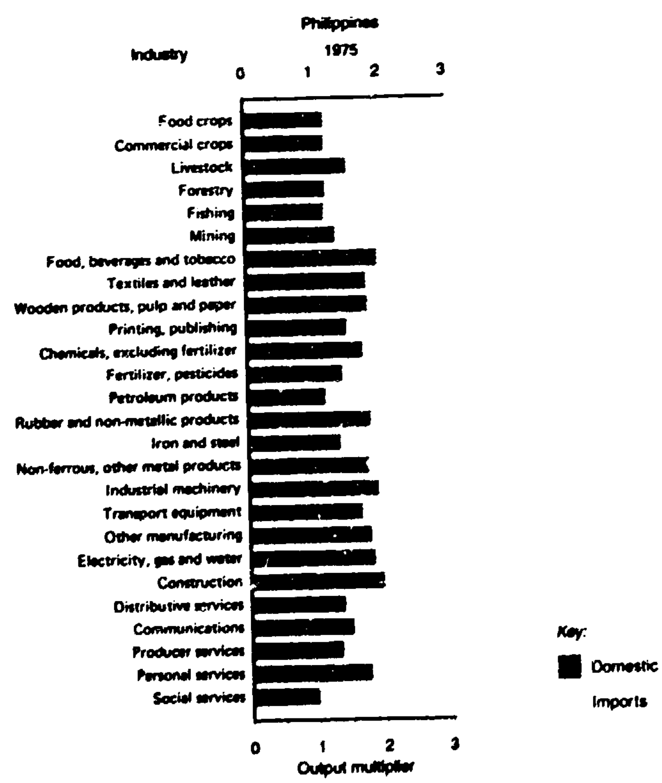
Figure III.4.


Singapore
Industry
1975
1985
8 6 4 2 0 2 4 6 8
Food crops
Commercial crops
Livestock
Forestry
Fishing
Mining
Food, beverages and tobacco
Textiles and leather
Wooden products, pulp and paper
Printing, publishing
Chemicals, excluding fertilizer
Fertilizer, pesticides
Petroleum products
Rubber and non-metallic products
Iron and steel
Non-ferrous, other metal products
Industrial machinery
Transport equipment
Other manufacturing
Electricity, gas and water
Construction
Distributive services
Communications
Producer services
Personal services
Social services
8 6 4 2 0 2 4 6 8
Output multiplier


Thailand
Industry
1975
1985
3 2 1 0 1 2 3
Food crops
Commercial crops
Livestock
Forestry
Fishing
Mining
Food, beverages and tobacco
Textiles and leather
Wooden products, pulp and paper
Printing, publishing
Chemicals, excluding fertilizer
Fertilizer, pesticides
Petroleum products
Rubber and non-metallic products
Iron and steel
Non-ferrous, other metal products
Industrial machinery
Transport equipment
Other manufacturing
Electricity, gas and water
Construction
Distributive services
Communications
Producer services
Personal services
Social services
3 2 1 0 1 2 3
Output multiplier

(continued)





Sources See table III 3

Table III.18. Ranking of sectoral multipliers in selected countries, 1975 and 1985

Industry	China 1985 Total	China 1985 Domestic	Indonesia 1975 Total	Indonesia 1975 Domestic	Indonesia 1985 Total	Indonesia 1985 Domestic	Japan 1975 Total	Japan 1975 Domestic	Japan 1985 Total	Japan 1985 Domestic	Malaysia 1975 Total	Malaysia 1975 Domestic	Malaysia 1985 Total	Malaysia 1985 Domestic
Food crops	24	24	25	25	26	26	25	23	24	23	21	20	23	23
Cash crops	23	22	22	21	19	18	24	24	21	20	23	22	22	22
Livestock	20	20	24	23	18	15	11	6	4	3	15	5	8	1
Forestry	25	25	21	22	24	24	21	16	18	15	25	24	20	17
Fishing	22	23	20	20	22	22	18	17	15	16	22	21	25	24
Mining	18	19	26	26	23	23	17	15	17	17	24	23	26	25
Food, beverages and tobacco	13	10	11	1	10	2	10	9	11	10	10	4	5	2
Textiles and leather	4	1	2	3	2	4	6	5	7	5	3	7	3	6
Wood products, pulp and paper	9	8	13	4	14	5	7	7	6	7	16	13	14	3
Printing and publishing	7	6	14	14	11	10	15	13	16	14	8	14	11	14
Chemicals, excluding fertilizer	11	11	5	19	5	17	5	10	3	9	2	3	10	10
Fertilizer and pesticides	8	4	17	16	6	13	2	3	5	8	7	12	12	12
Petroleum products	15	15	10	2	15	6	3	25	9	26	12	26	16	13
Rubber and non-metallic products	12	12	9	5	8	12	12	14	13	13	13	6	13	4
Iron and steel	10	13	1	10	12	11	1	1	1	1	4	1	1	7
Non-ferrous and other metal products	3	7	3	13	9	9	9	11	8	6	11	10	9	8
Machinery	5	9	4	19	4	20	8	4	10	4	5	11	2	19
Transport equipment	2	2	8	15	3	16	4	2	2	2	1	8	6	21
Other manufacturing	6	5	7	6	13	8	14	12	12	12	19	19	7	15
Electricity, gas and water	19	18	12	11	1	1	16	20	19	22	9	15	15	9
Construction	1	3	6	8	7	3	13	8	14	11	6	2	4	5
Distributive services	17	17	18	17	20	19	19	19	22	21	17	16	18	16
Communications	21	21	16	12	17	14	26	26	26	25	18	17	24	26
Producer services	26	26	19	18	21	21	23	21	23	19	20	18	21	20
Personal services	14	14	15	7	16	7	20	18	20	18	14	9	19	11
Social services	16	16	23	24	25	25	22	22	25	24	26	25	17	18

Industry	Philippines 1975 Total	Philippines 1975 Domestic	Republic of Korea 1975 Total	Republic of Korea 1975 Domestic	Republic of Korea 1985 Total	Republic of Korea 1985 Domestic	Singapore 1973 Total	Singapore 1973 Domestic	Singapore 1985 Total	Singapore 1985 Domestic	Thailand 1975 Total	Thailand 1975 Domestic	Thailand 1985 Total	Thailand 1985 Domestic
Food crops	24	23	26	25	24	23	-	-	-	-	24	23	23	21
Cash crops	23	22	22	21	23	21	19	16	16	16	21	20	22	23
Livestock	18	13	16	4	10	2	11	1	14	7	15	4	12	4
Forestry	22	21	25	22	25	24	-	-	-	-	25	24	24	20
Fishing	25	24	17	16	16	17	17	9	13	18	20	18	17	16
Mining	19	19	18	17	19	16	20	8	20	11	22	22	21	18
Food, beverages and tobacco	12	2	14	8	15	4	6	6	5	15	12	2	9	2
Textiles and leather	5	8	4	2	2	3	4	19	12	22	4	1	3	3
Wood products, pulp and paper	14	7	11	15	8	13	12	11	10	12	14	6	11	10
Printing and publishing	16	15	13	7	11	5	14	13	19	17	8	16	15	12
Chemicals, excluding fertilizer	13	11	8	14	7	12	8	10	5	10	10	12	10	13
Fertilizer and pesticides	11	16	2	1	6	14	-	-	-	-	2	13	5	22
Petroleum products	9	25	15	26	13	26	2	23	1	23	11	25	8	26
Rubber and non-metallic products	10	5	10	9	12	10	1	21	3	1	13	9	7	6
Iron and steel	2	18	1	3	1	1	10	4	4	13	1	10	1	8
Non-ferrous and other metal products	3	9	3	6	3	9	7	2	8	8	6	5	6	11
Machinery	6	3	6	13	5	11	5	20	6	[illegible]	5	14	14	17
Transport equipment	1	12	5	12	4	8	13	3	21	6	3	11	4	9
Other manufacturing	4	6	7	10	9	7	3	17	11	20	16	15	18	5
Electricity, gas and water	7	4	12	11	18	22	18	14	2	5	9	8	13	5
Construction	8	1	9	5	14	6	9	12	9	4	7	3	2	1
Distributive services	20	17	19	19	20	20	21	7	7	2	19	19	19	19
Communications	17	14	23	23	26	25	23	22	23	21	18	17	20	14
Producer services	21	20	21	18	17	15	22	15	22	14	23	21	25	24
Personal services	15	10	20	20	22	18	16	5	17	3	17	7	16	7
Social services	-	-	24	24	21	19	15	18	18	9	26	26	26	25

Sources: See table III.3.

terms of both potential and actual linkage effects in both 1975 and 1985, and also in the Republic of Korea in 1985, where the ratio of domestic to total multipliers increased from 56 to 70 per cent between 1975 and 1985. By contrast, the iron and steel industry in Thailand ranked first in terms of total multipliers in both 1975 and 1985, but ranked twentieth and eighth, respectively, in terms of domestic multipliers, with domestic to total multiplier ratios of 66 per cent and 63 per cent. This implies that Thailand attempted to develop this key industry mainly on the basis of foreign technology and imported inputs. The situation was the same for the iron and steel industry in Indonesia in 1975, Malaysia in 1985, and the Philippines in 1975, all reflecting heavy dependence on imported inputs as shown by a substantial gap between potential and actual multipliers.

However, the biggest gap between potential and actual production effects was shown in the petroleum products industry in all countries except oil-exporting Indonesia. That industry ranked relatively high in terms of potential backward linkage effects, but ranked consistently last or near the bottom in terms of actual linkage effects. The result simply confirms the fact that petroleum products are widely used as inputs, but oil has to be imported almost entirely, except for an exporting country like Indonesia. In a similar vein, a considerable gap exists between potential and actual linkages in the capital goods, or machinery and transport equipment industries. These industries show great potential for developing interindustry linkages, but actual linkage effects fell far short of their potential in most countries, as they ranked relatively high in total multipliers but low in domestic backward linkages. A major exception is Japan, which has the advantage of one of the most advanced technological capacities in the world.

On the other hand, the textile and leather industry generally showed strong multiplier effects with high domestic contents in most countries. The multipliers ranked among the top 10, and among the top five for both total and domestic multipliers in many countries, including China, Indonesia, Malaysia, Republic of Korea and Thailand. A relatively high multiplier with a small difference between potential and actual values in the textile industry may be explained by strong linkages to domestic agricultural industries and the use of less technologically sophisticated production technologies compared with other manufacturing industries such as capital goods and basic materials. On the other hand, the food, beverages and tobacco industry shows strong domestic linkages effects, but the total effects are considerably weaker in many countries, including Indonesia, Malaysia, Philippines, Republic of Korea and Thailand, all with a high proportion of domestic inputs, particulary from the domestic agricultural sector.

Finally, construction is a strategically important industry for the building of physical infrastructure and capital formation with extensive intersectoral linkages. The construction industry requires numerous inputs from the manufacturing sector, particulary wood and pulp products, chemicals, non-metallic mineral products, and machinery and equipment, as well as producer services in financial and legal matters, engineering and consulting, real estate matters etc. Reflecting these strong intersectoral domestic linkages, construction ranked consistently among the top five industries in terms of domestic backward linkage multipliers in most countries, including China, Indonesia, Malaysia, Philippines, Singapore and Thailand.

2. *Indices of backward and forward linkages*

A normalized formulation of the measure of intersectoral linkages lends itself to easy interpretation. The normalized backward linkage index for industry simply compares its multiplier against the overall national average of sectoral multipliers, that is, $\sum_i r_{ij}/(\sum\sum_{ij} r_{ij})/n$, where n is the number of sectors. If the index is greater than one, the industry in question yields linkages above the national average, while the opposite is true if the index is less than one. Moreover, it would also be useful to calculate the coefficient of variation for each index.* If the coefficient is low, the production expansion in industry j has more or less an equal impact on production in other sectors. If it is high, then the backward linkages are unevenly distributed among industries, or some industries benefit more than others.

Likewise, the forward linkage indices and their coefficient of variation are defined exactly in the same way. The only difference is that the forward linkage measures are derived from the inverse of the output coefficient matrix, which is formed by dividing each element of the transaction table by the row total instead of the column total.** The forward linkage indices attempt to measure the degree of response of the output of other sector to a larger input supply provided by a given sector. In other words, the forward linkage represents the linkages induced by output supply, while the backward linkage is those induced by input demand. Often in identifying key industries with high output and employment potential in developing countries, backward linkage is important, because it leads to attempts to supply its inputs through additional domestic production, and derived demand may be more effective in activating output and employment than induced supply by forward linkage.

Backward and forward linkage indices are given in tables III.19 to III.26. The sectoral ranking of backward linkage indices in tables III.19 to III.26 is identical to the sectoral ranking of output multipliers given in table III.18, and the foregoing discussion on the characteristics of sectoral output multipliers also remains exactly the same. Therefore, they require no further elaboration, except for their coefficients of variation. A cursory examination of the coefficients of variation across countries reveals some useful information about the distributional impacts of industrial production. First of all, taking the national average of sectoral coefficients, Japan yields the lowest average values among the countries compared, 0.71 in 1975 and 0.72 in 1985. The Republic of Korea was the second lowest, 0.74 and 0.73 respectively, followed by the Philippines (0.75 in 1975), Thailand (0.77 and 0.74), Malaysia (0.81 and 0.78), Indonesia (0.82 and 0.78) and

*For the mathematical formula for backward and forward linkage indices and their coefficient of variation, see mathematical notes in annex I to this chapter.

**For mathematical formulation, see annex I to this chapter.

Singapore (0.85 and 0.81). The value for the Philippines was somewhat lower than expected, while high values for Singapore were not surprising for the reasons explained earlier. Otherwise, the results seem to show that the more industrialized a country becomes, the more evenly distributed the sectoral impact of industrial production becomes. Such a trend was observed not only in a cross-country comparison, but also over time within particular countries, as the average coefficient of variation tended to decrease between 1975 and 1985 in most cases.

In general, individual sectoral coefficients of variation tend to vary substantially from sector to sector and from country to country. However, a few industries stand out across countries with the most uneven distribution of indirect impact. They are textile and leather goods in Indonesia, Malaysia, Philippines, Republic of Korea and Thailand; and iron and steel in Japan, Malaysia, Republic of Korea and Thailand. As expected, the petroleum products industry was shown to have a highly uneven sectoral impact in many countries, such as Malaysia, Philippines, Republic of Korea and Singapore, reflecting the backward linkages of the industry with a small number of industries and heavy reliance on imported crude oil.

Like backward linkages, forward linkages do not show a consistent pattern of intersectoral linkages. Furthermore, they seem to bear no considerable systematic relations to backward linkages.* However, a number of rough general patterns of forward linkages can be discerned, but with many individual exceptions.

With some major exceptions across countries, the results in tables III.19 to III. 26 seem to suggest that most of the primary products with weak interindustry demand for inputs from other sectors are among the highest-ranking industries in forward linkages. They include mining, forestry, cash crops and livestock. However, the livestock industry is characterized by relatively strong backward linkages in certain countries, including the Republic of Korea, as shown earlier. Among manufacturing industries with high forward linkages are now mainly intermediate goods industries such as the fertilizer, chemicals, petroleum products, iron and steel, and non-ferrous metals industries. Again, as an exception to the general pattern, the iron and steel industry is ranked very high for both backward and forward linkages in many countries, underscoring its strategic importance for industrialization in developing countries. Among service industries, communications and producer services are shown to

*The Spearman coefficients of rank correlation between backward and forward linkages for all countries yielded a weak correlation, ranging between −0.14 and 0.18. A major exception was Singapore, with a rank correlation coefficient of 0.60 in 1975 and 0.50 in 1985.

Table III.19. Backward and forward linkage indices in China, 1985

Industry	Backward linkages 1985			Forward linkages 1985		
	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank
Food crops	0.719018	0.885059	24	0.856062	0.681929	18
Commercial crops	0.771206	0.829173	22	1.025070	0.540099	14
Livestock	0.864544	0.656898	20	0.677241	0.703012	24
Forestry	0.718484	0.884315	25	0.982394	0.589921	15
Fishing	0.767231	0.713362	23	0.749289	0.682656	21
Mining	0.886941	0.626774	19	1.373164	0.361598	2
Food, beverages and tobacco	1.097503	0.668589	10	0.709696	0.814198	22
Textiles and leather	1.251397	0.993911	1	0.965824	1.131839	16
Wood products, pulp and paper	1.140972	0.562798	8	1.059897	0.539013	11
Printing and publishing	1.162989	0.498749	6	1.229388	0.424487	7
Chemicals, excluding fertilizer	1.090348	0.670283	11	1.156333	0.572129	9
Fertilizer and pesticides	1.203653	0.471501	4	1.284365	0.695822	4
Petroleum products	1.013223	0.612693	15	1.249710	0.391469	6
Rubber and non-metallic products	1.085633	0.575472	12	1.100523	0.571946	10
Iron and steel	1.040389	0.742940	13	1.261410	0.621356	5
Non-ferrous and other metal products	1.144247	0.638263	7	1.168796	0.599222	8
Industrial machinery	1.129429	0.729764	9	0.821278	0.895996	19
Transport equipment	1.235688	0.594982	2	0.810105	0.801747	20
Other manufacturing	1.177560	0.539048	5	1.359600	0.431849	3
Electricity, gas and water	0.887821	0.627202	18	1.385765	0.338686	1
Construction	1.210118	0.424961	3	0.453455	1.000000	26
Distributive services	0.922130	0.628196	17	1.051461	0.489409	13
Communications	0.785909	0.633966	21	0.917582	0.509059	17
Producer services	0.660161	0.778326	26	1.059385	0.466159	12
Personal services	1.034704	0.519989	14	0.690051	0.691002	23
Social services	0.998702	0.532725	16	0.602157	0.802789	25
Other	..	..		..	..	
Average		0.655382			0.628746	

Sources: See table III.3.

Table III.20. Backward and forward linkage indices in Indonesia, 1975 and 1985

	Backward linkages						Forward linkages					
	1975			1985			1975			1985		
Industry	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank
Food crops	0.761034	0.957048	25	0.742848	0.918879	27	1.076110	0.798108	8	0.964167	0.780489	14
Commercial crops	0.826073	0.925370	21	0.921901	0.952250	18	1.052360	0.793400	10	1.030261	0.851030	11
Livestock	0.789346	0.911702	23	0.949640	0.708777	15	1.074228	0.725491	9	1.035180	0.730355	9
Forestry	0.822823	0.874765	22	0.778368	0.842691	25	1.019460	0.660192	12	1.196513	0.622467	4
Fishing	0.827464	0.845207	20	0.819748	0.788035	23	0.888296	0.746411	21	0.747328	0.771652	24
Mining	0.743055	0.956637	26	0.793886	0.997236	24	0.737574	0.846355	22	0.898456	0.772233	19
Food, beverages and tobacco	1.292959	0.706050	1	1.288400	0.651380	2	0.715911	0.988668	23	0.689727	0.964910	25
Textiles and leather	1.254567	1.234778	3	1.205713	1.144776	4	1.012284	1.354631	13	0.957555	1.253453	15
Wood products, pulp and paper	1.199728	0.695584	4	1.166710	0.660666	5	1.236033	0.662829	4	0.948444	0.721323	16
Printing and publishing	0.945753	0.746728	14	1.059033	0.636864	10	0.904955	0.680089	19	0.973675	0.580261	13
Chemicals, excluding fertilizer	1.127017	0.759375	9	0.934562	0.766124	17	0.951419	0.792958	15	1.020365	0.598044	12
Fertilizer and pesticides	0.915288	0.759385	16	1.011245	0.649621	13	1.665537	0.654813	1	1.340427	0.605541	2
Petroleum products	1.283187	0.783705	2	1.134680	0.748393	6	0.968151	0.719416	14	1.128588	0.541810	7
Rubber and non-metallic products	1.191874	1.121830	5	1.043471	0.685374	12	1.257939	0.980572	2	1.133330	0.667310	6
Iron and steel	1.089259	0.686784	10	1.047784	0.781156	11	1.215962	0.578271	5	1.331597	0.782026	3
Non-ferrous and other metal products	1.016429	0.757706	13	1.061105	0.689901	9	1.106345	0.658906	7	1.032821	0.725141	10
Industrial machinery	0.866196	0.835558	19	0.852575	0.863383	21	0.951251	0.662780	16	0.894035	0.703085	21
Transport equipment	0.919222	0.836602	15	0.942788	0.983571	16	0.914549	0.760194	17	0.820380	0.984687	22
Other manufacturing	1.174434	0.603842	6	1.072630	0.717114	8	0.889967	0.695075	20	0.897492	0.747395	20
Electricity, gas and water	1.061050	0.709524	11	1.509919	0.700570	1	1.247368	0.525993	3	1.190907	0.679586	5
Construction	1.137751	0.633816	8	1.212288	0.551907	3	0.700383	0.897637	25	0.633632	0.905937	26
Distributive services	0.889727	0.863112	17	0.896731	0.815868	19	0.906076	0.747562	18	0.903386	0.705300	18
Communications	1.051540	0.662514	12	0.975911	0.721678	14	1.119546	0.560783	6	1.053660	0.594559	8
Producer services	0.870546	0.845809	18	0.834901	0.868870	22	1.032926	0.638513	11	0.918079	0.680970	17
Personal services	1.161671	0.627432	7	1.133158	0.595832	7	0.712989	0.898514	24	0.785645	0.759256	23
Social services	0.782007	0.897831	24	0.755290	0.867421	26	0.642384	0.968372	26	0.588318	0.973030	27
Other	..	..	27	0.854713	0.755404	20	..	..	27	1.886032	0.379298	1
Average		0.816873			0.780139			0.740612			0.743746	

Sources: See table III.3.

Table III.21. Backward and forward linkage indices in Japan, 1975 and 1985

Industry	Backward linkages						Forward linkages					
	1975			1985			1975			1985		
	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank
Food crops	0.735817	0.657441	24	0.772132	0.628828	23	0.893940	0.656191	17	0.916596	0.678178	16
Commercial crops	0.734942	0.671134	25	0.797976	0.634249	20	1.047896	0.602611	12	1.005925	0.614531	14
Livestock	1.136792	0.555615	7	1.208915	0.558034	4	1.035769	0.734106	14	1.106017	0.751703	10
Forestry	0.920713	1.253359	17	0.989369	0.944062	16	1.776811	0.829384	1	1.578747	0.608858	1
Fishing	0.876974	0.728125	18	0.986541	0.902178	17	0.860385	0.710615	18	0.905552	0.899929	18
Mining	0.922915	0.547316	16	0.978024	0.490326	18	1.272983	0.450321	4	1.301520	0.444409	3
Food, beverages and tobacco	1.093139	0.607278	10	1.075547	0.632444	12	0.664537	0.880109	24	0.696952	0.874616	24
Textiles and leather	1.159968	0.881270	6	1.117087	0.881961	7	0.799886	1.122476	21	0.780870	1.103785	21
Wood products, pulp and paper	1.118916	0.820488	8	1.112379	0.797918	8	1.271088	0.660460	5	1.263749	0.628863	5
Printing and publishing	1.065549	0.650299	14	1.028008	0.642406	15	1.138664	0.529685	8	1.208661	0.503256	8
Chemicals, excluding fertilizer	1.092098	0.693505	11	1.091377	0.993045	10	1.145788	0.567793	7	1.257954	0.750121	6
Fertilizer and pesticides	1.192143	0.549242	4	1.112062	0.587491	9	1.052156	0.672537	11	1.284124	0.628121	4
Petroleum products	0.697764	0.811565	26	0.614640	0.876841	27	1.403126	0.415078	3	1.137135	0.410503	9
Rubber and non-metallic products	1.064622	0.569606	15	1.046405	0.565003	14	1.071079	0.548177	10	1.027286	0.589283	13
Iron and steel	1.462774	1.519474	1	1.460684	1.416723	1	1.441021	1.374640	2	1.507819	1.259820	2
Non-ferrous and other metal products	1.084795	0.639056	12	1.122211	0.639399	6	1.023278	0.601745	15	1.078557	0.611995	12
Industrial machinery	1.171628	0.780907	5	1.163582	0.782767	5	0.789667	1.014200	22	0.759481	1.065542	22
Transport equipment	1.243848	0.647295	3	1.311127	0.767192	2	0.779767	0.917601	23	0.744058	1.187003	23
Other manufacturing	1.072039	0.538192	13	1.073107	0.541735	13	0.661413	0.771638	25	0.663576	0.772374	25
Electricity, gas and water	0.796879	0.630149	21	0.776924	0.650394	22	1.079732	0.398118	9	1.080108	0.407820	11
Construction	1.095900	0.438016	9	1.075568	0.448339	11	0.488005	0.870928	26	0.510141	0.845471	26
Distributive services	0.850258	0.713102	20	0.793618	0.705748	21	0.827903	0.629498	19	0.781549	0.612867	20
Communications	0.656568	0.735091	27	0.669335	0.738838	26	1.045873	0.413546	13	0.940099	0.467550	15
Producer services	0.773727	0.766480	22	0.729531	0.859339	25	0.939230	0.553545	16	0.912977	0.602439	17
Personal services	0.871848	0.574798	19	0.867235	0.593738	19	0.819314	0.569954	20	0.820546	0.579298	19
Social services	0.771843	0.612327	23	0.769451	0.634244	24	0.474053	0.889922	27	0.500305	0.869759	27
Other	1.335542	0.455911	2	1.257167	0.492115	3	1.196633	0.408198	6	1.229697	0.380405	7
Average		0.705446			0.718717			0.696040			0.709204	

Sources: See table III.3.

Table III.22. Backward and forward linkage indices in Malaysia, 1975 and 1985

	Backward linkages						Forward linkages					
	1975			1985			1975			1985		
Industry	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank
Food crops	0.829015	0.812622	20	0.798106	0.843568	23	1.098825	0.768043	7	0.821810	0.789574	20
Commercial crops	0.775409	0.881458	22	0.811886	0.823080	22	1.400245	0.647979	2	1.261447	0.635242	5
Livestock	1.152936	0.676749	5	1.331296	0.592680	1	1.299993	0.863422	4	1.043405	0.773013	10
Forestry	0.759149	0.895430	24	0.918539	0.795429	17	1.482704	0.698950	1	1.069112	0.676862	9
Fishing	0.777259	0.857368	21	0.748321	0.904294	24	0.828504	0.828321	20	0.965939	0.677078	14
Mining	0.765965	0.872385	23	0.745383	0.916403	25	1.056007	0.727279	10	0.901256	0.699359	17
Food, beverages and tobacco	1.244485	0.717655	4	1.324804	0.692903	2	0.838105	1.021489	19	0.802777	1.068741	23
Textiles and leather	1.121533	1.102093	7	1.156521	0.931262	6	0.943929	1.107911	15	0.893722	1.121039	18
Wood products, pulp and paper	1.059782	0.812049	13	1.283777	0.692540	3	1.029207	0.797626	12	1.091919	0.716853	7
Printing and publishing	1.013439	0.781040	14	0.989308	0.686580	14	0.990522	0.796662	13	1.265174	0.531769	4
Chemicals, excluding fertilizer	1.268721	0.629927	3	1.050818	0.704853	10	0.844469	0.839381	18	0.984294	0.691944	13
Fertilizer and pesticides	1.068970	0.795984	12	1.017821	0.746833	12	1.353911	0.636949	3	0.906167	0.778576	16
Petroleum products	0.712973	0.985633	26	1.004177	0.785738	13	1.111716	0.620175	6	1.077481	0.593142	8
Rubber and non-metallic products	1.146310	0.685635	6	1.167521	0.648918	4	0.851589	0.848680	17	0.910677	0.779011	15
Iron and steel	1.309393	1.012735	1	1.149636	0.813757	7	1.040225	0.872027	11	1.355777	0.752592	2
Non-ferrous and other metal products	1.104661	0.767780	10	1.115903	0.714558	8	0.809232	0.973303	21	0.994616	0.678813	12
Industrial machinery	1.074142	0.853909	11	0.886970	0.830905	19	0.743723	1.038586	25	0.786006	0.867401	25
Transport equipment	1.117878	0.739951	8	0.843104	1.023011	21	0.755250	0.971551	23	0.819866	0.967497	21
Other manufacturing	0.868880	0.890088	19	0.981484	0.706124	15	0.754495	0.973384	24	0.828051	0.780166	19
Electricity, gas and water	0.987925	0.767273	15	1.071861	0.669335	9	1.247167	0.573546	5	1.307973	0.488024	3
Construction	1.286664	0.523946	2	1.158067	0.584727	5	0.776930	0.878667	22	0.808812	0.784842	22
Distributive services	0.943229	0.760368	16	0.919842	0.835461	16	0.937911	0.765127	16	1.007642	0.709616	11
Communications	0.893189	0.833686	17	0.742145	0.922442	26	1.080582	0.717417	8	1.183501	0.531686	6
Producer services	0.874286	0.839591	18	0.845072	0.932339	20	1.062270	0.706217	9	1.449966	0.508849	1
Personal services	1.112437	0.642371	9	1.024592	0.684867	11	0.969038	0.718953	14	0.802247	0.813904	24
Social services	0.731369	0.921217	25	0.913046	0.739544	18	0.693450	0.996988	26	0.660360	0.955773	26
Other	..	..	27	..	..	27	..	..	27	..	..	27
Average		0.809959			0.777775			0.822640			0.745053	

Sources: See table III.3.

exert fairly strong forward linkage effects. The same holds for utilities.

By contrast, capital goods, such as machinery and transport equipment, and light consumer products, such as food manufactures and textile and leather goods, ranked relatively low on the basis of the forward linkage criterion. Also ranked low are construction, social services and personal services. A common characteristic of these low-ranking industries is that they generally purchase many inputs from other industries, but they sell the major portion of their output to final demand and very little to other industries. This is particulary true of the textile and leather and construction industries. Personal and social services are an important exception in this regard, and are shown to be weak in both backward and forward linkages.

The coefficient of variation for forward linkages varied greatly among sectors and across countries, ranging between 0.35 and 1.4. The most uneven distribution of forward linkages occurred among final-demand-oriented light manufacturing industries, and particularly textile and leather goods and food manufactures in all the countries studied. Capital goods industries are also considerably unbalanced in forward linkages in some countries, such as Japan, Malaysia and Singapore. On the other hand, those industries which ranked relatively high in the forward linkage indices are also the ones which showed relatively balanced impacts of forward linkages, namely intermediate-goods-producing industries, primary products industries and utilities.

Among service activities, social services consistently presented the highest coefficient of variation in all countries without exception, with their value of over 0.9, while those of producer services and communications are relatively smaller in most cases. Meanwhile, personal services and distributive services do not yield a consistent pattern across countries, being high in some and low in others.

3. *Income-induced multiplier effects*

So far, consideration has been given only to the cumulative effects of interindustry input purchases at successive rounds of production triggered by a unit increase in final demand for the output of the sector of origin. The cumulative effects of increased consumer spending generated in each successive round of the multiplier process have not been considered. Such income-induced effects could be quite substantial, depending on the extent of import leakages and the propensity to consume. To capture income-induced

Table III.23. Backward and forward linkage indices in the Philippines, 1975

	Backward linkages 1975			Forward linkages 1975		
Industry	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank
Food crops	0.760251	0.886597	23	1.232567	0.918786	3
Commercial crops	0.762681	0.916906	22	0.965920	0.705024	15
Livestock	0.976425	0.808347	13	1.131673	0.858950	7
Forestry	0.766230	0.835682	21	1.026652	0.633462	14
Fishing	0.751783	0.857571	24	0.684761	0.848231	24
Mining	0.856323	0.735398	19	0.833932	0.686180	20
Food, beverages and tobacco	1.247641	0.628767	2	0.691125	1.001724	23
Textiles and leather products	1.140011	0.988547	8	0.838848	1.208810	19
Wood products, pulp and paper	1.147648	0.723208	7	1.137637	0.674739	6
Printing and publishing	0.947763	0.671173	15	1.126686	0.533751	9
Chemicals, excluding fertilizer	1.096282	0.727005	11	0.950203	0.720911	16
Fertilizer and pesticides	0.900007	0.701551	16	1.442899	0.559848	1
Petroleum products	0.741485	0.900623	25	1.188305	0.494856	4
Rubber and non-metallics	1.159003	0.619548	5	1.078012	0.657351	10
Iron and steel	0.875662	0.791722	18	1.324823	0.612130	2
Nonferrous and other metal products	1.135476	0.642539	9	1.059883	0.593587	11
Industrial machinery	1.223789	0.665154	3	0.809414	0.894686	21
Transport equipment	1.069767	0.803562	12	0.886253	0.871639	17
Scientific equipment and other manufacturing	1.157267	0.584469	6	1.027913	0.592427	13
Electricity, gas and water	1.182989	0.674667	4	1.150807	0.560586	5
Construction	1.262850	0.504998	1	0.608794	0.943528	25
Distributive services	0.888582	0.791341	17	0.860129	0.723807	18
Communications	0.962638	0.663400	14	1.129573	0.554155	8
Producer services	0.855172	0.931908	20	1.033549	0.714180	12
Personal services	1.132275	0.617626	10	0.779642	0.809956	22
Social services	..	..	26	..	..	26
Other	..	..	27	..	..	27
Average		0.746892			0.734932	

Sources: See table III.3.

Table III.24. Backward and forward linkage indices in the Republic of Korea, 1975 and 1985

	Backward linkages						Forward linkages					
	1975			1985			1975			1985		
Industry	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank
Food crops	0.711009	0.849322	26	0.725558	0.799834	24	1.066022	0.819682	11	1.003584	0.736066	15
Commercial crops	0.794732	0.774393	22	0.815931	0.695737	22	0.974325	0.655102	15	1.067064	0.680741	13
Livestock	1.185186	0.602549	5	1.323258	0.572255	3	1.250375	0.690434	7	1.094998	0.768595	11
Forestry	0.754751	0.947732	23	0.676210	0.818046	25	1.001236	0.652237	14	1.165096	0.501007	9
Fishing	0.879055	0.670643	17	0.872678	0.750046	17	0.650422	0.866117	24	0.653747	0.918047	24
Mining	0.835914	0.683953	18	0.898971	0.594378	16	1.367416	0.414157	3	1.447983	0.428611	2
Food, beverages and tobacco	1.137154	0.687244	9	1.162844	0.671336	5	0.691393	0.927128	23	0.764029	0.867977	21
Textiles and leather	1.268000	1.028882	3	1.223774	1.045660	4	0.869095	1.402089	19	0.840332	1.359285	18
Wood products, pulp and paper	0.922333	0.796141	16	1.028147	0.904353	14	1.132512	0.607606	8	1.318107	0.626903	3
Printing and publishing	1.143252	0.584324	8	1.151668	0.571008	6	1.001721	0.567957	13	1.108010	0.517231	10
Chemicals, excluding fertilizer	1.004211	0.802162	15	1.030476	0.869469	13	1.297923	0.636865	6	1.174269	0.688699	8
Fertilizer and pesticides	1.329065	0.602239	2	1.010445	0.614114	15	1.391568	0.658917	2	1.299701	0.625652	5
Petroleum products	0.710508	0.891468	27	0.607166	0.996449	27	1.321549	0.447964	4	1.313267	0.419028	4
Rubber and non-metallic products	1.095986	0.577002	10	1.060845	0.627302	11	0.946910	0.649663	17	0.955993	0.686539	17
Iron and steel	1.258247	1.359623	4	1.435447	1.473918	2	1.492622	1.081185	1	1.522997	1.266188	1
Non-ferrous and other metal products	1.148949	0.647372	7	1.115786	0.642529	9	1.119730	0.574640	9	0.981532	0.622745	16
Industrial machinery	1.022107	0.736600	14	1.042592	0.758399	12	0.776045	0.898485	21	0.772621	0.919196	20
Transport equipment	1.047612	0.659266	13	1.114734	0.572609	10	0.732173	0.875459	22	0.637674	0.870866	25
Other manufacturing	1.078163	0.526708	11	1.125753	0.502497	8	0.648841	0.825871	25	0.676645	0.745804	23
Electricity, gas and water	1.050528	0.612714	12	0.786485	0.763110	23	1.064859	0.510065	12	1.271902	0.402381	6
Construction	1.178519	0.490760	6	1.132761	0.485654	7	0.591832	0.902172	26	0.575941	0.860324	26
Distributive services	0.823467	0.790860	20	0.841569	0.713448	21	0.885206	0.673303	18	0.793889	0.667481	19
Communications	0.749382	0.756897	24	0.646386	0.867523	26	1.078002	0.503185	10	1.067615	0.497251	12
Producer services	0.828381	0.741539	19	0.850582	0.790064	20	0.972049	0.580577	16	1.004379	0.592797	14
Personal services	0.811512	0.728011	21	0.868279	0.648413	18	0.806723	0.694593	20	0.715376	0.703986	22
Social services	0.736281	0.770775	25	0.853932	0.626038	19	0.560445	0.953188	27	0.522850	0.937956	27
Other	1.495696	0.533836	1	1.597722	0.465954	1	1.309007	0.533078	5	1.250397	0.419936	7
Average		0.735297			0.734820			0.725990			0.715974	

Sources: See table III.3.

Table III.25. Backward and forward linkage indices in Singapore, 1973 and 1985

	Backward linkages						Forward linkages					
	1973			1985			1973			1985		
Industry	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank
Food crops	..	..	25	..	..	25	..	..	25	..	..	25
Commercial crops	0.951222	0.809380	16	0.951008	0.706452	16	1.034949	0.685994	8	0.877559	0.685478	14
Livestock	1.337681	0.686035	1	1.054834	0.666732	7	0.924606	0.784486	11	0.929515	0.705148	11
Forestry	..	..	26	..	..	26	..	..	26	..	..	26
Fishing	1.014529	0.765053	9	0.936382	0.731781	18	0.906101	0.790793	12	0.732976	0.842821	20
Mining	1.021476	0.829803	8	1.025240	0.916956	11	1.545838	0.736094	1	1.497584	0.682858	1
Food, beverages and tobacco	1.031163	0.860516	6	0.955585	0.830008	15	1.010524	0.819323	10	0.841113	0.854800	16
Textiles and leather	0.941104	0.911353	19	0.855596	0.971066	22	0.765711	1.029831	19	0.754047	0.983026	18
Wood products, pulp and paper	0.989734	0.884290	11	1.023776	0.775981	12	0.883160	0.902115	14	0.963600	0.724527	10
Printing and publishing	0.970573	0.851372	13	0.937944	0.909786	17	1.167935	0.655918	7	1.349827	0.590547	4
Chemicals, excluding fertilizer	1.003493	0.847010	10	1.026185	0.722978	10	1.026075	0.743731	9	0.902939	0.732232	13
Fertilizer and pesticides	..	..	24	..	..	24	..	..	24	..	..	24
Petroleum products	0.833413	0.931555	23	0.830158	0.912213	23	0.751338	0.943358	23	0.751430	0.893841	19
Rubber and non-metallic products	0.886651	0.928796	21	1.161627	0.802084	1	0.866311	0.866848	16	1.069783	0.799712	8
Iron and steel	1.077454	0.744109	4	1.020005	0.692055	13	1.347401	0.570809	4	1.348691	0.545322	5
Non-ferrous and other metal products	1.125698	0.824106	2	1.045389	0.746343	8	1.180909	0.708622	6	1.028750	0.696009	9
Industrial machinery	0.933586	0.837097	20	0.924690	0.819464	19	0.760745	0.944474	21	0.700894	0.974297	21
Transport equipment	1.100969	0.912259	3	1.068996	1.212947	6	0.883258	1.044973	13	1.457874	0.843724	2
Other manufacturing	0.947977	0.811585	17	0.905114	0.822868	20	0.761243	0.930702	20	0.754661	0.882626	17
Electricity, gas and water	0.970182	0.830827	14	1.091541	0.749003	5	1.348731	0.525190	3	1.315500	0.471659	6
Construction	0.983048	0.794445	12	1.093738	0.611709	4	0.791585	0.907945	18	0.638204	0.949075	23
Distributive services	1.028456	0.923109	7	1.131103	0.843826	2	0.878039	0.984029	15	0.871174	0.969486	15
Communications	0.868946	0.952754	22	0.867875	0.848483	21	1.364681	0.561759	2	1.380431	0.540125	3
Producer services	0.962693	1.003919	15	0.967162	1.017350	14	1.225189	0.727709	5	1.273786	0.698315	7
Personal services	1.075990	0.731581	5	1.097287	0.681836	3	0.816168	0.892585	17	0.905927	0.751420	12
Social services	0.943961	0.831680	18	1.028766	0.661139	9	0.759504	0.953825	22	0.653735	0.947973	22
Other	..	..	27	..	..	27	..	..	27	..	..	27
Average		0.847941			0.911003			0.813527			0.772392	

Sources: See table III.3.

Table III.26. Backward and forward linkage indices in Thailand, 1975 and 1985

	Backward linkages						Forward linkages					
	1975			1985			1975			1985		
Industry	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank	Indices	Coefficient of variation	Rank
Food crops	0.749836	0.895226	24	0.843509	0.802390	22	1.002913	0.770170	15	1.057592	0.779877	11
Commercial crops	0.853714	0.996126	21	0.786490	0.811906	24	1.184828	0.733166	7	1.278163	0.543412	5
Livestock	1.157074	0.628518	5	1.207225	0.593572	5	1.088740	0.724495	10	1.128004	0.702697	8
Forestry	0.729520	0.924608	25	0.855895	0.863276	21	1.100635	0.626740	8	0.944755	0.705031	15
Fishing	0.867459	0.812899	19	0.935308	0.692835	17	0.767574	0.838992	22	1.121664	0.753096	9
Mining	0.771151	0.810445	23	0.898422	0.717669	19	1.250993	0.536171	4	1.505928	0.424358	1
Food, beverages and tobacco	1.217617	0.666130	3	1.215949	0.676713	3	0.736178	0.915700	24	0.770708	0.948216	22
Textiles and leather	1.218036	1.236606	2	1.210891	1.232645	4	1.004986	1.340710	14	0.985515	1.372011	13
Wood products, pulp and paper	1.115397	0.750393	7	1.018895	0.763829	11	1.073075	0.700681	11	1.113099	0.648426	10
Printing and publishing	0.966634	0.647357	17	1.001607	0.609182	13	0.939000	0.598317	18	1.208438	0.503756	7
Chemicals, excluding fertilizer	1.035121	0.724321	13	0.959492	0.674497	14	0.986003	0.674010	16	0.930896	0.618776	16
Fertilizer and pesticides	1.029556	0.664715	14	0.843488	0.713250	23	1.496451	0.584349	1	1.273816	0.617736	6
Petroleum products	0.722475	0.931185	26	0.747188	0.850121	27	1.363554	0.480094	3	1.433954	0.448885	2
Rubber and non-metallic products	1.070851	0.647525	10	1.098346	0.634807	7	1.013795	0.636410	13	0.998139	0.670892	12
Iron and steel	1.065763	1.093885	11	1.092453	1.014108	9	1.449394	0.924013	2	1.328918	0.840465	3
Non-ferrous and other metal products	1.119176	0.712490	6	1.005418	0.635924	12	0.943957	0.718876	17	0.818969	0.688451	21
Industrial machinery	1.007320	0.748640	15	0.902234	0.755745	18	1.095261	0.606745	9	0.862456	0.705509	19
Transport equipment	1.036967	0.687751	12	1.025655	0.721645	10	0.849547	0.761133	20	0.957917	0.741365	14
Other manufacturing	0.987443	0.658632	16	0.938220	0.754979	16	0.653562	0.901864	25	0.713352	0.903210	25
Electricity, gas and water	1.078601	0.698647	9	1.141386	0.813384	6	1.219036	0.505967	5	1.293119	0.608020	4
Construction	1.160166	0.543948	4	1.241945	0.520662	2	0.637845	0.884148	26	0.608573	0.927685	26
Distributive services	0.858340	0.810107	20	0.892757	0.786142	20	0.850494	0.726682	19	0.900896	0.698797	18
Communications	0.950419	0.756391	18	0.952127	0.692945	15	1.013892	0.647367	12	0.910441	0.648288	17
Producer services	0.787469	0.830586	22	0.775831	0.819409	25	0.775414	0.751121	21	0.835272	0.684834	20
Personal services	1.099842	0.603396	8	1.096876	0.575398	8	0.736266	0.787642	23	0.721071	0.775830	24
Social services	0.719882	0.875771	27	0.766190	0.796712	26	0.573027	0.989834	27	0.570899	0.977103	27
Other	1.624170	0.413195	1	1.546203	0.418529	1	1.193578	0.499255	6	0.727446	0.748550	23
Average		0.76924			0.738603			0.735728			0.729084	

Sources: See table III.3.

effects in the input-output framework, the household sector is usually removed from final demand and included in the producing sector. In other words, households are considered the additional sector in the transaction table, and consumption is regarded as the "input" necessary for the production of income.*

In table III.27, average domestic output multipliers without income-induced effects are compared with those with income-induced effects for six countries in 1975 and 1985. The multipliers in the first column represent the direct and indirect effects of the national average multiplier derived from the inverse of a domestic input coefficient matrix, netting out imported inputs, and those in the second column are the direct and indirect plus income-induced effects of the same multiplier derived from the inverse of an augmented matrix formed by the inclusion of the household sector in the transaction table as explained above. The values of two types of multipliers tend to be positively related to the level of development, except for Singapore, and also increase over time in most cases. At the top of the range, Japan not only yielded the highest multiplier values for both types and in both periods among the countries compared, but it also had the largest difference between the two multipliers. Such a result was expected, given the broad and technologically advanced industrial base with relatively small import leakages, combined with highly sophisticated consumerism, of the Japanese economy. Considerably behind Japan comes the Republic of Korea in second place, followed by Thailand, Malaysia and Indonesia all more or less at the same level of industrial linkages as measured by these average multipliers. A major exception is Singapore, where the domestic multiplier values of the two types are lowest among the group. Their relatively low values may reflect a high degree of import leakages in the Singapore economy, which would reduce considerably the value of domestic multipliers.

The above results show that an initial increase in output due to an autonomous increase in final demand, for example investment, could trigger a series of output expansions through interindustry purchases of inputs, and the cumulative effects of an initial output stimulus could be anywhere between 30 per cent (Singapore in 1975) and 100 per cent (Japan in 1975 and 1985) larger than the initial increase in output, depending on the extent of domestic interindustry linkages and import leakages. Moreover, household spending induced by additional incomes generated at successive rounds of production expansion could further increase the multiplier value, and this income-induced effect could be quite substantial. For instance, the income-induced effects accounted for about 40 per cent of the total multiplier effects (direct, indirect and income-induced effects combined) in Japan. Likewise, employment could be subjected to the same multiplier expansion, as increased output would require additional labour inputs, but the amount of cumulative employment expansion would depend on the labour-output ratios in various sectors of the economy.

As urbanization and industrialization accelerates, the service sector tends to grow fast, and there are two major sources of such growth. The first source of growth is the increase in transactions between industry and services as discussed in detail earlier. Industry needs more specialized commercial activities, trade and

*The inclusion of the household sector as part of the transaction table requires further elaboration. Typically, household inputs in the consumption column include personal consumption expenditures of industrial sectors, direct personal taxes, and personal savings which are allocated to gross private capital formation. Household outputs in the row vector in the value-added part consist of wages and salaries including bonuses and retirement benefits, depreciation, interest, dividends, proprietors' income, undistributed profits and various subsidy payments. Closing a transaction table with respect to the household sector calls for some adjustment. In the original transaction table without the household sector, the equality between the sum of the household row and the household column need not be maintained, since the only restriction is that the sum of all final demand columns has to equal the sum of all rows in the payment sector. When the household row and column are moved into the processing sector, it is, however, necessary to make the sum of row entries equal the sum of column entries by adjusting some of the other entries in the final demand and payment sectors. This household row and column reconciliation is needed to preserve the accounting identity of income and expenditure.

Table III.27. Direct, indirect and income-induced effects of aggregate domestic multipliers[a] in selected countries, 1975 and 1985[b]

Country	Year	(1) Direct and indirect effects	(2) Direct, indirect and income-induced effects	Ratio of column (2) to column (1)
Indonesia	1975	1.4151	1.8335	1.3053
	1985	1.5347	1.9369	1.2774
Japan	1975	2.0578	3.4167	1.6770
	1985	2.0317	3.3101	1.6415
Malaysia	1975	1.4907	1.8310	1.2428
	1985	1.4822	1.7165	1.1650
Republic of Korea	1975	1.7043	2.2147	1.3199
	1985	1.7872	2.4111	1.3592
Singapore	1973	1.2834	1.5524	1.2106
	1985	1.4711	1.5587	1.0599
Thailand	1975	1.5477	1.9159	1.2489
	1985	1.5962	2.0207	1.2751

Sources: See table III.3.

a/ Average of domestic sectoral multipliers.

b/ 1973 and 1985 for Singapore.

transport, telecommunications and various producer services. These service activities are directly linked to production. The second source of service sector growth is related to rising incomes, which create demand for the whole range of consumer services and social services such as recreation, entertainment, education, health care, security, environmental protection and other professional and specialized personal services. These services are usually superior goods whose income elasticity is greater than one, which means that a greater portion of rising incomes is spent to secure them.

The income elasticity of demand for services has important implications for an employment creation strategy. If income elasticities for most services are sufficiently high, a development strategy could concentrate on first maximizing economic growth through rapid industrial development. Then, apart from growing intermediate demand for specialized producer services and distributive services, rising per capita income should produce substantially increased demand for personal and social services, thus leading to the rapid expansion of service employment.

In the light of the above discussion, it is expected that the multiplier value of personal and social services should be relatively greater when the income-induced effect is taken into account, while those of producer services and distributive services should be relatively lower, since they are more closely linked to production activities than consumer spending.

Empirical results tend to confirm this expectation. Total sectoral multipliers including income-induced effects are plotted along with those without income-induced effects in figure III.5 (see table III.35 in annex II to this chapter), and the ranking of such total sectoral multipliers is summarized in table III.28. Social services, which were earlier placed at or near the bottom of the ranking in terms of production linkages, often ranked at the top, when the income-induced effects were taken into account, as in the case of Indonesia (in 1975 and 1985), Malaysia (1975), Republic of Korea (1975 and 1985), Singapore (1973) and Thailand (1975 and 1985). These total domestic multipliers ranged from 2.3 for Malaysia in 1975 to 3.1 for the Republic of Korea in 1985, Singapore, being an exception and the income-induced effects accounted for more than half of the multiplier effect in all the countries considered. In Japan, the multiplier for social services, although ranked lower in sixth place in 1975 and seventh in 1985 relative to other multipliers, was even greater with a value of 4.0 in 1975 and 3.8 in 1985, and the income-induced part explained around 60 per cent of the total multiplier. To a lesser extent, the income-induced effects of personal services were also shown to be relatively strong, and ranked among the top 10 in most countries, except for Japan and the Republic of Korea. But it must be noted that in Japan, although the multiplier value for personal services was ranked as low as eighteenth in 1975 and nineteenth in 1985, their total multiplier values were nevertheless quite high, 3.3 compared to 1.8 without the income-induced effect in 1975, and 3.2 compared to 1.8 in 1985. In fact, these multipliers for personal services, although ranked so low in Japan, were far greater than the same multipliers which were ranked relatively high in other countries. This underscores again the dominant impact of income expenditure on output and employment, which emerges only after a country reaches a high level of per capita income as in the case of Japan.

As expected, demand for producer services and distributive services was more strongly influenced by interindustry production linkages than household spending resulting from additional income flows in the multiplier process. Total domestic multipliers for producer services and to a somewhat lesser extent for distributive services were ranked relatively low, and the difference between the two types of multiplier were also relatively small in most cases, as shown in figure III.5 and table III.28, implying much weaker income-induced effects for these services than for social services and personal services as discussed earlier.

It is also worth noting that among non-service sectors, the multiplier for construction proved to be one of the highest not only in terms of production linkages, but also in terms of income-induced effects. Among manufacturing industries, textile and leather goods ranked relatively high in the total multiplier in most countries, while the food, beverages and tobacco industry yielded high multipliers in less industrialized countries such as China, Indonesia, Malaysia and Thailand. On the other hand, in Japan, manufacturing industries with strong total multiplier effects were found in the capital goods industry (machinery and transport equipment) and iron and steel. Similarly, transport equipment and iron and steel were also equally strong in the Republic of Korea.

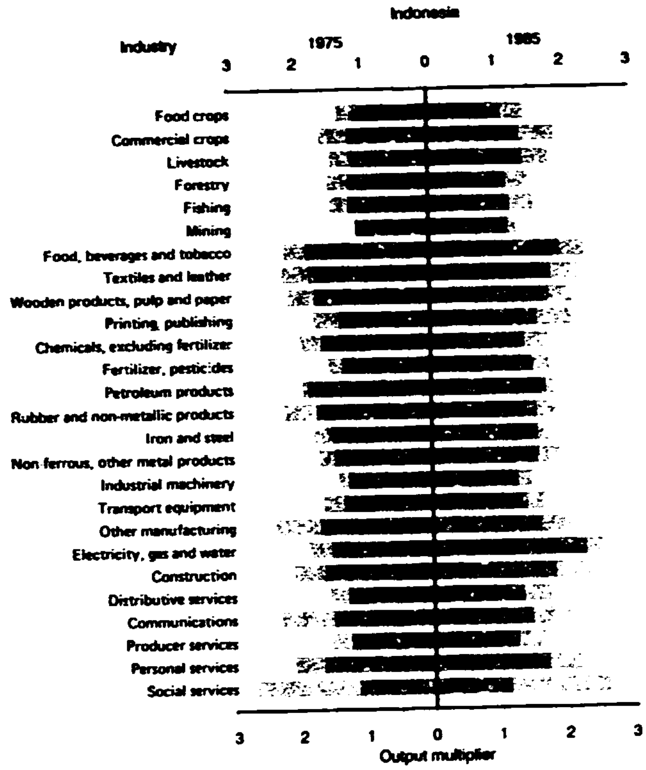
4. *Employment impact*

It was stated clearly at the outset that the present study would focus on the nature and evolution of the intersectoral relationships of manufacturing, with special reference to services and their implications for employment generation at different stages of industrialization. So far, various measures of intersectoral linkages of production have been examined in detail, and it seems logical to derive an employment equivalent of these production linkages.

Unfortunately, the paucity of detailed sectoral employment statistics precludes the translation of production and income linkages into an employment equivalent. Employment statistics for the countries examined here are available for the broad grouping of six sectors, although more disaggregated data were available for the manufacturing sector in some countries. Even at this level of disaggregation, the accuracy and reliability of data is open to question for the reasons given below. The numerical results based on crude aggregate employment data, as shown below, should therefore be interpreted with caution, and taken at best as a rough estimate of the unknown parameters.

The structure of employment by broad sectoral group for the selected countries of the Pacific region around 1975 and 1985 is summarized in table III.29. A number of caveats should be borne in mind in interpreting the results. First, employment statistics in China pertain only to State-owned enterprises, and hence are not comparable to the figures for other countries. A serious problem arises in relation to

Figure III.5. Industry income-induced output multipliers, 1975 and 1985



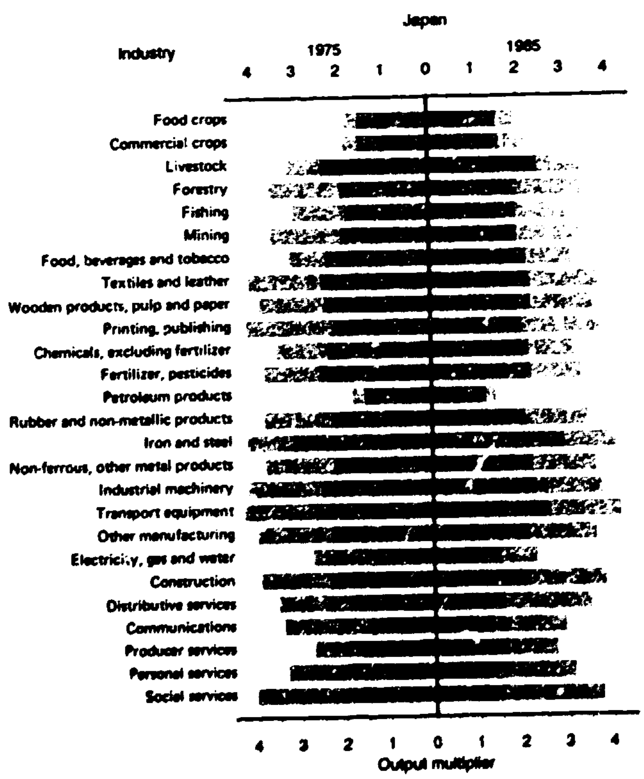
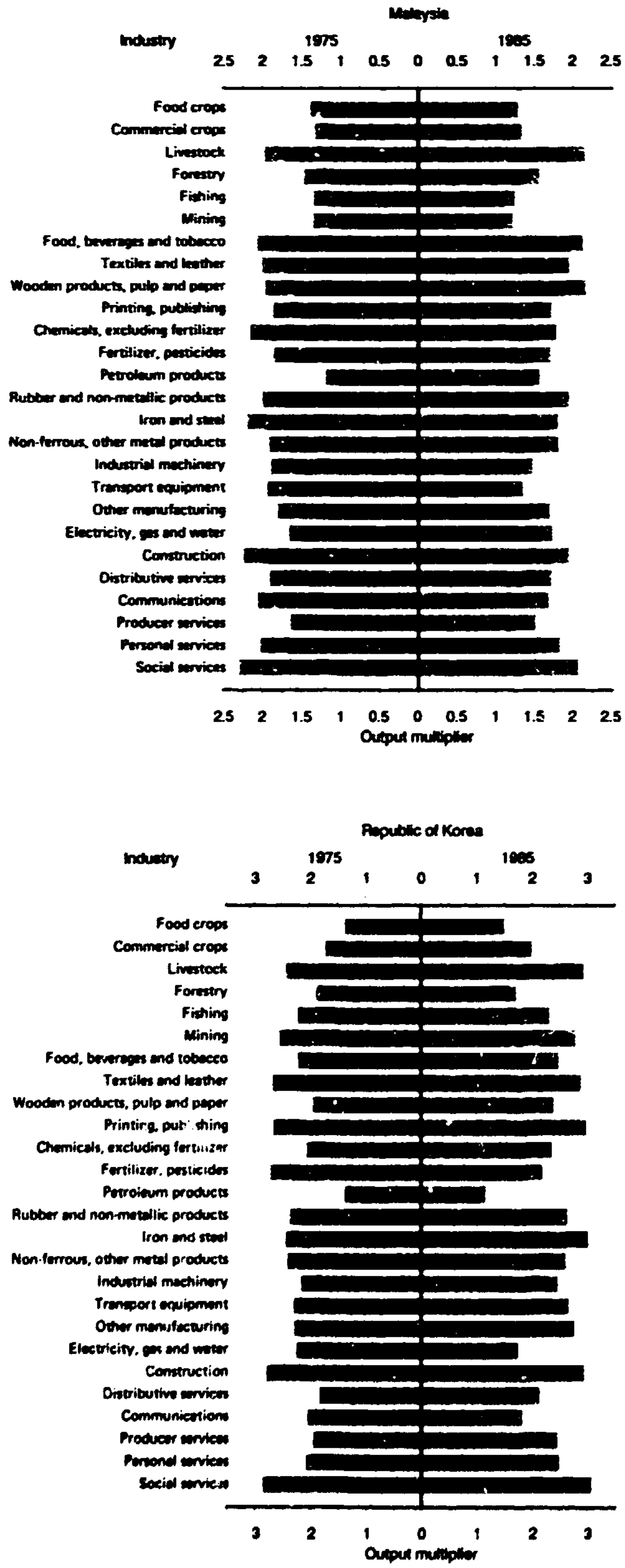
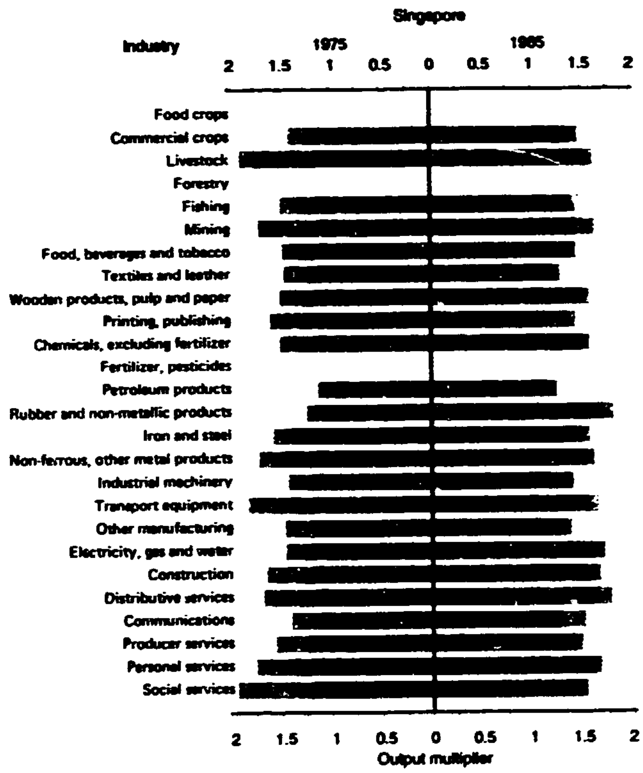


Figure III.5.



Malaysia
Industry
1975
1985
2.5 2 1.5 1 0.5 0 0.5 1 1.5 2 2.5
Food crops
Commercial crops
Livestock
Forestry
Fishing
Mining
Food, beverages and tobacco
Textiles and leather
Wooden products, pulp and paper
Printing, publishing
Chemicals, excluding fertilizer
Fertilizer, pesticides
Petroleum products
Rubber and non-metallic products
Iron and steel
Non-ferrous, other metal products
Industrial machinery
Transport equipment
Other manufacturing
Electricity, gas and water
Construction
Distributive services
Communications
Producer services
Personal services
Social services
Output multiplier
Republic of Korea
Industry
1975
1985
3 2 1 0 1 2 3
Food crops
Commercial crops
Livestock
Forestry
Fishing
Mining
Food, beverages and tobacco
Textiles and leather
Wooden products, pulp and paper
Printing, publishing
Chemicals, excluding fertilizer
Fertilizer, pesticides
Petroleum products
Rubber and non-metallic products
Iron and steel
Non-ferrous, other metal products
Industrial machinery
Transport equipment
Other manufacturing
Electricity, gas and water
Construction
Distributive services
Communications
Producer services
Personal services
Social services
Output multiplier

(continued)


Singapore
Industry
1975
1985
2 1.5 1 0.5 0 0.5 1 1.5 2
Food crops
Commercial crops
Livestock
Forestry
Fishing
Mining
Food, beverages and tobacco
Textiles and leather
Wooden products, pulp and paper
Printing, publishing
Chemicals, excluding fertilizer
Fertilizer, pesticides
Petroleum products
Rubber and non-metallic products
Iron and steel
Non-ferrous, other metal products
Industrial machinery
Transport equipment
Other manufacturing
Electricity, gas and water
Construction
Distributive services
Communications
Producer services
Personal services
Social services
2 1.5 1 0.5 0 0.5 1 1.5 2
Output multiplier

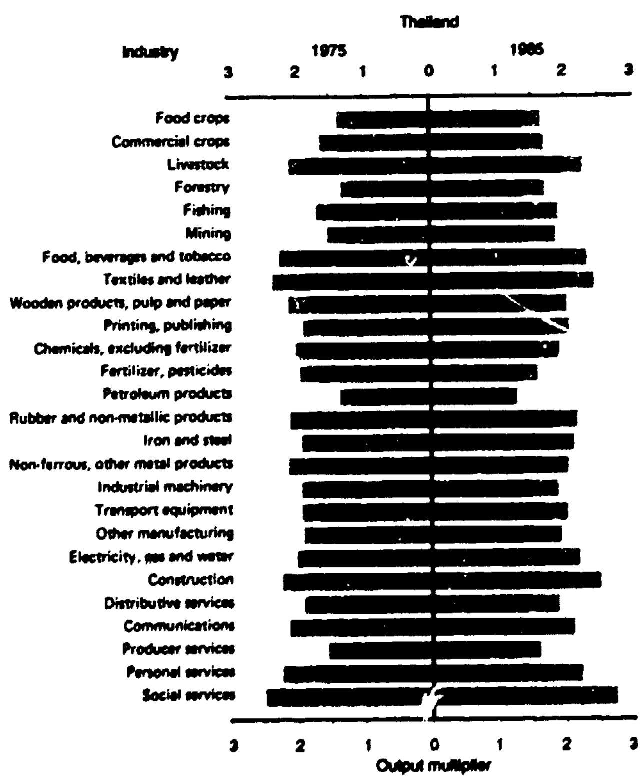
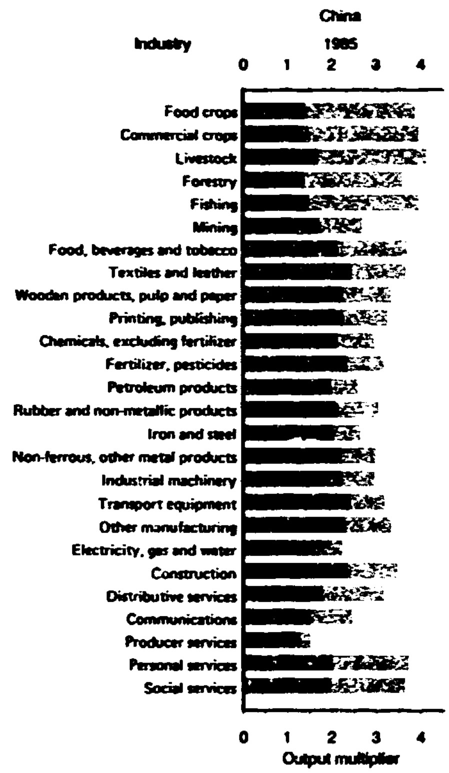
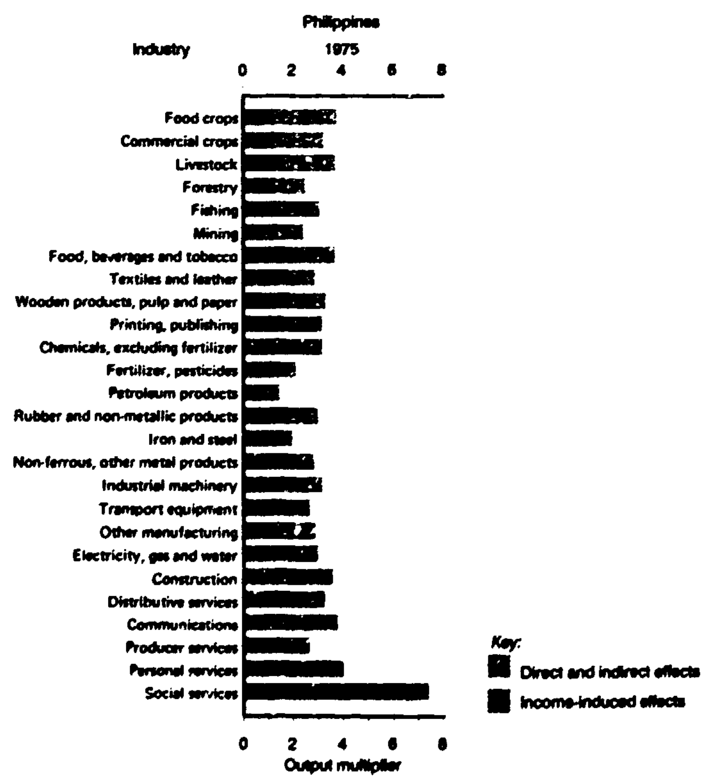

Thailand
Industry
1975
1985
3 2 1 0 1 2 3
Food crops
Commercial crops
Livestock
Forestry
Fishing
Mining
Food, beverages and tobacco
Textiles and leather
Wooden products, pulp and paper
Printing, publishing
Chemicals, excluding fertilizer
Fertilizer, pesticides
Petroleum products
Rubber and non-metallic products
Iron and steel
Non-ferrous, other metal products
Industrial machinery
Transport equipment
Other manufacturing
Electricity, gas and water
Construction
Distributive services
Communications
Producer services
Personal services
Social services
3 2 1 0 1 2 3
Output multiplier

Figure III.5. (continued)





Sources: See table III.3.

Table III.28. Ranking of domestic sectoral multipliers: direct, indirect and income-induced effects in selected countries, 1975 and 1985[a]

Industry	China 1985	Indonesia 1975	Indonesia 1985	Japan 1975	Japan 1985	Malaysia 1975	Malaysia 1985	Republic of Korea 1975	Republic of Korea 1985	Singapore 1973	Singapore 1985	Thailand 1975	Thailand 1985
Food crops	4	25	25	25	25	22	24	26	25	-	-	24	23
Cash crops	2	17	12	24	24	25	23	24	21	21	17	21	22
Livestock	1	23	15	19	13	10	2	8	4	2	8	10	5
Forestry	9	21	23	13	14	21	19	22	24	-	-	26	21
Fishing	3	22	22	21	20	24	25	15	18	14	16	20	17
Mining	21	26	26	14	15	23	26	6	7	6	7	23	20
Food, beverages and tobacco	6	6	4	20	18	5	3	14	12	15	18	3	4
Textiles and leather	7	4	5	4	4	8	5	4	6	17	22	2	3
Wood products, pulp and paper	12	7	7	9	10	11	1	20	16	13	10	8	13
Printing and publishing	13	14	8	4	5	16	13	5	3	9	19	19	11
Chemicals	19	10	17	16	17	4	11	18	17	12	12	12	16
Fertilizer and pesticides	14	20	16	11	16	17	15	3	19	-	-	13	25
Petroleum products	23	11	13	26	26	26	18	25	26	22	23	25	26
Rubber and non-metallic products	17	5	14	10	12	9	6	10	10	21	1	9	8
Iron and steel	22	13	19	2	2	3	10	7	2	10	11	15	9
Non-ferrous and other metal products	18	15	11	12	8	13	9	9	11	5	9	7	12
Machinery	20	24	24	3	6	15	21	16	14	19	20	16	18
Transport equipment	15	16	20	1	1	12	22	11	9	3	6	14	14
Other manufacturing	11	2	9	7	9	18	16	12	8	16	21	18	15
Electricity, gas and water	25	12	2	22	23	19	12	13	23	18	3	11	7
Construction	10	9	3	8	3	2	7	2	5	8	4	5	2
Distributive services	16	18	18	15	11	14	14	23	20	7	2	17	19
Communications	24	3	10	17	21	6	17	19	22	20	14	6	10
Producer services	26	19	21	23	22	20	20	21	15	11	15	22	24
Personal services	5	8	6	18	19	7	8	17	13	4	5	4	6
Social services	8	1	1	6	7	1	4	1	1	1	13	1	1

Sources: Table III.3.

a/ 1973 and 1985 for Singapore.

employment estimates for the service sector in developing countries, where the informal sector accounts for a dominant share of service employment, but remains officially unrecorded. Employment in the service sector is therefore likely to be considerably underestimated in developing countries. Moreover, even recorded statistics may be incomplete, as in the case of Thailand, whose data entirely omit producer service employment.

Despite these data shortcomings, a number of general patterns in the structure of sectoral employment can be gleaned from the results given in table III.29. First of all, the results reconfirm earlier observations that agriculture dominates all other sectors in providing employment at the early stages of industrialization, but its relative share of employment rapidly shrinks as a country industrializes. For instance, agricultural employment accounted for roughly 50 to 75 per cent of total employment in Indonesia, Philippines and Thailand, but less than 13 per cent in Japan during the period considered. The most remarkable change occurred in the Republic of Korea, where the share of agricultural employment dropped sharply from 46 per cent to 25 per cent between 1975 and 1985. Even in Indonesia and Thailand, the share of agricultural employment fell by about 10 percentage points, in the Philippines by 4 percentage points, during the period.

On the other hand, the service sector provided most employment, accounting for from 45 to 65 per cent of total employment in Japan, in NICs such as Singapore and the Republic of Korea (in 1985), and also in Malaysia. Service employment ranked second only to

Table III.29. Employment by sector in selected countries, 1975 and 1985[a]
(Thousands)

Country	Year	Total employment	Agriculture	Mining	Manufacturing	Utilities	Construction	Services
China[b]	1985	89 895	7 831 (8.71)	7 238 (8.05)	29 743 (33.09)	1 164 (1.29)	5 794 (6.45)	37 071 (41.24)
Indonesia	1976	55 444	35 258 (63.60)	44 (0.08)	3 560 (6.42)	34 (0.06)	1 098 (1.98)	12 596 (22.72)
	1985	62 457	34 142 (54.66)	416 (0.67)	5 796 (9.28)	70 (0.11)	2 096 (3.36)	19 871 (31.82)
Japan	1975	52 230	6 610 (12.66)	160 (0.31)	13 460 (25.77)	320 (0.61)	4 790 (9.17)	26 800 (51.31)
	1985	58 070	5 090 (8.77)	90 (0.15)	14 530 (25.02)	330 (0.57)	5 300 (9.13)	32 500 (55.97)
Malaysia	1985	5 653	1 717 (30.37)	44 (0.78)	850 (15.04)	32 (0.57)	419 (7.41)	2 569 (45.44)
Philippines	1976	14 238	7 659 (53.79)	81 (0.57)	1 598 (11.22)	51 (0.36)	428 (3.01)	4 773 (33.52)
	1985	20 327	10 085 (49.61)	129 (0.63)	1 926 (9.47)	79 (0.39)	678 (3.34)	7 429 (36.55)
Republic of Korea	1975	11 830	5 425 (45.86)	60 (0.51)	2 205 (18.64)	35 (0.30)	511 (4.32)	3 594 (30.38)
	1985	14 970	3 733 (24.94)	155 (1.04)	3 504 (23.41)	41 (0.27)	911 (6.09)	6 625 (44.26)
Singapore	1975	834	17 (2.04)	3 (0.36)	218 (26.14)	9 (1.08)	39 (4.68)	544 (65.23)
	1985	1 154	8 (0.69)	2 (0.17)	294 (25.48)	8 (0.69)	103 (8.93)	737 (63.60)
Thailand	1975	18 181	13 270 (72.99)	28 (0.15)	1 356 (7.46)	41 (0.23)	206 (1.13)	3 280 (18.04) [c]
	1985	34 227	15 383 (63.50)	88 (0.36)	2 280 (9.41)	107 (0.44)	664 (2.74)	5 696 (23.51) [c]

Sources: International Labour Organization, *Yearbook of Labour Statistics*, various issues.

Note: Figures in parentheses represent percentage share of total employment.

[a] 1976 and 1985 for Indonesia and the Philippines.

[b] Only State-owned enterprises.

[c] Excluding financing, insurance, real estate and business services.

agricultural employment in Indonesia, Philippines and Thailand. Unlike agricultural employment, service employment produced an appreciable upward trend in all the countries except Singapore, where the share of service employment marginally declined from 65 to 64 cer cent during the period. Again, the Republic of Korea experienced the most notable structural change, with the share of service employment rising sharply from 30 to almost 45 per cent, accompanied by an equally large decline in the share of agricultural employment between 1975 and 1985.

Manufacturing was shown to be the third-largest source of employment, but the intercountry differences are substantial. In Japan and NICs such as the Republic of Korea and Singapore, manufacturing employment ranged between 20 and 25 per cent of total employment, but it remained below the 10 per cent level in the remaining countries, except for Malaysia with a 15 per cent share. Furthermore, employment gains in the manufacturing sector over time were shown to be much smaller than those in the service sector in most countries. In other words, the results tend to support the argument advanced earlier that the major bulk of agricultural employment displaced in the process of industrialization is absorbed in the service sector.

Mining and utilities seem to be insignificant in terms of employment generation, accounting for less than 1 per cent of total employment in most countries. The employment share of construction varied markedly among countries, ranging between 1 and 10 per cent of total employment. The employment impact of construction was shown to be strongest in Japan, followed by Singapore, Malaysia and the Republic of Korea.

Given sectoral employment coefficients, that is, employment per unit of output, the standard input-output analysis would make it possible to derive sectoral employment multipliers, which represent the differential employment impacts on various sectors of a given stimulus originating from final demand. An attempt was made to measure such employment impacts at the six-sector classification level, and the results are given in table III.30. An analysis of employment impacts at more disaggregated levels of industrial classification was precluded by the lack of sufficiently detailed industrial employment statistics, particularly for the service sector. For the six-sector employment multipliers given in table III.30, the sectoral employment coefficients were derived from total sectoral employment, given in table III.29, divided by domestic sectoral output, given in input-output tables. Sectoral output figures for 1985 were deflated by GDP deflators with a base year of 1975. These employment coefficients are then multiplied to the two types of output multiplier to derive employment impact, where the two multipliers are driven by one unit increase in final demand with existing sectoral demand weights taken into account. In other words, the employment multiplier in the first column would represent a total employment change resulting from an increase of 1 million constant dollars in final demand, which are allocated among sectors according to the sectoral weights determined by the existing structure of demand, where only the inter-industry production linkages are considered in the multiplier process. The multiplier in the second column represents the same employment change under the same demand stimulus, but the employment expansion resulting from additional consumer spending as well as interindustry transactions in the multiplier process are taken into account. In other words, the second multiplier captures not only the direct and indirect effects of interindustry purchases, but also the income-induced effects.*

The most notable results of the table are that the total employment impact may vary vastly from country to country in response to the same amount of demand stimulus, and that the sectoral shares of employment created also greatly differ among countries. The total employment impact in Indonesia and Thailand was greater than that in Japan and Singapore by a factor of 10 to 20 for both types of multiplier; but over half of the employment expansion in the former occurred in agriculture, although its share tended to decline considerably over time, and the service sector accounted for the 20 to 30 per cent of employment generation. The manufacturing share of employment generation ranged between 7 and 10 per cent in these countries, but showed a modest upward trend over time. By sharp contrast, in Japan and Singapore, the service sector was a major source of employment generation, accounting for well over half of total employment created, although relatively small in absolute terms. The manufacturing sector was also an important source of new employment, absorbing about 20 to 25 per cent of total employment created, while the agricultural share was relatively small, at around 10 per cent, and continued to fall over time. The employment impact in the Republic of Korea was shown to be somewhere between the two contrasting cases described above, but the results reveal a most pronounced shift in the structure of sectoral employment expansion. In 1975, agriculture tended to be the largest source of employment absorption, accounting for about 45 per cent of total employment generation, while services and manufacturing accounted for around 32 per cent and 17 per cent, respectively. In 1985, new employment generated in the service sector was close to 50 per cent and 20 per cent in the manufacturing sector, while the agricultural share was sharply down to around 25 per cent.

The above results seem to suggest, first, that the total number of employment created by a given amount of demand stimulus may continue to fall as a country advances along the path of industrialization. This is partly because more capital-intensive methods of production are employed not only in manufacturing, but also in agriculture, thus releasing surplus agricultural labour to other sectors, and particularly to the service sector. Furthermore, as agriculture, which was formerly labour-intensive, becomes more mechanized, and, more importantly, its dominant position in terms of output and employment at the early stages of development progressively diminishes in the course of industrialization, the share of labour-intensive products in total output may continue to decline, although partly offset by output gains in the service sector. Secondly, the capacity of the manufacturing sector to generate employment may become significant only at

*For a mathematical derivation of employment multipliers, see annex I to this chapter.

Table III.30. Employment impact of an increase of 1 million 1975 dollars in final demand in selected countries, 1975 and 1985[a]
(Additions to workforce)

		Total employment change			Per cent distribution											
					Agriculture		Mining		Manufacturing		Utilities		Construction		Services	
Country	Year	Direct and indirect[b]	Total[c]	Ratio of two multipliers[d]	Direct and indirect	Total	Direct and indirect	Total	Direct and indirect	Total	Direct and indirect	Total	Direct and indirect	Total	Direct and indirect	Total
Indonesia	1975	1 642	2 268	1.44	66.05	67.77	-	-	6.91	6.95	0.06	0.06	2.32	1.72	24.65	23.49
	1985	2 806	3 931	1.40	53.46	55.57	0.18	0.17	9.35	9.39	0.12	0.12	3.08	2.77	33.09	31.98
Japan	1975	93	180	1.94	12.36	13.39	-	-	23.18	22.72	-	0.06	10.31	5.72	53.22	57.27
	1985	54	104	1.92	8.65	9.32	-	-	21.43	20.59	-	-	10.57	5.96	58.64	63.38
Malaysia	1985	227	272	1.20	30.54	30.88	0.75	0.65	15.10	15.01	0.57	0.61	7.44	6.47	45.62	46.38
Republic of Korea	1975	452	603	1.33	44.27	45.71	0.45	0.42	16.97	17.12	0.33	0.30	5.42	4.13	32.57	32.52
	1985	473	697	1.47	24.43	26.11	0.92	0.86	18.98	19.12	0.27	0.28	7.73	5.45	47.66	48.18
Singapore	1973	121	155	1.28	2.08	2.56	-	-	26.23	23.31	1.07	1.14	4.72	3.79	65.53	68.89
	1985	49	52	1.06	-	-	-	-	25.32	24.63	-	-	8.99	8.53	64.11	65.18
Thailand	1975	912	1 222	1.34	71.52	72.38	0.15	0.13	7.31	7.22	0.24	0.24	1.34	1.04	19.45	18.99
	1985	937	1 284	1.37	61.42	63.07	0.38	0.34	8.53	8.53	0.49	0.46	3.60	2.69	25.59	24.92

Sources: Tables III.3 and III.29.

[a] 1973 and 1985 for Singapore.

[b] Direct and indirect employment impact.

[c] Direct and indirect plus income-induced employment impact.

[d] Ratio of direct and indirect to total effects.

relatively advanced stages of industrialization in countries with a broad industrial base, such as Japan, the Republic of Korea and Singapore.

Interindustry linkages are not sufficiently developed at the initial stages of industrialization, and this could severely limit the capacity of manufacturing to generate employment through the multiplier process. The relatively rudimentary development of interindustry linkages may largely explain the small contribution of manufacturing to employment generation in Indonesia and Thailand, as compared with Japan and the Republic of Korea. Thirdly, the service sector becomes the most dominant sector in employment generation at the advanced level of industrialization, thus supporting the hypothesis of a de-industrialization phenomenon. As discussed extensively at the outset, the service sector absorbs the major bulk of rural-urban migrants pushed out by pervasive rural poverty, incorporating them mainly in the informal sector at the early stages of economic development. Employment absorption in the service sector is thus severely underestimated because of the virtual non-existence of employment statistics in the informal sector. However, it must be re-emphasized that the nature of service employment expansion at the both ends of the development spectrum is drastically different. At the early stage of development, service employment expansion is of a supply-push type, concentrated on low-skill labour-intensive activities, while service employment expansion in the industrialized countries is caused by the demand-pull type, involving interindustry demand for technologically sophisticated service inputs and income-induced demand for specialized consumer and social services.

Fourthly, it comes as no surprise that mining and utilities contribute relatively little to employment generation, mainly because of their relatively small share of GDP coupled with highly capital-intensive production in these industries. On the other hand, construction seems to contribute to employment generation significantly more than mining and utilities, and is particularly strong in Japan, the Republic of Korea and Singapore. In general, construction activities and consequent demand for labour is positively related to the level of economic development. At the same time, construction is known to be an industry with one of the most cyclical patterns of growth, in which employment is expected to fluctuate widely, depending on general economic conditions in a country when statistical data are compiled. Since business cycles are not likely to be synchronized across countries, this may to a great extent explain intercountry differences in employment creation in the construction sector.

Lastly, the empirical results seem to suggest that the income-induced employment effect becomes pronounced only at relatively high levels of per capita incomes, as in the case of output expansion discussed earlier. For instance, in Japan, employment generation resulting from additional personal spending almost equals that accounted for by interindustry transactions, while such income-induced employment effects are far less significant in the other countries studied, ranging from one tenth (Singapore in 1985) to nearly one half (Republic of Korea in 1985) of employment generation attributable to interindustry production linkages.

E. Concluding remarks and policy implications

1. Interindustry linkages and employment generation

Structural change in the course of economic development is characterized by the expansion of interindustry linkages. More importantly, the nature of interindustry relationships undergoes a fundamental change at different stages of industrialization, and this in turn gives rise to the different patterns of sectoral employment generation and composition. In this study an attempt has been made to examine the catalytic role that manufacturing could play in the interrelated development of structural change, interindustry linkages and employment generation at different phases of industrialization, using input-output tables for selected countries of the Pacific region in 1975 and 1985.

Industrialization has been historically a well-trodden path to high per capita incomes and high standards of living. In recent years, the paradigm of economic development via industrialization has been viewed with growing scepticism as a result of the disappointing outcome of industrialization drives of the past three decades in developing countries, with the exception of a few Asian countries. Despite many past failures, industrialization is still vital to economic development and employment generation, because manufacturing constitutes the core of supply-creating networks of production linkages with various sectors of the economy, such as agriculture, mining, manufacturing, public utilities and services. Manufacturing industries produce not only a wide range of consumer goods, but also, and more importantly, a whole host of intermediate inputs and capital goods, both of which are essential to the output growth of the linked sectors.

However, intersectoral linkage is a two-way symbiotic relationship, and the nature and extent of intersectoral linkages of manufacturing changes dramatically in the course of industrialization, with different policy implications at different stages of industrialization. For instance, at the embryonic stages of economic development, the linkage between agriculture and manufacturing is crucial. Agricultural growth stimulates domestic demand for industrial products, and supplies food for industrial workers, raw materials for agro-based industries, and labour to meet the growing labour needs of industrial expansion. Most importantly, due to the sheer size of agriculture in terms of output and employment, agriculture provides a major source of investment capital, such as rent, savings, taxes and foreign exchange, without which industrial development could not take root and grow. Meanwhile, industry provides agriculture with intermediate inputs, such as chemical fertilizers and pesticides, and with producer goods, such as farm implements, irrigation pumps, and transport equipment. Furthermore, non-agricultural products become an essential incentive to increase agricultural productivity.

Given these mutually supportive interactions between agriculture and manufacturing at the early stages of economic development, unbalanced growth of the two sectors could be potentially damaging to both. In recent years, a reordering of development priorities in favour of agriculture for developing countries at the initial stages of economic development, particularly in sub-Saharan African countries, has received considerable attention. However, sustained agricultural development without concomitant industrial development and agro-based industries may not materialize. Findings from the intersectoral linkage analysis in this study tend to provide strong empirical confirmation of the critical dependence of agriculture on the manufacturing sector.

Empirical results also support a stylized pattern of structural change which suggests that the importance of the linkage between agriculture and manufacturing, although crucial at the initial stages of economic development, progressively diminishes as a country moves up the ladder of industrialization. At the relatively advanced stages of industrialization, the linkage between services and manufacturing becomes far more important. The service sector bears the major share of the burden of income creation and employment generation. However, once again, as in case of agricultural development, the sustained growth of the service sector in terms of output and employment would not be possible without the concomitant development of industry, since the service sector of the economy depends on manufactured inputs for a significant portion of its total input requirements, exceeding 40 per cent in most cases.

As in the case of the linkage between agriculture and manufacturing, the mutually supportive and reinforcing nature of the intersectoral relationships between manufacturing and services is quite evident. This is particularly true of producer services, as discussed at length in this study. To recapitulate the main points, the phenomenal growth of producer services in industrialized countries may reflect a whole host of new demands brought on by a rapid change in the world economic environment, involving the globalization of financial and capital markets and certain product markets, such as those for automobiles, consumer electronics and semiconductors, and the intensification of global competition and deregulation. This revolutionary change in the global economy in recent years has created a wide range of new demands for specialized services, such as international trade law expertise, international marketing, plant location surveys, global sourcing of parts and components, technical engineering and construction services, and electronic, financial and accounting services. The availability of a rapidly expanding range of sophisticated producer services has become an essential condition for enhancing the competitive edge of manufacturing and withstanding fierce competition on global markets. Empirical results from the linkage analysis tend to confirm this crucial link between producer services and manufacturing at relatively advanced stages of industrialization.

Prima facie, the service sector accounts for the largest share of employment creation at both ends of the development spectrum. At the early stages of industrialization, the informal sector absorbs the bulk of agricultural workers pushed out by rural overcrowding and poverty, as well as new labour market entrants attributable to rapid population growth, primarily because of the limited capacity of industry to generate employment. On the other hand, a huge restructuring of the labour market is currently under way in developed countries, with a major shift of jobs away from manufacturing and towards the service industries as a result of the de-industrialization phenomenon. However, the employment absorptive capacity of the manufacturing sector has so far been seriously underestimated by most investigators, since only the direct employment effect of manufacturing activities has been taken into account. Undoubtedly, in developing countries there is considerable scope for increasing manufacturing employment by formulating and implementing more rational industrial policies, removing some factor price distortions and adopting techniques of production that would entail the maximum use of an abundant supply of unskilled labour. But what is equally, if not more, important for employment creation is the catalytic role that manufacturing could play in expanding legitimate employment opportunities in the service sector through interindustry demand for service inputs and income-induced demand for various types of services. It is on this indirect rather than direct employment impact of the manufacturing sector that a strategy of employment generation must be focused.

To be more specific, as urbanization and industrialization accelerate, the service sector tends to experience rapid growth, of which there are two major sources. The first source of growth is the increase in transactions between manufacturing and services; manufacturing needs more infrastructure services, such as distributive services and telecommunications, and various producer services. These service activities are directly linked to production, and manufacturing growth exerts demand pressure for the expansion of output and employment in these service industries. Empirical results show that distributive services are quantitatively the most important source of service inputs for the manufacturing sector in process of development. However, the relative importance of distributive services declines and producer services become relatively more important in advanced stages of industrialization, for reasons explained earlier.

The second source of service sector growth is related to rising incomes, which creates demand for a whole host of new consumer services and social services, such as recreation, entertainment, education, health care, security, environmental protection, and other professional and personal services. These services are usually superior goods whose income elasticities are greater than one, with a greater proportion of incomes being spent on these services as incomes rise. In other words, the level of social and personal services provided is less related to the level of industrial activities than to the level of per capita incomes, which industrialization helps to increase. The sectoral multiplier analysis confirms the sensitivity of social and personal services to the income effect. The direct and indirect production effects on these services tend to be relatively small, but the effects on these services of personal spending from additional income generated in production seems to be quite significant.

The income elasticity of demand for services clearly has an important implication for an employment strategy. If income elasticities for most services are sufficiently high, a development strategy could concentrate on first maximizing economic growth through rapid industrialization, even if this strategy may entail capital-intensive production. Then, apart from growing intermediate demand for distributive services and producer services, the resulting higher per capita incomes are likely to generate significantly increased demand for personal and social services, thus leading to the rapid expansion of service employment.

It comes as little surprise that the manufacturing sector tends to generate considerably greater output multiplier effects on the economy than any other sector, perhaps except for construction, although its employment impact is not commensurate with its output effect. The reason for this is the comparatively high density of interindustry transactions involving both forward and backward linkages within and around the manufacturing sector. The crux of the problem is not the relative size of the employment multiplier effects of manufacturing *vis-à-vis* services or any other sector of the economy, but the intersectoral dynamics. For instance, the capability of the service sector to generate and sustain a high level of employment critically hinges upon its vital linkages with the manufacturing sector. Historically, high per capita incomes and high standards of living in the world have always been associated with a high degree of industrialization. Very few economies could sustain economic growth on the strength of the service economy alone. In this regard, it is worth noting that the primacy of industrialization has been extensively postulated, empirically tested and confirmed at the local and regional levels in developed countries.

The crucial role that manufacturing could play in economic development by producing a wide range of intermediate and capital goods as well as consumer goods, thus expanding the supply capacity of the economy and creating extensive backward and forward linkages with other sectors, has been amply discussed. However, other important aspects of industrialization should not be overlooked. A few such examples of are as follows:

(a) Since the most dynamic technological change is likely to occur in manufacturing, with its increasing returns, industrialization tends to foster rapid technological change not just in one sector but in the economy as a whole. This is particularly true of the emergence of technology- and information-intensive producer services catering to advanced manufacturing sectors;

(b) A diversified structure of production and trade may be the best defence of a country producing a narrow range of products, against its vulnerability and uncertainty in a rapidly changing external economic environment;

(c) Manufactured exports are the most viable way of earning badly needed foreign exchange for imports of capital goods and intermediate inputs and for debt servicing.

2. *Possible lessons for other developing countries*

The countries of the Pacific region considered in this study have undergone the fastest industrial development ever seen. These countries including Japan were all poverty-stricken three or four decades ago. Today, Japan is a superindustrial power. The Republic of Korea and Singapore are at the threshold of industrial maturity and may soon surpass, if they have not already done so, the industrial performance of OECD countries such as Greece, Portugal and Turkey. Closely behind them are also another generation of four rapidly industrializing countries, namely, China, Indonesia, Malaysia and Thailand, and they are well under way towards an industrial take-off. Only the Philippines have stagnated in this part of the world distinguished by its rapid pace of economic growth.

A logical question to be asked is: what lessons could other developing countries draw from the success stories of countries in the Pacific region? The literature on this subject is extensive and still growing. Above all, there is a great divergence of views and opinions about the basic causes of the successful industrial revolution in the Pacific region. They range from sociocultural factors, such as national pride, thrift, family cohesion, social stability and a work ethic underpinned by Confucianism and other religions, to political and economic factors, such as selective State intervention, guided by élite technocrats and bureaucrats, to steer the economy towards a market system with a strong export orientation, relatively equal distribution of income and low taxes to motivate workers, and top priority given to investment in education. It is beyond the scope of this study to investigate the many complex interrelated determinants of the rapid industrialization of this region. Instead, the policy implications of one important aspect of the development issues will be considered, namely, the export-led industrialization strategy pursued in recent years by all developing countries of the Pacific region covered in this study.

One of the striking results that emerges from this empirical analysis is the significant difference between the index of domestic industrial linkages and the overall linkages observed in most developing countries examined in this study. The result implies that these countries have built up a complex network of inter-industry linkages nearly comparable to that of Japan, relying heavily on imports of intermediate inputs, capital goods and foreign technology. For instance, Singapore, with its tiny workforce of 1.3 million, critically depends on foreign investment to sustain its exports, with over 3,000 transnational corporations having set up offices on its territory. These countries achieved remarkable economic growth fuelled by the export drive, and the resultant export earnings made it possible for them to expand imports of intermediate inputs, capital goods and technology essential to the production of exportables. One of the important features of this export-led industrialization strategy, particularly for relatively large countries such as Indonesia, Republic of Korea, Thailand, and even Malaysia, is that all necessary intermediate inputs and capital goods are initially imported to establish a broad industrial capacity to produce and export a broad array of products ranging from items of light manufacturing, such as shoes and garments, to technologically sophisticated products, such as electronic components and automobiles. An abundant supply of cheap labour offers a competitive advantage at the early stages of the export drive. At the same time, a country could launch a conscious industrial policy to build up its technological capacity to produce domestically an increasing portion of previously imported intermediates and capital goods, through learning-by-doing or other measures. A good example of this is a vigorous promotion of the localization programme of parts and components used in the production of automobiles and electronic products in Malaysia, the Republic of Korea and Thailand.

The total and domestic linkages indices for the eight countries compared in table III.5 reflect the crucial importance of imports in building up an industrial base. Both potential and actual production capacities, as measured by the linkage indices, rose between 1975 and 1985 in most of the countries except Japan, and the gap between the two remained the same or slightly increased during the period in most of the countries except the Republic of Korea. This means that these countries have been pursuing a double-pronged strategy for rapid industrialization, building up an export capacity based on foreign technology and imports, and at the same time developing domestic capacity to replace an increasingly larger portion of total imports. It must be noted, however, that import substitution would be hindered by adjustment costs and various non-trade-specific-factors such as land sites, specific natural resources and climatic conditions. Moreover, complete import substitution would not be possible even at advanced stages of industrialization, because of a rapid increase in intra-industry trade in numerous similar but differentiated products, which no country could conceivably produce on its own, given all the economic costs of self-sufficiency.

A logical question arises as to the limitations of an import-substitution strategy compared with the export-led industrialization described above. At the risk of oversimplification, the experience of import-substitution strategies, particularly in many Latin American countries in the 1960s and 1970s, tends to show that the industrialization process has often stifled by import shortages. These countries could not meet their growing need for imports, which had to be sharply curtailed because of inadequate export growth and a resulting foreign exchange shortage. By limiting imports and relying on the domestic industrial base, they impeded the introduction of new technologies and seriously eroded their productive efficiency and competitive edge on global markets.

Another important question concerns the extent to which the experience of the countries of the Pacific region could be duplicated in other developing countries. According to the model of industrialization suggested by the experience of the countries of East and South-East Asia, a country would climb up the ladder of industrial development, through a continuous shifting of comparative advantage driven by an export-led growth strategy, from a lower stage of labour-intensive industrialization to a higher stage of technologically sophisticated skill-intensive industrialization. The development experience of the countries of the Pacific region over the last two decades seems to suggest such a pattern of shifting international division of labour. As Japan moved up to an advanced stage of technology-intensive industrialization, Asian NICs (Hong Kong, Republic of Korea, Singapore and Taiwan Province) stepped into the markets vacated by Japan. Today, another echelon of Asian developing countries (China, Indonesia, Malaysia, Philippines and Thailand) seems to be penetrating into the markets in which Asian NICs have no longer a comparative advantage, primarily due to their sharply rising labour costs.

In discussing the relevance and replicability of a model of industrialization based on the experience in East and South-East Asian economies, and its adoption by a large number of developing countries in other regions of the world, it would be useful, for analytical purposes, to distinguish between, on the one hand, possible constraints imposed by changing demand conditions and, on the other, supply-related problems. First, on the demand side, there is a problem that may be expressed in terms of the "fallacy of composition", which consists in stating that what is true of a part is necessarily true of the whole. In particular, export market saturation may occur if a large number of developing countries attempt to export simultaneously. Recent trends in developed countries do not seem to offer much encouragement in this regard. Traditionally, the United States has been a major market for the countries of the Pacific region. The mounting trade imbalance of the United States *vis-à-vis* Asian developing countries and Japan, together with its huge and chronic budget deficits, is causing pressure to build up in the United States to correct the trade imbalance by reducing its imports. That would mean a substantial shrinkage of this large market and severe losses for a small number of Asian countries, with much more serious implications for a large number of potential new entrants from other regions.

The other major market for the exports of developing countries has been the EEC. There is great uncertainty regarding the impact of the single European market of 1993 on the export prospects of developing countries. Apart from the real or imagined threat of a "Fortress Europe" surrounded by protectionist barriers, there is concern that the economic integration may produce more trade diversion than trade creation, given the greater heterogeneity of member countries in terms of development stages since the accession of Greece, Portugal and Spain to the Community. Moreover, recent market reforms in Eastern Europe and the former USSR may generate additional pressure to open up EEC markets to these newly emerging market economies, and this may in turn lead to a further trade diversion of the EEC market at the expense of developing countries.

It thus appears likely that the coming decade will see a shrinkage of the United States and EEC markets for the exports of developing countries, those of Asia included. However, certain options appear open to developing countries to counterbalance or at least soften the negative impact of diminishing export prospects in the United States and EEC. First, developing countries should have greater access than hitherto permitted to a huge market in Japan. Second, serious attention should be given to the expansion of domestic markets as well as exports. Many products could be produced for both export and domestic consumption. As discussed earlier, the growth of domestic markets at the early stage of development requires a massive investment in agriculture and agro-based industries to make farming productive and increase the purchasing power of farmers, together with land reforms and other institution-building. Third, intraregional trade may provide a huge export opportunity, once a group of developing countries has reached the take-off stage in the process of industrialization. Developing countries in the Pacific region appear to be well positioned to benefit from the potential gains of intraregional trade, assuming that most trade barriers are lowered significantly or eliminated by all the parties concerned. In fact, emerging Asian markets are now the world's fastest-growing consumer markets. Two factors favour the intensification of intraregional trade. First, rising incomes create rapidly expanding markets for an ever-increasing range of consumer goods and services, and for intermediate and producer goods through inter-industry linkages. Second, in contrast to the ageing population in developed countries, the younger population cohorts are expanding fast and the number of new urban households is also likely to increase sharply. This dramatic demographic change may drastically alter the structure of demand, generating a housing boom and demand for a wide range of consumer goods as well as various social services such as health, education, recreation facilities and other welfare services, whose institutionalized provision is a function of the level of development. There is no reason why this growth dynamic could not spread to developing countries in other regions.

On the supply side, the foremost obstacle to the building of an export base using borrowed technology is the development of the capacity to absorb technology and adapt it to the special conditions of the country concerned. In general, the acquisition of technology seems to pose no serious problem. The world market for technology is highly competitive, and most state-of-the art technology could be bought. The capacity to absorb new technology is the crux of the problem. Technological absorptive capacity is based on the following requirements: the availability of machinery and skills in equipment operation and handling hardware, including its repair and maintenance; expertise in the organization, management, control and execution of plant operations in the most efficient way; the capability to design and redesign products and to adapt and even improve their quality; and a domestic R and D capability to enhance the technological base and expand domestic production of parts and components and other imported industrial intermediate inputs.

It becomes evident at this point that the parallel development of producer services is essential to strengthening the technological capacity and increasing the productivity and competitiveness of an economy. As discussed earlier, on grounds of cost efficiency internally, manufacturing enterprises could not provide a wide range of complex producer services preferring to contract most of them out to firms specializing in a narrow range of highly sophisticated producer services. In fact, the externalization (contracting out) of producer services by manufacturing firms is an important factor for strengthening linkages between manufacturing and services, as confirmed by the empirical results of this study, and provides small and medium-size enterprises at the advanced stage of industrialization with greater access to such services.

In the short run, there seems to be no alternative to imports of producer services to build up a competitive export base and progress rapidly towards the attainment of industrial maturity in most developing countries. The existence of advanced telecommunications and a sophisticated information network, together with a sufficient pool of skilled labour, are some of the prerequisites for the development of producer services. A large majority of developing countries lack such essential physical and human infrastructure, and it takes time to build them up. It is imperative, however, that developing countries should concentrate their efforts on the development of indigenous producer services that would enable them to assimilate and adapt advanced technologies from developed countries, establish an export base, and increase their international competitiveness. To this end, Governments could target producer services as a priority industry and formulate and implement national policies, accompanied by fiscal and financial incentives similar to the export processing zones offered for export promotion, to facilitate the growth of this key industry. The provision of a comprehensive incentive scheme for the establishment of special service centres providing a wide range of producer services to manufacturing enterprises is an instructive example of the type of action required. There is also ample scope for regional cooperation to pool the human and physical resources of a group of developing countries, particulary small countries with limited resources, for the establishment of a common regional producer-service infrastructure to meet the needs of rapid industrial development.

All the discussion about the building of an export base, technological absorptive capacity and the paramount importance of producer services, as well as industrialization in general, seems to revolve around the role of one obvious but all-important factor, namely human capital. Cheap labour alone is not enough. What gives a country its competitive edge is the quality of its labour. Nothing matters more than education. In this regard, it must be recognized that what gives developing countries a potential edge is not cheap unskilled labour, but a skilled workforce, that is, managers, professionals, engineers, technicians, scientists and even bureaucrats who are relatively cheap compared to those in developed countries. Many NICs such as Brazil, Hong Kong, India, Republic of Korea, Singapore and Taiwan Province, have a rapidly expanding and skilled workforce. A growing pool of skilled labour could be a key factor in the success of export-driven industrialization in developing countries. A competitive edge based on low-cost skilled labour is not confined to manufacturing, but applies to many types of service exports, thanks to the recent acceleration of technological progress in world telecommunication systems, as evidenced by the considerable amount of data processing work being contracted out by United States firms to producer service firms in India, Ireland and some Caribbean countries. In short, the development of human resources should be given the highest priority in developing countries.

Finally, of critical importance to developing countries is the as yet uncertain impact of information technologies based on micro-electronics, commonly known as "informatics", on structural change in both services and manufacturing, and on the linkages between the two sectors. A tidal wave of technological change based on the informatics is sweeping through the service sector, affecting such industries as telecommunications, banking and finance, trade and transport, and various producer services. This technological change is radically restructuring service industries. Parallel changes are also taking place in many branches of manufacturing, increasing the diversity of products and processes, and improving quality and efficiency. In this context, there is growing concern that the application of new information technologies to the production of goods and services could undermine the competitive advantage of developing countries in labour-intensive manufacturing industries, such as textiles and clothing, and microchips and semiconductors ([30] and [31]). The consequence of such a reversal of competitive advantage is that developing countries may face severe export constraints, leading to the failure of export-led industrialization, unless they are also allowed to absorb and develop the micro-electronics-based technologies. The extent to which micro-electronics-based automation in developed countries could erode the competitive edge of developing countries in labour-intensive products remains uncertain, given the high initial costs of such investments, which could hinder the spread of new technologies. However, since, continuous technological upgrading is an essential component of an export-led industrialization strategy, the problem of technological lag in developing countries could be handled through such a strategy. It is more difficult to assess the impact of information technologies on the possible shape of structural change in both the manufacturing and service sectors, and on the evolution of intersectoral relationships between them, as well as the implications of these changes for employment generation ([32] and [33]).

Annex I

MATHEMATICAL NOTES ON INTERINDUSTRY LINKAGE MEASURES

Unless specified otherwise, matrices are henceforth denoted by capital letters, vectors are written as lower-case letters with a bar attached below them, and scalars represented by lower-case letters without a bar. Let the matrices and vectors be defined as follows:

A is a (nxn) total input coefficient matrix, that is, domestic plus imported inputs divided by the total output of each industry (column sum);

M is a (nxn) imported input coefficient matrix;

$A^d = A - M$, *a (nxn)* domestic input coefficient matrix;

B is a (nxn) total sales coefficient matrix, that is, domestic plus imported sales divided by the total sales of each industry (row sum);

$B^d = B - M$, *a (nxn)* domestic sales coefficient matrix;

$\underline{x}$ *is a (nx1)* output vector;

$\underline{f}$ *is a (nx1)* final demand vector;

$\underline{f}^m$ *is a (nx1)* import demand vector;

$\underline{f}^d = \underline{f} - \underline{f}^m$, *a (nx1)* domestic demand vector.

The interindustry linkage measures can then be defined as follows:

1. Sectoral dependency ratio

(a) The total dependency ratio is defined as, $d_{ij} = \dfrac{a_{ij}}{\sum_i a_{ij}}$,

where a_{ij} is a total input-output coefficient (domestic coefficient plus imports), and $\Sigma_i a_{ij}$ is the column sum of the input-coefficient matrix. This ratio measures the degree of importance of an input of sector i to the total inputs required for an output of sector j;

(b) The domestic dependency ratio is likewise defined as,

$$d_{ij}^d = \frac{a_{ij}^d}{\sum_i a_{ij}^d}.$$

2. Sectoral sales ratio

(a) The total sales ratio is defined as $s_{ij} = \dfrac{b_{ij}}{\Sigma_j b_{ij} + f_i}$,

where b_{ij} is an element of the B matrix, $\Sigma_j b_{ij}$ is the row sum of intermediate sales, and f_i is final demand sales for sector i. The sales ratio measures the degree of importance of a sale to sector j in the total sales of sector i (intermediate and final sales);

(b) The domestic sales ratio is likewise defined as:

$$s_{ij}^d = \frac{b_{ij}^d}{\sum_j b_{ij}^d + f_i^d}.$$

3. Output multipliers.

Let the Leontief inverse be denoted by $C = (I - A)^{-1} = [c_{ij}]$ for the total quantity, and $C^d = (I - A^d)^{-1} = [c_{ij}^d]$ for the domestic components. Then, the total direct and indirect output multiplier for sector j is $v_j = \Sigma_i c_{ij}$, and for the domestic direct and indirect output multiplier for sector j is $v_j^d = \Sigma_i c_{ij}^d$.

4. Backward linkage.

A normalized measure of backward linkage developed by Rasmussen compares the average stimulus created by sector j with the overall average $q_j = (\sum_i c_{ij})/(\sum_i \sum_j c_{ij}/n)$ for the total backward linkage index, and $q_j^d = (\sum_i c_{ij}^d)/(\sum_i \sum_j c_{ij}^d/n)$ for the domestic backward linkage index. The numerator represents the average stimulus transmitted to other sectors by a unit worth of demand for sector j, and the denominator represents the average stimulus to the economy when all final demands increase by one unit. If $q_j > 1$, a sector yields above average backward linkages, while the opposite is true if $q_j < 1$.

5. Forward linkage.

Let the inverse of identity matrix minus B matrix likewise be denoted by $D = (I - B)^{-1} = [d_{ij}]$ for the total quantity and $D^d = (I - B^d)^{-1} = [d^d_{ij}]$ for the domestic components. Then, a normalized total direct and indirect forward linkage for sector i is $g_i = (\sum_j d_{ij})/(\sum_i \sum_j d_{ij}/n)$, and for the domestic direct and indirect forward linkage is $g^d_i = (\sum_j d^d_{ij})/(\sum_i \sum_j d^d_{ij}/n)$.

6. Sectoral import coefficients

$\underline{m}' = \underline{I}' M(I - A^d)^{-1}$, where $\underline{I}'$ is a (1xn) unity row vector, that is, $\underline{I}' = (1,1,\ldots,1)$ the sectoral import coefficient for sector i measures imported input requirements for one unit increase in sector i output.

7. Sectoral import contents induced by final demand

$\underline{m}_k = M(I - A^d)^{-1} \hat{f}^d_k$, where $\hat{f}^d_k$ is the normalized domestic final demand vector k (k = 1, 2, 3 and 4). The sectoral import contents measure sectoral imported inputs requirements for each increase of one unit in the domestic final demand vector k. Stated simply, they measure the impact of final demand on intermediate import requirements.

8. Indices of sectoral net foreign exchange earnings

$\underline{\hat{e}}^* = \underline{\hat{e}} - M(I - A^d)^{-1}\underline{\hat{e}}$, where $\underline{\hat{e}}$ is a (nx1) normalized sectoral export vector.

9. Value-added coefficient induced by final demand

$\underline{v}_k = \hat{V}(I - A^d)^{-1} \hat{f}^d_k$, where $\hat{V}$ is a (nxn) diagonal matrix of value-added coefficients defined by

$v_j = 1 - \sum_i a_{ij}$, and $\underline{v}_k$ is a (nx1) value added coefficient induced by the domestic final demand vector k. They simply measure the impact of final demand on valued added by each sector.

10. Direct and indirect plus income-induced backward linkage multipliers

To derive income-induced effects, let an augmented matrix be defined in the following partitioned form:

$$A^* = \begin{pmatrix} A & \underline{k} \\ \underline{h}' & \alpha \end{pmatrix}$$

where $\underline{k}$ is a (nx1) vector of total consumption coefficients, $\underline{h}'$ is a (1xn) vector of total labour inputs, and α is a scalar representing the intra-household consumption coefficients.

Let the domestic components be defined as:

$$A^{d*} = \begin{pmatrix} A^d & \underline{k}^d \\ \underline{h}^d & \alpha \end{pmatrix}$$

Also $C^* = [I - A^*]^{-1} = [c^*_{ij}]$ and $C^{d*} = [I - A^{d*}]^{-1} = [c^{d*}_{ij}]$.

Then, the direct and indirect plus income-induced backward linkage multiplier for sector j is:

$v^*_j = \sum_i c^*_{ij}$

The same multiplier for domestic components is:

$v^{d*}_j = \sum_i c^{d*}_{ij}$.

11. Sectoral employment multipliers

Let an employment coefficient matrix be denoted by a diagonal matrix $\hat{L}$ whose elements e_j are the number of employees per unit of output in sector j. The sectoral employment impacts would then be:

$\underline{\varepsilon} = \underline{I}' \hat{L}[I - A^d]^{-1}$ for direct and indirect effects

$\underline{\varepsilon}^* = \underline{I}' \hat{L}[I - A^{d*}]^{-1}$ for direct and indirect plus income-induced effects

$\underline{\varepsilon}$ and $\underline{\varepsilon}^*$ represent a vector of the employment generated by one unit of increase in final demand for domestic output of a particular sector.

12. Sectoral employment induced by domestic final demand

$\underline{\varepsilon} = \hat{L}[I - A^d]^{-1} \underline{f}^d_k$ for direct and indirect employment effects

$\underline{\varepsilon}^* = \hat{L}[I - A^{d*}]^{-1} \underline{f}^d_k$ for direct and indirect plus income-induced effects, where $\underline{f}^d_k$ is a normalized final demand vector k.

Annex II

STATISTICAL TABLES

Table III.31. Industrialization and employment, 1975 and 1985

Region, country and area	Population 1975	Population 1985	Urban populatation 1975	Urban populatation 1985	Total employment 1975	Total employment 1985	Agricultural employment 1975	Agricultural employment 1985	Service employment 1975	Service employment 1985	Manufacturing employment 1975	Manufacturing employment 1985	MVA 1975	MVA 1985	GDP 1975	GDP 1985
	(thousands)		(percentage of total population)		(thousands)		(thousands)		(thousands)		(thousands)		(millions of 1980 dollars)			
Africa																
Burundi	3 680	4 731	2	2	29	45	17	7	5	22	3	6	56	89	755	1 209
Côte d'Ivoire[a]	6 755	9 201	33	45	331	433	72	75	130	266	71	69	810	1 091	7 366	10 283
Ghana	9 832	12 839	32	32	445	464	63	56	234	300	77	52	479	299	4 568	4 686
Kenya	13 742	20 097	12	20	819	1 174	214	241	426	702	101	159	454	960	5 225	8 059
Sierra Leone	2 931	3 665	21	25	61	69	5	6	36	38	6	8	57	52	709	832
Zambia	4 842	7 007	34	48	394	362	36	35	171	183	44	48	736	785	3 891	3 972
Zimbabwe[b]	6 144	8 040	20	27	1 050	1 036	364	271	400	492	156	166	1 134	1 258	5 123	6 202
Total	47 926	65 580	22	29	3 128	3 583	798	691	1 402	2 003	457	508	3 726	4 534	27 637	35 243
Asia[c]																
Hong Kong	4 396	5 457	90	93	1 341	2 543	0	42	550	1 373	679	919	3 431	7 132	15 414	36 134
India	620 700	769 180	21	25	19 668	24 578	1 152	1 305	10 941	13 989	5 130	6 183	21 868	40 538	148 385	229 337
Pakistan	74 740	103 230	26	29	20 424	26 961	11 192	13 631	5 393	7 735	2 783	3 686	2 772	6 257	20 518	39 177
Philippines	42 565	55 121	34	39	14 143	20 327	7 633	10 085	4 359	7 429	1 546	1 926	6 421	7 989	26 050	34 221
Republic of Korea	35 281	40 806	49	64	11 830	14 970	5 425	3 733	3 594	6 625	2 205	3 504	9 706	27 666	43 047	90 009
Singapore	2 263	2 559	100	100	834	1 154	17	8	544	737	218	294	2 045	3 669	7 792	15 821
Sri Lanka	13 604	16 111	24	21	999	5 132	509	2 531	196	1 430	189	648	707	936	3 165	5 303
Thailand	41 359	51 604	14	18	18 182	24 227	13 270	15 383	3 280	5 696	1 356	2 280	4 281	8 567	21 953	42 323
Total	834 908	1 044 068	24	28	87 420	119 892	39 198	46 718	28 856	45 015	14 106	19 440	51 230	102 774	286 324	492 325
Latin America																
Bolivia	4 895	6 371	30	44	1 547	1 686	744	800	491	616	156	147	637	442	4 447	4 508
Chile	10 351	12 122	79	83	2 716	3 721	586	751	1 428	2 217	457	495	3 200	4 275	14 961	21 075
Colombia	23 991	29 880	66	67	2 147	3 100	35	42	1 430	2 146	514	681	6 214	8 230	25 735	37 325
Cuba	9 306	10 079	63	71	2 394	3 164	685	544	1 029	1 610	472	695	5 313	10 899	14 346	24 937
Guatemala	6 023	7 964	37	41	546	632	398	234	65	291	71	78	904	1 179	5 967	7 447
Jamaica	2 013	2 312	46	53	685	782	232	280	327	361	74	99	608	455	3 138	2 678
Panama	1 748	2 181	51	50	461	627	147	185	216	318	43	64	287	351	2 621	4 094
Trinidad and Tobago	1 012	1 179	21	64	332	392	48	42	171	220	67	58	384	405	3 755	4 874
Venezuela	12 666	17 317	80	85	3 504	5 106	699	826	1 923	3 006	538	790	8 802	12 373	59 347	66 043
Total	72 005	89 405	64	68	14 332	19 209	3 574	3 703	7 080	10 785	2 392	3 107	26 349	38 608	134 317	172 980

Eastern Europe and USSR																
Bulgaria	8 772	8 961	59	68	3 677	4 095	811	895	1 214	1 380	1 297	1 411	6 010	11 433	14 724	22 837
Czechoslovakia	14 803	15 501	59	66	7 060	8 317	1 119	1 003	2 587	3 537	2 480	2 754	24 041	31 831	44 004	57 166
German Democratic Republic	16 851	16 645	75	76	7 404	7 935	299	331	3 172	3 483	3 384	3 569	46 957	77 757	96 966	148 286
Hungary	10 532	10 649	50	55	5 089	5 121	1 140	1 089	1 772	1 924	1 800	1 538	5 367	7 101	18 888	24 184
Poland	34 023	37 204	54	60	17 176	18 531	5 043	5 169	5 203	6 124	4 679	4 896	23 010	24 563	53 428	54 575
Romania	21 246	22 725	44	51	10 151	10 586	3 864	3 060	2 230	2 657	3 110	3 928	12 732	25 184	24 335	42 693
USSR	254 470	277 540	61	66	117 132	130 303	25 946	25 201	45 308	53 612	31 338	38 103	313 372	485 530	714 303	1 062 526
Yugoslavia	21 353	23 125	38	45	4 667	6 378	264	326	1 993	2 771	1 722	2 413	14 060	22 283	52 518	71 058
Total	382 050	412 350	58	64	172 356	191 266	38 485	37 074	63 479	75 488	49 809	58 611	445 549	685 682	1 019 166	1 483 325
OECD[d/]																
Australia	13 628	15 759	87	86	5 841	6 676	398	415	3 485	4 436	1 263	1 113	26 674	31 557	137 389	183 396
Austria	7 579	7 558	53	56	2 686	1 957	48	157	1 397	839	911	664	17 188	23 037	64 978	82 399
Belgium	9 797	9 859	71	96	3 782	3 561	136	109	2 188	2 391	1 095	803	25 475	32 724	103 655	124 661
Canada	22 727	25 379	78	77	9 284	11 221	564	575	6 000	7 795	1 871	1 960	40 861	53 990	217 150	303 192
Denmark	5 060	5 123	82	86	2 332	2 553	228	169	1 358	1 670	529	515	9 842	12 938	58 594	75 577
Finland	4 712	4 903	57	60	2 312	2 466	391	280	1 104	1 408	616	557	10 335	15 184	44 554	59 902
France	52 700	55 171	75	78	20 885	21 236	2 158	1 582	10 676	12 967	5 793	4 850	139 316	157 263	569 569	715 031
Germany, Federal Republic of	61 830	61 025	83	86	25 285	26 626	1 773	1 262	12 032	14 463	9 010	8 468	226 815	274 175	690 226	861 650
Ireland	3 178	3 553	55	57	1 050	1 076	233	168	480	598	222	203	3 215	5 600	15 414	21 503
Israel	13 456	4 233	87	90	1 113	1 349	72	72	660	877	275	303	3 983	5 059	20 133	26 653
Italy	55 442	57 142	67	67	18 818	20 894	2 964	2 296	11 702	7 549	6 132	4 766	87 295	133 161	358 669	490 149
Japan	111 520	120 840	75	76	52 230	58 070	6 610	5 090	26 800	32 500	13 460	14 530	214 978	442 537	831 511	1 283 335
Netherlands	13 654	14 485	76	88	4 645	5 145	263	268	2 761	3 403	1 162	993	26 114	33 253	148 868	178 038
New Zealand	3 084	3 284	83	83	1 223	1 341	1 31	148	661	763	297	318	4 953	5 885	22 751	25 989
Norway	4 008	4 153	47	73	1 707	2 014	159	147	960	1 322	411	348	9 455	9 889	45 577	68 041
Portugal	9 094	10 158	28	31	3 734	4 279	1 265	1 018	1 195	1 815	939	1 037	6 426	8 379	19 323	26 358
Spain	35 597	38 602	71	77	12 692	10 641	2 799	1 949	5 036	5 036	3 394	2 419	54 311	61 143	194 428	227 090
Sweden	8 193	8 351	85	86	4 062	4 299	263	208	2 330	2 806	1 125	968	26 774	29 096	116 205	135 673
Switzerland	6 339	6 471	56	60	3 017	3 352	237	203	1 534	1 955	1 018	1 194	23 380	27 366	93 479	108 700
Turkey	40 026	50 346	43	46	1 823	2 608	..	50	397	607	850	1 161	11 807	18 457	49 608	71 886
United Kingdom	56 416	56 815	90	92	24 703	24 539	677	616	14 012	15 933	7 669	5 540	130 598	129 105	488 812	588 956
United States	215 970	239 280	70	74	85 846	107 150	3 505	3 338	55 824	73 521	19 457	20 879	480 455	694 514	2 291 730	3 095 560
Total	744 010	802 454	72	74	289 069	323 054	24 872	20 120	158 439	199 073	77 498	73 588	1 580 250	2 204 313	6 582 623	8 753 739

Sources: International Labour Organisation, *Yearbook of Labour Statistics*, various issues; and World Bank, *World Development Report*, various issues.

a/ 1985 figures for Côte d'Ivoire are 1983 figures.

b/ 1985 figures for Zimbabwe are 1984 figures.

c/ Excluding centrally planned economies.

d/ Including Israel.

Table III.32. Sectoral shares of GDP in developing countries, 1970-1985
(Percentage)

Economic grouping or region	Year	Agriculture	Mining	Manufacturing	Utilities	Construction	Services
Developing economies	1970	21.91	4.89	18.16	5.14	1.40	48.48
	1975	17.29	11.95	18.03	5.91	1.18	45.64
	1980	14.55	14.41	17.87	6.77	1.25	45.14
	1985	14.99	9.14	18.58	5.89	1.51	49.88
Developed market economies	1970	4.16	1.56	27.62	6.28	2.36	58.01
	1975	4.36	1.86	25.56	6.59	2.47	59.16
	1980	3.51	2.81	24.99	6.45	2.54	59.69
	1985	2.94	2.54	23.10	5.55	3.10	62.77
Tropical Africa (sub-Sahara)	1970	31.29	6.47	8.24	4.90	0.92	48.17
	1975	29.35	8.95	9.65	5.67	0.87	45.51
	1980	29.16	12.67	8.97	5.00	1.08	43.12
	1985	32.18	10.03	9.40	3.45	1.01	43.93
Latin America	1970	12.02	3.12	23.79	5.54	1.67	53.85
	1975	10.91	3.56	25.44	6.48	1.42	52.18
	1980	9.43	4.82	24.23	6.80	1.49	53.23
	1985	10.01	4.65	24.29	4.57	1.45	55.04

Source: UNIDO database.

Table III.33. Input dependency ratios in selected countries, 1975 and 1985[a/]

Country and sector	Year	Agriculture Ratio	Agriculture Imports	Mining Ratio	Mining Imports	Manufacturing Ratio	Manufacturing Imports	Utilities Ratio	Utilities Imports	Construction Ratio	Construction Imports	Services Ratio	Services Imports	Total Ratio	Total Imports
China															
Agriculture	1975														
	1985	52.55	0.08	0.21	-	34.10	4.81	1.33	0.01	-	-	11.80	0.38	100	5.28
Mining	1975														
	1985	3.62	-	5.18	-	60.38	4.53	13.06	0.07	-	-	17.76	0.57	100	5.17
Manufacturing	1975														
	1985	17.15	0.77	5.42	0.30	60.20	7.75	2.99	0.02	-	-	14.24	0.48	100	9.32
Utilities	1975														
	1985	0.14	-	49.76	0.29	28.36	0.46	4.34	0.02	-	-	17.40	1.68	100	2.45
Construction	1975														
	1985	6.65	1.89	1.82	0.01	77.94	8.28	0.88	-	-	-	12.72	0.02	100	10.21
Services	1975														
	1985	7.20	-	1.38	-	52.77	1.14	2.44	0.01	-	-	36.21	0.68	100	1.83
Indonesia															
Agriculture	1975	24.38	0.03	0.01	-	37.80	8.26	0.36	-	6.66	-	30.77	0.60	100	8.90
	1985	31.49	0.30	-	-	45.81	5.18	0.46	-	2.44	-	19.81	0.03	100	5.51
Mining	1975	0.20	-	5.04	-	43.79	8.36	14.96	-	4.21	-	31.81	1.87	100	10.24
	1985	0.04	-	52.20	0.01	12.30	3.77	0.22	-	3.37	-	31.88	2.52	100	6.29
Manufacturing	1975	47.40	2.38	5.85	0.20	31.85	12.59	1.46	-	0.45	-	12.98	0.43	100	15.60
	1985	39.07	2.05	15.82	3.49	29.19	12.13	0.83	-	0.32	-	14.77	0.50	100	18.18
Utilities	1975	-	-	0.93	0.22	62.17	30.25	7.12	-	10.10	-	19.67	0.51	100	30.98
	1985	-	-	7.18	0.03	54.81	4.39	20.46	-	3.58	-	13.97	0.06	100	4.47
Construction	1975	4.76	-	6.66	0.25	53.15	24.54	0.12	-	0.37	-	34.95	1.14	100	25.93
	1985	3.79	-	6.12	0.01	58.99	11.65	0.09	-	0.27	-	30.74	1.15	100	12.80
Services	1975	7.35	0.05	0.03	0.01	43.92	8.32	1.64	-	6.67	-	40.39	5.82	100	14.21
	1985	4.78	0.05	-	-	36.88	5.29	3.85	-	6.00	-	48.49	5.68	100	11.01

Table III.33. (continued)

Country and sector	Year	Agriculture Ratio	Agriculture Imports	Mining Ratio	Mining Imports	Manufacturing Ratio	Manufacturing Imports	Utilities Ratio	Utilities Imports	Construction Ratio	Construction Imports	Services Ratio	Services Imports	Total Ratio	Total Imports
Japan															
Agriculture	1975	31.36	1.99	-	-	45.46	1.92	0.66	-	0.38	-	22.14	0.26	100	4.17
	1985	37.09	3.52	-	-	37.00	1.08	1.13	-	0.48	-	24.29	0.53	100	5.13
Mining	1975	0.56	-	0.58	0.08	17.33	1.05	4.85	-	0.35	-	76.33	0.69	100	1.82
	1985	0.53	-	0.68	0.48	43.80	0.56	6.41	-	0.72	-	47.86	0.70	100	1.74
Manufacturing	1975	9.48	2.49	8.40	7.67	58.21	3.18	2.35	-	0.14	-	21.42	0.32	100	13.67
	1985	6.33	1.57	5.60	5.13	62.38	4.01	3.40	-	0.34	-	21.95	0.37	100	11.08
Utilities	1975	-	-	24.64	21.70	38.33	4.23	3.90	-	4.73	-	28.39	0.49	100	26.43
	1985	0.01	-	30.33	27.32	29.29	3.78	4.48	-	4.82	-	31.07	0.42	100	31.52
Construction	1975	0.18	0.01	3.27	0.04	61.16	0.93	1.15	-	0.04	-	34.19	0.57	100	1.55
	1985	0.35	-	2.24	0.05	63.56	1.15	1.53	-	0.33	-	31.99	0.48	100	1.68
Services	1975	1.83	0.16	0.32	0.29	32.26	1.06	2.91	-	3.65	-	59.03	2.87	100	4.39
	1985	1.43	0.12	0.05	0.03	27.95	1.45	3.95	-	3.57	-	63.06	2.98	100	4.58
Malaysia															
Agriculture	1975	6.38	0.75	-	-	69.98	19.61	0.51	-	3.21	-	19.93	0.12	100	20.48
	1985	17.91	1.73	0.16	0.09	58.06	21.08	1.85	-	3.74	-	18.28	0.22	100	23.12
Mining	1975	0.74	0.03	-	-	56.51	22.92	0.64	-	2.43	-	39.68	1.94	100	24.89
	1985	0.22	-	15.50	11.96	33.63	19.12	6.55	-	6.46	-	37.64	6.50	100	37.58
Manufacturing	1975	33.79	1.73	15.54	8.70	38.14	14.96	1.23	-	0.49	-	10.81	0.14	100	25.52
	1985	17.23	0.01	13.20	5.30	49.95	28.64	3.34	-	1.19	-	15.09	0.17	100	36.28
Utilities	1975	-	-	0.39	0.27	81.20	28.58	7.10	-	0.52	-	10.79	0.15	100	29.00
	1985	0.01	0.01	-	-	71.44	34.45	3.51	0.80	6.32	-	18.73	-	100	35.26
Construction	1975	0.55	0.03	2.29	1.59	78.89	20.80	0.17	-	0.03	-	18.07	0.35	100	22.77
	1985	0.11	0.01	3.36	0.30	68.64	29.61	0.39	-	1.90	1.02	25.59	5.79	100	36.72
Services	1975	2.69	0.51	3.97	1.01	39.58	12.33	2.44	-	2.12	-	49.19	1.11	100	14.95
	1985	2.20	0.18	0.14	0.08	33.79	19.48	4.73	0.08	10.91	-	48.22	17.94	100	37.76
Philippines															
Agriculture	1975	27.87	0.20	0.09	-	49.48	10.21	0.16	-	1.23	-	21.17	-	100	10.41
	1985														
Mining	1975	1.18	-	0.22	-	64.19	12.41	5.92	-	0.09	-	28.40	-	100	12.41
	1985														
Manufacturing	1975	32.97	2.07	12.87	11.67	36.43	13.03	0.51	-	0.13	-	17.09	-	100	26.77
	1985														
Utilities	1975	0.09	-	-	-	70.64	6.75	6.27	-	0.11	-	22.88	-	100	6.75
	1985														
Construction	1975	1.65	-	6.31	0.18	69.79	9.36	0.39	-	0.58	-	21.28	-	100	9.54
	1985														
Services	1975	3.58	0.01	0.06	-	37.06	3.76	4.06	-	1.65	-	53.59	0.65	100	4.42
	1985														

Republic of Korea															
Agriculture	1975	33.47	0.47	0.53	-	51.61	8.54	0.17	-	0.46	-	13.76	0.97	100	9.99
	1985	30.55	0.83	0.23	-	52.42	3.15	0.95	-	1.20	-	14.65	1.46	100	5.44
Mining	1975	16.20	8.13	0.93	-	39.26	3.46	13.48	-	0.58	-	29.53	1.16	100	12.75
	1985	5.40	-	0.08	-	46.16	1.50	17.28	-	3.41	-	27.66	0.03	100	1.53
Manufacturing	1975	26.02	6.90	9.28	7.84	50.40	13.84	2.17	-	0.06	-	12.07	1.02	100	29.59
	1985	13.84	3.14	10.49	9.06	59.87	14.04	3.01	-	0.20	-	12.59	0.70	100	26.95
Utilities	1975	0.17	0.08	2.57	-	72.60	11.94	2.80	-	0.26	-	21.60	1.53	100	13.55
	1985	-	-	15.62	12.64	58.09	7.93	9.54	-	4.22	-	12.53	0.25	100	20.82
Construction	1975	1.34	0.52	2.81	-	72.02	5.57	0.21	-	0.03	-	23.59	0.67	100	6.77
	1985	0.16	-	2.04	-	68.16	4.52	0.71	-	0.53	-	28.40	0.12	100	4.64
Services	1975	0.90	0.14	0.17	0.04	42.64	3.97	2.51	0.08	3.90	-	49.88	4.51	100	8.75
	1985	0.80	-	0.07	0.00	41.07	5.99	4.68	0.01	5.07	-	48.31	5.34	100	11.35
Singapore															
Agriculture	1973	2.55	1.95	-	-	80.87	8.44	0.61	-	1.30	-	14.67	-	100	10.39
	1985	22.63	21.10	-	-	53.84	19.47	2.36	-	0.12	-	21.04	0.40	100	40.98
Mining	1973	-	-	17.87	4.06	19.49	17.87	3.25	-	0.81	-	58.57	-	100	21.93
	1985	-	-	40.65	-	18.82	8.69	4.16	-	1.88	-	34.49	1.65	100	10.34
Manufacturing	1973	7.47	7.13	0.16	0.01	81.00	70.35	1.32	-	0.11	-	9.95	-	100	77.49
	1985	0.90	0.85	0.35	0.08	84.10	68.59	1.65	-	0.12	-	12.88	0.29	100	69.82
Utilities	1973	-	-	-	-	59.31	4.42	8.04	-	1.26	-	31.39	-	100	4.42
	1985	0.04	-	-	-	88.55	5.33	3.54	0.17	0.04	-	7.83	0.21	100	6.21
Construction	1973	0.09	0.09	5.38	1.54	84.65	58.23	0.27	-	1.66	-	7.96	-	100	59.86
	1985	-	-	1.63	0.37	75.95	35.97	0.65	-	0.04	-	21.73	0.29	100	36.63
Services	1973	5.30	2.57	-	-	28.57	16.78	3.11	-	2.75	-	60.27	12.94	100	32.29
	1985	1.61	0.87	0.02	-	32.34	13.93	3.14	-	1.05	-	61.84	11.99	100	26.79
Thailand															
Agriculture	1975	31.38	0.28	0.02	-	47.03	6.90	0.30	-	1.04	-	20.22	0.40	100	7.58
	1985	28.15	0.34	0.06	0.02	54.29	11.76	0.61	0.01	0.91	-	15.99	0.14	100	12.28
Mining	1975	2.42	-	-	-	54.96	11.11	0.65	-	5.17	-	36.81	1.61	100	12.72
	1985	0.44	-	1.89	0.01	36.45	7.20	3.57	0.17	1.61	-	56.04	0.05	100	7.45
Manufacturing	1975	36.50	1.73	9.27	7.23	37.21	10.79	2.00	-	0.76	-	14.26	0.46	100	20.21
	1985	25.22	1.80	10.63	7.75	45.19	13.12	3.07	-	0.41	-	15.49	0.31	100	22.98
Utilities	1975	-	-	0.59	-	69.30	5.59	9.38	-	0.76	-	19.98	0.26	100	5.85
	1985	-	-	41.87	-	22.36	7.25	27.19	-	0.26	-	8.32	0.12	100	7.38
Construction	1975	1.09	0.02	7.97	0.40	63.02	11.89	0.66	-	0.05	-	27.21	0.51	100	12.81
	1985	0.86	0.30	8.31	0.12	54.16	10.11	1.91	-	1.39	-	33.36	0.43	100	10.97
Services	1975	3.69	0.05	0.03	-	49.03	3.65	2.52	-	3.69	-	41.04	1.42	100	5.12
	1985	2.05	0.20	0.46	-	53.75	13.03	5.20	0.02	1.65	-	36.88	1.30	100	14.55

Sources: See table III.3.

Note: Imports represent imported inputs as a percentage of total inputs.

a/ 1973 and 1985 for Singapore.

Table III.34. Sectoral output multipliers in selected countries, 1975 and 1985[a/]

	China			Indonesia						Japan					
	1985			1975			1985			1975			1985		
Industry	Total	Domestic	D/T	Total	Domestic	D/T	Total	Domestic	D/T	Total	Domestic	D/T	Total	Domestic	D/T
Food crops	1.48[illegible]2	1.4025	94.49	1.0984	1.0770	98.05	1.1842	1.1337	95.73	1.6467	1.5339	93.15	1.7027	1.5897	93.36
Commercial crops	1.5370	1.5042	97.87	1.2225	1.1690	95.63	1.4973	1.4069	93.97	1.6730	1.5321	91.58	1.7917	1.6429	91.69
Livestock	1.7368	1.6863	97.09	1.1300	1.1170	98.85	1.5187	1.4493	95.43	2.6393	2.3698	89.79	2.7185	2.4878	91.51
Forestry	1.4312	1.4014	97.92	1.2256	1.1644	95.01	1.2429	1.1879	95.57	1.9785	1.9194	97.01	2.1622	2.0335	94.05
Fishing	1.5491	1.4965	96.61	1.2348	1.1710	94.83	1.3104	1.2510	95.47	2.0961	1.8282	87.22	2.3374	1.9885	85.08
Mining	1.8586	1.7300	93.08	1.0731	1.0515	97.99	1.2510	1.2116	96.85	2.1104	1.9240	91.17	2.2410	1.9861	88.63
Food, beverages and tobacco	2.2675	2.1407	94.41	1.9028	1.8297	96.16	2.0662	1.9663	95.16	2.6832	2.2788	84.93	2.5094	2.2007	87.70
Textiles and leather	2.6585	2.4409	91.81	2.3206	1.7754	76.50	2.3848	1.8401	77.16	2.8051	2.4182	86.21	2.6983	2.2912	84.91
Wooden products, pulp and paper	2.4984	2.2255	89.08	1.8895	1.6978	89.85	1.9708	1.7806	90.35	2.7726	2.3326	84.13	2.7000	2.2730	84.18
Printing and publishing	2.5385	2.2684	89.36	1.8250	1.3384	73.34	2.0240	1.6162	79.85	2.3983	2.2213	92.62	2.2611	2.0797	91.98
Chemicals, excluding fertilizer	2.4305	2.1267	87.50	2.1265	1.5949	75.00	2.2844	1.4263	62.44	2.8064	2.2767	81.12	2.7502	2.2310	81.12
Fertilizer and pesticides	2.5382	2.3477	92.49	1.6397	1.2953	78.99	2.1991	1.5433	70.18	2.9869	2.4852	83.21	2.7143	2.2635	83.39
Petroleum products	2.0708	1.9763	95.44	1.9340	1.8159	93.90	1.9526	1.7317	88.69	2.8984	1.4546	50.19	2.5975	1.2620	48.58
Rubber and non-metallic products	2.3678	2.1175	89.43	1.9667	1.6867	85.76	2.1635	1.5925	73.61	2.5529	2.2194	86.94	2.4375	2.1365	87.65
Iron and steel	2.4334	2.0293	83.39	2.3293	1.5415	66.18	2.0159	1.5991	79.32	3.6996	3.0494	82.43	3.4294	2.9913	87.23
Non-ferrous and other metal products	2.6627	2.2319	83.82	2.1506	1.4384	66.88	2.1432	1.6194	75.56	2.6868	2.2614	84.17	2.6874	2.2884	85.15
Industrial machinery	2.5817	2.2030	85.33	2.1422	1.2258	57.22	2.2936	1.3011	56.73	2.6986	2.4425	90.51	2.5966	2.3685	91.22
Transport equipment	2.6907	2.4102	89.58	1.9721	1.3008	65.96	2.3110	1.4388	62.26	2.8306	2.5930	91.61	2.9023	2.6854	92.52
Other manufacturing	2.5438	2.2968	90.29	2.0213	1.6620	82.22	2.0114	1.6370	81.38	2.4781	2.2349	90.18	2.4602	2.1895	89.00
Electricity, gas and water	1.8081	1.7317	95.77	1.8932	1.5015	79.31	2.5514	2.3043	90.32	2.2220	1.6612	74.76	2.0912	1.5965	76.34
Construction	2.7037	2.3603	87.30	2.0339	1.6101	79.16	2.1642	1.8501	85.49	2.5136	2.2846	90.89	2.4107	2.2002	91.27
Distributive services	1.8693	1.7986	96.22	1.3795	1.2591	91.27	1.4625	1.3685	93.57	2.0124	1.7725	88.08	1.7785	1.6304	91.67
Communications	1.5964	1.5329	96.02	1.6415	1.4881	90.65	1.5983	1.4894	93.18	1.4265	1.3687	95.95	1.4316	1.3803	96.42
Producer services	1.3268	1.2876	97.05	1.3232	1.2319	93.10	1.3648	1.2742	93.36	1.6901	1.6130	95.43	1.7670	1.6803	95.09
Personal services	2.1268	2.0182	94.89	1.8082	1.6439	90.91	1.9318	1.7293	89.52	1.9793	1.8175	91.63	1.9134	1.7712	92.57
Social services	2.0652	1.9480	94.32	1.1465	1.1067	96.53	1.1983	1.1527	96.19	1.7342	1.6090	92.78	1.6971	1.5767	91.91
Average	2.1298	1.9505	92.33	1.7089	1.4151	84.97	1.8499	1.5347	84.90	2.3854	2.0578	87.23	2.3380	2.0317	87.51

Industry	Malaysia 1975 Total	Malaysia 1975 Domestic	Malaysia 1975 D/T	Malaysia 1985 Total	Malaysia 1985 Domestic	Malaysia 1985 D/T	Philippines 1975 Total	Philippines 1975 Domestic	Philippines 1975 D/T	Republic of Korea 1975 Total	Republic of Korea 1975 Domestic	Republic of Korea 1975 D/T	Republic of Korea 1985 Total	Republic of Korea 1985 Domestic	Republic of Korea 1985 D/T
Food crops	1.4014	1.2358	88.19	1.3806	1.1830	85.68	1.3045	1.1918	91.35	1.3817	1.2353	89.40	1.4592	1.3292	91.09
Commercial crops	1.2919	1.1559	89.47	1.4286	1.2034	84.24	1.3062	1.1956	91.53	1.5686	1.3808	88.02	1.6221	1.4911	91.92
Livestock	1.9285	1.7187	89.12	2.4877	1.9733	79.32	1.6503	1.5306	92.75	2.2843	2.0591	90.14	2.6923	2.4230	90.00
Forestry	1.2574	1.1317	90.00	1.5914	1.3615	85.55	1.3363	1.2011	89.89	1.4158	1.3113	92.62	1.3627	1.2288	90.18
Fishing	1.3178	1.1587	87.93	1.3047	1.1092	85.02	1.2609	1.1785	93.47	1.9745	1.5273	77.35	2.1040	1.5889	75.52
Mining	1.2796	1.1418	89.23	1.2337	1.1048	89.55	1.5594	1.3424	86.08	1.7105	1.4523	84.91	1.8951	1.6259	85.79
Food, beverages and tobacco	2.1285	1.8552	87.16	2.6390	1.9636	74.41	2.1683	1.9558	90.20	2.4178	1.9757	81.72	2.4684	2.1260	86.13
Textiles and leather	2.5539	1.6719	65.46	2.8242	1.7142	60.70	2.6028	1.7871	68.66	2.9748	2.2030	74.06	3.0790	2.2310	72.46
Wooden products, pulp and paper	1.8619	1.5798	84.85	2.2821	1.9028	83.38	2.0897	1.7990	86.09	2.5586	1.6024	62.63	2.7724	1.8768	67.70
Printing and publishing	2.1873	1.5108	69.07	2.3646	1.4664	62.01	1.8163	1.4857	81.80	2.5324	1.9863	78.43	2.5925	2.0764	80.09
Chemicals, excluding fertilizer	2.6568	1.8913	71.19	2.4032	1.5575	64.81	2.1391	1.7185	80.34	2.7451	1.7447	63.56	2.8092	1.8782	66.86
Fertilizer and pesticides	2.2833	1.5935	69.79	2.3393	1.5086	64.49	2.3829	1.4108	59.21	3.7174	2.3091	62.12	2.8728	1.8384	63.99
Petroleum products	2.0492	1.0628	51.87	2.0301	1.4884	73.32	2.4119	1.1623	48.19	2.3522	1.2344	52.48	2.5593	1.1093	43.34
Rubber and non-metallic products	2.0370	1.7088	83.89	2.2917	1.7305	75.51	2.3969	1.8168	75.80	2.6246	1.9041	72.55	2.5786	1.9311	74.89
Iron and steel	2.5052	1.9519	77.92	3.8214	1.7040	44.59	2.7096	1.3727	50.66	3.9156	2.1861	55.83	3.7278	2.6178	70.22
Non-ferrous and other metal products	2.0526	1.6467	80.23	2.4657	1.6540	67.08	2.6272	1.7800	67.75	3.2154	1.9962	62.08	3.0399	2.0328	66.87
Industrial machinery	2.4975	1.6012	64.11	2.9712	1.3147	44.25	2.5704	1.9184	74.63	2.9035	1.7758	61.16	2.8836	1.8959	65.75
Transport equipment	2.7115	1.6664	61.46	2.6178	1.2497	47.74	2.7882	1.6770	60.15	2.9434	1.8201	61.84	2.9292	2.0360	69.51
Other manufacturing	1.5493	1.2953	83.60	2.5454	1.4548	57.15	2.6147	1.8141	69.38	2.7478	1.8732	68.17	2.7652	2.0486	74.08
Electricity, gas and water	2.1367	1.4727	68.93	2.2776	1.5887	69.75	2.5479	1.8544	72.78	2.5566	1.8252	71.39	1.9365	1.4350	74.10
Construction	2.4797	1.9181	77.35	2.7501	1.7165	62.42	2.4724	1.9796	80.07	2.6680	2.0475	76.75	2.5527	2.0750	81.29
Distributive services	1.6223	1.4061	86.67	1.8760	1.3634	72.68	1.5273	1.3929	91.20	1.6676	1.4307	85.79	1.8947	1.5158	80.00
Communications	1.5494	1.3315	85.94	1.3656	1.1000	80.55	1.6812	1.5090	89.76	1.4756	1.3020	88.23	1.3083	1.1760	89.89
Producer services	1.4248	1.3033	91.47	1.4912	1.2526	84.00	1.4084	1.3406	95.18	1.5990	1.4392	90.01	1.9746	1.7808	90.19
Personal services	1.9421	1.6583	85.39	1.8557	1.5187	81.84	1.9935	1.7749	89.04	1.6068	1.4099	87.75	1.7672	1.5837	89.62
Social services	1.1443	1.0903	95.28	1.8964	1.3533	71.36	..	..	..	1.4160	1.2792	90.34	1.8570	1.5168	81.68
Average	1.9173	1.4907	79.83	2.1744	1.4822	71.21	2.0141	1.5458	79.84	2.3451	1.7043	75.74	2.3655	1.7872	77.43

Table III.34 (continued)

Industry	Singapore 1973 Total	Singapore 1973 Domestic	Singapore 1973 D/T	Singapore 1985 Total	Singapore 1985 Domestic	Singapore 1985 D/T	Thailand 1975 Total	Thailand 1975 Domestic	Thailand 1975 D/T	Thailand 1985 Total	Thailand 1985 Domestic	Thailand 1985 D/T
Food crops	..	..	..	..	..	..	1.2740	1.1890	93.33	1.5587	1.3753	88.23
Commercial crops	1.7401	1.2208	70.16	2.6007	1.3990	53.79	1.4725	1.3538	91.94	1.5695	1.2823	81.70
Livestock	2.6025	1.7167	65.97	2.7017	1.5518	57.44	1.9230	1.8348	95.41	2.1877	1.9683	89.97
Forestry	..	..	..	..	..	..	1.1973	1.1568	96.62	1.5164	1.3955	92.03
Fishing	1.8047	1.3020	72.15	2.8483	1.3775	48.36	1.4793	1.3756	92.99	1.9272	1.5250	79.13
Mining	1.6480	1.3109	79.54	2.2200	1.5082	67.94	1.3420	1.2228	91.12	1.6746	1.4648	87.47
Food, beverages and tobacco	2.8528	1.3234	46.39	3.2420	1.4058	43.36	2.0444	1.9308	94.45	2.1983	1.9825	90.19
Textiles and leather	2.8939	1.2078	41.73	2.8882	1.2587	43.58	2.3617	1.9315	81.78	2.4291	1.9743	81.28
Wooden products, pulp and paper	2.5882	1.2702	49.08	2.9684	1.5061	50.74	2.0019	1.7687	88.35	2.1944	1.6613	75.70
Printing and publishing	2.3024	1.2456	54.10	2.2847	1.3798	60.39	2.1481	1.5328	71.36	2.0443	1.6331	79.88
Chemicals, excluding fertilizer	2.8161	1.2878	45.73	2.6320	1.5096	57.36	2.1346	1.6414	76.90	2.1959	1.5644	71.24
Fertilizer and pesticides	..	..	..	..	..	..	2.4535	1.6326	66.54	2.3539	1.3753	58.42
Petroleum products	5.2666	1.0696	20.31	8.7446	1.2212	13.97	2.0832	1.1457	54.99	2.2088	1.2182	55.16
Rubber and non-metallic products	5.6372	1.1379	20.19	3.5957	1.7089	47.53	2.0292	1.6981	83.68	2.2225	1.7908	80.58
Iron and steel	2.6560	1.3828	52.06	3.4353	1.5005	43.68	2.5768	1.6900	65.59	2.8107	1.7812	63.37
Non-ferrous and other metal products	2.8464	1.4447	50.76	3.0552	1.5379	50.34	2.3063	1.7747	76.95	2.3297	1.6393	70.36
Industrial machinery	2.8568	1.1981	41.94	3.0704	1.3603	44.30	2.3422	1.5974	68.20	2.0892	1.4710	70.41
Transport equipment	2.5422	1.4129	55.58	2.1329	1.5726	73.73	2.3945	1.6444	68.67	2.4266	1.6723	68.92
Other manufacturing	3.2741	1.2166	37.16	2.8979	1.3315	45.95	1.8724	1.5658	83.63	1.8936	1.5297	80.78
Electricity, gas and water	1.7869	1.2451	69.68	5.0990	1.6058	31.49	2.1385	1.7104	79.98	2.1502	1.8610	86.55
Construction	2.7026	1.2616	46.68	3.0240	1.6090	53.21	2.2209	1.8397	82.84	2.5027	2.0249	80.91
Distributive services	1.6203	1.3199	81.46	3.0590	1.6640	54.40	1.4936	1.3611	91.13	1.7650	1.4556	82.47
Communications	1.3064	1.1152	85.36	1.5479	1.2767	82.48	1.6478	1.5071	91.46	1.7570	1.5524	88.36
Producer services	1.4328	1.2355	86.23	1.8862	1.4228	75.43	1.3064	1.2487	95.59	1.3576	1.2650	93.18
Personal services	1.9743	1.3809	69.94	2.5667	1.6142	62.89	1.8606	1.7441	93.74	2.0186	1.7884	88.60
Social services	2.0499	1.2114	59.10	2.5114	1.5134	60.26	1.1895	1.1415	95.97	1.3362	1.2492	93.49
Average	2.5740	1.2834	56.58	3.0875	1.4711	53.16	1.8959	1.5477	83.58	2.0276	1.5962	79.94

Sources: See table III.3.
Note: D/T = Ratio of domestic to total output multipliers
a/ 1973 and 1985 for Singapore.

Table III.35. Domestic income-induced output multipliers in selected countries, 1975 and 1985[a]

Sector	China 1985 LD	China 1985 LYD	China 1985 LYD/LD	Indonesia 1975 LD	Indonesia 1975 LYD	Indonesia 1975 LYD/LD	Indonesia 1985 LD	Indonesia 1985 LYD	Indonesia 1985 LYD/LD	Japan 1975 LD	Japan 1975 LYD	Japan 1975 LYD/LD	Japan 1985 LD	Japan 1985 LYD	Japan 1985 LYD/LD
Food crops	1.4025	3.9365	280.69	1.0770	1.3738	127.56	1.1337	1.4661	129.33	1.5339	1.8933	123.43	1.5897	1.9674	123.76
Commercial crops	1.5042	4.0194	267.21	1.1690	1.6179	138.40	1.4069	1.9071	135.55	1.5321	1.9105	124.70	1.6429	2.1991	133.86
Livestock	1.6863	4.1970	248.89	1.1170	1.4691	131.51	1.4493	1.8230	125.79	2.3698	3.1757	134.01	2.4878	3.5209	141.53
Forestry	1.4014	3.6524	260.62	1.1644	1.5110	129.77	1.1879	1.5219	128.11	1.9194	3.5976	187.43	2.0335	3.4768	170.98
Fishing	1.4965	4.0119	268.09	1.1710	1.4817	126.54	1.2510	1.5891	127.02	1.8282	3.0550	167.10	1.9885	3.1051	156.15
Mining	1.7300	2.7414	158.46	1.0515	1.1010	104.70	1.2116	1.3447	110.99	1.9240	3.5445	184.23	1.9861	3.4027	171.32
Food, beverages and tobacco	2.1407	3.7408	174.75	1.8297	2.1867	119.51	1.9663	2.3418	119.10	2.2788	3.1702	139.11	2.2007	3.1951	145.18
Textiles and leather	2.4409	3.7112	152.05	1.7754	2.2264	125.40	1.8401	2.2307	121.23	2.4182	4.0759	168.55	2.2912	3.8724	169.01
Wooden products, pulp and paper	2.2255	3.3946	152.53	1.6978	2.1293	125.42	1.7806	2.1491	120.70	2.3326	3.8259	164.02	2.2730	3.6722	161.56
Printing and publishing	2.2684	3.3097	145.90	1.3384	1.7565	131.24	1.6162	2.1307	131.83	2.2213	4.1334	186.08	2.0797	3.8585	185.53
Chemicals, excluding fertilizer	2.1267	3.0243	142.20	1.5949	1.9635	123.11	1.4263	1.7664	123.85	2.2767	3.4758	152.67	2.2310	3.3310	149.31
Fertilizer and pesticides	2.3477	3.2486	138.37	1.2953	1.5351	118.52	1.5433	1.7938	116.23	2.4852	3.7521	150.98	2.2635	3.3724	148.99
Petroleum products	1.9763	2.6448	133.83	1.8159	1.9415	106.92	1.7317	1.8994	109.68	1.4546	1.7768	122.15	1.2620	1.4805	117.32
Rubber and non-metallic products	2.1175	3.1115	146.94	1.6867	2.2203	131.64	1.5925	1.8926	118.84	2.2194	3.7527	169.09	2.1365	3.5339	165.41
Iron and steel	2.0293	2.6944	132.78	1.5415	1.7776	115.32	1.5991	1.7557	109.80	3.0494	4.1460	135.96	2.9913	4.1431	138.50
Non-ferrous and other metal products	2.2319	3.0331	135.90	1.4384	1.7090	118.82	1.6194	1.9211	118.63	2.2614	3.7447	165.59	2.2884	3.7069	161.99
Industrial machinery	2.2030	3.0234	137.24	1.2258	1.4147	115.41	1.3011	1.5092	115.99	2.4425	4.1447	169.69	2.3685	3.8323	161.80
Transport equipment	2.4102	3.2459	134.67	1.3008	1.6453	126.48	1.4388	1.7469	121.41	2.5930	4.2321	163.21	2.6854	4.2393	157.87
Other manufacturing	2.2968	3.3949	147.81	1.6620	2.3701	142.61	1.6370	2.0653	126.16	2.2349	3.9514	176.81	2.1895	3.6903	168.55
Electricity, gas and water	1.7317	2.2881	132.13	1.5015	1.8907	125.92	2.3043	2.6487	114.95	1.6612	2.7122	163.26	1.5965	2.3278	145.81
Construction	2.3603	3.5299	149.55	1.6101	2.1123	131.19	1.8501	2.3689	128.04	2.2846	3.8794	169.81	2.2002	3.8875	176.69
Distributive services	1.7986	3.2281	179.48	1.2591	1.5608	123.96	1.3685	1.7558	128.30	1.7725	3.4989	197.40	1.6304	3.5543	218.01
Communications	1.5329	2.5175	164.23	1.4881	2.3018	154.68	1.4894	2.0502	137.66	1.3687	3.3834	247.19	1.3803	2.9591	214.38
Producer services	1.2876	1.5619	121.30	1.2319	1.5497	125.79	1.2742	1.6731	131.31	1.6130	2.7007	167.44	1.6803	2.7781	165.33
Personal services	2.0182	3.7733	186.96	1.6439	2.1241	129.21	1.7293	2.2027	127.37	1.8175	3.2943	181.25	1.7712	3.1625	178.55
Social services	1.9480	3.6904	189.45	1.1067	2.7022	244.18	1.1527	2.8062	243.45	1.6090	4.0082	249.11	1.5767	3.7939	240.62
Average	1.9505	3.2586	172.39	1.4151	1.8335	130.53	1.5347	1.9369	127.74	2.0578	3.4167	167.70	2.0317	3.3101	164.15

Table III.35 (continued)

Sector	Malaysia						Philippines			Republic of Korea					
	1975			1985			1975			1975			1985		
	LD	LYD	LYD/LD	LD	LYD	LYD/LD	LD	LYD	LYD/LD	LD	LYD	LYD/LD	LD	LYD	LYD/LD
Food crops	1.2358	1.3944	112.83	1.1830	1.3065	110.45	1.1918	3.8111	319.78	1.2353	1.3746	111.28	1.3292	1.5134	113.86
Commercial crops	1.1559	1.3353	115.52	1.2034	1.3490	112.10	1.1956	3.2651	273.10	1.3808	1.7356	125.70	1.4911	2.0007	134.17
Livestock	1.7187	1.9724	114.76	1.9733	2.1700	109.97	1.5306	3.7660	246.04	2.0591	2.4282	117.93	2.4230	2.9538	121.91
Forestry	1.1317	1.4654	129.49	1.3615	1.5745	115.65	1.2011	2.5463	211.99	1.3113	1.8822	143.53	1.2288	1.7297	140.76
Fishing	1.1587	1.3516	116.65	1.1092	1.2614	113.72	1.1785	3.1156	264.37	1.5273	2.2126	144.87	1.5889	2.3252	146.34
Mining	1.1418	1.3573	118.87	1.1048	1.2372	111.98	1.3424	2.4738	184.29	1.4523	2.5407	174.95	1.6259	2.7985	172.12
Food, beverages and tobacco	1.8552	2.0723	111.71	1.9636	2.1420	109.09	1.9558	3.7500	191.74	1.9757	2.2141	112.07	2.1260	2.4957	117.39
Textiles and leather	1.6719	2.0083	120.12	1.7142	1.9571	114.17	1.7871	2.9134	163.03	2.2030	2.6723	121.30	2.2310	2.8935	129.70
Wooden products, pulp and paper	1.5798	1.9651	124.39	1.9028	2.1775	114.43	1.7990	3.3399	185.65	1.6024	1.9500	121.69	1.8768	2.3958	127.65
Printing and publishing	1.5108	1.8611	123.19	1.4664	1.7250	117.64	1.4857	3.2088	215.98	1.9863	2.6625	134.04	2.0764	2.9890	143.95
Chemicals, excluding fertilizer	1.8913	2.1593	114.17	1.5575	1.7894	114.89	1.7185	3.2067	186.60	1.7447	2.0575	117.93	1.8782	2.3631	125.82
Fertilizer and pesticides	1.5935	1.8597	116.71	1.5086	1.7135	113.58	1.4108	2.1894	155.18	2.3091	2.7089	117.32	1.8384	2.1927	119.27
Petroleum products	1.0628	1.1932	112.26	1.4884	1.5772	105.96	1.1623	1.4836	127.64	1.2344	1.3867	112.34	1.1093	1.1617	104.72
Rubber and non-metallic products	1.7088	2.0039	117.27	1.7305	1.9550	112.97	1.8168	3.0264	166.58	1.9041	2.3754	124.75	1.9311	2.6432	136.87
Iron and steel	1.9519	2.2006	112.74	1.7040	1.8124	106.36	1.3727	2.0114	146.53	2.1861	2.4440	111.80	2.6178	3.0263	115.60
Non-ferrous and other metal products	1.6467	1.9164	116.38	1.6540	1.8166	109.83	1.7800	2.8677	161.11	1.9962	2.4123	120.85	2.0328	2.6148	128.63
Industrial machinery	1.6012	1.8964	118.44	1.3147	1.4769	112.34	1.9184	3.1925	166.42	1.7758	2.1556	121.39	1.8959	2.4695	130.25
Transport equipment	1.6664	1.9378	116.28	1.2497	1.3607	108.88	1.6770	2.7110	161.66	1.8201	2.2977	126.24	2.0360	2.6664	130.96
Other manufacturing	1.2953	1.8042	139.29	1.4548	1.7026	117.04	1.8141	2.9355	161.81	1.8732	2.2886	122.18	2.0486	2.7658	135.01
Electricity, gas and water	1.4727	1.6605	112.75	1.5887	1.7398	109.51	1.8544	3.0061	162.10	1.8252	2.2459	123.05	1.4350	1.7605	122.68
Construction	1.9181	2.2432	116.95	1.7165	1.9490	113.54	1.9796	3.6331	183.53	2.0475	2.7862	136.08	2.0750	2.9422	141.79
Distributive services	1.4061	1.9066	135.59	1.3634	1.7228	126.36	1.3929	3.2872	235.99	1.4307	1.8315	128.02	1.5158	2.1312	140.60
Communications	1.3315	2.0674	155.27	1.1000	1.6889	153.54	1.5090	3.8096	252.46	1.3020	2.0502	157.47	1.1760	1.8300	155.62
Producer services	1.3033	1.6424	126.02	1.2526	1.5166	121.08	1.3406	2.6816	200.04	1.4392	1.9451	135.15	1.7808	2.4550	137.86
Personal services	1.6583	2.0286	122.33	1.5187	1.8368	120.95	1.7749	4.0389	227.55	1.4099	2.0664	146.57	1.5837	2.4914	157.31
Social services	1.0903	2.3027	211.20	1.3533	2.0715	153.07	1.0000	7.4309	743.09	1.2792	2.8565	223.30	1.5168	3.0791	203.00
Average	1.4907	1.8310	124.28	1.4822	1.7165	116.50	1.5458	3.2193	219.01	1.7043	2.2147	131.99	1.7872	2.4111	135.92

Sector	Singapore						Thailand					
	1973			1985			1975			1985		
	LD	LYD	LYD/LD	LD	LYD	LYD/LD	LD	LYD	LYD/LD	LD	LYD	LYD/LD
Food crops	..	..	..	..	..	..	1.1890	1.3681	115.06	1.3753	1.6724	121.60
Commercial crops	1.2208	1.3991	114.61	1.3990	1.4794	105.74	1.3538	1.6311	120.48	1.2823	1.7111	133.44
Livestock	1.7167	1.8807	109.55	1.5518	1.6287	104.96	1.8348	2.0818	113.46	1.9683	2.2968	116.69
Forestry	..	..	..	..	..	..	1.1568	1.3084	113.11	1.3955	1.7249	123.61
Fishing	1.3020	1.4818	113.81	1.3775	1.4945	108.49	1.3756	1.6820	122.28	1.5250	1.9158	125.63
Mining	1.3109	1.6963	129.40	1.5082	1.6413	108.82	1.2228	1.5208	124.37	1.4648	1.8790	128.28
Food, beverages and tobacco	1.3234	1.4707	111.13	1.4058	1.4580	103.72	1.9308	2.2439	116.22	1.9825	2.3485	118.46
Textile and leather	1.2078	1.4581	120.73	1.2587	1.2966	103.01	1.9315	2.3459	121.46	1.9743	2.4509	124.14
Wooden products, pulp and paper	1.2702	1.4913	117.41	1.5061	1.5879	105.43	1.7687	2.1071	119.13	1.6613	2.0402	122.81
Printing and publishing	1.2456	1.5935	127.93	1.3798	1.4472	104.89	1.5328	1.8826	122.82	1.6331	2.0789	127.30
Chemicals, excluding fertilizer	1.2878	1.4960	116.16	1.5096	1.5841	104.93	1.6414	1.9966	121.64	1.5644	1.9310	123.43
Fertilizer and pesticides	..	..	..	..	..	..	1.6326	1.9399	118.82	1.3753	1.6023	116.51
Petroleum products	1.0696	1.1228	104.98	1.2212	1.2556	102.81	1.1457	1.3456	117.46	1.2182	1.2930	106.13
Rubber and non-metallic products	1.1379	1.2294	108.05	1.7089	1.8213	106.58	1.6981	2.0971	123.50	1.7908	2.1928	122.45
Iron and steel	1.3828	1.5679	113.39	1.5005	1.5843	105.59	1.6900	1.9214	113.69	1.7812	2.1431	120.32
Non-ferrous and other metal products	1.4447	1.7091	118.31	1.5379	1.6263	105.75	1.7747	2.1093	118.85	1.6393	2.0492	125.01
Industrial machinery	1.1981	1.4211	118.61	1.3603	1.4243	104.70	1.5974	1.9173	120.03	1.4710	1.8938	128.74
Transport equipment	1.4129	1.8159	128.52	1.5726	1.6696	106.17	1.6444	1.9219	116.88	1.6723	2.0370	121.81
Other manufacturing	1.2166	1.4600	120.01	1.3315	1.3967	104.90	1.5658	1.8912	120.78	1.5297	1.9376	126.67
Electricity, gas and water	1.2451	1.4543	116.80	1.6058	1.7263	107.51	1.7104	2.0006	116.97	1.8610	2.2089	118.70
Construction	1.2616	1.6379	129.83	1.6090	1.6809	104.47	1.8397	2.2261	121.00	2.0249	2.5202	124.46
Distributive services	1.3199	1.6722	126.70	1.6640	1.7920	107.69	1.3611	1.8957	139.28	1.4556	1.8928	130.04
Communications	1.1152	1.4019	125.71	1.2767	1.5328	120.06	1.5071	2.1210	140.73	1.5524	2.1215	136.66
Producer services	1.2355	1.5561	125.95	1.4228	1.4970	105.21	1.2487	1.5446	123.69	1.2650	1.6088	127.19
Personal services	1.3809	1.7532	126.96	1.6142	1.6803	104.09	1.7441	2.2305	127.89	1.7884	2.2366	125.06
Social services	1.2114	1.9369	159.89	1.5134	1.5455	102.12	1.1415	2.4836	217.57	1.2492	2.7516	220.26
Average	1.2834	1.5524	121.06	1.4711	1.5587	105.99	1.5477	1.9159	124.89	1.5962	2.0207	127.51

Sources: See table III.3.

Note: LD - direct and indirect domestic output multipliers; LYD - domestic output multipliers including income-induced effect; LYD/LD - ratio of LYD to LD.

a/ 1973 and 1985 for Singapore.

IV. Privatization

The two most important objectives of privatization are the improvement of economic efficiency and the reduction of public budget deficits. Deficit reductions should occur directly as the result of the privatization transaction, while efficiency gains occur in the longer run as new management implements changes in enterprise operations.

However, efficiency at the enterprise level depends less on ownership than on market structures and such factors as company organization and management incentives, and efficiency gains from effective competition are likely to be greater than gains from change of ownership. Competition is vital to efficiency, and in competition the most powerful incentives are success and failure or bankruptcy. Competition by itself will not ensure economic efficiency, nor will any other factor such as private ownership without competition. Maximum efficiency gains will result from privatization which is integral to overall price liberalization in factor and product markets. The divestiture of State-owned enterprises in the industrial sector holds the promise of higher efficiency since most industrial products are tradable and therefore subject to competition from imports. However, in practice, this promise can be realized only where the divestiture is preceded by trade liberalization, by the credible threat of liberalization, or by measures to facilitate domestic production by competitors.

While there is a considerable commitment to divestiture by the Governments of numerous developing countries, this commitment has not been matched in practice by the speed of divestiture. Consequently, efficiency gains and especially urgently required public deficit reductions have also been delayed. These delays have occurred because of the very considerable constraints to divestiture arising from economic conditions in these countries, including difficulty in mobilizing resources arising from an underdeveloped financial and capital market infrastructure, low domestic savings rates, distorted prices in factor and product markets, a weak administrative capacity and lack of foreign investor interest. These conditions also reflect the limited applicability of what can be learnt from privatization in industrialized countries such as the United Kingdom. Given the lack of foreign investor interest and weak institutional and administrative capacity, some of the benefits of full divestiture could be obtained by divesting operational management and control to the private sector, with asset ownership retained by the State. Full divestiture involving asset transfer is likely to be gradual and confined generally to some middle-income developing and Eastern European countries, to countries with the required institutional and administrative capacity, and to countries and sectors attractive to foreign investors.

While it is clear that privatization has to be seen as an integral part of price liberalization including the removal of tariffs and other forms of protection, the most powerful justification for various forms of protection in the early stages of industrialization, as well as for the important role of the State in initiating and facilitating the industrial development process if necessary through State ownership, has been the infant industries argument. However, this justification was never for the permanent protection of industries, whether State-owned or privately owned. After all, infants should grow up. This justification has lost much of its force in parts of Latin America, which have been independent for over 100 years. Similarly in parts of Asia, there has been either a relatively mature industrial tradition, or new industrial development has been uniquely successful. Nevertheless, in some other regions or subregions, the infant industries argument retains much of its force. Thus, in much of Africa, industrialization and indeed the development process itself, dates only from the 1960s, while in Eastern Europe and the former USSR the problems of transition following a period of between 40 and 70 years of suboptimal economic planning are severe, and industry needs to be "born again". The possibility of divestiture to foreign investors is especially important, since foreign direct investment brings new skills, capital and expanding markets. Perhaps more important than the investment is the foreign contribution to skill, in particular to the management skills required for large industrial undertakings. While many skills can be learnt in technical schools and universities, the management of large enterprises is best learnt through actual practice. Most developing countries achieved political independence only in the period following the Second World War, so that it was not surprising that despite the benefits foreign direct investment could bring, for many years after independence such investment was viewed with suspicion. The issue in the last decade of the twentieth century for most developing countries is whether, having overcome the reaction against the imperial past, their managerial and entrepreneurial class has sufficient skill and capacity to seize the opportunities opened by privatization and by foreign participation in privatization. A different issue confronts Governments in Eastern Europe: having escaped from over 40 years of rigid central planning and bureaucratic control, the temptation to pursue forms of nineteenth-century capitalism will be strong. Governments still have an important job to do facilitating industrial development in developing countries, as well as in the countries of Eastern Europe. The problem for Governments is to decide the fine balance between too much and too little intervention, between too much and too little protection, and between too much and too little privatization.

One similarity between major Brazilian steelmaker Usiminas, telecommunications monopoly Telekom of Malaysia, or leading Czechoslovak car maker Skoda, and relatively tiny enterprises such as Nyambal Sawmill of Gambia, food production enterprise Hanover Spices of Jamaica, or Taal Volcano tourist resort of the Philippines, is that all were State-owned enterprises (SOEs) just a few years or months ago, and today all are part of a growing private sector in their respective national economies. Privatization became a major economic phenomenon throughout the world during the 1980s. After three decades in which Governments worldwide increased the scope and magnitude of their activities, there has been a shift in thinking away from what Governments can do via the public sector, towards greater reliance on private enterprise. As part of this process, the divestiture of State assets has been placed high on the policy agenda of many countries. Practically all Governments are either implementing or actively considering privatization. Since 1984, State assets worth an impressive $250 billion had been sold throughout the world. In 1991 alone, sales of SOEs totalled some $50 billion [1].

The recent wave of privatization started in the United Kingdom at the end of the 1970s; since that time, dozens of SOEs have been sold, including some of the largest in the country, and 34 billion pounds sterling raised [2]. Substantial privatizations have occurred in other industrialized countries, including Canada, Germany, New Zealand and Spain. In the United States, where Government has never had as many assets to privatize as in other industrialized countries, privatization has focused on contracting out to private providers a growing proportion of State services. Influenced by the privatization drive in the developed market economies, especially in the United Kingdom, but mainly as a response to massive and growing development problems as well as to implicit or explicit pressures from multilateral and bilateral development agencies, developing countries have joined the trend of worldwide privatization. Today, more than 80 developing countries of all sizes (from Brazil to tiny island countries) and of very different political and economic ideologies (from countries like United Republic of Tanzania which have traditionally favoured a prominent role for the State in the economy to countries with traditionally strong private sectors) have active privatization plans and many have already privatized some SOEs. Privatization has become fashionable and in many countries one of the crucial ingredients of political and economic reform.

If privatization of SOEs in many countries has aimed at reducing the role of the State, under the new regimes in the countries of Eastern Europe privatization has become the crucial test of the commitment of the Governments to the creation of market-based economic systems. This is not surprising, because most developing countries have mixed economies where SOEs account for less than one fourth of GDP, while in the reforming Eastern European countries this share is over four fifths. Decisions to privatize in Eastern Europe are primarily political, while in developing countries such decisions are primarily economic. Because of this dominance of the State sector, extensive and fast privatization, both to improve economic performance and as a step towards dismantling centrally planned economic systems, is considered a top priority for reforms. It is a not unusual opinion that the future of today's burgeoning democratic movements in that region will be highly dependent on the success or failure of their privatization process.

The amount of privatization in developing countries during the 1970s and 1980s and more recently in the formerly centrally planned economies of Eastern Europe varies significantly from one region to another and within regions. In spite of these differences, two main conclusions can be drawn about privatization experiences in these two groups of countries. First, in both regions the pace of privatization has begun to accelerate. The number of privatization transactions that have taken place in developing countries amounts to over 1,000, and to over 4,500 if extensive denationalization in Bangladesh, Chile, Mexico and Pakistan are taken into account. The worldwide privatization leader is, however, Eastern Europe. In no country of the world has the pace of privatization been as rapid as in the five new states of reunified Germany, where about 5,500 companies have been sold off in less than two years [3]. Three other Eastern European countries, Czechoslovakia, Hungary and Poland, have also privatized close to 1,000 larger State enterprises, as well as thousands of shops, restaurants and other small businesses. Second, in both groups of countries almost every Government has failed to reach publicly established privatization targets.

The complexity of privatization has slowed down the pace desired during the 1980s for its implementation and has left privatization objectives unachieved. This complexity suggests that the selling-off of State-owned assets is likely to remain high on the policy agenda of most countries in the current decade. The more compelling reason however, is that factors which motivated policy makers to consider privatization are today as valid as 10 years ago. Furthermore, the significant movement towards economic pragmatism in Africa and especially Latin America has accelerated, and the profound political change in Eastern Europe, unthinkable a decade ago, has put privatization at the centre of economic reform.

Privatization is a global trend that involves businesses of very different sizes and cuts across practically all sectors of the economy. Governments are turning over to the private sector control of a wide range of activities from State telecommunications and other public sector utilities, from banks and insurance businesses to SOEs in the industrial, trade and tourism sectors. Thus industry is only one of many sectors in which privatization has been taking place, but as country experience indicates a very important one. Although the process is in many respects not sector-specific, there are issues which distinguish privatization of industrial assets from the privatization patterns in other sectors of the economy, especially in public utility sectors. However, relatively little is known currently about the relative importance of industry in the overall privatization process in developing and Eastern European countries, either in terms of their number or the value of State-owned assets transferred. Even less is known about the economic and financial impact of industrial sector privatization. This is not only because effects of ownership change are very complex and difficult to measure, but also because the whole process is of recent origin, going back less than 10 years in most developing countries and less than three years in all Eastern European countries.

In the following study a picture of industrial sector privatization in developing and Eastern European countries, of its relative importance in an economy-wide context and of its specific patterns *vis-à-vis* other sectors of the economy is presented. More specifically, the exercise is intended to examine the reasons behind the worldwide privatization trend in this sector, to discuss objectives and problems related to this process, to review factors which determine the mode of privatization, and to draw lessons from the privatization of industrial sector assets. In examining reasons for privatization, attention necessarily must also be given to reasons for the creation of State enterprises and for State intervention in economies. Special attention is given in the analysis to how inter-sector differences in market structures, such as natural and statutory monopolies, on the one hand, and competitive market structures, on the other, influence economic efficiency effects of privatization in different sectors. The study is based on two sources: on a cross-regional examinaton of privatization achievements in developing and Eastern European countries, and on questionnaire replies of managers from 28 industrial companies considered for privatization in developing and two Eastern European countries.

Privatization does not have a generally accepted definition, as the term covers a different range of government actions in different countries. It is most commonly used to refer to the sale, that is to the transfer of ownership and control of assets of SOEs, in part or totally, to private owners. There is a broader concept which regards privatization as transfer of management, and not necessarily ownership, to the private sector. Leasing, management contracts and engaging the private sector to provide public services through contracting out fall into this category, sometimes called "partial privatization". The main focus of this study is on the divestiture of SOEs through the sale of majority equity to the private sector, although various forms of "partial privatization" are also considered.

A. Public enterprises and the need for reform

If the problem of industrial sector privatization in developing countries is to be approached in a developmental context, it is necessary first to understand the factors which led to a strong public sector expansion in the industrial sector of these countries in the three decades prior to the 1980s, and to determine whether these factors remain relevant, and second, to identify the factors which are behind the current privatization drive.

1. Rationale for establishing industrial public enterprises

According to economic literature, the main economic argument in favour of direct government involvement in production activities, and therefore also in industry, is to respond to different forms of market imperfections or failures which prevent economies from achieving efficient resource allocation. A major concern in this context has been a seemingly inevitable tendency in certain markets towards monopoly, especially when technological factors imply that only one producer can fully exploit available economies of scale. The establishment of a public enterprise may be justified as a mechanism to regulate such a natural monopoly and to meet compelling social objectives which the private market would ignore. However, public ownership is not the only instrument available to correct market imperfections; this same objective could be achieved also through trade liberalization or the use of regulatory provisions.

Although efficiency and equity considerations have played a certain role in establishing public enterprises throughout the world, many other factors—economic, political, social—have to be taken into account to provide a more comprehensive explanation of why the preferred mechanism of public intervention has been through public ownership, that is, through creation of SOEs. To trace the origins of industrial public enterprises in developing countries, one has to go back to colonial times. In many former colonies, most mining and manufacturing enterprises were in the hands of colonial owners, or in the hands of minority groups closely identified with the colonial power, an identification that was at the same time political, economic and social. In other developing countries, foreign corporations were often blamed for perpetuating racial exclusiveness, foreign dependence and economic backwardness, and accused of despoiling the national patrimony and of exploiting countries' human and physical resources. Moreover, for many developing countries, the alternative to foreign private investment was not domestic private investment. The private entrepreneur class in many cases did not have the capacity to undertake major investment; in other cases it was too closely identified with the former imperial power. Moreover, it was widely thought that public sector enterprises and where necessary nationalization would bring about structural changes of the economy and would provide Governments with additional savings and investments. This reasoning was based on the hypothesis that public ownership, in contrast to indigenous or foreign private ownership, would direct investment into priority areas determined by planners, leading to a rise in aggregate levels of savings and investment, and welfare benefits for the population as a whole.

It should be noted that nationalizations have shown little correlation with the ideological bias of Governments, as both left- and right-wing regimes have actively intervened in taking over foreign firms. Foreign oil and mining companies, for example, have been nationalized by many African Governments openly committed to central planning, as well as by many highly conservative regimes in Western Asia and Latin America. Nationalization of foreign firms in developing countries owed more to nationalism and to the perception of public ownership as a necessary counterweight to foreign ownership than to any doctrinaire belief in central planning ([4], p. 17). This does not mean that ideological reasons have not had a role in encouraging the establishment of State enterprises in developing countries. On the contrary, strong anti-capitalist sentiment, a pronounced mistrust of the free enterprise system as the cause of mass poverty and social imbalance, and the association of colonialism with exploitation as well as the post-war ascendancy of a leftist intellectual climate, the support for independence which had come from Governments committed to central planning and the seeming success stories offered by models of rapid industrialization based on central planning are some of the factors which prompted many developing countries, especially in Africa, to accept one form or another of central planning ([5], p. 13). Following the experience of centrally planned economies in Eastern Europe, where public ownership had been seen as a necessary condition for the establishment of socialism and was therefore advocated as an end in itself, Governments in many developing countries with an orientation toward central planning have strongly encouraged the setting-up of State enterprises.

Although expropriation of enterprises contributed to the growing stock of State enterprises in developing countries, the largest number of SOEs was established in areas where production activity previously had not been developed domestically. Beside the fact that local private entrepreneurs were in short supply in many countries, especially in Africa, private sector activity was, and to some extent still is, highly constrained by high risk aversion and little access to adequate levels of investment capital. During the early stages of industrial development, as Lewis has remarked [6], if the rate of industrialization were left exclusively to decisions made by private enterprise, it would nearly always be below the economic rate. The private sector would have difficulty in overcoming the initial costs to be faced in countries without an industrial sector. When the industrial sector first begins to grow its productivity is low; its labour force untrained; its public utilities generally expensive and inefficient; the network of numerous firms supporting each other yet to be developed. The "infant industries" argument has been accepted by almost all economists since 1800, and has been adopted by all countries in the early stages of their industrialization. Protection was the norm in the early stages of industrialization in the United Kingdom, Germany, France, the United States and Japan. If a Government believes that new industries which would prove profitable are being neglected, it has a pioneering function to fulfil; if risk is the obstacle as it so often is, it can itself shoulder the risk of pioneering, whether by putting up the capital or some part of it, or by guaranteeing the interest on private capital, or by subsidizing or protecting the industry in other ways. Japan more than any other country had shown how effective such pioneering leadership can be; nearly every industry started in that country between 1870 and 1900 was started on the initiative of the Government, and mostly in factories opened and operated by the Government and sold to private enterprise when the teething troubles were past. The pioneering function is particularly important because of the high incidence of failure even in industries which eventually prove very profitable. Moreover, the more successful economies of Asia, such as Malaysia, Republic of Korea and Taiwan Province, did not entrust to the market or to foreign investors the responsibility for deciding which of their industries would prosper and which would fail. Instead, Governments formulated industrial strategies and strategies of industrial upgrading, based on forecasts of market developments and assessment of which infant industries could be expected to carve out a competitive niche in the world market, and those which could not. To ensure that the beneficiary industries would not become protection-dependant, and would become internationally competitive over time, fiscal and other support was provided on a declining scale. Moreover, exchange rates were set low to encourage exports and discourage imports, and to encourage savings and discourage consumption. These key prices were set to ensure that the signals they emit conform to national priorities, such as aggressive exporting and relative self-sufficiency in food [7].

Thus State enterprises were created as a result of government development strategies aimed at overcoming critical bottlenecks in the economy and at steering, strengthening and diversifying the economic structure of poorly developed countries. In the industrial sector, this orientation led to a process of industrial development with strong or even decisive public sector participation in all segments believed to have significant linkages effects. Basic industries, such as iron and steel, chemicals, heavy engineering, fertilizers and petrochemicals, have been most commonly seen as industries with a strong catalytic function in the process of industrialization by providing inputs to other manufacturing branches. In many developing countries, Governments also entered into those segments of industry which were considered to have strong development potential, such as electronics in Brazil, aircraft manufacture in Indonesia, and practically all technology-intensive activities in India ([4], p. 18). Similarly, the import-substitution economic development strategy has led to the establishment of the manufacturing branches producing consumer durables. In some countries, automobile assembly plants are a well-known example of this kind. National security reasons which opt for a strong national defence sector were sometimes added to the above justifications for strong government involvement in some industries. Public enterprises in industries which provide vital products have often been established with a conscious choice for security and self-reliance over profit, and the desire to control the so-called "commanding heights" of the economy.

Until the mid-1980s, international financial institutions and bilateral aid-giving agencies had been instrumental in encouraging the creation of public enterprises. In these institutions and agencies there was still a strong belief in the "urge to develop" and the infant industries argument. A fair number of public enterprises in developing countries was created with loans and technical assistance from the World Bank and other multilateral financial institutions which by their constitutions lend only with sovereign guarantees. Transnational corporations operating in developing countries have also preferred to have a State enterprise as a business partner in the host country. Such arrangements were expected usually to give the transnational corporation access to various advantages, such as less government control of business operations, reduction or even elimination of potential import competition through high tariffs, financial assistance, tax concessions and political connections [8].

Justifications for the creation of public enterprises have derived also from the view that they can be used as an instrument for income redistribution. Although employment generation has rarely been the explicit objective for setting up State enterprises. Governments of many developing countries have found it necessary to prevent business failures and to take over loss-making private companies to protect employment of citizens working in these companies.

2. *Factors behind privatization*

It is widely believed nowadays that performance of public enterprises, including public sector industrial enterprises, has been poor and disappointing, and that they have not accomplished the objectives for which they were established. Public enterprises were expected to build a country's infrastructure, to contribute to production and achievement of self-sufficiency in basic goods and services, to promote employment and reduce mass poverty, to serve as instruments for enhancing national economic development and sovereignty, to generate surpluses for capital accumulation and to be economically efficient and financially profitable. In the industrial and manufacturing fields, public enterprises were also often created with the expectation that they would contribute to government revenues.

To evaluate the overall performance of a public enterprise is a very difficult, if not an impossible, task, as the degree of attainment of each individual objective set for the enterprise has to be measured. It is beyond the scope of this study to make an empirical analysis of public enterprise performance and to deal with the considerable difficulties involved in this process; objectives of public companies are seldom specified clearly, there are problems in devising performance measures and the necessary data are often not available ([9], p. 11). Instead, a body of studies and reviews analysing public sector performance in individual countries or regions will be relied upon, together with available limited data from individual countries on performance of industrial SOEs.

In contrast to the societal objectives of public enterprises which may be difficult to measure in terms of quantified indicators, their financial performance can be appraised by examining their profitability. Table IV.1. presents fragmented empirical findings of selected empirical studies about the financial performance of the public enterprise sector in developing countries.

The fragmentary country-level information on profitability of SOEs in the industrial sector seems to be very much in line with poor profit performance of the public sector in general. This could be illustrated by the financial performance of industrial enterprises in two countries of the Asian subcontinent, India and Nepal. In India, for example, an average rate of return before interest and taxes for 250 industrial State-level public enterprises was only 1.74 per cent during the period from 1981/82 to 1986/87. Of this total, 33 earned profit continuously, 80 had given mixed performances (that is, their financial position changed from profit to loss and vice versa), and 137 incurred losses without fail. According to the study analysing these results, the continuously profit-making enterprises operated in competitive and high-technology fields. The mixed-performance firms operated in the field of textiles, minerals, sugar and steel, with fluctuations in the demand for their products and changes in the policies of the controlling State governments influencing their financial results. The continuously losing enterprises included jute mills, engineering firms and chemical units [10]. In neighbouring Nepal, manufacturing public enterprises as a group accumulated significant financial losses between 1984/85 and 1988/89 (overall rate of return on assets was negative). However, there were five manufacturing companies in the country (out of the total of 25) which generated profits consistently during this period. The best-performing companies were cigarette and sugar producers, while the largest losses were accumulated by a cement factory and jute mills ([11], p. 8).

Profitability is a partial indicator of public enterprise performance, which has to be applied with care where markets are highly distorted and prices administered, that is, where prices do not reflect scarcities or real opportunity costs. For example, the major cost faced by aluminium producers is the cost of electrical power. If power is sold significantly below its economic or opportunity cost, a not unusual phenomenon, the aluminium producer may appear highly profitable. Similarly and just as relevant in many developing countries, a SOE in a monopoly position protected from competition from imports may often appear to be highly profitable, although its management and workforce are highly inefficient. Or a public company with a highly efficient management and workforce may be loss-making because of administered pricing policy (price of output being kept low for whatever non-economic reason) or pressure exerted on the public enterprise to fulfil certain non-commercial objectives, such as the provision of jobs to surplus labour.

The existing empirical information and studies on the actual performance of SOEs in achieving societal objectives does not provide sufficient ground for a general conclusion. Some authors argue that SOEs have done little to provide basic industrial goods, to create employment thus redistributing income and reducing mass poverty, and to enhance national economic sovereignty. However, macroeconomic policies in many developing countries have conspired to artificially cheapen the cost of capital: official foreign exchange rates have often been much lower than market rates, so that subsidies are provided to SOEs with privileged access to foreign exchange at official rates. A second set of subsidies to SOEs has taken the form of access to investment capital at controlled interest rates well below market rates, or very often at rates below the social rate of discount. A third set of subsidies has arisen from privileged access to domestic and foreign financing institutions, that is, SOEs have been able to borrow from these institutions on the basis of explicit or implicit sovereign guarantees. The results

Table IV.1. Financial performance of public enterprises in developing countries: summary of selected empirical studies

Region or country		Summary of findings
West Africa	(1)	"Of the public enterprises in a sample drawn from 12 West African countries, 62 per cent showed net losses, while 36 per cent had negative net worth".
North and sub-Saharan Africa	(2)	"A survey of 48 public enterprises in North and sub-Saharan Africa showed that in 1984, only 12 of the firms reported net profit margins in excess of 4 per cent".
Ghana	(3)	"Altogether, about 43 per cent of State-owned enterprises in the economy have been shown to operate at net loss in each year during the period 1979-1983".
Republic of Korea	(4)	"Although the performance of the government-invested enterprises compared favourably with most other developing countries, their estimated 3.7 per cent rate of return on operating capital in 1982 contrasted with a 10.1 per cent return for the Republic of Korea's industry as a whole".
Philippines	(5)	"The average rates of return on equity and assets of SOEs have been 2.9 per cent and 3.71 per cent respectively. These rates are about 10 percentage points below the average interest rate and lag behind the average return on equity of the top 1,000 corporations from 1984-1987".
Indonesia	(6)	"The overall returns on asset employed in SOEs was below 2.5 per cent from 1983-1987, and 3.5 per cent in 1989.... about 70 per cent of SOEs do not have a healthy financial standing".
Thailand	(7)	"In 1989, the SOE sector in Thailand returned pre-tax profits of 45.9 billion baht ($1.8 billion) on 312.5 billion baht of revenues - a respectable 14.7 per cent return. Only five state enterprises (officially there are 63 SOEs) lost money".
Trinidad and Tobago	(8)	"The non-petroleum enterprises (SOEs) were very large dissavers during the year (1985), with expenditure exceeding their revenue by almost $700 million".

Sources:

1. John R. Nellis, *Public Enterprises in Sub-Saharan Africa*, Discussion Paper No. 1 (Washington, D.C., World Bank, 1986), p. 17.
2. John Nellis and Sunita Kikeri, "Public enterprise reform: privatization and the World Bank", *World Development*, vol. 17, No. 5 (1989), p. 660.
3. H. Akuoko-Frimpong, *Rebalancing the Public and Private Sectors in Developing Countries: the Case of Ghana*, Technical Paper No. 14 (Paris, OECD Development Centre, 1990), p. 15.
4. Young C. Park, "Evaluating the performance of Korea's government-invested enterprises", *Finance and Development*, vol. 24, No. 2 (June 1987), p. 25.
5. Zinnia F. Godinez, "Privatization and deregulation in the Philippines: an option package worth pursuing", *ASEAN Economic Bulletin*, vol. 5, No.3 (March 1989), p. 264.
6. *Towards A Competitive Economy: The Emerging Role of the Private Sector in Indonesia* (Manila, Asian Development Bank, April 1991), p. 31.
7. Paul Handley, "Privatized parts", *Far Eastern Economic Review* (27 June 1991), p. 48.
8. Frank Rampersad, "The rationalisation of the State Enterprise Sector", Trinidad and Tobago Economics Association, Ninth Annual Conference, Port of Spain, November 1991.

of cheap capital to SOEs have been two types of resource misallocation: misallocation with regard to the mix of products and mistakes in the choice of production processes and techniques at the enterprise level. Thus some products are made which would not be made in conditions where prices reflected real scarcity. Other products are made using capital-intensive production techniques, that is, techniques which use relatively little of the plentiful resource—unskilled labour—and relatively large amounts of the scarce resource—investment capital. Moreover, capital-intensive production usually requires the use of highly skilled workers and managers, often a scarce resource in developing countries. Where workers and managers do not have the requisite skills, either industrial operations are inefficient, or managers and workers with the required skills have to be imported at high costs. Misallocation in choice of product can lead to production operations which are uneconomic in the long term, that is, after that period during which an industry can be considered "infant". This implies that when distortions are removed from macroeconomic policy, these industries will fail. Misallocation with regard to choice of technology may be less serious: the technology mix can be changed over time, managers and skilled workers can become eventually efficient etc. But in the short term, the employment impact and hence redistribution will remain well below expectations, as will the ability of an industry to produce basic industrial goods.

Some analysts defend the performance of SOEs with arguments that indigenous industrialization in developing countries is largely attributable to public enterprises, that these enterprises have been an important forum for training indigenous managers, and that public enterprises have been an important source of employment. Since unemployment is one of the major problems of developing countries, the authors say that employment generation, even at the expense of lower productivity ratios, might be a defensible proposition. This proposition may of course be true, but only when the opportunity costs are duly assessed. In many cases, individual companies or countries have claimed positive results in employment generation and in achieving other "non-economic" objectives, but no assessment of the costs involved in producing these results has been made, and no consideration has been given to whether better or similar results were obtainable by lower cost methods ([5], p. 18). It should also be noted that in the macroeconomic regime described earlier, with distortions in the price of capital and foreign exchange, private producers with access to these resources at official rates, that is, prices below market prices, can also appear to be very efficient and are often in practice highly profitable.

In contrast to the remarks above on the performance of SOEs, attention must also focus on the impact of this performance on the public budget. Governments require loss-making SOEs to stay afloat, and this objective often requires continuous cash injections from the public treasury. Calls of SOEs on government expenditures are of two main types: subsidies to finance current operations, including subsidies to cover losses due to public control of output prices and subsidies to finance overmanning and similar operating losses; as well as subsidies to finance capital expenditures, including resources for the replacement of equipment as well as for expansion. Budgeted allocations to public enterprises do not always reflect the full extent of their dependence on government money, which is often underestimated. The issue can be again illustrated by the case of Nepal, where estimated off-budget expenditures for three public enterprises were equivalent to 38 per cent of total budgeted expenditures for 17 major SOEs in the period from 1986/87 to 1988/89. The main factors in the understatement of government transfers to public enterprises were the following: direct donor disbursements to projects which are later transferred to government upon completion; donor payments for technical assistance that is often channelled directly to service providers, tax rebates for sick public enterprises which are not reflected in enterprise accounts, proceeds from counterpart funds from commodity aid that is expected to be paid into government account but is instead retained by public enterprises etc. ([11], p. 12). Apart from these indirect cost subsidies, there may be others, such as utilities supplied to SOEs at preferential rates. In some cases, more important than these cash subsidies, however, are the "hidden subsidies" arising when capital and foreign exchange are allocated to SOEs at prices which do not reflect scarcity.

The volume of public sector deficits in developing countries has been extensively analysed elsewhere, and it is sufficient for the purpose of this study to briefly summarize some of the results. Table IV.2 gives an illustrative survey of regional and country data showing the budgetary burden arising from public sector activity. The table is not meant to be a systematic survey of financial transfers between the State and the public enterprise sector, but it nevertheless allows three major conclusions. First, the public sector deficit has amounted to a significant proportion of the national product of developing countries. For developing countries as a group, the overall deficit of public enterprises averaged almost 4 per cent of GDP in the mid-1970s, although there were significant differences among individual countries. Second, data for developing countries as a whole and for the seven largest Latin American economies indicate that the public sector deficit as a percentage of the national product tended to grow in the period between the mid-1960s and the beginning of the 1980s. Third, the contribution of public enterprises to the total government deficit is substantial, and ranged from around one quarter in the case of Bolivia, Morocco and Tunisia to 65 per cent in the case of Malaysia in various years in the 1980s. Although data for Eastern European countries are even more fragmentary than for developing countries, they point in the same direction.* The Polish SOE sector, for instance, received subsidies, either directly from the budget or through the banking sector, which amounted to 5.5 per cent of GDP in 1988, and even 9.2 per cent in the following year. A similar trend has been registered in Yugoslavia, where cumulative losses of public enterprises increased from 5.7 per cent of gross social product to between 8 and 9 per cent in the same two years [12].

The impact of poor performance of SOEs extends however beyond the increase of the public deficit. Privileged access to foreign exchange and interest rates are provided to SOEs by the economy. Other purchasers including other investors have to pay more for foreign exchange and investment capital. It should be noted that in the mixed economies that are typical in most developing countries, some private sector enterprises also have privileged access to foreign exchange and investment capital, that is, these private sector enterprises also receive considerable "hidden" subsidies which, just as in the case of SOEs, do not show up as direct subsidies in public budgets.

As discussed earlier, poor financial performance of public enterprises increased their dependence on government financing in many developing countries in the period of the 1970s and at the beginning of the 1980s. In circumstances when financial resources were available on relatively easy terms, this trend had been tolerated on the grounds that social objectives fulfilled by these companies justified such subsidies. The growing financial burden of public enterprises on government budgets had nevertheless provided a basis for the reassessment of the public sector role in developing countries, but the process was triggered only in the first half of the 1980s when Governments were faced with a drastic reduction of financial resources. In fact, the sudden reduction of government financial resources has strengthened the intensity of the problem of poor financial performance of public enterprises, although many enterprises had been losing money well before the beginning of the 1980s.

Major changes in international economic conditions between the 1970s and 1980s led to a reduction of financial resources available to finance public sector

*In developing countries, public budget deficits arise primarily where government spending exceeds tax-based revenues, but in Eastern Europe taxes have played only a minor role, with enterprise surpluses providing the major direct source for government spending.

Table IV.2. Public enterprises in the State budget deficit: survey of studies

Economic grouping, region or country	Period	Volume of deficit
Developing countries	Mid-1970s[a]	The overall deficit of public enterprises averaged almost 4 per cent of GDP. It increased by 2.5 per cent of GDP between late 1960s and the mid-1970s
Seven largest Latin American countries	1980-1982[b]	Combined deficit of public enterprises is about 4 per cent of GDP
	Mid-1970s[b]	Combined deficit of public enterprises is about 1 per cent of GNP
Bolivia	1980[c]	Public enterprises incurred one fourth of the total deficit, at that time 9.2 per cent of GDP
Mali	End 1970s[d]	Cumulative losses of public enterprises reached 6 per cent of GDP
Malaysia	1981-1984[c]	Public enterprises share amounted to 65 per cent of the public deficit (in 1982, budget deficit was 16.9 per cent)
Mexico	1977-1982[c]	Public enterprises deficit after tax amounted to slightly less than one third of the budget deficit
Morocco	1983-1985[c]	Cumulative total of transfers from the State to public enterprises made up to about 25 per cent of budget deficit
Philippines	1981-1983[c]	Net transfer from the state averaged 2.8 per cent of GDP, or 45 per cent of the national deficit
Togo	1980[d]	Losses of 8 public enterprises equalled 4 per cent of GDP
Tunisia	1982-1986[c]	The proportion of public enterprises deficit in the national consolidated budget deficit after transfers from the State amounted to 23 per cent on average

Sources:

[a] Paul Cook and Colin Kirkpatrick, "Privatization in less developed countries: an overview", in *Privatization in Less Developed Countries* (New York, St. Martin's Press, 1988), p. 14.

[b] *World Development Report 1987* (Washington, D.C., World Bank, 1987), p. 67.

[c] O. Bouin and Ch.-A. Michalet, *Rebalancing the Public and Private Sectors; Developing Country Experience* (Paris, OECD, 1991), p. 75.

[d] John R. Nellis, *Public Enterprises in Sub-Saharan Africa*, Discussion Paper No. 1 (Washington, D.C., World Bank, 1986), p. 19.

deficits. During the 1970s, high liquidity on international capital markets allowed many developing countries to finance growing balance-of-payments and budget deficits through commercial bank credits. In addition, this was a period when many developing countries switched to foreign loans to finance projects in directly productive sectors. In earlier years, such projects had been traditionally financed through foreign direct investment. Easy access to external debt financing had also a negative influence on the capital structure of production in many developing countries. In these countries company accounts became seriously unbalanced as Governments relied predominantly on debt financing, of domestic and foreign origin, for funding. Consequently, most public companies were excessively dependent on debt financing and had an insufficient equity base. This highly geared capital structure resulted in higher financial vulnerability.

The overreliance of developing countries on debt finance emerged as a major problem at the beginning of the 1980s as international surpluses contracted and creditors became more sceptical about the creditworthiness of these particular clients. An immediate consequence of this scepticism was a sharp drop of new credits to developing countries. The reduction of new loans was accompanied by an increase in the burden of debt service caused by deteriorating conditions on international capital markets (rise of interest rates and of the value of the dollar), and by the fact that many borrowers had not made productive use of their borrowing or had financed too many capital-intensive projects with low initial returns and long lead times. Moreover, economic recession and growing protectionism in industrialized countries led to falling demand for imports and the deterioration of the terms of trade of developing countries.

Confronted with the hardening of terms for and availability of external loan finance, and increased debt service problems, many developing countries were forced to restructure their external debts. A major change in the relationship between the IMF and developing countries occurred with the introduction of the practice that debt restructuring negotiations with either official creditors or commercial banks could begin only after debtors reached agreement with the IMF on stabilization policies. During the 1970s, with the easy availability of commercial bank credit, developing countries seldom approached the IMF; IMF-sponsored stabilization programmes had only a marginal impact on the economic policy of debtor countries. In the 1980s, however, as a consequence of greater dependence on World Bank and IMF resources, the perceptions of these institutions have become much more important and have led, partly, to the growing commitment to macroeconomic stability and structural adjustment, and thus to privatization in developing countries over the last decade, and also in Eastern European countries in recent years. The objective of World Bank and IMF programmes was to shrink public deficits, and to reduce the mismatch between official prices and market prices for foreign exchange and investment capital. A shrinking of public deficits had the effect of exposing those SOEs dependant on direct public subsidies to a harsh financial regime, that is, their books had to be balanced through cutbacks in costs (very often including the laying-off of workers) and increases in sales revenues. Reduction of the price mismatch had a severe impact on all enterprises in the State and non-State sector which previously had access to "hidden" subsidies. Many SOEs became candidates for early privatization, and many private sector enterprises were forced either to undergo a painful restructuring in which their product mix and production techniques were fundamentally changed or to fall into bankruptcy.

In addition to the deterioration in the financial performance of public enterprises and growing pressure to reduce budget deficits as borrowing conditions have tightened, another motivation for the current interest in privatization in developing countries and in Eastern Europe is the changing perception in government thinking all over the world from an emphasis on the public sector towards greater reliance on private enterprises. This phenomenon should be seen as part of the shift in development policies in these countries. In the 1950s and 1960s, the dominant approach to development economics was based on the belief that markets frequently failed to allocate resources efficiently, and thus that price mechanisms needed to be supplemented by various degrees of government control. The stress was on the selective promotion of manufacturing and an inward-looking development strategy based on import substitution, planning, active State involvement in economic development and on expansion of the public enterprise sector. As already mentioned, this interventionist approach was supported by international financial institutions as the World Bank, by United Nations agencies as well as by major bilateral aid agencies. All these institutions strongly encouraged development planning in recipient countries, while practically all financial resources from these bodies were allocated for projects in the public sector. The 1970s saw a slight modification of this development strategy. While faith in planned economic development remained unchallenged at that time, this phase was centred on a perceived failure of the so-called "trickle-down approach" of the previous two decades, and reflected a belief that poverty and inequality were worsening in many developing countries. This was a period when multilateral and bilateral financial institutions attributed special attention to distributional effects of their financial transfers to developing countries. Integrated rural development, appropriate labour-intensive technologies, basic needs and redistribution with growth were some fashionable catch-phrases of this period [13].

It is beyond the scope of this study to examine the performance of developing countries over the three decades of State interventionism (different indicators, like per capita GNP growth, child mortality, life expectancy, and many other social indicators, suggest that achievements were significant, as shown in *Global Report 1990/91* ([14], pp. 12-35), and to discuss the relative importance of various factors such as the following: the drastic worsening of the external environment; the election of conservative Governments in Germany, the United Kingdom and the United States; and economic policy mistakes in developing countries. Nor can a detailed examination be made of why the development planning approach was transformed to a strong reliance on the role of market forces and the price mechanism in developing countries, and on the reduction or removal of various forms of government intervention in product and factor markets. It can be asserted with confidence, however, that the changes in political and economic thinking in the United Kingdom and the United States led to the election of governments broadly reflecting those changes. Furthermore, these changes were grounded in perceptions of what was wrong in the domestic economies of these highly developed countries, and what should be done to right these wrongs. These perceptions coincided with the rediscovery by the development community that in general most Governments of developing countries were less efficient and competent than their own, and that mismanagement, corruption and a strong tendency towards authoritarian and undemocratic rule were endemic among these Governments. The result of these new perceptions of the role of government and the nature of underdevelopment was a neo-classical, market-oriented view of the development process. This emphasis on the efficacy of competitive forces as an engine of development is clearly reflected in development strategies designed by the IMF and World Bank during the 1980s.

Under the financial pressure discussed earlier, the governments of many developing and Eastern European countries had little choice but to approach these two institutions for highly conditional financial resources. By committing themselves to stabilization and structural adjustment programmes prepared under the strong influence of the IMF and the World Bank, these countries had to accept the philosophy of the new development strategy in which priority is given to an export-oriented path of development, and to competitiveness on the world scale, rather than to the earlier aims of development ([13], p. 101). On the public sector issue, this new development model advocates that the public sector should be restructured and its role reduced, that certain activities formerly undertaken by State enterprises should be handed over to the private sector, which should become the driving force of growth, and that the State should retreat into a position of holding the ring and fostering competition. The attention attributed to public enterprises in programmes sponsored by the IMF and the World

Bank seems to be more related to macroeconomic consequences of public sector deficits than to concern with financial performance of public enterprises as such. As public enterprises contribute significantly to budget deficits and balance-of-payments difficulties of a country, it is not surprising that a concern with their impact on macroeconomic stability is reflected in the priority given in these programmes to measures aimed at improving the financial performance of public enterprises ([9], p. 15).

3. Conclusions

Socialist and nationalist ideologies, together with perceptions of the responsibility of Governments for economic development, were the major motivations for the founding of SOEs in developing countries. However, the financial performance of SOEs in both industrial and non-industrial sectors varies widely, although in general State companies have not performed well when measured in financial terms, and have failed to achieve the financial results that Governments have hoped for. As for the fulfilment of distributional or "non-economic" objectives, SOEs have in general fallen short of expectations. There is a general impression, however, that public enterprises have performed better in fulfilling at least some of the "non-economic" objectives than in achieving production objectives measured by financial and economic criteria. This is hardly surprising, as SOEs were in many cases established primarily to serve socio-political objectives, while profitability, or broader economic efficiency, was very often considered as a second priority objective.

In contrast to that period during which the majority of SOEs was established (between the late 1950s and the 1970s), and when positive financial performance was considered as only one among several objectives, often of secondary priority, the prevailing realities of the 1980s have established financial considerations as the most important yardstick for measurement of overall performance of public enterprises. The whole process of "rolling back the State" in this decade, of which privatization is an integral part, should therefore be seen primarily as a response to disappointing financial performance of public enterprises and to growing overall public sector deficits, in circumstances where capital resources available for transfer from the State to public enterprises decreased, and when a new development strategy emphasizing the importance of market forces became generally accepted.

B. Survey of industrial privatization in developing countries and Eastern Europe

1. Latin America and the Caribbean

Of all developing-country regions Latin America and the Caribbean is currently the most active divestor of SOEs. Burdened with external and domestic debt obligations, Governments have found that their withdrawal from productive sectors and sale of SOEs to private investors, domestic and foreign, can provide much-needed capital to modernize and strengthen the performance of the remaining parastatals. The Latin American rush to privatize is part of the major shift in economic policy across the region. Governments in many countries have brought budget deficits under control and have transformed their external trade regimes. Most Governments no longer see any future in the inward-looking, protected economic regimes which predominated in Latin America over several decades. Free trade is seen as a way of promoting efficiency and, as a result, Governments have moved to negotiate free trade areas and customs unions. These reforms, together with the Brady initiative launched by the United States Secretary of the Treasury three years ago, which provided a framework for the easing of bank debt burdens in the most heavily indebted countries, have resulted in a dramatic change in the prevalent view of Latin America among international financial centres. Some $40 billion flowed into the region in 1991, compared to $13.4 billion in 1990 and only $5 billion in 1989, and much of the influx came from residents bringing home flight capital. Most of the money went into Mexico ($16.1 billion), followed by Brazil ($11.6 billion), Argentina ($5.1 billion), Venezuela ($4.8 billion) and Chile ($1.5 billion). Although a significant part of the 1991 inflow is of short-term and therefore highly volatile character, the region also raised $8.5 billion of medium-term debt, $6.4 billion of portfolio investment, and $10.4 billion in the form of direct investment, of which $3.5 billion directly resulted from privatization [15].

Virtually all Governments of the region, regardless of ideology, have started or are actively considering far-reaching divestment programmes. Some, including Chile, Mexico and several smaller countries, such as Costa Rica, Honduras and Jamaica, have already made strong progress. This survey gives a brief overview of privatization efforts in Mexico, Argentina, Brazil, Venezuela and Chile, as well as in other countries where some divestiture of industry is under way.

While Chile has led the way in privatization, Mexico learned from its experience and has, in many ways, surpassed the programme of Chile. As in Chile, Mexican privatization began as a countermeasure to past nationalization. In 1982 the Government had nationalized banks and through banks many enterprises as a response to imminent financial collapse, and as in Chile, it moved to sell off traditional State assets such as airlines and telecommunications, only after the divestiture of most production enterprises. The scale of the Mexican programme was much bigger than in Chile. Between 1982 and mid-1990, Mexico sold, merged and liquidated 750 SOEs out of some 1,155 ([16], p. 45). Some $17 billion was raised, the bulk coming from the sale of 12 banks ($10 billion) and the telephone monopoly Telmex (more than $4 billion) [15]. By the end of 1992, the Government is expected to privatize the six remaining banks, the insurance company Aseguradora Mexicana, and plants of the fertilizer producer Fertimex. Beyond these companies, the Government is also looking to involve the private sector in concession-type arrangements for infrastructure financing, especially for highways ([16], p. 67). As far as Pemex, the country's oil monopoly, is concerned, the intention of the Government is to keep the corporation in the public sector. An outstanding debt of $15 billion and a desperate need to modernize facilities and rationalize operations may nevertheless open Pemex operations to increased private participation [15].

In contrast to Mexico, Argentina embarked on privatization only recently and started the programme with a number of "high-profile" sales. After decades of strong nationalism, Argentina sold its national airline (Aerolineas Argentinas) and its telephone monopoly (Entel). Both transactions were a part of the country's debt-swap programme, and their combined sale resulted in a $7 billion reduction in its external debt ([16], p. 94). There has, however, been heavy criticism that these companies were sold cheaply, without adequate regulatory mechanisms, and under terms giving purchasers too large profits. Recently, the Government has designed a new privatization programme aimed at raising some $6 billion by 1993 ($1.9 billion in cash and $4 billion worth of equity for domestic and foreign debt). SOEs to be sold or for which concessions will be offered include five long-distance rail lines (concession), Buenos Aires commuter rail and underground lines, the shipping line ELMA, ports, hydroelectric generators, the Buenos Aires water company OSN, the national gas company, the national savings and credit bank CNAS, SOMISA steel mill, Petroquímica Gen Mosconi and Petroquímica Bahia Blanca. YPF, the national oil company, is being restructured for future privatization [15].

After many initial problems, the Brazilian programme was launched by selling the steel giant Usiminas for $1.4 billion in October 1991. From that time until March 1992, the programme has run smoothly, with further sales of Celma (aircraft maintenance) for $90.7 million, Mafersa (transport) for $48.4 million, Cosinor (steel) for $13.6 million, SNBP (river transportation), Intag (fertilizer) for $6.8 million and Piratini (steel) for $106.2 million [15]. The Government intends to continue its programme at a pace of one or two transactions per month. By the end of 1992, it plans to sell at least 14 more companies, including two big steel mills (Cosipa and Tubarao), two petrochemical plants (Petroflex and Copesul) and fertilizer complex Arafertil, to raise $3.4 billion [15]. Thus privatization is heavily concentrated on public industrial enterprises, although some firms in transport are also included in the programme. There is much foreign interest in the divestiture of telecommunications giant Telebras, but the constitutional amendment to end the State monopoly has not yet been approved by the parliament.

As in Brazil, privatization had a slow start in Venezuela. In 1990, the Government sold its majority holding in one government-owned bank only (Banco occidental de Descuento). In 1991, however, the pace improved with $2.2 billion brought to the public budget. By far the largest sale occurred in November 1991, when 40 per cent of equity and operating control of the telephone monopoly CANTV was sold to an international consortium lead by GTE of the United States for $1.89 billion ($1 billion over the minimum price set by the Government). Other divestitures included 60 per cent of shares in the national airline VIASA for $145.5 million, and all State holdings in two commercial banks, a shipyard (Astinave) and a large sugar mill (El Tocuyo) [15]. Assets to be sold in 1992 include 12 hotels, six sugar mills and at least two regional electric companies, while a number of commercial ports and highways are expected to be subject to concession and franchise agreements. Also being considered is the sale of parts of Corporacion venezolana de Guyana which controls the country's heavy industry, and which includes its largest steel producer (Sidor), the world's largest aluminium smelter (Venalum) and other aluminium companies, mining and the largest hydroelectric company in the country (Edelca) [15]. As in Mexico, the Venezuelan government does not intend to sell its profitable petroleum company PDVSA, but is seeking foreign capital for joint ventures in exploration, refining and other activities.

Chile, a pioneer in developing country privatization, has sold more than 500 companies and banks for $3.4 billion in the period since 1973. This occurred in the following three stages: first in 1973 and 1974, 350 previously nationalized small and large agricultural and industrial companies were reprivatized for $1 billion; second, from 1975 to 1982, the State holding company CORFO privatized 135 companies and 16 banks for $1 billion; and third, from 1985 to 1989 electricity (Endesa), telecommunications (Compañía de Teléfonos de Chile and Empresa nacional de Telecomunicaciones), civil aviation (Lan Chile), steel (Compañía de Aceros del Pacífico—CAP), nitrates and chemical companies were privatized for $1.4 billion [15]. The Government has divested much of the traditional industry in the public sector with the major exception of Codelco, the world's largest copper producer. It is expected that the State will retain control of the country's biggest exporter, although foreign and domestic private firms are increasingly used as consultants, service providers and technical experts to rationalize the operations of the company.

In Costa Rica between 1986 and 1990, the Government privatized 44 of 46 companies owned by the State development corporation CODESA, including the aluminium company Alunasa and the sugar producer Catsa, while two big privatizations are scheduled in 1992, involving the cement group Cempasa and the fertilizer producer Fertica [15]. In Guyana, SOEs in paint production, wood products, food processing, transport, telecommunications, trading services and leather products were divested, while transactions are being pursued for companies in fish, rice milling, soap and detergent production, livestock and livestock food production, as well as a sugar company and a bauxite company [17]. In Honduras some 10 companies worth $247 million have been sold, while a number of other transactions are under way. These transactions include several sawmills, a dairy, two cement factories, a foundry, a paper and pulp factory and a regional airline. The programme is characterized by the strong presence of United States companies or their subsidiaries. In Jamaica, between 1983 and 1989, the Government privatized more than 40 big and small companies in practically all sectors through a variety of techniques. Privatization included the lease and transfer of assets of the Jamaica Broadcasting Corporation, the public share offering of the largest commercial bank (National Commercial Bank of Jamaica) and of the sole cement producer (Caribbean Cement Company), as well as management contracts for 12 State-owned hotels ([18], pp. 247-251).

In future, the programme of the government will focus on privatization of public sector utilities.

2. *Africa*

In Africa, also, Governments are trying to divest SOEs in an attempt to revive their economies and provide the base for renewed growth in the 1990s. As elsewhere, most African countries created, for historical, economic, social and political reasons, a large SOE sector during the 1960s and 1970s. Privatization in Africa aims at an increase in economic efficiency and reduction in government spending in circumstances where traditional sources of money have dried up. In contrast to Latin America, where SOEs in practically all sectors have been divested and where a significant number of transactions of over $500 million have been made with participation of foreign investors, in Africa privatization has tended to take place in enterprises that are small, in terms of both assets and number of employees. Most divestiture has occurred in manufacturing and services, with privatization of utilities, mining and other resources being exceptional. The region is characterized also by a relatively high share of management contracts in the total number of privatizations as well as by many liquidations in the public sector all around the continent. The World Bank and IMF have played a key roll in pressing for, and assisting in, divestiture, usually as part of structural adjustment measures. There are significant differences among countries regarding completed transactions and transactions under way or in late planning. The most active countries in divestiture so far have been Nigeria, Togo, Côte d'Ivoire, Gambia, Ghana, Guinea, Senegal and Niger, and, in North Africa, Tunisia followed by Morocco. This list of countries is not exhaustive; others, for example Zaire and Liberia, among the more developed, and Malawi, Mali and Mozambique, among the least developed, have divested some of their SOEs.

Divestiture has not yet occurred in Kenya and Egypt, but is in the planning stage. In Kenya, some parastatals and majority or minority holdings in 138 companies will face divestiture. This programme, the largest in eastern and central Africa is focused on a wide range of small and big companies in food and beverages, motor transport and allied industries, printing and publishing and the allied packaging and paper industries, finance and insurance, textiles, hotels and lodges, commercial and industrial service activities (including the country's largest conglomerates Kenya Breweries and East African Industries), and the national flag-carrier airline (Kenya Airways). Different modes of privatization will be used, including public offerings through the Nairobi Stock Exchange [19]. Major obstacles to successful divestiture in virtually all countries are tiny domestic financial markets and virtual absence of stock markets (only Nigeria, Kenya and Côte d'Ivoire have relatively well developed stock markets), little interest of foreign investors, and in some countries shortage of competent domestic managers.

The Privatization and Commercialization Programme of Nigeria started in mid-1988 as an integral part of overall economic reforms aimed at competitiveness and efficiency. By September 1990, the Government had sold, through public issue, shares of 20 companies with a total market capitalization of 250 million naira, with 3 cement companies and 2 companies in the oil business having capitalizations exceeding two thirds of the total. Future plans include the full divestiture of 74 companies in finance and in manufacturing, including food, textiles, wood and furniture, engineering and automobiles, and partial divestiture in 5 cement companies, 3 sugar plants, 3 steel rolling mills, 3 oil companies, 2 fertilizer companies and 2 paper companies [20].

Between 1984 and 1990, the Government of Togo entirely privatized 11 companies in the food-processing, plastics, detergent and extraction industries, with two enterprises leased to foreigners, one through a management contract, several through private sale of assets, and another two with a capital increase financed by private investors. In contrast to most African privatization programmes, that of Togo has attracted the significant interest of foreign investors ([21]; [22], p. 71).

The economy of Côte d'Ivoire is known to be relatively open and has traditionally encouraged foreign participation. By 1989, a total of 28 parastatals had been privatized in various manufacturing branches as well as in the services sector. Beside the privatization methods applied in Togo, two manufacturing companies have been divested through management buy-outs and one, the tobacco company SITAB which covers about 95 per cent of the domestic market, was sold through the stock exchange ([22], pp. 42-43).

The policy of the Government of Gambia emphasizes demonopolization of the public sector, and the privatization of SOEs has been less focused on manufacturing; thus, of 10 privatizations completed by 1989, half were in manufacturing ([22], p. 46). To reduce the size of the public sector, Ghana has made a list of 32 mostly industrial companies to be divested, half of which had been expropriated; in addition, 22 SOEs have been identified which would not be sold. By 1989, some 10 companies were privatized either through direct sale (Willowbrook Bus Co., Neoplan (bus and coach assembly), DL Steel) or through management contract (State Gold Mining Corp., Volta Aluminium, Ghacem Ltd. (cement) ([22], p. 48, [23]). In 1985, Guinea launched a series of economic reforms including privatization of 43 SOEs. By 1989, about 18 mostly industrial enterprises had been sold privately, with foreign investors participating in more than half of the transactions ([22], p. 50); two further privatizations were accomplished by other means. The privatization programme of Tunisia was put in place in 1987, and since then the programme has been moving at an appreciable pace, with significant sell-offs occurring regularly. By 1989, about 15 SOEs were divested through direct transfer of assets to a private buyer, transfer of capital via the stock market, subscription on an increase of capital by a private investor or staff buy-out. In addition, at least five hotels were sold to private buyers in that period ([18], pp. 241-242).

3. *Asia*

Privatization in Asia has differed from that in Latin America or Africa in that most Governments have never had as many assets to privatize, so that the potential for divestiture is relatively smaller. On the other hand, Asian countries in general relied much less on external debt during the 1970s, and grew much faster during the 1980s. In most Asian countries, the main objective has been to reduce the budgetary burden of loss-making public enterprises and to generate finance from the sale of assets. There have also been some country specific reasons for privatization, such as reprivatization of nationalized assets in Bangladesh and Pakistan or an increase of the ratio of share ownership by a *bumiputra* population in Malaysia.

The Republic of Korea, Singapore and Taiwan Province have divested for much less traditional reasons. Most SOEs in these economies are run strictly on a commercial basis and are expected to make profits; if losses occur they are supposed to go bankrupt. Private ownership makes relatively little difference to performance, and the reasons for privatization extend beyond efficiency and budgetary gains. In Singapore, for example, where SOEs are often more efficient than other local companies and where they are profitable, two objectives of privatization have been to withdraw from commercial activities where the presence of the State was no longer required, and thus to avoid competition with the private sector, and to enlarge the stock market by increasing the number and types of companies listed ([24], p. 54). Development of domestic stock markets has been an important privatization objective also in the Republic of Korea and Taiwan Province, and in Malaysia and Thailand, but with the objective of returning profits to the public in the Republic of Korea, while in Taiwan Province, revenue from privatization has been earmarked for infrastructure. While private sale has been common, also common has been a partial or total new listing or capital expansions and rights issues through the stock market. In addition, Governments have extensively used leasing and management contracts.

Privatization in Asia is rich not only in terms of techniques, but has involved SOEs and projects of practically all sizes and sectors, including agriculture, tourism, transport and financial services to a broad range of public utilities with significant differences among individual countries. In Bangladesh, Indonesia and Sri Lanka, for example, privatization has been strongly focused on industrial sector enterprises, and the objective can be found in the programme of Pakistan. In Malaysia, in contrast, practically all transactions are focused on services. Malaysia, Philippines and Singapore (if reprivatizations are included, also Bangladesh and Pakistan) lead the way in the number of enterprises being entirely or partially divested. The list of countries and areas is long, and includes India, Indonesia, Republic of Korea, Sri Lanka, Taiwan Province, Thailand and many others.

Bangladesh has divested 1,076 SOEs, including more than 600 industrial SOEs (food, textiles and derivatives, tanning, chemicals, steel etc). Most of these generally small transactions took place between 1976 and 1984 either through bids from private entrepreneurs or through negotiated return to former owners after a period of nationalizations at the beginning of the 1970s ([22], pp. 1-3). The second stage of divestiture was carried out in the second half of the 1980s. In contrast to the first one, it was not only much slower but also very different in character. Between 1987 and 1989, the Government sold 49 per cent of the capital (34 per cent by public offering and 15 per cent earmarked for employees) in nine manufacturing enterprises, with prices ranging from 2.5 million taka in the case of Eagle Box and Carton Manufacturing Ltd. and Metalex Corporation Ltd. to 98 million taka for Eastern Cables Ltd. ([18], pp. 253-254).

Singapore has been systematic in its programme. In January 1986, the Public Sector Divestment Committee was formed and the following February it presented a comprehensive programme for the divestment of government-linked companies (GLC) and statutory boards over a 10-year period. The recommended value of shares to be divested to the public was estimated at $2.88 billion for GLCs and $3 billion for statutory bodies ([24], pp. 54-55). Given that statutory bodies are more complicated to privatize because they are monopolies, the Committee recommended that profit-oriented GLCs, of which many are in the industrial sector, should be privatized first. As of November 1989, 6 out of 15 GLCs had been fully listed, including Jurong Shipyard, Resource Development Corporation and Singapore National Printers. Government holdings in other SOEs have been reduced as follows: in Singapore Airlines (63 to 56 per cent); in DBS Bank (48 to 44 per cent); in Keppel Corporation (68 to 48 per cent); in Neptune Orient Lines (62 to 39 per cent); in Sembawang Shipyard (74 to 54 per cent) and in INDECO (100 to 67 per cent). Of another 16 GLCs recommended for total privatization, 7 were completely sold. Significant progress has been made in privatization (partial or total) of GLCs, and $1.28 billion have been raised. The interesting pattern of Singapore GLC privatization, however, is that at the same time when the Government is leaving certain areas of activities, it is also entering new areas considered to be of strategic importance which its private sector had been avoided. This indicates that Singapore continues to see SOEs as instruments of restructuring and economic development. As for statutory boards, privatization has so far taken the form of deregulation and the leasing and contracting-out of certain existing services to the private sector.

In contrast to many other developing countries, Thailand has a relatively small SOE sector—63 in 1990. Though the enterprises have been producing net operating revenues for the State, privatization efforts were launched in 1986 because of the increasing inability of SOEs to finance their own investment, estimated in transport, power, communications and other utilities at $35 billion for the period 1992-1996 ([25], p. 48), and their increasing reliance upon external debt financing. Deepening of the domestic capital market and pressure from the World Bank have also been claimed as reasons for privatization. Among the companies privatized in the second half of the 1980s were Paper Mill Organization (private sale), State Alum Organization (lease), North-East Jute Mill and Sugar Mills (partial divestiture through public issue of shares) [26]. Much interest has been shown in multi-billion dollar build-operate-transfer (BOT) agreements, such as that of Telephone Organization of Thailand with Chareon Pokphand Telecoms for the provision of 3 million telephone lines ($4 billion) ([25], pp. 48-49). Fifteen per cent of Thai Airways International is scheduled for sale in late 1992, and privatization of the power monopoly, by far the largest SOE, continues to be a matter of intense discussion.

In order to reduce the budget burden of public enterprises, in 1987 the Philippines launched a major programme featuring the sale of 296 companies, and of 399 so-called non-performing assets of the Development Bank of Philippines and the Philippines National Bank [27]. Between 1987 and 1991, sales transactions covered only 69 companies for 9 billion pesos and 259 non-performing assets, mostly financial claims on companies indebted to government banks, for 33 billion pesos [28]. At the beginning of 1992, Philippine Airlines, the biggest State company, was sold, with AB Capital and Investment Corporation buying 67 per cent of equity for $368 million [29].

Between 1968 and 1987, privatization in the Republic of Korea was focused on the manufacturing and transport sectors and banks. In this period, the Government sold its shares in 20 State-owned enterprises, including 5 banks, directly to private corporations [30]. The 1987 programme, still in place, consists of the following:

(a) Total divestiture of the Government from firms whose goals or purposes of establishment have been achieved or which are competing directly with the private sector. Under this plan, the Government sold 68.1 per cent of its holding in the Korea Stock Exchange (for $107 million) to the 25 securities houses that are members of the stock exchange;

(b) Partial divestiture where the Government retains the controlling interest and the remaining shares are distributed as people's stock. The people's stock distribution programme has four main objectives: to return the profit of public enterprises to a majority of the nation; to increase public participation in the management of public enterprises; to increase the wealth of individuals in middle- and low-income groups; and to promote the sound development of the capital market through a wide distribution of stocks. For this programme the Government has selected enterprises that are engaged in key industries and have stable management, potential for continuous development and a sound financial basis. By 1989, shares of Pohang Iron and Steel Company (12.3 per cent) and Korea Electric Power Corporation (21 per cent) were sold as people's stock for a total of $2,061 million, with Korea Telecommunication Corporation and Citizens National Bank remaining in the pipeline;

(c) Under the category "adjustment of functions", the Government will transfer to the private sector those public enterprises which are competing with the private sector [30].

The privatization activities of Pakistan date back to 1977 when 2,000 cotton-ginning, rice-husking and flour mills, nationalized in the first half of the 1970s, were returned to their previous owners ([22], p. 19). More recently, there has been the private sale of Republic Motors and the employee-led take-over of Exxon Chemical Pakistan Ltd. ([22], p. 20; [31]). The new government of Pakistan has put in place a programme for containing firms for sale, including 14 chemicals manufacturers, 7 fertilizer plants, 12 automotive firms, 11 engineering and steel companies, 14 cement plants, 3 energy production plants, 8 textile mills, 24 vegetable-oil plants, 16 bakeries and 4 banks. In addition, the divestiture of Pakistan Telecommunication Corporation is a subject of vigorous debate, while implementation of a BOT-structured Hab River thermal power project, a $1.2 billion venture supported by the World Bank, is already in an advanced stage [32].

4. Eastern Europe

In contrast to most developing countries where a mixed economy prevails and where privatization aims at strengthening existing market activity, for the newly transformed countries of Eastern Europe privatization has become a crucial test for new Governments in their commitment to a market-based economic system and a political system based upon private property rights and individual freedoms. Almost all countries either have already adopted programmes or are still in the process of doing so. These programmes have reached different stages of implementation in different countries, but in no country has the pace of change been as rapid as in the former German Democratic Republic. Privatization is also well under way in Czechoslovakia, Hungary and Poland. In all four countries, the sale of thousands of shops, restaurants and other "small" businesses under State ownership for essentially non-economic reasons proceeded much faster and with significantly fewer problems than privatization of large companies. In contrast to smaller enterprises, most often sold by auction, divestiture of large companies faces much delay. Although Hungary and to a lesser extent Poland and Czechoslovakia have set the legal framework for privatization of large SOEs and have surmounted may obstacles found in the initial stage of the actual sale of State assets, only a few of some 14,600 SOEs in these three countries have been privatized ([33], p. 10). Even the Treuhandanstalt, the German State agency responsible for privatizing the industries of the former German Democratic Republic, still has some 5,800 companies for sale ([34], p. 77).

Eastern Europe is challenged not only by the massive scope of planned privatization, but equally by the desire that the process should be as fast as possible. The Russian Federation, for example, aims at selling over 100,000 shops, and most of the country's light industry by the end of 1992, and a further 850 billion roubles worth of assets is due to be sold in 1993 and 1994 [35], while Czechoslovakia, Hungary and Poland all want to privatize up to 60 per cent of their capital stock in a much shorter period, over the years 1991-1994 ([36], p. 47). It was expected that foreign investment and modern management techniques drawn from major foreign corporations would be of crucial importance in achieving these objectives. They are still regarded as essential in the programmes of practically all countries, although the euphoria of the early days that led to unrealistic expectations seems to be over. Despite the well-founded caution of major foreign investors towards committing large sums of money in still fragile economies, a number of high-profile investments, such as the acquisition by Volkswagen of the Czechoslovak car-maker Skoda and the minority stake of General Electric in Tungsram, and intense negotiations for other projects indicate that the region has a strong potential to attract foreign investors, especially in the long run.

Programmes in individual countries differ significantly as Governments have specific concerns regarding the sectoral structure of industries to be privatized. Other differences relate to the sequencing, procedures and methods of privatization. In contrast to those other countries where divestiture focuses on public utilities, in Eastern Europe the focus is on industrial companies in terms of numbers of SOEs and volume of financial resources. This is because there is a high concentration of SOEs in industry, and because these SOEs either already operate in a competitive environment or competition is relatively easy to introduce through the removal of entry barriers and by foreign trade liberalization. Such SOEs are among the easiest to privatize and therefore the most appropriate for divestiture in the short run, which applies also to all producers of tradable goods, especially consumer goods, and to firms in tourism and trade. Sale takes place either on an "as is" basis or after restructuring. Privatization of public utilities is for the time being of relatively minor importance. It is not that Governments do not wish to divest these traditional monopoly service sectors. There is interest in such divestiture, but the process is often complex and time-consuming. Available information, however, indicates that Czechoslovakia, Hungary and Poland are considering the sale of large parts of their telephone companies to foreign operators by the end of 1993 [37]. With Latin American and some Asian telephone companies also up for sale, Eastern European countries may find difficulties in finding potential buyers.

In contrast to most other countries, a prerequisite for privatization in Eastern Europe is the so-called "commercialization" of SOEs, that is, their transformation into a joint stock or limited liability company. Commercialization of a company is important because it concentrates ownership rights in a corporate board appointed by the owners or the State. In order to implement this transformation, the Government has to define who is to have nominal and temporary ownership rights over State property. In Czechoslovakia and Poland this role has been given to a privatization ministry, while in Germany, Hungary, Romania and some other countries special agencies were established.

Another big difference between privatization in Eastern Europe and elsewhere is that in Eastern Europe, given the scale and the speed of divestiture, Governments are unable to arrange for the sale of each individual enterprise. Consequently, privatization is either government-initiated, or enterprise-initiated or spontaneous. Government agencies draw up a list of enterprises considered suitable for privatization, determine conditions under which these companies will be privatized, and supervise the whole process. In general, government-initiated privatization has been used primarily for the larger and more viable enterprises with actual sales completed through a public offering of shares, direct sale to foreign or domestic investors, or management/employee buy-out. In contrast, enterprise-initiated privatization has proved to be more appropriate for small and medium-sized companies, while privatization methods applied have been again direct sale and management/employee buy-out. Faced with the objective of fast and massive privatization on the one hand, and very limited purchasing power of the population, on the other, some Eastern European countries, such as Czechoslovakia and Poland, have introduced another innovation in the process of privatization, the distribution of the State property to all eligible citizens in the form of free or low-priced vouchers.

(a) Former German Democratic Republic

In no country of the world has the process of privatization been as rapid as that in the five new German federal States. In less than two years of full operation, the Treuhandanstalt, the State-owned trustee company in which the assets of the former German Democratic Republic have been vested, has privatized some 5,500 manufacturing and service companies and nearly 15,000 retail outlets (80 per cent of the retail sector). Privatization is about half complete, as the Treuhandanstalt still has some 5,800 companies to divest. The number of remaining companies has increased because the splitting of the country's 270 Kombinate (vertically integrated, public-sector holding companies) continues. The achievements of the Treuhandanstalt are impressive in terms of the number of companies privatized, and in its success in attracting over $90 billion of new investment to the former German Democratic Republic and securing over 1 million jobs in the private sector [38].

Table IV.3. shows the structure of firms disposed of in their entirety from the books of the Treuhandanstalt as of end November 1991. The largest number of companies had been sold by direct negotiations mostly to purchasers from the "old" Federal Republic of Germany. Foreign buyers were less active at the beginning of the programme (international investment normally takes longer; the Treuhandanstalt started international marketing only in mid-1991; and language was a problem), but recently there has been an increase in interest. According to the most recent information, the percentage of non-German applications for weekly tenders of the Treuhandanstalt has risen to nearly one third of the total. By April 1992, some 250 non-

Table IV.3. Status of Treuhandanstalt firms as of end-November 1991

Status	Number of firms
Firms disposed off in their entirety[a/]	4 125
Sold to the private sector, of which:	2 467
Sold as management buy-outs	602
Sold to foreigners	223
Reprivatized (returned to previous owners)	463
Transferred to local authorities	250
Being closed	636
Other (wound up through closure, merger of splitting up)	241
Enterprises still to be disposed of	6 744
Majority owned by private sector	557
Majority owned by Treuhandanstalt	6 187
TOTAL	10 869

Source: *Economist*, 21 March 1992, p.77.

a/ Including incomplete transactions.

German companies had invested $6.57 billion in the former German Democratic Republic [38]. A significant percentage of all company disposals (some 15 per cent) has been to company executives through management buy-outs. To date the Treuhandanstalt has closed a relatively small number of firms (636 by November 1991, that is, roughly 6 per cent of all firms divested and still for disposal under the control of the Treuhandanstalt at that time), indicating the reluctance of the agency to liquidate. The Treuhandanstalt estimates that 30 per cent of its remaining 5,800 companies are not commercially viable (one independent survey puts this figure twice as high), but it is postponing its final decision regarding their future for social and political reasons ([34], p. 20); thus it appears that basically uneconomic firms constitute around one-quarter of the total SOE sector in the former German Democratic Republic. The policy of the Treuhandanstalt has been criticized on the grounds that money should not be spent to save jobs and restructure basically uneconomic industries. Dornbush and Wolf have argued in a recent study that it is better to let these companies fail and to use resources for retraining and investment in entirely new companies ([34], p. 77). Indeed, Treuhandanstalt transactions contain provisions for price reductions in return for binding commitments to protect an agreed number of jobs and securing new investment to improve capital stock and products. In practice, actual sales prices are lower and the writing-off of old debt is taken into account. Thus the Treuhandanstalt combines industrial with social policy in implementing the privatization programme in a process that is less market-based and more interventionist than in most other countries in the world. To encourage new investment in these new States, the federal Government has also introduced various investment and tax incentives which, according to one source, reduce the effective cost of such investment by up to 50 per cent [39].

(b) Hungary

In terms of the legislation and institutional setting necessary for privatization, Hungary is still the most advanced country in the region (excluding the former German Democratic Republic). Actual sales are, however, much slower. In addition to some 10 per cent of shops, restaurants and other small businesses privatized so far (their total number is more than 20,000; they are not a major subject of this study), about 200 former SOEs out of a total of 2,300 were privatized between mid-1989 and the end of 1991. A small number of companies operating in strategic sectors such as petrochemicals, energy, telecommunications and transport will be subject to restrictions on divestiture. In contrast, significant industrial sectors, including cigarettes and tobacco, distilling, brewing, vegetable oils, sugar, confectionery, bread, newspapers, paper, refrigerators, cement and glass are largely in the hands of transnational firms [40].

In contrast to many other Eastern European countries, privatization in Hungary has not been preplanned, but has developed through "learning by doing", going through numerous stages and modifications to improve the effectiveness of the process and to better adapt policies to the needs of the country. In the second half of 1989 and early in 1990, privatization transactions were carried out on the basis of the 1989 Transformation Law, which legalized the private acquisition of SOEs but contained relatively few guidelines to ensure fairness of the process for all concerned. Some important foreign acquisitions, such as the sale of a 75 per cent stake in Ganz electric-meter works to Schlumberger Industries (France), purchase of a 51 per cent stake purchase in Ganz engineering enterprise by Hunslet (United Kingdom), and the most spectacular purchase, that by General Electric (United States) of 50 per cent and one share of the Tungsram light-bulb producer, were completed under this legal setting ([41], p. 68). This uncontrolled "spontaneous privatization" became a subject of growing criticism, with the accusation that company managers were selling off their enterprises to foreign buyers below their perceived real values.

In March 1990 the Government established the State Property Agency to maximize revenues from divestiture and to control "spontaneous privatizations", even at the risk of delay. The Agency is a legal body that holds nominal ownership rights in SOEs. More than 80 per cent of the 300 or so transactions approved by the Agency between mid-1990 to November 1991 belong to the category of spontaneous privatization, where the initiative in almost every aspect of privatization is left to the enterprise, while Agency approval is intended only to guarantee the legality and transparency of the deal and to protect the value of State assets involved ([42], pp. 1-2). Recently, the Agency has announced a more flexible means of privatization which applies to 343 companies mainly in manufacturing and services, with less than 300 employees or less than 300 million forint per year in turnover. Under this so-called "self-privatization", the enterprises concerned are entitled to choose an adviser approved by the Agency, and the transaction as such does not need its approval ([43], pp. 17-18). Although the sectoral structure of completed spontaneous privatization is not available, scattered information suggests that a large majority of enterprises are from various manufacturing branches and service sectors, especially trade and tourism. Most transactions have been done through direct sales of a company's assets or equity to outside investors. Some other characteristics of Hungarian spontaneous privatization are the following:

(a) Many transactions have involved not only an outright sale but a new share issue to increase paid-in capital or a firm commitment of the new owner to undertake substantial investments;

(b) A majority of transactions involve foreign partners, either professional investors making direct investment or institutional investors making portfolio investment (in 1991, cumulative foreign investment—not only related to privatization—reached $2 billion, with an additional $800 million expected in 1992);

(c) All deals offer some opportunities to employee participation;

(d) Environmental issues are becoming increasingly important;

(e) A transaction does not necessarily require wide invitation to bid ([42], pp. 2-4).

In addition to controlling spontaneous privatization, the State Property Agency also initiates privatization. Under this "active privatization", the Agency takes the initiative by selecting privatization candidates, and determines the divestiture and the limits of foreign participation. As of October 1991, three programmes and two sector-specific privatization efforts were initiated by the Agency, involving approximately 124 companies ([43], pp. 11-15). The first, launched in September 1990, comprised 20 of the larger, well-known and generally better-performing companies from the manufacturing, trade and tourism sectors. A larger proportion of manufacturing firms was contained in the second programme, of December 1990. Unfortunately, because of various obstacles, delays have occurred in implementation, and by August 1991 no sales under the first programme had yet gone through. In practice, professional foreign investors have shown relatively little interest in purchasing under this programme, because the Agency has set upper limits on foreign capital in several of the top profit makers all destined for flotation on the Budapest stock exchange; including pharmaceutical company Richter Gedeon (33 per cent), the hotel chains Hungarhotels (49 per cent), Pannonia (30 per cent) and Danubius (50 per cent), and department store Centrum (30 per cent) [44]. Foreigners seem to be much more interested in spontaneous privatization. As far as institutional foreign investors are concerned, there are still doubts as to how much interest foreign portfolio investors will have in the Hungarian stock market. In practice, spontaneous privatization of mostly industrial and service sector companies has absolutely dominated the Hungarian privatization scene over the last two and a half years, and has made a major contribution to the total of 31 billion forint raised by the Government through privatization in 1991 (the Government expected 50 billion forint) [45]. About four fifth of this money was expected to be used to reduce the country's national debt, with the rest going to various government activities, such as the National Employment Fund and the promotion of direct foreign investment [46].

(c) Czechoslovakia

In contrast to Hungary, the Government of Czechoslovakia has moved more slowly on the question of privatization in spite of significant interest of foreign investors in the acquisition of enterprises in the country. In addition to general economic problems, there are two more specific obstacles which have caused delays in initiating the privatization process. First, there is a question of dividing responsibility for privatization between the republican and federal levels; and secondly, to prevent company managers from benefiting from the privatization process, the Government has not allowed enterprise-initiated privatization which has been widely applied in Hungary. In 1990 and 1991, Czechoslovakia adopted comprehensive privatization legislation, which provides for two major types of privatization, both currently at different stages of implementation. The so-called "small privatization", carried out in a decentralized manner through regional privatization commissions, has achieved roughly half of its potential. Over 13,000 small and medium-size units, mainly in the service sector and retail trading, out of a total of 21,500 were sold by public auctions by November 1991. Although foreign participation was not allowed in the first round of auctions, in order to give an advantage to Czechoslovak citizens, in practice many foreign partners have been de facto silent partners hidden behind eligible local investors ([47], pp. 8-9).

Simultaneously with the small privatization programme, "large-scale privatization" has been organized, but unfortunately its implementation is lagging far behind. The Law on Large Privatization (some 1,800 Czech and up to 700 Slovak enterprises have been designed as the "first wave of large scale privatization") requests each company to prepare its own privatization plan which will delineate the part of the enterprise to be privatized, the form of privatization, the time schedule and the names and foreign partners interested in acquisition, if applicable. The Law defines 10 different modes of privatization, including voucher privatization. Once a privatization plan is drawn up, it must be approved by the relevant ministry, while SOEs in telecommunications, mining, transport, national defence and strategic sectors must secure approval from the federal institutions at the federal level. After approval of the privatization plan, ownership of the enterprise is transferred to one of the institutions known as National Assets Foundations. These Foundations are responsible for actual privatizations, including the drawing-up and signing of final contracts. This rather complex legal procedure suggests that the whole large privatization process is under strong and direct government control.

As the deadline for submission of plans in the first wave of large privatization was the end of 1991, implementation has been possible for a few months only. However, before the deadline the Government had approved some 15 privatization projects on a case by case basis, and some new projects were approved on a similar basis in early 1992. Such sales included the following high-profile transactions ([48], [49]):

(a) Volkswagen acquired, for 620 million deutsche mark, 31 per cent of the shares and management control in Skoda. Volkswagen will increase its holding to 70 per cent in 1995 and will invest some 9 billion deutsche mark by the year 2000;

(b) Siemens (Germany) and Framatome (France) may take 67 per cent of the $170-million power generation business of Skoda Pilsen;

(c) Mercedes acquired 31 per cent of truckmakers Avia and Liaz for $250 million, a further $210 million to be invested over the next three years;

(d) Nestle (Switzerland) and BSN (France) acquired a 43 per cent share, and the newly established European Bank for Reconstruction and Development 15 per cent, of Czechoslovakia's largest food processor Cokoladovny;

(e) Air France (France) and EBRD bought stakes in the State-owned airline CSA.

These well-publicized acquisitions had the following characteristics:

All involved strategically important enterprises that attracted considerable interest among foreign investors;

Box IV.1. Manager's view of privatization:

This part of the analysis presents the results of a survey of managers of industrial SOEs considered for privatization. The survey aimed at obtaining the opinions of managers on the reasons for privatization of their companies, on expected obstacles to divestiture, on the market position of their companies, and on the expected mode and timing of privatization. The survey was carried out through a questionnaire distributed by mail to managers of a sample of some 200 SOEs in developing and Eastern European countries considered for future divestiture.

The questionnaire was composed of five sections. In the first, respondents were asked to provide information about general characteristics and the current status of the company, including the name and address of the company, its main products and ownership structure, and the number of employees over the last three years. The second section aimed at obtaining information about the position of the company in the domestic market, including questions about the domestic market share for its main products and about the import regime for competing products. In the third and fourth sections, managers were asked to assess the importance of individual reasons for and the expected obstacles to privatization of their companies, with reasons and obstacles scaled from "(1) very important" to "(2) fairly important" to "(3) less important". The last section of the questionnaire requested information on the expected mode of privatization, on its timing and on whether the company should be restructured prior to divestiture. Respondents were advised that replies would be treated in confidence and that information provided would be used exclusively for analytical purposes.

Tables IV.4, IV.5, IV.6 and IV.7 present the summary of replies of managers from 28 industrial SOEs in 9 developing countries (Argentina, Brazil, Morocco, Nepal, Nigeria, Pakistan, Philippines, Sri Lanka and Turkey) and 2 Eastern European countries (Hungary and Poland). These SOEs come from a range of manufacturing branches, including food production, petroleum refineries, industrial chemicals, iron and steel production, textiles, printing, cement production as well as electrical and transport equipment. The small size of the response made the sample unrepresentative, and the survey was biased in at least three ways: information was gathered largely from rather big companies—more than half of the surveyed firms have more than 1,000 employees, six of them even more than 5,000 employees; information on the company's privatization is given only from the managers' point of view, and therefore does not include views of other groups participating in the process, such as workers or government officials; and there were no means of cross-checking the information from the survey. For all these reasons, the survey results are tentative and provide very preliminary conclusions or working hypotheses.

Tables IV.4, IV.5, IV.6 and IV.7 provide the basis of the following observations:

(a) More than half of the surveyed companies in developing countries and slightly less than half in the Eastern European countries have a domestic market share at a level of at least 50 per cent, while only two have a share at 10 per cent or less (see table IV.4). This suggests that a majority of the surveyed companies still operate, in highly distorted markets with a concentration of near-monopoly power. To expose companies producing internationally tradable goods to more competition, Governments of many countries have strongly liberalized their imports. Regarding the import regime for competing products, 87 per cent of the managers responded that the import of competing products is liberal, while no respondents indicate that competing products were banned;

(b) Regarding individual reasons for privatization of their companies, managers from the two groups have, in general, surprisingly similar views (see table IV.5). In both groups of countries "government strategy towards privatization" is considered as the single most important reason for privatization of their companies (rank 1). There are three other reasons for privatization, namely "attracting foreign capital investment", "improved access of the company to new financial resources" and "reduction of production costs due to improved decision on allocation of human and capital resources", which are in both groups of countries ranked among the top five most important reasons for privatization. The high importance attributed by respondents from both groups to privatization as a mechanism for resource mobilization reflects the realities of the 1980s, with divestiture being seen primarily as a response to poor financial performance of these enterprises in circumstances of

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Most involved industrial enterprises;

All involved much foreign competition;

Although price was important in judging offers, other criteria, including commitment to new investment and the saving of jobs, were also important;

These transactions brought more than half the total foreign direct investment in Czechoslovakia in 1991, amounting to about $600 million ([47], p. 3).

5. Conclusions

This survey of privatization in various countries varies in scope and depth depending on data availability. Despite the lack of uniformity certain common features of privatization can be identified as follows:

(a) Privatization programmes priorities and methods differ significantly from one country to another as Governments attach different priority to individual economic objectives, such as reducing the fiscal burden, increasing budget revenues or strengthening economic efficiency, as well as to different socio-political objectives, such as increasing popular capitalism, decreasing external and domestic debt, strengthening domestic capital markets, disciplining the power of public sector trade unions and transforming centrally planned into market economies in the countries of Eastern Europe. In some countries, this broad spectrum of privatization goals has led also

questionnaire findings

drastically reduced availability of domestic and foreign financial resources;

(c) Regarding expected obstacles to privatization, managers from the two groups are again of rather similar position. Both groups share the view that "thin and underdeveloped capital markets" is the most important problem to be faced in the divestiture of their companies. In developing countries, other problems ranked among the top five expected obstacles are "indebtedness of the company", "lack of foreign investor's interest", "limited administrative capacity of the government to implement privatization" and "resistance of employees" (see table IV.6). The first three obstacles are also among the top five expected obstacles in the Eastern European sample, but in contrast to managers from developing countries, respondents from Hungary and Poland attributed high importance to "legal problems related to company property rights". This is not surprising, taking into account that re-establishing clear property rights in these countries has already proved to be complex and time-consuming. Managers from both groups have similar views also about those obstacles which are expected to have small influence on privatization, namely that "resistance of management", "fear of increased foreign ownership" and "lack of legal, accounting and management consulting services" are of minor importance in divestiture. While the views of respondents on expected management resistance should be taken very cautiously and is unsurprising, low fear of increased foreign ownership could be explained by the strong commitment of Governments and the growing consensus throughout the developing world to attract foreign investment. It is somehow surprising that "lack of legal, accounting and management consulting services" is considered as an obstacle of minor importance to privatization, but the reasons for this seems to be of two kinds: first, companies in the sample are rather large; and second, most of the companies in the sample are from relatively developed developing countries, where these services are more easily available than in those which are less developed;

(d) Regarding the expected mode of privatization, an almost common characteristic of replies is that divestiture will be done through a combination of two or even three privatization techniques (see table IV.7). The two main techniques are expected to be private sale and sale of shares through a stock exchange. Only two of the surveyed companies from Hungary and Poland (17 per cent) intend to use the stock market, but among the companies from developing countries some 44 per cent will do so. This figure of 44 per cent may be partly attributed to a biased sample. Another two privatization methods expected to be widely applied in both groups of countries are also the sale of shares to management and employees, no doubt aimed at neutralizing workers' resistance to divestiture. They both are commonly used as supplementary methods; 16 out of 28 companies are expected to apply management-employee buy-out methods, but in all cases in combination with other divestiture techniques; and 10 out of 28 companies are expected to apply inflow of capital, but in all but one case in combination with other privatization methods;

(e) Most managers expect divestiture to take place in 1992 or 1993 (see table IV.7). This, together with the reply on the question whether they agree with this timing (23 out of 24 replied positively), indicates the managers' view that privatization should be implemented as fast as possible. Experience from the past decade indicates however that privatization is a complex process, and this raises doubts whether these divestitures will actually be implemented as planned;

(f) Managers of the surveyed companies from both groups of countries expect the strong involvement of foreign partners in the privatization process. About 80 per cent of respondents thought that foreign investors would buy either minority or majority stakes (see table IV.7.). High expectations in this area seem to be in line with government efforts to attract foreigners to participate in privatization programmes of individual countries;

(g) Responses to the question regarding substantial preparatory restructuring prior to divestiture slightly differ between managers from the two groups of countries. Three quarters of those from Hungary and Poland think that these measures, especially financial restructuring and physical rehabilitation and modernization, are necessary. In developing countries this percentage is lower—56 per cent—and focused on both financial and management restructuring (see table IV.7).

to changing objectives at different times, reflecting changes in socio-political and economic circumstances in each particular country;

(b) Not even rough data exist on the number of divestitures that have occurred. In developing countries, this number may be estimated at over 1,000, and at over 4,500 if extensive reprivatizations in Pakistan (some 2,000 companies in 1977), Bangladesh (1,076 in the period 1976-1984), Chile (some 350 in 1973 and 1974) and Mexico (750 companies privatized since 1982) are taken into account. If denationalizations are excluded, most divestitures among developing countries have been in Chile and Mexico, each with more than 100 transactions completed. In many other developing countries, including Costa Rica, Honduras and Jamaica in Latin America, Côte d'Ivoire, Gambia, Ghana, Guinea, Mali, Niger, Togo and Tunisia in Africa, as well as Philippines, Malaysia, Republic of Korea, Singapore and Sri Lanka in Asia, Governments have sold off at least 10 SOEs. There are many other countries which have only recently either started with some large-scale privatization, like Argentina, Brazil and Venezuela, or have come out with extensive privatization plans, like Egypt, Kenya, Morocco and Pakistan;

(c) Divestiture in Eastern Europe is only three years old, with most transactions carried out in the former German Democratic Republic, where 5,500 companies had been privatized by April 1992. In some other countries the tempo is much slower, but still significantly faster than in most developing countries. This is not surprising, since divestiture has become an

Table IV.4. General characteristics, current status and relative market position of industrial companies considered for privatization: questionnaire replies

Country of origin of the company	Sample number	Activity	Private sector share in the ownership of the company (percentage)	Number of employees		Domestic market share of the company for its main product (percentage)	Do other companies pose a competitive threat to products of your company in the domestic market?		Import of products which compete with your company's product is		
				1990	1988		Yes	No	Banned	Restricted	Liberal
A. Developing countries											
Argentina	1	..	-	36 935	36 673	54	x				x
Argentina	2	Petrochemicals	-	1 096	799	70	x				x
Brazil	3	Phosphates	-	2 200	2 400	82		x			x
Brazil	4	Iron products	-	15 285	14 445	41	x				x
Brazil	5	Iron products	-	19 106	22 714	100	x				x
Brazil	6	Iron products	15	13 413	13 928	45				x	
Morocco	7	Cement	14	630	609	24		x			x
Morocco	8	Iron products	-	609	576	80	x				x
Nepal	9	Cement	5	801	821	20		x			x
Nigeria	10	Car production		1 284	1 337	10	x				x
Pakistan	11	PVC products	-	91	96	50	x				
Pakistan	12	Cement	9	742	740	80	x				
Philippines	13	Food products	-	367	437	44		x			x
Turkey	14	PVC production	-	7 297	7 423			x			x
Turkey	15	Cement	-	9 301	9 553	24	x				x
Sri Lanka	16	Ceramics	-	2 988	3 028	90	x				x
Total, A							10	5		1	13
B. Eastern Europe											
Hungary	17	Printing	-	305	302			x			
Hungary	18	Machinery	-	202	233	25	x				x
Hungary	19	Tools production	-	110	180	50	x				x
Hungary	20	Plastic products	-	211	309	50		x			x
Poland	21	Metal products	-	4 912	5 619	25				x	
Poland	22	Textiles	-	1 161	1 266	25		x			
Poland	23	..	-	1 410	2 287	100		x		x	
Poland	24	Textiles	-	2 275	2 466	40	x				x
Poland	25	Machinery	-	1 269	1 452	90	x				x
Poland	26	Metal products	-	1 640	2 038		x				x
Poland	27	Cement	-	1 106	1 188	8	x				
Poland	28	Ceramics	-	503	612			x			x
Total, B							6	5		2	7
Total, A and B							16	10		3	20

Source: Replies to questionnaire.
Note: Totals represent total number of responses.

Table IV.5. Reasons for privatization of industrial companies considered for privatization: questionnaire replies

Country of origin of the company	Sample number	Reduction or elimination of government subsidies needed to cover operating losses	Reduction or elimination of government subsidies needed for the capital investment	Part of government overall privatization strategy towards privatization	Removal of government interference in operating decisions	Broader popular participation in ownership	Enlargement of domestic capital market	Creation of job opportunities in the long-run	Attraction of foreign capital investment	Compliance with requests of foreign lenders and donors	Provision of better incentives for managers in the company	Improved access of the company to new financial resources	Improved access of the company to new technologies	Improvement of product quality	Reduction of production costs due to improved decisions on allocation of human and capital resources
Developing countries															
Argentina	1	1	1	1	1	2	1	2	1	3	1	2	3	3	1
Argentina	2	1	2	1	1	2	2	2	2	2	3	3	3	3	1
Brazil	3	3	2	1	1	2	2	3	3	3	3	2	2	2	2
Brazil	4	1	1	1	2	1	1	1	1	2	3	1	1	1	1
Brazil	5	2	3	1	1	2	1	3	1	3	3	1	1	1	1
Brazil	6	3	3	1	2	3	2	3	1	1	3	2	2	3	2
Morocco	7	1	2												
Morocco	8	1	3	1	3	2	1	1	1	1	2	2	3	3	1
Nepal	9					1					2				1
Nigeria	10	3	3	1	2	2	1	1	2	2	3	2	3	3	3
Pakistan	11	1	2	1					2						
Pakistan	12	3	3	2	1	3	2	2	2		2	3	2	3	1
Philippines	13	3	3	1	1	2	3	2	3	3	1	1	3	3	3
Turkey	14	1	2	2	1	3	3	2	2	1	3	1	2	3	1
Turkey	15	2	3	1	1	3	2	3	1	1	2	1	3	3	1
Sri Lanka	16	2	2	2	1				1	2					
Average		1.86	2.33	1.21	1.38	2.15	1.75	2.08	1.64	2	2.38	1.75	2.33	2.58	1.46
Eastern Europe															
Hungary	17	3	2	1	2	1	2	1	1	2	1	1	1	3	2
Hungary	18	3	3	1	1	3	3	3	2	2	2	1	1	1	2
Hungary	19	1	2	1	1	3	1	1	1	2	1	1	1	1	1
Hungary	20	1	2	2	3	3	3	3	1	3	3	2	2	3	3
Poland	21	1	2	1	3	2	1	1	1	1	2	1	1	3	2
Poland	22	1	3	1	1	1	1	2	1	3	2	1	2	2	1
Poland	23														
Poland	24	3	3	1	3	2	1	1	1	1	1	1	1	1	2
Poland	25	3	3	1	3	1	2	2	1	2	1	3	2	2	1
Poland	26	3	3	1	2	1	1	2	1	1	1	2	1	1	1
Poland	27	3	3	1	3	2	2	2	1	1	2	1	3	3	1
Poland	28	3	3	1	3	2	1	1	1	2	1	1		1	1
Average		2.27	2.63	1.09	2.27	1.9	1.63	1.72	1.09	1.81	1.55	1.36	1.50	1.91	1.55

Source: Replies to questionnaire.
Note: 1 = very important reason; 2 = fairly important reason; 3 = less important reason.

Table IV.6. Expected obstacles to privatization of industrial companies considered for privatization: questionnaire replies

Country of origin of the company	Sample number	Legal problems related to company property rights	Lack of legal accounting and management consulting services	Limited administrative capacity of the government to implement privatization	Poor popular image of the private sector	Lack of foreign investors' interest	Thin and underdeveloped capital market	Lack of market information	Indebtedness of the company	Fear of increased foreign ownership	Resistance of the management	Resistance of the employees	Resistance of national civil servants
Developing countries													
Argentina	1	2	3	3	3	2	1	2	3	3	3	3	2
Argentina	2	3	3	2	3	2	2	3	1	3	2	2	2
Brazil	3	3	3	3	3	3	3	3	3	3	3	3	2
Brazil	4	3	3	3	3	2	3	3	2	3	3	3	3
Brazil	5	3	3	3	2	3	2	3	3	3	3	2	3
Brazil	6	2	3	2	1	2	2	2	3	1	3	3	1
Morocco	7	..	..	..	..	..	..	..	..	..	..	..	..
Morocco	8	3	3	3	3	2	1	2	1	3	3	3	3
Nepal	9	..	..	..	2	..	1	..	1	..	..	2	..
Nigeria	10	2	3	3	3	1	2	2	3	3	3	2	3
Pakistan	11	..	..	..	..	..	..	..	2	..	..	..	..
Pakistan	12	3	3	..	2	2	2	2	3	3	3	3	3
Philippines	13	1	3	2	3	3	3	2	1	3	3	3	3
Turkey	14	3	1	1	1	1	2	2	2	3	1	1	1
Turkey	15	3	3	1	3	3	2	3	1	2	3	2	3
Sri Lanka	16	2	2	2	3	3	..	2	3	2	2	1	3
Average		2.53	2.76	2.33	2.50	2.23	2	2.38	2.13	2.69	2.69	2.35	2.46
Eastern Europe													
Hungary	17	3	3	3	2	1	1	1	3	3	3	3	3
Hungary	18	2	3	2		1	1	1	2	3	3	3	1
Hungary	19	2	3	2	1	3	1	1	1	3	3	2	2
Hungary	20	1	3	3	3	2	2	3	1	3	3	3	3
Poland	21	3	2	3	2	2	1	2	1	3	1	1	1
Poland	22	2	3	1	3	1	1	2	1	2	3	2	1
Poland	23	..	..	..	..	..	..	..	..	..	..	..	..
Poland	24	1	3	2	3	1	1	2	2	2	3	3	3
Poland	25	1	3	2	2	1	1	2	3	3	3	3	3
Poland	26	1	3	1	2	2	2	1	2	2	1	2	2
Poland	27	2	3	1	1	2	1	3	3	3	3	3	3
Poland	28	1	1	2	3	1	1	1	3	3	3	3	2
Average		1.72	2.72	2.00	2.20	1.54	1.18	1.72	2	2.72	2.63	2.55	2.17

Source: Replies to questionnaire.

Note: 1 = very important obstacle; 2 = fairly important obstacle; 3 less important obst le.

Table IV.7. Expected mode and timing of privatization of industrial companies considered for privatization: questionnaire replies

Country of origin of the company	Sample number	Expected mode of ownership transfer: Sale of shares through stock exchange	Sale of shares to investors other than employees (private sale)	Sale of shares to the management and/or employees	Inflow of capital	Are foreign investors expected to participate in the ownership? Yes	No	If "Yes", by how much? (percentage)	Do you agree with mode of privatization Yes	No	When is privatization completed?	Do you agree with this timing? Yes	No	Should the company be restructured before privatization Yes	No	If answer from previous question is 'Yes', of what kind? Financial restructuring and debt rescheduling	Changes with respect to staffing	Physical rehabilitation and/or modernization	Management restructuring
Developing countries																			
Argentina	1	x				x			x		1993	x		x		x	x	x	x
Argentina	2		x	x		x		80-90	x		1992	x		x		x			
Brazil	3		x	x		x		less than 40	x		1992	x			x				
Brazil	4	x	x	x	x	x		40	x		1993	x		x		x			x
Brazil	5		x			x		15	x		1992	x			x				
Brazil	6	x	x	x		x		30	x		1992	x			x				
Morocco	7					x									x				
Morocco	8	x			x	x			x		1995-96				x				
Nepal	9	x				x			x		After 1995	x		x		x		x	x
Nigeria	10	x	x	x			x			x	1992	x		x		x	x	x	x
Pakistan	11		x	x			x		x		1992-93	x			x				
Pakistan	12		x	x							1992	x			x				
Philippines	13			x	x		x		x		1992	x		x		x		x	
Turkey	14	x				x		51	x		1993	x		x		x			x
Turkey	15			x	x	x				x	1992-94	x		x		x	x	x	x
Sri Lanka	16													x		x		x	x
Total, A		7	8	9	4	11	3		11	2		13	-	9	7	9	3	5	7
Eastern Europe																			
Hungary	17			x	x	x		50	x		1992	x		x					
Hungary	18		x			x		70	x		1992	x		x		x		x	x
Hungary	19		x	x		x		70	x		1992	x			x				
Hungary	20		x			x		25	x		1992	x			x				
Poland	21						x							x					
Poland	22	x		x					x		1992		x	x		x	x	x	x
Poland	23		x				x		x		1992	x		x		x		x	
Poland	24				x	x		49			1992	x		x		x		x	
Poland	25		x	x	x	x		50	x		1993	x		x		x		x	x
Poland	26		x	x	x	x		30	x		1993	x		x		x	x	x	x
Poland	27	x	x	x	x	x		20		x	1993	x		x					
Poland	28			x	x	x			x		1993	x			x				
Total, B		2	7	7	6	9	2		9	1		10	1	9	3	6	2	6	4
Total, A and B		9	15	16	10	20	5		20	3		23	1	18	10	15	5	11	11

Source: Replies to questionnaire.
Note: Totals represent number of responses.

economic and political priority, and a necessary precondition for the transformation from a centrally planned to a market economy. If privatization of small-scale businesses is excluded, Hungary privatized some 200 SOEs, Poland close to 600, while the Government of Czechoslovakia had approved some 15 privatization transactions by the end of 1991;

(d) In both developing countries and Eastern Europe, the number and volume of sales are very modest in comparison to the total asset base of the public enterprise sector. More modest still is the achievement in comparison with expectations, as evidenced by the small number of actual transactions that have met publicly stated targets;

(e) Governments differ in their definition of strategic industries to be excluded from divestiture. Recent trends in many countries have reduced those sectors defined as strategic (banking is a very notable case). Some segments of SOEs remain where Governments prefer restructuring to divestiture. In general, enterprises considered to be strategic are those in the utilities sector, or are major exploiters of natural resources that happen to be profitable and important foreign exchange earners. Thus utilities in the water, electricity, transport and telecommunications sectors are still excluded from divestiture because of reasons such as non-competitive market structures, strategic constraints and lack of certainty as to profitability. In practice some countries in Asia and Latin America are exceptions to the trend and have divested certain public utilities;

(f) Privatization cuts across practically all sectors of the economy. The past few years have seen privatization of telecommunications in several Latin American and Asian developing countries, including Argentina, Chile, Malaysia, Mexico and Venezuela. It is estimated that telecommunication companies in at least another 15 developing and Eastern European countries will be targeted for full or partial privatization by 1995. The reason for divestiture of large telecommunication monopolies seems to be the lack of government funds for new investments. Hence the privatization of telecommunications in Argentina and Venezuela. Airlines comprise another government monopoly targeted for divestiture in several countries. Airlines in at least 15 countries have already been privatized either through total or partial divestiture (Argentina, Chile, Czechoslovakia, Malaysia, Mexico, Philippines, Singapore, Thailand), or through management contracts or leases (Malawi, Mali, Sri Lanka, Zaire), while air carriers in many other countries (Congo, Gambia, Hungary, Indonesia) are known to be in the privatization pipeline. As in telecommunications, the number of divestitures in air transport is relatively small, but at a relatively high price, sometimes over $100 million. Other segments of the transport sector, such as port and airport activities, shipping and bus companies, as well as road construction and management have also been privatized in some developing and Eastern European countries through ownership and management transfer, although railways, for the time being, have not been privatized. Banks in developing countries have also been privatized, with the most spectacular transactions currently under way in Mexico, where the sale of 18 banks is expected to fetch over $10 billion. Banks have been sold in other countries, including Chile, Guinea, Jamaica, Philippines and Republic of Korea;

(g) In contrast to privatization of telecommunications, air carriers and banks which have attracted, by the size of individual transactions and by the sensitivity of their operations often as monopoly providers, a great deal of professional and media attention, privatization of industrial enterprises, operating in more competitive, quasi-competitive or potentially competitive markets, has been less frequently the focus of discussion. Industrial sector enterprises have been sold off in practically all developing and Eastern European countries that embarked on the privatization route, and in many of those countries they constitute the core of the divestment programme. There are no comprehensive data about the relative importance of industry in the overall privatization process in developing and Eastern European countries. The four regional surveys and other fragmentary data suggest that the industrial sector, together with capacities in trade and tourism, accounts by far for the highest number of privatization transactions completed so far. Companies from these sectors have participated with more than two thirds or even four fifths in the total number of completed or planned transactions. In contrast to Asia and Latin America, where enterprises of practically all sectors have been divested, in Africa and recently in Eastern Europe divestiture has occurred principally in manufacturing and the services sectors. Moreover, in contrast to deals in telecommunications, air carriers and banking, small in number and high in price, industrial privatizations have been large in number but relatively low-priced. Small industrial firms in competitive markets are among the first to be divested in most countries. A few countries then go on to consider the divestiture of State utilities;

(h) Methods of divestiture include public offerings, private sales, management-employee buy-outs, management contracts and leases, with private sale to domestic and foreign investors being by far the most important, in practically all countries including Argentina, Brazil, Chile, Costa Rica, Honduras, Jamaica, Mexico and Panama, in Latin America; Côte d'Ivoire, Guinea, Niger and Senegal in Africa; Czechoslovakia, Hungary, Poland and the former German Democratic Republic in Eastern and Central Europe; and Bangladesh, Pakistan and Philippines in Asia and the Indian Subcontinent. Public offerings have not been much used, *inter alia* because of the absence or inadequacy of such markets in most countries. Where such markets are relatively well developed as in Chile, Malaysia, Mexico, Republic of Korea and Singapore, public offerings have been much more frequent. Of the surveyed countries, Czechoslovakia and Poland have used arrangements by which the government issues to the domestic population investment vouchers that can be exchanged for shares, with the aims of speeding up divestment in the absence of a stock market and building up a share-owning class;

(i) Most countries have combined the divestiture of SOEs with legislation aimed at attracting direct foreign investment. Latin America has succeeded in this aim, especially in Argentina, Chile and Mexico, where debt-equity swaps have also been an incentive. However,

Eastern Europe has been less successful in attracting foreign investment, despite some well-publicized but exceptional transactions; the special case of the former German Democratic Republic has also been exceptional. In contrast to Latin America and Eastern Europe, foreign investors have been much less interested in purchasing SOEs in Africa. With the exception of Côte d'Ivoire, Togo, and to a lesser extent Guinea, Liberia and Zaire, few foreign investors have been attracted. In contrast, the foreign presence in Asian divestiture, in particular Malaysia, Republic of Korea, Singapore and Taiwan Province, has been limited by governments.

C. Analysis of industrial sector privatization issues

The present section focuses on a more detailed analysis of issues most relevant to privatization of industry. Each of the issues is analysed in view of conclusions of other empirical studies on privatization as well as conclusions suggested in a growing stock of literature dealing with conceptual aspects of privatization.

1. Diversity of privatization objectives

(a) Economic efficiency gains from privatization

There is growing belief worldwide that government-owned and -managed enterprises by and large do not work as well as privately owned enterprises, and that therefore a transfer of ownership from public to private hands would increase the efficiency with which resources are used. Economic efficiency gains have been stated as the priority objective in privatization programmes of all groups of countries, developed, developing and Eastern European. There is little doubt that unless efficiency levels are increased, the achievement of all other privatization objectives would be either impossible or highly questionable. There is, however, much less consensus on whether privatization as such, that is, ownership transfer from public to private hands, will bring about efficiency gains. Evidence on the connection between ownership and efficiency are mixed, and the widespread perception that private enterprises are more efficient than public enterprises is harder to prove than might be expected.

When discussing the relationship between ownership and economic efficiency, it must always be borne in mind that efficiency is a broader concept than profitability and should be measured not only in "money" terms but also in "real" terms. Besides, the concept distinguishes between productive efficiency, and allocative efficiency where the need to enhance productive efficiency would emphasize reforms within a firm, such as management autonomy, incentives to managers and workers, and innovation, while the need to increase allocative efficiency directs attention to reforms external to the firm, such as reducing price distortions in the cost of capital and foreign exchange and the general introduction of competition and deregulation.

Productive efficiency

In regard to the issue of ownership and productive efficiency, Alan Walters has summarized the extreme position by emphasizing that "economic theory is quite explicit: due to the nature of ownership and hence incentives, a state entity cannot be as efficient as a private entity in the production of the same output" [50]. This "pure" position is analysed below through four propositions that private ownership is associated with higher efficiency, so that privatization does bring increased productive efficiency. The propositions summarized by Nellis [51] will be presented one by one and challenged with contrary views arguing that theoretically private ownership is not superior to public ownership, and that privatization is not a necessary condition for improved production efficiency.

First, the private ownership of companies carries the implication that business decisions will be taken on business rather than on political criteria, as private firms are subject to less political intervention in their operations than SOEs. The contrary view is that change in ownership is not a necessary condition in making public enterprises more independent from political interference, and that internal reforms in a public enterprise which increase the independence of managers and define more clearly company goals, as well as government (and individual ministers') decisions to reduce its intervention, may result in the same efficiency gains as accomplished with ownership change. Second, in contrast to SOEs that have often operated under soft budget constraints with easy access to cheap capital and foreign exchange, private firms are more subject to the discipline of commercial banking and capital markets, and cannot use easy access to capital and foreign exchange to cover losses or finance new investments. Consequently, the shift from public to private ownership in a company will result in an increase of its productive efficiency. This argument can again be questioned on the grounds that for SOEs to be exposed to the discipline of financial markets it is not necessary to change their ownership. The same can be achieved by their "commercialization" and by removing their access to the "hidden" subsidies implicit in easy access to investment capital and foreign exchange. Note also that in many developing countries large private firms also have had access to these hidden subsidies. Third, private companies in some countries have the reputation of offering higher salaries and therefore attracting better managers than public enterprises. There is also the claim that a "business culture" in contrast to a bureaucratic culture is more geared towards cost minimization, profit maximization and opportunity-seeking than in public companies [52]. In addition, private firms are often considered to be better able to develop new techniques and exploit new markets than companies in the public sector. All this may be true in some firms in some countries (developed and developing), but again the differences in efficiency are not caused by differences in the ownership structure between public and private enterprises, but by differences in management incentive systems and the organization of firms. Fourth, in contrast to SOEs where the interests of the owner of the capital, the State, are represented by people (civil servants and workers) who are not personally interested in profitability of the firm, private firms are supervised by self-interested shareholders who impose profitability as the main objective of the firm. The argument that the interests of capital are better served under private ownership has been contradicted by Goodman and Loveman. In their recent article they argue that private ownership alone is not enough to ensure that managers will invariably act in the best interest of the shareholders. By analysing specific characteristics of mergers and acquisitions that took place in the United States in the late 1980s, they found that the sharp increase in shareholder value generated by most of the take-overs was a result of the market's anticipated removal of managerial practices commonly thought to characterize only public sector management. In conclusion they say that "the lessons from this experience are directly applicable to the debate over privatization: managerial accountability to the public's interest is what counts most, not the form of ownership" [53].

This schematic characterization of pros and cons might seem exaggerated, but it nevertheless leads to the conclusion that at a conceptual level it is not ownership so much as internal characteristics, that is, a firm's organization, corporate culture, managerial motivation and control mechanisms which determine the productive efficiency of companies. This conclusion has been widely confirmed in practice. On the one hand, there are hundreds of privately owned companies all over the world that go bankrupt every day, while on the other hand there are many State-owned companies that perform successfully. This suggests that private ownership is not a guarantee of good performance, nor is State ownership necessarily associated with poor performance and bad management [54]. On the contrary, experience from developing countries clearly indicates that State enterprises are very diverse in their character. Aylen, for example, has identified two completely different types of public enterprises with little in common. These two types, the "market model" and the "bureaucratic model" whose characteristics are shown in table IV.8, lends credence to the view that what matters about the performance of firms is not ownership, but issues of market environment, firm organization and managerial incentives. The author persuasively emphasizes the importance of local business norms and administrative culture in determining how State-owned enterprises are established and how they operate thereafter. Acknowledging the danger of caricature, he contrasts the "market model" in some Asian economies where State-owned enterprises follow the commercial principles of family-owned private enterprises, where links with the political structure are loose and where SOEs have to compete with other firms and with imports, with the "bureaucratic model" in other countries of the developing world. In these countries, bureaucratic principles rather than market autonomy determine decisions in SOEs, with the result that domestic managers are more interested in earning profits through rent-seeking activities such as obtaining import licences, rather than earning profits through providing products or services to the market. The bureaucratic framework tends to blur the border between enterprise accounts and national budgets, thus reducing the likelihood of independent financial control. The financial responsibility of company managers becomes ambiguous and may provide ample opportunities for corruption ([4], p. 20).

The validity of the claim that the productive efficiency of private firms is superior to that of SOEs has been discussed not only at the conceptual level but has also been analysed empirically. In his relatively extensive review of empirical studies which compare the performance of public and private enterprises in developing countries, using the criteria of productive (technical) efficiency, Millward has come to the following conclusion: "There is no evidence of a statistically satisfactory kind to suggest that public enterprises in LDCs have a lower level of technical efficiency than private firms operating at the same scale of operation", but that "on a less formal level the tendency in Turkey, Indonesia and United Republic of Tanzania seems to be nevertheless pointing in that direction" [55]. Similar results are to be found in a number of other country studies ([56], [57]).

The relationship between ownership and productive efficiency prompts the question why privatization is so

Table IV.8. Two models of public enterprises in developing countries

Market model	Bureaucratic model
Financial autonomy with emphasis on profitability	Finances overlap with national budget. Losses accepted for social reasons.
Clear commercial and social objectives	Confusion about objectives and political interference in decisions.
Operating independence	Close scrutiny of input decisions (employment, investment) and attention to politically sensitive outputs (prices). Lack of concern with overall enterprise efficiency.
Performance monitored by outputs	
Potential competition from rival and imports	Tariff barriers and import licensing to limit competition. Legal restrictions prevent market entry by potential domestic competitors.

Source: Jonathan Aylen, "Privatization in developing countries", *Lloyds Bank Review*, January 1987, p.19.

enthusiastically advocated if ownership is not a distinguishing reason for the difference in performance, and if productive efficiency gains can be achieved through SOE reforms which do not include a change in ownership? Apart from fashion, the most convincing explanation seems to be that public enterprise reforms, even when well designed, very often have failed to achieve the expected results. The history of these reforms in developing countries and formerly centrally planned economies of Eastern Europe indicates that while these reforms are relatively easy to formulate, in practice they are difficult to implement. In circumstances where Governments for various socio-political reasons (lack of government commitment, failure to achieve consensus among various interest groups or lack of technical capability to design and manage effective implementation plans) have failed to reform public enterprise and where the availability of government subsidies has fallen, Governments in many countries believe that privatization is the most realistic way to make public enterprises subject to the discipline of market forces where they must earn profits to survive and therefore increase productive efficiency.

If privatization tends to promote productive efficiency because of the rationalization of production processes and therefore better use of resources, gains in allocative efficiency from the change from public to private ownership are less clear and depend on how well the markets function. Policy makers sometimes equate private ownership with the discipline of market forces, without recognizing that competition is necessary both in factor markets and in product markets. Competition in product markets provide alternative supplies to customers, with downward pressure on prices and upward pressure on quality, while competition in factor markets can pose the threat of bankruptcy or corporate take-over, both of which act as a stimulus to allocative efficiency. Without competition, privately owned firms no less than SOEs will be less efficient than otherwise. In practice, allocative efficiency gains from privatization depend on a change in market structures before and after the ownership transfer. If privatization involves the mere transfer of public monopoly to the private sector with monopoly power left intact and no change in regulatory policy, then allocative efficiency gains from ownership transfer might well be negative, as newly privatized monopolies use their market power to maximize profit, leaving the efficiency with which resources are used unchanged. For example, Nellis has emphasized that factors which contribute to poor public enterprise performance are the very same factors which weaken the capacity of African states to regulate large and powerful private sector firms. There is, he argues, no reason to believe that replacement of inefficient public monopoly with poorly or unregulated private monopoly would increase a country's net socio-economic welfare ([5], pp. 44-45).

Allocative efficiency

Even if privatization tends to promote productive efficiency because of a more rational use of fixed assets, that is, existing plant and equipment etc., it is more uncertain that ownership change will be accompanied by or will lead to increases in allocative efficiency. The efficiency with which resources are allocated to producing a given product mix, depends crucially on the price of investment capital and on the price of foreign exchange. SOEs and those private firms which have access to these scarce resources at the same price will tend to use these resources in the same way. Where there are significant differences between official prices and market prices for these scarce resources, that is, a significant "hidden subsidy", SOEs and privileged private firms may well appear highly profitable, but at the cost of resource misallocation (allocative inefficiency) economy-wide. It should not be forgotten that "hidden" subsidies are financed by other users of capital and foreign exchange as well as foregone consumption by the public at large. This pattern of funding hidden subsidies by other users of capital and foreign exchange, that is, the "underprivileged" part of the private sector, might well account for an often-noticed phenomenon of small- and medium-scale enterprises in developing countries. It is commonplace in the economic literature [58] that small- and medium-scale enterprises, which are typically underprivileged, are efficient users of foreign exchange and capital: they have to be to survive. The reverse of the hidden subsidies coin is hidden taxes; small- and medium-scale enterprises often finance subsidies going to their competitors and the playing field is doubly titled. Such enterprises operate in an economic environment which is highly competitive on both the demand and supply sides.

Conceptually, there are three possible outcomes on allocative efficiency as a result of privatization. First, private sector ownership will have no impact on allocative efficiency where the new owners have the same access to hidden subsidies as the previous owners, that is, the State. Second, if as a result of the ownership change the enterprise manages to survive with no fall in quality and output, and without access hidden subsidies, this would tend to indicate that new capital and foreign exchange invested post-privatization was being used more efficiently as a result of the ownership change. The third outcome occurs where privatization has been accompanied by measures which equilibrate subsidized, or administered, prices and market prices. In these circumstances there may or may not be an increase in efficiency as a result of ownership change, but there should certainly be an increase in allocative efficiency as a result of the macroeconomic measures. These remarks justify the linking of macroeconomic reform to policies of privatization, since privatization by itself may not improve resource allocation.

(b) Reduction of the budgetary burden

Another commonly stated rationale for privatization is to reduce growing budgetary burdens of State-owned enterprises on Governments. Facing severe shortage of foreign and domestic financial resources, Governments of many countries have been unable to simultaneously sustain basic social services, to subsidize parastatal enterprises and to provide resources for basic infrastructure, all prerequisites of national economic stability. In such a financial situation, Governments of varying ideological backgrounds have become keen to offload in all areas where their presence was not essential. Budget burdens can be reduced both by subsidy cuts and by the sale of State assets, since many SOEs draw on the public budget either to cover operating losses or to maintain and modernize their facilities. Lacking new financing to sustain State ownership, Governments have found that withdrawal and divestment from productive sectors can provide resources for their traditional functions, such as defence, health services, housing and education. Moreover, some Governments have preferred to cut taxes through cash generated from the sale of enterprises, as in the case of the United Kingdom, which raised, as already mentioned, 34 billion pounds sterling from the sale of State assets by the end of 1991 [2]. Smaller amounts have been obtained by some developing countries such as Singapore, which had raised $1.3 billion by the end of 1989, with much of this generated by the sale of its Resource Development Corporation (construction), Singapore National Printers and Jurong Shipyard ([24], p. 49). In the 1992 budget debate in India, it was proposed that up to 20 per cent of government equity in selected SOEs would be divested in favour of mutual funds and financial or investment institutions in the public sector. The measure was expected to yield 25 billion rupees in 1991-1992 and to improve enterprise management, but there was criticism that the exercise was purely revenue-generating and likely to have little impact on the corporate cultures in these SOEs since the divestiture was only partial [59].

However, cash generation from the sale of SOEs in many developing and Eastern European countries has not lived up to government expectations. Market valuations have simply not matched up to original cost or book values, and this is hardly surprising. As noted above, in many countries severe distortions in the prices of capital and foreign exchange have caused significant resource misallocation, as evidenced by enterprises with unsustainable and uneconomic dependence on artificially cheap capital and foreign exchange. Artificially cheap capital was used to purchase artificially cheap capital equipment, but eventually such equipment wears out and has to be replaced. Replacement costs have to be financed in 1992 by capital at prices fixed by free or near-free financial markets in many countries. Similar calculations have to be made by potential purchasers with respect to foreign exchange needs, including purchases of imported intermediate inputs, for example, energy, raw materials, electricity etc., often available to earlier owners at subsidized prices. To increase sale prices, the Governments are sometimes willing to provide privileges to the buyer in the form of subsidies and protection from competition. These concessions have caused considerable controversy in many countries, and indicate that there is a trade-off between the budgetary gains and the efficiency gains from privatization. Pressed by a shortage of funds, Governments may find short-term budgetary gains attractive, but in the longer run, overgenerous concessions may be questionable from both an economic and a fiscal point of view.

Among the other issues which have to be considered by Governments in planning the sale of SOEs are the net private returns to incremental investment and the instability of markets in which sales take place. Governments can drive harder bargains to obtain better sales prices for assets where the potential future net returns to new investment (for example, in repair, replacement and modernization) are high and obvious; if a Government can demonstrate such considerations to potential purchasers, it can strengthen its bargaining position which, it should be noted, is not based on issues of original cost or book value. Original cost and accountants' book value largely reflect sunk costs, and this is of no consideration in an investment (i.e. purchase) which is essentially new. The other issue, instability in markets, means that there may be few potential purchasers for some SOEs, particularly in Africa and Eastern Europe. Factor and product markets are often also unstable, due to conditions associated with the transition. Such circumstances are exacerbated in these countries by gross inadequacies in the financial system, such as underdeveloped banks, absence of a capital market etc. It should be noted that even in the better-endowed countries of Latin America, instability in financial markets can be identified by the unsustainable high interest rates shown in table IV.9.

Table IV.9. Benchmark real domestic interest rates, 1990-1991
(Percentage)

Country	1990	1991
Argentina (Intercompany lending rate)	47.4	22.0
Brazil (Monthly rate - LTN/BBC)	25.4	32.4
Chile (90-365 day real annual deposit rate)	9.5	5.5
Mexico (28-day CETES rate)	34.7	15.9
Venezuela (91-day zero coupon rate)	33.8	35.5
Reference (dollar, LIBOR, six-month average)	8.4	4.4

Source: Salomon Brothers, based on national and international sources. Quoted in Stephany Griffith-Jones, "The return of private capital to Latin America; the facts, an analytical framework and some policy issues", paper presented at a FONDAD workshop held at the Hague in 1992.

(c) Transition from centrally planned to market economies

For Eastern European countries, privatization is not only a change in the ownership structure and a mechanism aimed at increasing economic efficiency and easing pressure on the budget, but even more a process which will transform economies from centrally planned systems with predominantly (nearly 100 per cent) State-owned property into fully competitive market systems with a mixed ownership structure. This transformation is considered imperative since the predominance of State ownership delays the efficiency impact on macroeconomic aggregates of monetary, fiscal and other economic policy changes. Moreover, the dominance of State ownership creates a political environment which may be disposed to bend to pressure for a return to past systems of central planning. Beyond this strategic objective of economic and political transformation, privatization in Eastern Europe has been guided by similar motives as in developing countries. Privatization is again expected to enhance economic efficiency at the level of the firm through more efficient resource use, to generate government revenues from the sale of public sector assets, as well as to achieve some other goals, such as to create a class of managers who will run enterprises on commercial principles, to ensure a wide diffusion of ownership of privatized assets, to attract foreign investors and, in some countries like Poland, also to reduce external debt by using debt-equity swaps in the privatization process.

(d) Other objectives

Both developing and especially Eastern European countries use privatization to attract foreign investment. Such investment is reckoned to bring an inflow of foreign capital, improved access to new production technologies and marketing strategies, and opportunities to learn the application of modern management techniques. Besides, the privatized company is expected to benefit from the access of transnational firms to raw materials and additional foreign markets.

Resisting and even disciplining public sector trade unions has been an objective of privatization programmes in some countries, as in the case of the United Kingdom programme, and in contracting municipal and State services to private providers as widely adopted in the United States. Unionized government employees are still important political opponents to privatization in many developing countries, although in Latin America where such unions have been traditionally strong their resistance to privatization has fallen recently; the expected massive lay-offs of labour have not occurred for the most part. Indeed, significant cuts have occurred in management structures, as in Mexico, where one survey has shown an average 25 per cent reduction in management staff [60]. In another country, Bangladesh, the State-owned labour-intensive textile industry, badly run down and uncompetitive, has resorted to divestiture in an effort to save jobs [61].

The above list of objectives of privatization is not exhaustive. Other objectives are relevant in particular instances. Although privatization as such is not commonly an explicit condition in order to qualify for stabilization and adjustment programmes financed by the World Bank and IMF, it is often implicit in the request for public enterprise reforms. Moreover, an explicit list of divestiture candidates in such programmes may help to earn goodwill from the providers of external finance [61]. As part of their efforts of persuasion, multilateral finance agencies offer various carrots (loans and technical assistance) and sticks (cutting off access to their own funding, and de facto funding from other sources). Another justification for privatization has been provided by Nellis, who noted that "African Governments are turning towards privatization out of desperation, in an attempt to stem the drain on their budgets, even though they are aware of the experimental nature of this effect. There is a growing sense that even unproven measures such as privatization, which at least hold some promise for improvement, must be tried because a continuation of the current public enterprise situation cannot be tolerated" ([5], p. 45).

2. *Efficiency, liberalization and regulation*

The conclusion to emerge from the preceding discussion on ownership change and efficiency gains is that privatization tends to promote productive efficiency while supply-side competition is more important than ownership for increasing allocative efficiency. It is not ownership but the inter-connection between ownership and supply-side competition that promotes overall economic efficiency. Greater efficiency gains can be expected from liberalization measures and regulatory reforms than from privatization, even though in practice all three often come together. It is beyond the scope of this study to analyse in detail liberalization and deregulation (measures to enhance competition and deregulation) and reregulation (measures to enhance control over the behaviour of privatized companies and to enforce efficiency in the overall public interest), which are highly important to the privatization debate. It is, however, necessary to briefly look at factors that constrain market competition in developing countries and at policy responses to these constraints, since both are of crucial importance in determining the results of the privatization process.

(a) Competitive versus monopoly and oligopoly market structure

The starting-point of the analysis is the so-called Pareto optimum, which says that an optimal use of resources is achieved when they are distributed between alternative uses in a way that it is impossible to make somebody better off without making somebody else worse off. Under perfectly competitive market conditions, the market mechanism directs resources to be used in the most efficient manner where private costs and benefits do not differ from social costs and benefits. In reality, however, market structures are hardly ever close to perfect competition, although "workable competition" is relatively common in some manufacturing branches and in some service sectors such as hotels or road transport or laundries. Most privatization transactions have actually been completed in those sectors where competition works reasonably well with little need for regulatory reforms. This general conclusion has been confirmed not only in the present analysis, but also in an OECD Development Centre study which has analysed the public-private rebalancing process in 10 developing countries. In five of these countries, Bangladesh, Ghana, Mexico, Morocco and Tunisia, most of the firms privatized were of a modest size and operating in the markets that were in general competitive (agriculture-based food industry, small-scale industry, tourism) ([18], p. 191).

Also very common in developing countries are uncompetitive market structures where there is a large divergence between private and social costs and benefits. Deviations from perfectly competitive markets or market failures are of different sources. The most important and most controversial source of market failures arises from the possible abuse of market power, in the form of monopoly. There are two types of monopolies: monopoly based on statutory restrictions (restrictions introduced for political and other non-economic reasons against alternative suppliers, domestic or foreign). All developing countries contain monopolies of this type. There are also natural monopolies where facilities exhibit such economies of scale that duplicate facilities would be financially unprofitable and economically inefficient. In many developing countries, because of their small markets, natural monopolies have been important also in the industrial sector. Markets with per capita incomes of less than $1,000 per annum and populations of less than 7 million, that is, the majority of developing countries [62], frequently contain producers who have a natural monopoly for many domestically produced industrial goods.

Four general comments can be made with respect to industrial sector monopolies in developing countries: monopolistic market structure is quite widespread in the industrial sector, especially in branches with higher capital-intensity; the relative importance of monopolistic market structures in the industrial sector tends to be more significant in developing than in developed countries; most of the industrial sector firms with monopoly markets are statutory monopolies rather than natural monopolies; and there is a tendency that industrial natural monopolies are relatively more important in countries with small markets.

(b) *Policy response to monopolistic market structure*

Governments have often justified State ownership in the case of standard natural monopolies. To regulate operation of these firms, Governments have two main alternatives. One is to fix prices on the basis of normative standards (close to marginal costs) and to act as a proxy for market pressure, while the other alternative is to enter into franchising contracts. With this arrangement the Government, through a bidding process, gives the right to the most successful competitor to engage in an industrial activity for a certain period, with proceeds from the contract sale accruing to the public treasury. Franchising therefore leads to the introduction of competition at an early phase prior to the operation of a monopoly. Ownership rights remain with the Government and the existing market structure, in other words, the monopoly position, remains unchanged.

In contrast to the case of natural monopoly, the policy alternative to statutory monopoly is competition, which is economically feasible but was excluded by Governments for other reasons. By removing statutory restrictions, Governments can expose ex-statutory monopolies to competition, especially in manufacturing where usually internationally tradeable goods are produced. Competition can be introduced relatively easily by opening the market to new entrants, domestic and foreign, and by foreign trade liberalization. Table IV.10 gives some rough information on trade liberalization trends (tariffs and non-tariff measures) in developing countries between October 1985 and April 1988, and since that time these trends have continued.

In a few countries, public sector monopolies have been among the first to be privatized. This is because it is much easier to sell an established monopoly than a number of newly separated enterprises, since a monopoly is more attractive to potential buyers. Such sales occur where Governments stress the revenue effects of privatization and are concerned to maximize the revenue obtained from the sale of assets rather than to support measures for increased efficiency obtained from liberalization. Potential buyers value monopolies where there are prospects for high profitability as a result of the exploitation of market power. Sales prices for such enterprises tend to be further strengthened by promises that protection will be continued or introduced.

Privatization should be seen as an effective instrument promoting competition only when accompanied with other measures which promote efficiency. There is now widespread agreement that decisions on privatization should be delayed until markets are made competitive, even if this results in some loss of interest from potential buyers. Establishing effective competition policy before embarking on divestment results in the benefit of competitive prices, with products and services supplied on better terms. United Kingdom experience indicates that it is difficult to liberalize through removing barriers to entry, after statutory monopolies have changed ownership. Moreover, where competitive conditions are difficult to create in the short run, as is the case in many developing and Eastern European countries, it is necessary to establish regulatory bodies which perform a watchdog function. Again, a regulatory framework should be put in place before ownership transfer is undertaken, because subsequent changes might be much more difficult to introduce.

3. *High relative importance of the industrial sector in the overall privatization process*

One of the earlier conclusions is that privatization of industrial sector assets constitutes the core of privatization activities in many developing and in all Eastern European countries. The discussion below focuses on the reasons for the high relative importance of the industrial sector in the overall privatization process in these countries.

(a) *Scope of the public sector as producer of goods and services determines potential for privatization*

One way of assessing the importance of the public sector is its contribution to GDP. Table IV.11 shows that before public-private rebalancing in developing countries started in the 1980s, the contribution of SOEs to GDP varied from as low as 3 per cent for Bangladesh, Nepal, Philippines and Paraguay to as high as 40 per cent and to even 90 per cent for Algeria. Nevertheless, two thirds of the countries from this politically heterogenous group are grouped in the 5 to 25 per cent range, that is, higher than in the United States, but similar to the 12 EEC countries. As table IV.11 shows, SOEs in developing countries are also important investors since they tend to be capital-intensive and are generally not major employers. In contrast to the mixed economies of developed and developing countries, the State has been a dominant entrepreneur in Eastern Europe. Prior to the reforms of

Table IV.10. Developing countries: summary of trade measures, October 1985-April 1988

Country or area	Tariffs			Non-tariff measures			Memorandum
	Up	Down	Mixed	Tightened	Liberalized	Mixed	
Argentina			x			x	
Bangladesh			x		x		
Brazil		x		x			
Chile		x				x	
China			x	x			
Colombia					x		
Côte d'Ivoire	x						
Egypt		x			x		C
Gabon				x			
Ghana					x		
India			x		x		
Indonesia			x		x		S;C
Kenya			x				
Malaysia		x					
Mexico		x				x	S;C
Morocco		x			x		
Nigeria			x		x		C
Pakistan			x		x		
Peru		x		x			
Philippines			x		x		S
Republic of Korea		x			x		
Singapore		x					
Sri Lanka					x		
Taiwan Province		x			x		
Thailand		x			x		
Tunisia		x		x			
Turkey			x		x		
Uruguay		x					C
Yugoslavia				x			
Zaire			x				C
Zambia					x		
TOTAL	1	13	11	6	16	3	..

Source: Margaret Kelly and others, *Issues and Developments in International Trade Policy* (Washington, D.C., International Monetary Fund, December 1988), p.132.

Note: C = Comprehensive tariff reform; S = Substitution of tariffs for quantitative restrictions.

the late 1980s, SOEs contributed between 80 and 90 per cent of value added in Hungary, Poland and Yugoslavia and over 95 per cent in Czechoslovakia, German Democratic Republic and USSR ([33], p. 10). SOEs were dominant producers, investors and, to a lesser extent, employers. SOEs operate in almost all sectors, but as table IV.12 shows, agriculture, commerce, and personal services are largely left to the private sector in developing countries, while utilities, that is, water, gas and electricity, are typically State-owned. SOEs often operate in other service sectors, such as banks and insurance, as well as marine, rail and urban transport.

The relative importance of the State in the industrial sector varies considerably, and is strongly influenced by the structure of the sector as well as by government development policy. In practice, SOEs are often to be found in capital-intensive branches of industry with production concentrated in a small number of large enterprises, very often with a monopoly market. SOEs tend to be less important in those industrial branches where small and medium-scale enterprises predominate, with relatively low capital-intensity and with "workable" market competition.

The scope for privatization in the industrial sector is obviously limited by the number of SOEs there. Table IV.13 shows that in all but two countries, the industrial sector (manufacturing and mining) accounted for the largest number of public enterprises, while in the remaining two countries (Malaysia and the Philippines) industry was ranked second. The study analysing public enterprises in 10 developing countries, carried out by the OECD Development Centre came to the following conclusions regarding the number and general pattern of public enterprises in the industrial sector ([18], pp. 67-72):

(a) Although not numerous, public enterprises are very much present (they represent a high share in value added) in the traditional industrial export sectors where they frequently have a virtual monopoly position (oil in Mexico and Tunisia; mineral resources in Bolivia, Jamaica, Morocco and Tunisia). Public involvement in these areas has normally been a result of nationalizations carried out to strengthen national sovereignty over natural resources;

(b) Public enterprises account for a significant or even dominant position also in those segments of the

Table IV.11. Size of the public enterprise sector in national economies before public and private rebalancing began in developing countries

Region, country or area	Share of public enterprises in GDP or GNP (percentage)	Year	Share of public enterprises in total gross fixed capital formation (percentage)	Year	Share of total investment provided by public enterprises (percentage)
Africa					
Benin	8[a]	end-1970s	..	..	..
Botswana	7.3	1978-1979	7.7	1978-1979	..
Côte d'Ivoire	10.5	1979	39.5	1979	..
Ghana	36.5	1983	28.7	1979	..
Guinea	25.0	1979	..	..	..
Kenya	8.1	1970-1973	17.3	1978-1979	..
Liberia	6.8	1977	14 1	1974-1976	..
Mali	10[a]	end-1970s	..	..	..
Niger	10.0	1979	39.5	1979	..
Senegal	19.9	1974	17.9	1974	..
Sierra Leone	7.6	1979	19.6	1979	..
Sudan	40.0	1975	..	..	..
Togo	11.8	1980	..	..	..
United Republic of Tanzania	12.3	1974-1977	32.7	1970-1980	..
Zambia	37.8	1979-80	61.2	1979-1980	..
Asia					
Bangladesh	3.2	1984-1985	20	1984-1985	9.0
India	10[a]	end-1970s	33	1978	..
Nepal	3	end-1970s	..	..	..
Pakistan	8[a]	end-1970s	45	1978-1981	..
Philippines	3.3	1983	22.4	1981-1983	0.9
Republic of Korea	9	1981-1983	23	1981-1983	7.0
North Africa and Western Asia					
Algeria	90	1987	68	1978-1981	..
Morocco	19.7	1982	28.1	1982	4.5
Tunisia	24	1984	40.4	1982-1983	12.0
Latin America					
Argentina	5[a]	..	..	..	..
Bolivia	17.3	1980-1982	68.4	1981-1984	3.1
Chile	12.3	1982-1984	24.5	..	4.3
Jamaica	21	1984	42	1984	6.9
Mexico	18.2	1983	25.5	1982	5.1
Paraguay	3[a]	end-1970s	..	..	..
Venezuela	27[a]	end-1970s	36	1978-1980	..

Sources: John R. Nellis, *Public Enterprises in Sub-Saharan Africa*, World Bank Discussion Paper No.1 (Washington, D.C., World Bank, 1986), pp.7 and 9; O. Bouin and Ch.-A. Michalet, *Rebalancing the Public and Private Sectors: Developing Country Experience* (Paris, OECD, 1991), pp. 64-65; *World Development Report 1983* (Washington, D.C., World Bank, 1983), pp. 49-51; Hacene Boukaraoun, "The privatization process in Algeria", *The Developing Economies*, vol. XXIX, No. 2 (June 1989), p. 112; and Young C. Park, "Evaluating the performance of Korea's government-invested enterprises", *Finance and Development*, vol. 24, No. 2 (June 1987), p. 25.

[a] Approximate figure.

industrial sector which are selected by the Government as segments of strategic importance for industrial development of the country. These companies, again generally few in number but very often highly capital-intensive, are situated either downstream from export activities (oil refining or basic chemicals in Mexico and Tunisia; fertilizer factories in Morocco and Tunisia), or in consumer durable production (automobile assembly units in Morocco, Mexico, Philippines and Tunisia) in accordance to the import substitution policy;

(c) In the context of taking over failed industrial enterprises in order to prevent unemployment or to achieve other political objectives, Governments of many developing countries increased, without planning, public sector involvement in the industrial sector (Jamaica, Mexico, Malaysia in the 1970s, Chile at the beginning of the 1980s). SOEs acquired through such public interventions are large in number, typically small and medium-scale enterprises from various industrial branches, and often operate under competitive market conditions.

(b) Priority of industrial sector assets in privatization programmes

The broad strategy of a Government for public sector reforms often promoted by the World Bank and

Table IV.12. Public enterprise share of GDP by sector in developing and Eastern European countries

Region and country	Year	Agriculture	Commerce, personal services	Construction	Manufacturing	Mining	Transport, communications	Electricity, gas, water
Africa								
Cameroon								
Congo	1980	A	A	B	B	A	C	E
Côte d'Ivoire	1979	A	A	B	B	B	C	E
Kenya	1980	A	A	A	B	A	D	E
Senegal	1980	A	B	A	B	E	C	E
Sierra Leone	1979	A	A	A	B	B	D	E
Somalia					E			
United Republic of Tanzania	1980-81	A	C	B	C	E	B	D
Zambia					D			
Asia								
Bangladesh	1980	A	B	A	C	E	B	E
Burma	1980	A	C	D	C	E	B	E
India	1978	A	A	B	B	E	C	E
Republic of Korea	1974-77	A	A	A	B	B	C	E
Nepal	1978-79	A	B		B	A	B	E
Pakistan	1980	A	B	A	B	B	C	E
Sri Lanka	1974	A	B	B	C	A	B	E
Turkey	1980				C			
North Africa and Western Asia								
Algeria		B	C	C	C	E		
Egypt	1979				D			
Syrian Arab Republic	1977				D			
Tunisia	1976	A	A		B	B	C	E
Latin America								
Argentina	1980	A	A	B	B	C	C	D
Bolivia	1973-75				B			
Mexico	1980	A	B	A	B	E	C	E
Nicaragua	1980	B	B	E	B	E	C	E
Panama	1977				A			
Uruguay	1979	A	A	A	A	A	B	E
Eastern Europe								
Hungary	1978				E			
Romania	1978				E			

Sources: *World Development Report 1983* (Washington D.C., World Bank, 1983), p.50.; John R. Nellis, *Public Enterprises in Sub-Saharan Countries*, World Bank Discussion Paper No.1 (Washington, D.C., World Bank, 1986), p. 8; and Hacene Boukaraoun, "The privatization process in Algeria", *The Developing Economies*, vol. XXIX, No. 2 (June 1991), p. 112.

Note: Share of sectoral value added (percentage): A= 0-5; B= 5-25; C= 25-50; D= 50-75; and E= 75-100. No entry appears where data not available.

IMF is to address first macroeconomic policy deficiencies and to improve its regulatory framework for SOEs so as to stimulate private sector development and to increase the pressure on SOEs to improve efficiency. Key measures include the removal of barriers to entry, removal of barriers to exit by limiting direct subsidies to SOEs, and replacement of discriminatory direct controls on SOE purchases by incentives to motivate both the public and private sector to use local resources. In addition, price controls are relaxed and remaining subsidies made explicit and targeted to specific groups. In practice, the progress of liberalization of domestic markets depends largely on macroeconomic, social and political conditions in individual countries. An optimal mix and phasing of economic policy measures for the implementation of reforms is a highly complex process and objectives are not easy to achieve.

At the enterprise level, the main objective is to determine which SOEs should be rehabilitated and should remain in the public sector and which should be divested or liquidated. In practice, each SOE is analysed to determine: its competitive advantage and strategic importance with emphasis on market assessment, whether competitive or monopoly or quasi-monopoly; and its cash flow and profitability determinants. The strategy seeks to evaluate the overall position and perspective of the SOE by using the yardstick of financial performance and by taking into account its market position. SOEs which already operate in a competitive environment or where competition can be introduced or broadened by the removal of entry barriers, and by trade liberalization are, according to this strategy, the best candidates for divestiture in the short-run. This is why industrial sector enterprises figure prominently in the privatization programmes of many countries. Financially viable industrial enterprises are in principle attractive to the private sector, and the policy advice usually has been to privatize them on an "as is" basis; inherently

Table IV.13. Number of SOEs in 10 developing countries and Poland, selected years

Sector	Tunisia 1981	Bolivia 1983	Mexico 1983	Jamaica 1984	Philippines 1984	Morocco 1985	Trinidad and Tobago 1985	Bangladesh 1986	Nepal end-1989	Poland 1989	India 1987
Agriculture	11	16	24	10	20	44	10	28		1 384	..
Mining and oil	4	2	53	5	8	55	11	15	..	..	..
Manufacturing	100	19	335	57	47	176	17	175	28	240 a/	250
Agrofood	20	5	118	45	..	89	..	23	..	..	..
Chemicals	10	1	35	..	..	..	14	..	26	..	..
Oil refining	3	1	3	1	..	..	..	9	..	..	..
Other	67	12	179	11	..	73	..	117	..	..	..
Electricity, gas water	4	9	7	3	6	45	..	5	4	..	..
Transport and communication	27	8	47	17	25	110	9	14	4	..	..
Construction	15	..	..	2	4	14	..	..	..	1 542	..
Commerce, restaurants, hotels	38	1	44	36	24	47	..	21	7	..	121
Finance, insurance	15	15	..	19	54	37	4	14	8	..	54
Other services	35	2	35	23	57	165	15	17	13	..	..
Other										1 971	329
TOTAL	249	72	545	172	245	693	66	289	64	66	754

Source: O. Bouin and Ch.-A. Michalet, *Rebalancing the Public and Private Sectors: Developing Country Experience* (Paris, OECD, 1991), p.69; World Bank, *Nepal Nonfinancial Public Enterprises Sector Report*, vol. I. (Washington, D.C., 16 January 1991); Frank Rampersad, "The rationalization of the state enterprise sector", paper presented at the Trinidad and Tobago Economics Association Ninth Annual Conference, World Bank, November, 1991; T.L. Sankar, R.K. Mishra, R. Nandagopal, "Working of state-level manufacturing public enterprises", *Economic and Political Weekly* (New Delhi, 25 May, 1991, p. M-43; and "Poland: recent developments in the private sector" (unpublished paper of the World Bank).

a/ Including mining.

unprofitable industrial public enterprises operating in a competitive market should be liquidated. Companies that are potentially profitable should be first restructured and than sold. It is not only easier for the Government to sell a restructured public enterprise which is earning profits, but the Government can in such cases expect higher sale prices from the ownership transfer operation.

Sales decisions are more complex where SOEs operate in monopoly conditions. Such SOEs are relatively few in number, but highly capital-intensive, and very often represent a large burden for the government budget. Some SOEs of this type may not be sold for strategic or social reasons, but performance improvements are sought through "commercialization". For such enterprises, the strategy aims at efficient operational and financial performance, with compensation to cover costs arising from social objectives. To implement the strategy, additional financial resources normally are required to write off or restructure old debt and to rehabilitate and modernize machinery so as to ensure the financial health of the restructured SOE and to increase its production efficiency. Other SOEs of this type may be sold in the medium to long-term, after rehabilitation or restructuring, and after either policy change to increase competition, or after the development of appropriate State regulations. Experience from industrialized countries indicates that dealing appropriately with SOEs in monopoly positions is both complex and time-consuming.

4. *Methods of privatization*

Given the multiple objectives of privatization, a variety of techniques has to be used to actually transfer ownership and management from SOEs to the private sector. This transfer may be simple, but in practice it is a complex process which requires examination of SOEs on a case-by-case basis. Often a transaction has to be carried out through a creative combination of techniques suited to the company's environment. Techniques used depend both on government objectives and on the company's financial position and performance of the company, its ability to attract private sector resources, particularly through a domestic capital market, as well as the organizational form and status of the SOE. Furthermore, techniques applicable to large industrial enterprises may be different from those suitable for large public utilities and for smaller industrial enterprises. Enterprises in trade, agriculture and services sectors may also require different techniques. The markets in which transactions take place also influence the choice of privatization techniques. Five techniques, public offerings of shares, private sale of shares, restructuring into several components, new private investment in SOEs and management-employee buy-out, involve transfer of ownership and control to the private sector, while two techniques, leasing and management contract, denote management divestiture, with the Government maintaining asset ownership. Other activities, referred to sometimes as privatization, are not a direct subject of this study, including full liquidation or closure of non-viable public enterprises, sale of assets, contracting-out of services as well as BOT arrangements.

There is abundant literature on privatization techniques, their characteristics, advantages and limitations ([63], [64]). The discussion below, however, focuses only on privatization methods which have had a wide application in privatization of industrial SOEs in developing and Eastern European countries.

(a) Private sale

This method of divestiture has been used in about two thirds of all industrial divestments in developing countries.* Government sells all or part of its shareholding t[illegible] n individual or a group of private investors, ei[illegible] through competitive tender or negotiations with pre-identified buyers. Among the reasons for wide application of this privatization technique is its flexibility, relative simplicity in terms of legal requirements and speed of implementation. Private sales provide an opportunity to evaluate prospective new owners and offer flexibility in negotiating the transaction. Because of this flexibility, private sales frequently present the only privatization alternative for weak-performing SOEs, for SOEs in need of strong owners (with managerial, commercial, financial and technological strength), as well as for companies too small to justify a public offering. For a large majority of industrial SOEs privatized in developing and Eastern European countries, flexibility, simplicity and speed were required.

The other major reasons for the importance of the private sale technique were either the absence of an effective stock market or the policy objective of ensuring a foreign purchaser. It should be noted that the sale of SOEs has been important for practically all countries in stimulating foreign direct investment. The success of Governments in attracting foreign purchasers of SOEs has depended not only on reformed investment codes, but also on prevailing domestic economic conditions. With the exception of Togo and a few other countries, African countries have had little success in attracting foreign investors as SOE purchasers, because of poor macroeconomic performance, as well as because of small and difficult markets. In contrast, Latin America has been very successful in attracting foreign investors in their divestiture programmes, with one third of total direct foreign investment in the region in 1991 arising from the sale of SOEs [15].

Box IV.2, on privatization and direct foreign investment in Eastern Europe, confirms again that where capital markets hardly exist direct sale is the only feasible method of selling off SOEs. However, direct sales have drawbacks which have been criticized. Few people have enough capital to be potential buyers in developing and Eastern European countries. In many countries, the most likely buyers of SOEs, apart from foreign investors, are private conglomerates leading to further concentration of ownership and control. Price-setting is also controversial: high prices result in too few bids, while low prices result in accusations of "giving away" public assets. The problem is exacerbated if the buyer is chosen without bids, as corruption may be suspected. Limited transparency of decision-making criteria by transfer authorities seems to be common for private sales, even when a transparent tender procedure is defined in advance.

(b) Public offering of shares

This procedure, favoured in many developed countries, entails a sale of all or part of the government holding in a company to the general public. The transaction is usually done on a stock exchange, but an exchange is not strictly necessary, in which case share sales are done through a finance institution. In some cases, public offers of shares are done together with other privatization methods, such as the sale of a minority but controlling stake to a strategic investor.

A public offer has advantages over other privatization techniques. It increases the public's participation in the ownership of local companies and therefore reduces the concentration of economic wealth; this has been one objective of privatization in many countries. The method also strengthens the stock market of a country by adding to its depth and breadth. Public offers usually imply political and financial transparency, give less discretionary power to Governments and educate the public in the principles of investment and the market economy. The method is however not without disadvantages. To offer prices that are too low draw criticism relating to the poor management of public property, while too high a price may result in undersubscription and may jeopardize the sale. Other criticisms are that the sale of large State enterprises excessively consume public savings and crowd out other non-SOE flotations, that transaction costs are high and that public offers may result in corporate managements not strong enough to implement a company restructuring or turnaround.

Although public offers are the generally preferable method of privatization, such offers have been made in less than 15 per cent of all privatization transactions carried out in developing and Eastern European countries because most SOEs have been relatively small, or have required significant management change and corporate restructuring or rehabilitation, or capital markets have been too weak. Almost all public offers of industrial SOEs have occurred in the more developed capital markets of such countries as Chile, Malaysia, Mexico, Republic of Korea and Singapore.

One application of divestment through public offer that is currently under way in some Eastern European countries is the voucher scheme, whereby free or almost free vouchers are given to all citizens; vouchers can subsequently be exchanged for shares ([33], p. 30; [68]). This technique is expected to speed up the divestiture process in circumstances where there is a lack of domestic financial assets. In addition, the technique is expected to compensate citizens who have contributed to the development of the State-owned productive assets, to build up a share-owning class, to neutralize potential resistance arising from egalitarian social philosophy and to reduce social tensions. While distribution of vouchers may serve all these purposes, the process can be complicated for inexperienced beneficiaries who have to make choices between firms or mutual funds under conditions of extreme ignorance and uncertainty. No new capital or expertise is introduced into companies through a voucher scheme.

*Based on [22], [63] and other sources.

Box IV.2. Privatization and direct foreign

The sale of SOEs has attracted some interest of foreign investors in Eastern Europe. Indeed, in Eastern Europe, much privatization has to be looked at within the context of direct foreign investment. In contrast to Latin America where foreign capital has traditionally had an important role in economic development and where the economic and political implications of such investment have been a subject of controversy, it is only since the end of the 1980s that Eastern European countries opened their markets to foreign investors. Table IV.14 shows that the number of foreign investments registered increased from 2,931 to 23,600 between September 1989 and April 1991, with registered capital increasing from $3.4 billion to $11.7 billion. Some estimates put only about 7,800 direct foreign investment projects as being operational, with not more than $3.8 billion actually flowing into the region to April 1991. Svetlicic has summarized major characteristics of these inflows to be as follows [65]:

(a) Projects are small, with average foreign investment of $0.5 million;

(b) There is a high share of "sleeping joint ventures" or those keeping a foothold in the market;

(c) Wide diversification of activities, with a significant accent on import substitution (i.e. with modest export orientation);

(d) In spite of the possibility to invest in wholly owned companies, joint ventures prevail;

(e) Nationals working or living abroad, or subsidiaries of local companies established abroad are among major foreign investors;

(f) As foreign exchange and foreign trade regulations are less stable than direct foreign investment regulations, foreign investments are used as a means of stabilizing business operations;

(g) There is a high share of services, particularly consultancy direct foreign investment;

(h) There is a predominance of foreign investors from Europe who are more familiar with the environment than those from more distant countries.

Until very recently, the only practicable option for foreign investment was through a joint venture. However, with recent moves towards a market economy, and, in particular, with laws encouraging new private enterprise and giving priority to the divestment of the enormous State sector, the range of investment options has broadened considerably. Table IV.15 shows the largest 15 foreign investments, including those carried out via divestment in three Eastern European countries by September 1991; 12 involve industrial investment. Foreign companies considering larger-scale investment in the region indicate that the use of the area as a base for sales to the potentially gigantic market of the former USSR was one reason for their interest. The political and economic collapse of the USSR, the largest trading partner of the Eastern European countries, has however made this reason for investment in the region less appealing than expected, at least for the next few years. The other attraction of Eastern Europe for foreign investors is that they see the region as a potential manufacturing base for export to rich markets, because of the availability of skilled labour and extremely low wages. In Poland, for example, hourly pay in manufacturing was in 1990 only 50 per cent of wages in Mexico, 25 per cent of wages in the Republic of Korea and Taiwan Province, and less than 8 per cent of wages in Japan, France,

and it does not facilitate the inclusion of foreign capital or management. Holders of vouchers will try to buy shares in profitable companies, but share prices will probably fluctuate erratically. If bankruptcies are too numerous, Governments may have to reacquire companies to save jobs. No consensus has emerged as yet regarding this method of privatization.

(c) *Management-employee buy-outs*

Management-employee buy-outs can be a viable option for small and medium-scale enterprises, and have been applied on a very limited scale in developing and Eastern European countries. The exception is in the former German Democratic Republic, where some 900 companies have been sold to their managers. It should be noted that the well-developed financial and capital markets of Germany have rapidly expanded into the former German Democratic Republic. More than 50 per cent of these management buy-outs have involved companies with less than 20 employees and have been in the construction, services, machine-building and speciality engineering sectors [38]. The main obstacle for a wider application of this otherwise attractive privatization method in developing countries seems to be the lack of financial resources at the disposal of the SOE staff, and insufficient sources of credit. In contrast to rare examples of full-fledged management-employee buy-outs in Chile, Côte d'Ivoire, Gambia, Mexico and Tunisia, the technique has been more extensively used in combination with other privatization methods, with staff given the possibility to buy minority holdings in SOEs. The method has served to neutralize worker resistance to privatization, and to broaden ownership, an objective in many privatization programmes. Bangladesh, for example, has earmarked 15 per cent of the capital of all divested firms for employees in the period since June 1987 ([18], pp. 253-254), while in other countries, such as Argentina, Chile, Malaysia and Mexico, employees have participated in the privatization of major public companies. In Eastern European countries, most privatization legislation includes discount and other financial privileges for employees wanting to buy shares in their enterprises.

(d) *Management and leasing contract*

One alternative to divestment of SOEs is to transfer management control through leasing or through management contract to the private sector. Both schemes have a certain attraction for public authorities, as they are flexible, generate some revenue for the Government, and can improve operational effi-

Investment in Eastern Europe

Germany and the United States ([33], p. 28). In the case of the acquisition by Brigl and Bergmeister of a 51 per cent stake in the Slovene Vevce paper factory, one of the main reasons for the purchase was the strong market share of the enterprise in Germany and Italy ([41], p. 9). Low labour productivity and either the unimportance of labour costs or fears of wage inflation seem to be why relatively few foreign companies have as yet invested to take advantage of low wages in Eastern Europe.

Over the past three years foreign investors have been attracted also by potential domestic sales to a market of over 100 million (excluding the former USSR and Yugoslavia), with low per capita consumption of most consumer goods, well below consumption levels of developed market economies, where, for example, Polish consumers eat one eighth as many chocolates as in the western part of Germany and soft drink consumption is one sixth of United States levels [66]. Most major foreign companies expect the main investment pay-off in the longer term, by which time improving standards of living should create sustained increased demand. Currently, the main focus of foreign investors is in manufacturing, especially firms producing basic goods such as food, tobacco, glass, detergents or cars. Cut-throat competition among major foreign companies to buy shares in existing State-owned companies in these branches continues. For example, the Volkswagen-Skoda transaction was carried out against tough competition from Renault-Volvo, while the transaction between Pepsi Co. and Polish chocolate producer Wedel was ahead of bids by Nestle (Switzerland) and BSN (France). The latter have jointly acquired, with the European Bank for Reconstruction and Development, a majority holding in the biscuit and confectionery maker Cokoladovny. In these transactions the foreign partner brings new money, technology and marketing techniques to a local partner with an established sales network and local marketing know-how. Major foreign companies investing in Eastern Europe are interested in completing acquisitions quickly because opportunities to gain market share by buying a major existing supplier are limited, as production is highly concentrated, and an early start in building brand loyalty among consumers untouched by modern mass-marketing techniques is valuable.

In contrast to Latin America, where the issue of privatization and foreign investment appears in variants, such as direct foreign investment, debt-equity swaps, joint ventures and portfolio investment, in Eastern Europe so far it has been limited to direct foreign investment. Practically all Eastern European privatizations involving foreign investors have been completed as direct acquisition of shares of SOEs. Investment funds targeting Eastern Europe, although their number has doubled in the past three years, initially had intended to invest via portfolio holdings in listed companies, now find that they have to invest directly. The slow pace of stock market development and privatization as well as inefficient SOE management have forced this change. Fund managers have started to invest in unlisted companies, the geographic scope of some funds' investment has expanded, and fund managers have to become more aggressive in negotiating their own deals rather than waiting for opportunities to arise on infant stock markets [67]. These near-venture-capitalist activities are in contrast to the portfolio management skills of fund managers in the emerging equity markets of South-East Asia and Latin America.

ciency, while at the same time the Government retains ultimate ownership. In addition, through these arrangements some problems associated with other privatization methods involving ownership transfer, such as purchasers' lack of funds, valuation and legal problems, which are especially relevant in Eastern Europe, can be avoided. Comprehensive data are not available, but estimates of such management and

Table IV.14. Foreign investment in Eastern European countries: number and value of registered foreign capital, 1989-1991
(Million dollars)

	15 September 1989		1 September 1990		1 April 1991	
Country	Number	Foreign capital	Number	Foreign capital	Number	Foreign capital
Bulgaria	25	..	70	..	400	210
Czechoslovakia	[illegible]	85	500	180	2 850	418
Hungary	600	360	3 300	1 020	7 000	1 410
Poland	551	80	1 950	290	3 700	460
Romania	5	..	570	66	1 200	260
USSR	1 000	1 846	2 051	3 208	3 750	5 725
Yugoslavia	700	1 080	3 170	2 500	4 700	3 200
TOTAL	2 931	3 451	11 611	7 264	23 600	11 683

Source: Marjan Svetlicic, "Foreign investment in Eastern and Central Europe: general overview", *Development and International Cooperation*, vol. VII, No. 12, (June 1991), p.14.

Table IV.15. The top 15 foreign investments in three Eastern European countries, September 1991

Investor	Partner	Industry	Amount committed (million dollars)
Volkswagen (Germany)	Skoda, BAZ (Czechoslovakia)	Passenger cars	6 630
CBS (France)	Tourinvest (Czechoslovakia)	Hotels	175
General Electric (United States)	Tungsram (Hungary)	Lighting	150
General Electric (United States)	Raba (Hungary)	Engines, cars	150
Pilkington (United Kingdom)	HSO Sandomierz (Poland)	Glass	140
Guardian (United States)	Hungarian Glass (Hungary)	Glass	120
Suzuki (Japan) (partnership with C. Itoh and the International Finance Corporation)	Autokonzern (Hungary)	Cars	110
Linde (Germany)	Technoplyn (Czechoslovakia)	Gases	106
Electrolux (Sweden)	Lehel (Hungary)	Appliances	83
Hamburger (Austria)	Dunapack (Hungary)	Packaging	82
Ford (United States)	New plant (Hungary)	Cars	80
Sanofi (France)	Chinoin (Hungary)	Pharmaceuticals	80
Oberoi (India)	Hungarhotels (Hungary)	Hotels	80
US West (United States) (partnership with Bell Atlantic)	Government (Czechoslovakia)	Telephones	80
Sara Lee (United States)	Compack (Hungary)	Food processing	60

Source: "Business in Eastern Europe", *The Economist*, 21 September 1991, p.27.

leasing contracts put the figure at about 20 per cent of industrial SOEs privatizations, with management contracts awarded about twice as often as leases.

In the case of a management contract, the Government hires a management firm to operate a SOE where the manager assumes no capital risk, since the State is responsible for the cash flow of the firm. The Government thus pays a management fee not linked to the level of operating profit or loss [69]. With the exception of some management contracts in Sri Lanka and Jamaica, such arrangements have been used almost exclusively in Africa.

The main difference between leasing and management contracts is that the lessee assumes commercial risk and makes a lease payment to the State according to negotiated terms and conditions, usually regardless of profit. Leasing therefore exerts more pressure on operating firms, and that may be the reasons why the method has been used less often than management contracts. In addition, especially relevant for the industrial sector is the fact that the method is difficult to apply where specification of maintenance conditions is difficult. In contrast to management contracts, leasing contracts often include an option of eventual purchase of leased assets by the operator at the end of the lease period. Leasing may therefore be the first step to ownership transfer, and may be appropriate where the Government wants to temporarily retain ownership, for reasons such as an inadequate regulatory framework.

5. *Constraints to privatization*

Government targets for privatization have been met in hardly any country. Expectations were too high even for optimal economic and socio-political circumstances, without operational constraints. Governments of most countries embarking on ambitious privatization programmes have underestimated the complexity and time required for individual transactions. Particularly for larger SOEs, divestiture normally involves a range of technical, legal, financial, social and political problems, and the political and administrative risks of ownership transfer are considerable. Problems may be general or sector-specific. Some problems arise as a result of weaknesses within the economy and deficiencies within the administration, while other problems are related to political constraints. The difference in conditions which exist between most developing and Eastern European countries, and developed countries need hardly be emphasized. Indeed, conditions in the first group of countries are hardly comparable with conditions in the countries chosen (Chile, Malaysia, Mexico and United Kingdom) by the researchers in the otherwise very valuable series of World Bank case-studies of SOE divestiture prepared for the World Bank Conference on Welfare Consequences of Selling Public Enterprises, held at Washington, D.C., from 11 to 12 June 1992. In these countries, apart from other conditions, in every case the opportunities offered by the presence of a stock market typically well beyond the 'infant' category, played a significant role in the process of divestiture. In most developing and Eastern European countries, the process of divestiture confronts problems which can be conveniently grouped under the following headings: macroeconomic environment; resource mobilization; past performance and valuation; and political constraints.

(a) *The macroeconomic environment*

The divestiture of SOEs has a two-way impact upon the domestic economic environment, that is, it affects and is affected by this environment. Typically, divestiture takes place in conditions of high debt burdens, acute budget deficits, and often in economies with high inflation and severe balance-of-payments problems. The economic objectives of divestiture, ignoring ideological objectives together with liberalization policies that reduce price distortions, aim at a reduction of budget deficits and alleviation of external dept burdens in the short term, leading to increases in economic growth, at least in the medium term.

Viewed schematically, the reduction of price distortions on capital and foreign exchange typically leads to increased interest rates and a depreciation of the value of the domestic currency as foreign exchange becomes more expensive. Where SOEs as well as privately owned enterprises are exposed to these price increases, a reduction of hidden subsidies takes place, and there is an immediate impact on their operational costs as the costs of working capital and imported inputs increase. At the enterprise level these cost increases can be offset by improvements in operational efficiency, and by increasing sales revenues, but short-run improvements in operational efficiency are limited and such market competition as exists will limit increases in sales revenues. Since policies of price liberalization usually prescribe a reduction of protection, competition from imports will typically limit sales revenues of industrial enterprises. It should be noted that the reduction of price distortions will have the same type of impact on privately owned industrial enterprises and on SOEs in receipt of the hidden subsidies.

Prospective purchasers of SOEs have to contend with a number of other macroeconomic constraints. Domestic purchasers face an increase of investment costs in line with interest rate increases. Price liberalization elsewhere in the economy will often lead to an increase in the costs of intermediate inputs, including energy, water and transport, as well as raw materials. For example, it is reported that in Brazil domestic consumers of electrical energy pay 6 to 7 United States cents per kilowatt; commercial firms, 15 cents; and large industrial users, such as aluminium plants, 2.5 cents, while in Russia, domestic oil prices were about one fifth of world prices [70]. While a competitive exchange rate will offset lost sales from import competition, those countries facing falls in foreign exchange earnings, access to external debt financing and severe budget deficits, also typically face high rates of inflation and declines in domestic demand.

All these factors, together with the increased costs of investment finance, have to be very carefully weighed by prospective purchasers of SOEs. Prospective purchasers from the domestic corporate sector are unlikely to have escaped unscathed from these adverse conditions and will undoubtedly be very cautious. However, the most difficult problem in some developing and Eastern European countries embarking on the divestiture of SOEs is the very considerable uncertainty in the economic environment. Many policies are in transition and changes very unpredictable. Major fluctuations in interest and exchange rates, external trade, tax and tariff regulations and the interpretation of these regulations, labour market reform and labour laws etc. give rise to this unpredictability and increase risk and uncertainty.

In Eastern Europe special macroeconomic uncertainties arise because of the collapse of the CMEA trading system. Under this system, trade between member countries took place in transferable roubles and at prices which had little relation to world market prices. USSR oil and raw materials were generally highly underpriced, with manufactures imported at higher than normal international trade prices. Exporters to the USSR enjoyed highly favourable terms of trade. Trade was highly integrated, with CMEA member countries heavily dependent on trade with one another. At its peak, in the second half of the 1980s, mutual trade dependence was at a level of around 70 per cent for the region as a whole. For Czechoslovakia, for instance, these markets accounted for

Table IV.16. Summary: status of economic reform in Eastern Europe

Policy Issues	Albania	Bulgaria	Czechoslovakia	Hungary	Poland	Romania
Privatization laws	Passed in August 1991; restrictions on purchase of land	Submitted to Parliament in December 1991	Restitution and privatization laws passed in 1990/91	Legal framework established in 1989; privatization agency established in 1990	Passed in July 1990; mass privatization plan unveiled in June	Passed in August 1991
Progress in privatization	Modest number of small enterprises, including 15 per cent of shops; no large enterprises	Modest number of small enterprises leased; no large enterprises	A large share of small enterprises privatized through auctions and restitution; some large-scale joint ventures concluded; comprehensive large-scale privatization to begin in 1992	2,120 small and medium and large firms privatized by end-1991	All retail and whole-sale trade privatized; nearly 800 small and 20 large industrial firms privatized or commercialized	Free distribution of shares equivalent to 30 per cent value of enterprises planned for 1992
Price liberalization	20 per cent of consumer goods; remaining trans-actions carried out largely in parallel markets	80-90 per cent since February 1991	95 per cent, the majority since January 1991	90 per cent of consumer and 93 per cent of producer prices at end-1991	100 per cent of agricultural, 88 per cent of industrial producer, and 83 per cent of consumer prices	83 per cent of consumer, 88 per cent of industrial producer, and 70 per cent of commodity, raw materials, and agricultural prices
Import liberalization	Monopoly of foreign trade organizations abolished in August 1990; foreign trade licensing introduced in December 1990; trade liberalized in August 1991, followed by ban on food exports	All imports liberalized but subject to tariffs	All imports liberalized except oil, gas, arms and drugs	90 per cent of imports free of control	All imports liberalized; licenses required for arms and radio-active materials	Nearly 100 per cent of imports liberalized
Exchange rate	Official rate and legalized parallel rate, with large premium	Unified rate, freely floating in inter-bank auctions since February 1991	Unified in December 1990	Unified rate pegged to a basket	Unified offical rate pegged to a basket; legal parallel market with no significant differential in rates	Unified since November 1991, determined daily in interbank market with managed float
Interest rate liberalization	No liberalization; some rates increased in November 1991	Free determination of bank rates since February 1991	Flexible interest rates with maximum ceilings on bank lending rates	Deposit and lending rates freed for the enterprise sector since 1987; deposit rate ceilings for households lifted in 1991	Banks are permitted to set interest rates, but the central bank informally influences some spreads	Deposit, lending and money market rates deregulated in April 1991

Source: *World Economic Outlook*, IMF, (Washington, D.C., IMF, May 1992) about 80 per cent of total trade, half of it with the USSR alone ([36], p. 45). In January 1991 the CMEA system was formally abolished, with intra-Eastern European trade shifting to convertible currencies. Consequently, companies are now required to purchase production inputs, especially energy and raw materials, at exchange rates subject to different restrictions. Severe trade contraction has occurred because of the acute shortage of foreign exchange. Table IV.16 provides in summary form the status of economic reform in Eastern Europe.

(b) Resource mobilization

Governments have been by far the most important direct mobilizers and allocators of finance in many developing countries and in all of Eastern Europe in the past. The range of institutions common in developed countries, such as banking institutions, building societies (that is specialized banks providing housing finance), pension and insurance companies, mutual funds and stock markets, has yet to be developed in many countries in Africa south of the Sahara, Central America and the Caribbean, part of Asia, and in Eastern Europe. These are the institutions which have been essential to the divestiture of SOEs in Australia, New Zealand and the United Kingdom, and the former German Democratic Republic, and in certain successful developing countries and areas such as Chile, Malaysia, Mexico, Singapore and Taiwan Province. Without these institutions, direct sale of SOEs to foreign buyers or to wealthy domestic purchasers has become the only feasible method of divestiture and has been applied extensively as indicated earlier.

Even in the case of Chile, with its relatively well-developed financing system, there was considerable concentration of ownership and control in its private sector during the period of its first privatization in the second half of the 1970s. During that period, as a result of a very tight monetary policy and restriction of domestic credit, the sale of SOEs was financed primarily through foreign credit to which only a small number of large and well-established conglomerates had access. As Yotopoulos has remarked "... access to finance is the decisive factor that determines if privatization becomes a vehicle for further economic democratization, or rewards instead local elites ... Privatization that takes place in the absence of well-functioning domestic capital markets is likely to lead to increased concentration rather than increased competition" [71]. However, Chile later provided two further interesting lessons. As a result of its economic crisis in 1982, including a major devaluation of the peso, some 50 banks and other private sector enterprises previously divested faced bankruptcy. Liquidation was avoided only through renationalization. In contrast to the 1975-1982 wave of divestiture, policy objectives during the wave in 1985-1990 included the spreading of popular ownership, the deepening of the stock market and the recapitalization of enterprises damaged in the 1982 crisis. On this occasion, a variety of mechanisms were used, including flotations on the stock market, direct sale through public auction, and direct sales to employees. The sales process was gradual and spread over several years, and buyers included the general public, pension funds, foreign and domestic investors, and employees of the enterprises themselves and of the public sector in general, with special arrangements and incentives being used to facilitate their participation. Thus, to diffuse ownership and to avoid the concentrations found in the first privatization, on divestitures of some large enterprises there was a limit to the value of the shares that an individual investor could purchase; a down payment of only 5 per cent was required; for the balance, the State development institution provided a 15-year loan, with a zero real interest rate and a grace period of one year; and timely payment of each instalment resulted in a 30 per cent discount and income tax credits [72].

One specific aspect of the resource mobilization constraint is to be found in the mobilization of management resources in contrast to financial resources. It should be noted that the infant industry argument has as its roots a recognition of the crucial importance of the development of modern management resources, that is, the development of a management class skilled in the disciplines required for managing modern industrial enterprises. In the most modern sectors of industry at the leading edge of new technology in the OECD countries, the management challenge is how to transform scientific and technological innovation into commercially profitable products. It is well recognized that much can be learned from Japan on how this transformation can be done efficiently [73]. The hope is that over a period of time European and North American manufacturing management will learn the best Japanese management practice. This same argument holds good for many developing and Eastern European countries, although in these countries the ambition is merely to catch up with the industrial norm and not to compete at the leading edge.

In Eastern Europe the problem of managers is that they are often competent engineers or technologists but do not have the capacity and skills to operate in a market economy environment, having worked for decades in centrally planned economic systems. Above all, these managers have to regain the habits and mental processes required for a market system to function effectively. Many of these managers do not know much about how to create market advantages, how to use information systems, how to deal with risks and how to mobilize and invest capital. They are also unfamiliar with various other aspects of business management, such as cash-flow management and accounting systems traditionally used in the market-oriented economic system. In some developing countries, the issue of the development of a domestic managerial and entrepreneurial class was one of the most persuasive parts of the infant industries argument. This class still remains very weak in a number of developing countries, and it constitutes a constraint on privatization in these countries.

(c) Past performance and valuation

Conceptually the issue of valuation is quite straightforward, using standard techniques of cost-benefit analysis ([74], [75]). Net present value calculations have to be carried out that take into account price distortions within an economy. Thus, the first step in the calculation, usually on the basis of a project (or SOE) profit and loss account (operating account) is to provide a cash flow statement for about 20 years into the future. The second step is to convert this cash-flow statement into a statement of net economic benefits to the country by making the appropriate adjustments to take into account such factors as direct taxes and subsidies, employment effects in conditions of usually high unemployment, as well as the distortions caused by the fact that even in liberalizing economies some prices will remain administered and not equivalent to border prices, that is, world market prices. The third step is to calculate the net present value of the net benefits stream, that is, discounting the net benefits stream at the opportunity cost of capital [76]. Adjustments can be made to both net revenues and net benefits to take into account externalities, for example the costs of obeying environmental laws and regulations (this is one way of "internalizing externalities"). These net present value calculations provide the following two benchmarks: discounted net benefits represent conceptually the maximum worth of an enterprise to the national economy (not to the government); and discounted net revenues represent conceptually the maximum worth of an enterprise to a private investor. Particularly where past prices of capital, foreign exchange, intermediate inputs, raw materials, and production output have been heavily distorted, and where cost benefit techniques have not been used in the past, as in some developing countries, and especially in Eastern Europe, the net present value of benefits may be negative. This will be a signal to liquidate, except possibly where a private investor is prepared to bid above the liquidation value. This decision on the part of a private investor may be entirely rational: that he can run the operation more efficiently or can use the existing fixed assets, particularly land and buildings, for some other purpose. However, where the investor intends to remain in the same area of industrial production, Governments will have to be especially cautious about any form of subsidy, especially hidden subsidies in the form of protection etc. that the investor requests as part of the divestiture transaction. Where the present value of net benefits is clearly positive, sweetening privatization transactions with lower sales prices and special market privileges is not a problem *per se*, provided due account in taken of all subsidies in present value calculations which should accompany transactions.

Government strategy when embarking on a programme of divestiture of a range of SOEs is also important. Sometimes the sale of public enterprises to the private sector is feasible only if potential buyers are attracted by reduced sales prices or by provision of concessions and privileges, such as monopoly rights, concessionary financing terms, tax concessions or protection from imports. In Togo, for example, a high rate of effective protection (protection rate of 41 per cent; tax-free imports of all raw materials) was granted, and a small lease fee ($175,000 per year) was charged for a steel mill leased to a foreign investor ([5], pp. 47-48). The deal was justified as an arrangement that would attract other investors, although similar concessions would not be offered in future. On similar grounds, divestiture has been lubricated by tax and market concessions in many other African countries, as well as in other developing regions. For example, in Argentina, the multi-billion-dollar privatization of the State telecommunication monopoly was accompanied by provisions granting the new owners exclusive rights to domestic and international services for the period of 10 years [77]. In Eastern Europe, Governments have been faced with mounting pressure for protection which has been particularly difficult to resist, in the case of joint ventures set up with major foreign partners, or in the case of acquisition of SOEs by foreign investors. Thus in Hungary, although the overall trend is towards liberalization (in 1991, 92 per cent of imports needed no licences, up from 70 per cent the year before, with average tariff rates being reduced from 16 to 13 per cent), the Government has recently restricted imports of steel and cars, along with cement and televisions. In the first half of 1992, import licences for only 84,000 cars will be issued, a reduction of 44 per cent on the 1991 level, in response to claims for infant industry status by General Motors (United States) and Suzuki Motor Corporation (Japan), both of which have set up car plants in that country. Similarly, tariffs have increased to 25 per cent on colour televisions locally produced by Samsung (Republic of Korea) [78].

A further point is relevant with regard to the negotiated price in the SOE divestiture transaction. There has been major controversy on whether Eastern European countries, and some developing countries, should move to fully market-based systems on the basis of a sharp "big bang" of which one component is rapid divestiture of SOEs. For small enterprises such as small service establishments and workshops, this may be appropriate particularly where a significant number of these enterprises will be taken over by some of the existing workforce, and where in any event sales prices will be relatively low. However, with larger SOEs there is a danger of flooding the market. In developed countries where the stock market plays a major role in the divestiture process, a great deal of care is taken that divestiture flotations are launched in relatively stable and rising market conditions, so as to realize reasonable prices.

The next aspect of the valuation problem faced in different forms in some developing countries but of a more severe nature in Eastern Europe, is related to ownership and other legal issues. In Eastern Europe, a precondition of property sale is solution of unclear property and ownership rights. Although in theory, property in Eastern European countries was State-owned, in practice Governments did not hold clear titles to firms but shared these rights with various groups, including managers, workers, cooperatives, provincial and municipal bodies and banks. With political changes and the announcement of large-scale divestiture programmes, it is necessary that the process begin with clearly defined property rights. Laws have to be passed defining property rights, legalizing private ownership and establishing guidelines of incorporation. A further legal issue is connected with restitution of the property to previous owners. In the aftermath of the Second World War, assets were either confiscated or paid for only symbolically. Governments now feel morally obliged to restore property rights. In some countries such as the former German Democratic Republic, Czechoslovakia and Slovenia, new laws were passed giving former owners the right to either restitution in kind (return of original property to previous owners) or to various forms of financial compensation (in cash, causing an enlarged budget burden, or in treasury and corporate bonds and shares). In contrast to some developing countries, such as Chile, Bangladesh and Pakistan, where assets could be returned rapidly to their original owners because of the short period following expropriation, in Eastern Europe the period was several decades long, which together with the poor quality of records makes this process much more complicated. With the number of individual claims large and growing and given limited administrative capacities, the process of restitution will be lengthy and may well delay the overall privatization process.

In practice, the issue of valuation becomes much more difficult than the conceptually straightforward method discussed above. The discounted present value of after-tax profits, which provides the upper benchmark below which the private investor will aim to make an offer, is not easily understood by laymen, even (or perhaps especially) political laymen. The discounted present value of net benefits is even less straightforward. In these circumstances, the fact that a SOE invested 10 years in the past a massive amount of capital in the wrong production process producing the wrong products can result in a "value-subtracting" rather than a "value-adding" industrial operation. It should be emphasized that in grossly distorted economies, valuation methods based on some variant of historical cost or book value of plant and equipment may not provide much useful information. This situation is compounded in a transitional period of price liberalization. The situation is doubly compounded if past financial records are unavailable, incorrect or fictitious. In addition where there is a lack of transparency in implementing privatization deals, that is, sales without a clear bidding procedure, including sales made to politically preferred domestic or foreign buyers, there may be considerable political and public unease. The political sensitivity of this issue is indicated by the complications with many divestiture transactions in developing countries. In Brazil, for instance, the auction of the country's largest steel mill Usiminas was suspended because the court questioned the setting of a $1.8 billion minimum price for the flotation. Or in Chile, the State development agency Corfo issued in 1991 a critical report alleging irregularities during privatizations carried out by the previous administration. According to this report, Corfo suffered losses of $2.2 billion because companies were sold below book value, and in some cases below stock market value as well [79].

Once the target selling price of a company is established, the actual transaction may be further delayed because of limited administrative capacity of a Government in setting up a regulatory framework in which the firm will operate efficiently. The problem is particularly important where a product or service is sold in a monopoly or oligopoly market, or when the enterprise carries out social functions. The issue of monopoly is of higher relative importance in Africa, where internal markets are often small, and in Eastern Europe, where under the old system large firms dominated their domestic markets. In such situations there is a fear that privatization may replace the "economic dictatorship" of a State with the dictatorship of privately owned monopolies.

(d) *Political constraints*

In addition to economic and technical obstacles, privatization is very often delayed or even halted by political opposition. As with any economic policy reform, privatization has a strong political dimension. The process changes property rights; certain groups within society benefit more than, or at expense of, others. In individual countries, the spectrum of potential opponents to privatization and their relative strengths vary, but in most they pose a challenge to divestiture. Two main groups are opposed to privatization. In the first are those against privatization on ideological grounds. For these privatization and sometimes indeed structural adjustment programmes are impositions from international financial institutions which bring nothing good for their country. Such opposition tends to be strong in countries which have in the past supported a large and active social, redistributive and economic role for the State. The second group of opponents are a range of subgroups that perceive privatization as a direct or indirect threat to their interests. In many developing and Eastern European countries the most serious opposition comes from employees, trade union leaders and managers. Government officials, especially middle-level civil servants in ministries and agencies whose primary function is to control and monitor public enterprises, may resent privatization because their authority is endangered and privileges that come with it restricted. Opposition may come also from certain consumer groups because of fears that price subsidies will be cut. Other opponents may be found in the military who may fear loss of State control over strategic industries. In some developing countries, the military created or controlled public enterprises in order to have an independent source of funds and employment opportunities. In some countries, part of the private sector may be against privatization because it undermines special relationships with the public sector, such as protection from foreign competition, the supply of inputs at subsidized prices, or subsidized bank credit. In addition, part of the intellectual élite may oppose privatization because of fears that only the rich will benefit.

These opponents of privatization, each with specific motivations and expectations, place Governments designing privatization programmes in a delicate position. The interests of each group must be understood so as to develop strategies to address their concerns and to achieve the objectives of the programmes. Often, defining privatization strategies, selecting SOEs for divestiture and choosing privatization techniques cause various problems, including long delays with negative effects on business confidence and government commitments. Without the strongest political will to command organizational obedience, privatization may never move from the design to the implementation phase. To prevent difficulties during implementation, divestiture programmes should indicate policy on the principal issues, including employment (redundancy and redeployment of staff; management-employee share purchase schemes), foreign ownership and ownership concentration. Lack of consensus on these issues has been a major obstacle to programme implementation in many countries. In some countries, further delays in implementation have been caused by a dilution of decision-making authority within a Government with no strong central authority to resolve disputes. The lessons of successful programmes in Chile, the former German Democratic Republic and Mexico, indicate that centralized authority with relative simplicity of procedures are of crucial importance in avoiding delays in implementation.

By and large, employees oppose divestiture because of fears of job losses, rising unemployment, and subsidy cuts which reduce job-related benefits such as free health and education. In addition, trade unions perceive divestiture as a measure aimed at reducing the power of organized public sector labour through weakened collective bargaining powers, reduced rights to organize, etc. In the medium- to long-term, there should be a tendency for more jobs to be created or for earnings to increase, to the extent that the divestiture of SOEs brings efficiency gains to individual enterprises and to economies. In the short-run, almost certainly divestiture will result in the lay-off of surplus labour, particularly in those developing countries in the throes of structural adjustment programmes and in the countries of Eastern Europe. The impact of redundancy can be alleviated by generous layoff-payments, and in the case of those countries with functioning stock markets where a stock market flotation is a relevant divestiture option, by making available equity shares to employees on generous terms. However, these options are not available in many countries.

For some countries embarking upon divestiture programmes, past policy objectives had aimed at "employing" the unemployed in SOEs, with such "employment" being the major substitute for social welfare services such as unemployment offices provided by the State. This certainly appears to have been the situation in most Eastern European countries and in a few parts of the developing world. Thus a textile mill or a steelworks would have functioned not only as a more or less efficient production unit, but also as a social welfare agency; indeed, this was often explicitly recognized, with production units being formally responsible for housing, health care, kindergartens etc. Loss of employment in these circumstances has the consequence of not only losing a wage, but also of being expelled from an existing social safety net into an environment where social safety nets similar to those found in developed market economies hardly exist. In those economies without such safety nets, and where the informal social safety nets are also missing, the social impact of unemployment can be near catastrophic. In Eastern Europe, the problem of lay-offs is especially sensitive not only because of its potentially large scale, but also in the context of the region's transition from values viewing employment as a basic right to values based on market forces. Job losses occur simultaneously with deterioration of living standards and with a rise of income inequality (see table IV.17). In Hungary, for example, only 10 per cent of the population was in 1991 better off than a few years earlier, 30 per cent was worse off, and the remaining 60 per cent has seen no meaningful change in living standards.

Managers of SOEs may also oppose divestiture for fear of job loss. Other reasons for management opposition to divestiture include a loss of administrative power in making appointments, and a loss of inside information used to derive financial and other benefits through ties with other government and private enterprises and institutions, including sometimes benefits from corruption. Such opposition to divestiture may also spread to senior officials in the sectoral ministry with oversight functions, and there may be joint attempts either to block divestiture or to limit its impact on economic efficiency through influence on the regulatory environment. The problem with changing this is obviously that of how to engineer a rigorous and efficient implementation of reform policies when the

Table IV.17. Unemployment, real wages and consumer prices in selected Eastern European countries, 1990 and 1991
(Percentage)

Item	Hungary		Poland		Czechoslovakia		Bulgaria		Romania	
	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991
Registered unemployment	1.6	7.5	6.1	11.4	1.0	6.6	1.6	10.5	..	4.3
Real wages and salary changes against the preceding years	-5.1	-8.6	-27.6	3.6	-5.6	-24.2	-7.8 a/	-57.6 a/	4.6	-16.3
Consumer price increases	28.9	35.0 b/	585.8 c/	70.3 b/ d/	10.0	57.9 b/	26.3	479.8 b/	4.2	165.3 b/ d/

Source: Presentation of Kazimierz Laski of the Wiener Institut für Internationale Wirtschaftsvergleiche at UNIDO in March 1992.

Note: Countries presented according to stage of reform.

a/ Calculated with retail price index.

b/ Preliminary.

c/ Based on consumer prices.

d/ Based on retail prices.

principal instrument of implementation must necessarily be the defective bureaucracy itself [80]. In contrast to management opposition in many developing countries, the situation in Eastern Europe is somewhat different. Democratic reforms which have overthrown old political regimes have left the managerial class lacking political backing and in a weak position *vis-à-vis* demands from their employees and the public at large. Where managers are discredited by their *nomenklatura* past, and where there is an insistence on fair distribution of the country's wealth in partial compensation for the suffering of the past, there is resistance to forms of divestiture which passes control of SOEs to the same managerial *nomenklatura*, since such sales might restore their earlier dominance. The problem, however, is that undiscredited managerial personnel are scarce, and existing managers are among the richest and best informed on the real worth of enterprises. In more general terms, privatization and the economic liberalization process has to confront the difficulty of breaking out of a set of powerful constraints upon the political process. Constraints such as élite corruption and conflict, segmented and mistrustful groups, and the centrality of the political struggle in the absence of alternative structures of power, are powerful in many developing and Eastern European countries. These constraints limit the results that can reasonably be expected, particularly in the short-run, from the policy-making and policy-implementing systems of these countries [81].

V. Survey of selected manufacturing industries

Seven comprehensive industry surveys and five mostly shorter reviews of selected industries and industrial branches are presented in this chapter. Included among the surveys are three primary processing industries, aluminum (ISIC 372022-372034), sugar processing (ISIC 3118), and paper and paperboard (ISIC 3411); five intermediate industries, agrochemicals (ISIC 351216), investment casting (part of ISIC 3710 and 3720), powder metallurgy (part of ISIC 3710 and 3720), synthetic fibres (ISIC 3513), and iron and steel (ISIC 371); three capital goods industries, machine tools (ISIC 3823), food-processing machinery (ISIC 3824), and mineral-processing equipment (part of ISIC 3824 and 3831); and one lightweight manufacturing industry, footwear (ISIC 324).

In the comprehensive surveys, detailed statistical information is provided on each industry to illustrate current supply and demand conditions, trade patterns, profits and losses, production costs, capacity utilization and, where possible, employment. The features of restructuring are examined using measures of overcapacity, of shortages, of changes in output composition of foreign direct investment and of the role of government. Manufacturing capacity in developing countries is given special emphasis; of particular importance are the build-up of productive capacity, project investment plans, profit potential, environmental impacts and technological trends, as they affect the competitive position of those countries. Finally, short- and medium-term outlooks for demand, prices, employment, trade and investment are presented, within the context of the globalization of industrial structure and a changing international division of labour.

As expected in a primary processing industry, profitability depends critically on the ups and downs of other industries requiring its output. The review of the paper and paper-board industry deals with an industry where sales are closely linked to the business fortunes of other industries, such as printing or those needing packaging. It also shows how rapidly rising environmental concerns can change an industry such as that of waste paper. Sugar processing represents a typical primary agricultural industry in as far as high prices will induce higher sugar production in a crop which will reproduce for five or more years, while low prices will result in gradual stagnation of output. The consequence of both is wide and violent swings in raw sugar prices. The review of the aluminium industry shows how recent economic declines have had a severe impact on aluminium consumption.

Despite the gains of industrialization in certain countries and areas of the South (notably the Republic of Korea and Taiwan Province), the industrial strength of the North in both resource-based and high-technology industries remains overwhelming. For example, the review of the aluminium industry shows that smelting in developed countries accounts for 80 per cent of primary production and 97 per cent of secondary production. In synthetic fibres, however, over 50 per cent of production now comes from outside the major industrialized countries, and in plastics production the centre of gravity is shifting heavily towards the South.

In the case of intermediate industries, the production level depends not only on the derived demand for their outputs but also on the costs of their inputs. These industries are also critical for their forward and backward linkages to other industries in the overall economy. The first three of these industries also depend on technological advances to continue their growth. The review of the agrochemical industry reveals that it has very close forward linkages with the agricultural raw-materials and food industries. New types of chemicals have to be developed as insect, fungus and weed varieties became hardier and more resistent. The review of investment casting suggests an industry also highly dependent on business fluctuations in the automotive and the aircraft industries and hence on business cycles in developed countries. In the case of powder metallurgy, this industry is more technology-intensive and its growth depends on developing and applying its products for new uses, also in the automotive industry. The review of the synthetic fibres industry indicates a period of highly competitive transition, with natural fibres making a comeback in some end-uses. Profitability also depends on crude petroleum input prices. The iron and steel review deals with new technological developments in this now relatively mature industry, and also suggests environmental implications for the developing industry of the South.

Among the capital goods industries, the machine tools review points to the technological complexity of its products and why this leads to the domination of developed countries in worldwide production and trade. The development of these strategic industries poses a formidable challenge to developing countries. The review of the food-processing-equipment industry shows that industry to be highly sensitive to technological change. Moreover, it has remarkable growth potential as more countries become consumers of prepared foods. More dependence on the growth of other industries such as mining and mineral processing is necessary for the recovery of sales of mineral-processing equipment.

Concerning the light manufacturing industry included here, the review of the footwear industry concentrates on illustrating how labour costs have been instrumental in moving production sites to low-cost countries.

The surveys and reviews vary in scope and depth according to the availability of data, which are still obtainable in only scant amounts for certain industries, particularly those in the South. Despite the lack of uniformity in data provision, certain common threads can be discerned running through many of the individual industry surveys. These are summarized below:

(a) Growth has levelled off, if not declined, in many industries, reflecting a general slow-down of the world economy in the latter part of 1991 and its continuation in 1992. The iron and steel industry has just gone through a period of retrenchment, and price levels are not yet sufficiently high to stimulate capacity expansion. In the aluminium industry, demand increases pushed prices upwards, inducing substantial capacity additions and creating excess capacity that has forced prices back down to their lowest levels in years. Likewise, the currently low level of capacity utilization coupled with environmental concerns in the agrochemicals industry suggests that no new capacity expansion will soon occur. In capital goods industries such as food-processing machinery, sales in some countries are influenced by recession, while growth is occurring in the markets of other countries;

(b) A growing trend towards less government intervention and more deregulation and privatization is discernible. In the countries of Eastern Europe, the rate of privatization has become extremely high; this movement in fact is likely to dominate economic change in those countries over the next several years. Even in the sugar-processing industry, where Governments have owned plantations and controlled sugar distribution, attempts at deregulation are being made;

(c) In international trade, the United States and Asia are of growing importance as export markets for other countries, the former because of more favourable production costs in exporting developing countries, and the latter because demand has far outstripped the capacity of local supplies. The countries of Eastern Europe and the former USSR are likely to provide markets eventually for high-technology products such as those based on powder metallurgy. Another important factor will be the impact on world markets of increasing unification of the EEC countries;

(d) The machine tool industry, which is usually characterized by long upward swings in new tool orders and production followed by downward swings resulting from the accumulation of idle capacity, now seems to be stagnant. Industry changes also suggest the redeployment of machine tool capacity to NICs. Other industries that are sensitive to business cycles include paper and paper-board, investment casting and powder metallurgy;

(e) The rapid adoption of new technologies appears to be essential to the survival and expansion of many traditional industries. For example, the modernization of the machine tool industry depends on new technologies such as automatic tool and process control operations, numerical control systems, machining centres, turning machinery, automation and computers, and flexible cells. In the case of powder metallurgy, better parts depend on methods of hot isostatic compaction, hot pressing, hot extrusion, and hot forging during sintering;

(f) Not surprisingly, many transnational corporations located in the United States, Japan and Western Europe are increasingly moving towards global market integration and concentration, particularly in technology- and R and D-intensive industries such as the powder metallurgy, machine tools, mineral-processing-equipment and food-processing-equipment industries. However, the location of such industries in many cases will remain unchanged, partly because of their need for advanced technology, and partly because of geographic proximity to their respective end-using industries;

(g) Manufacturing capacity in developing countries has shown differing degrees of progress in different industries. For labour-intensive production, such as that of footwear, industry is well established in most developing countries, but NICs such as the Republic of Korea and Taiwan Province, where wage rates have risen, are finding it more difficult to compete with neighbouring developing countries such as China, Indonesia and Malaysia. They are now concentrating efforts on the upper end of the market. In high-technology industries such as powder metallurgy, where R and D is more important than equipment and labour costs, developing countries generally find themselves at the lower end of the market;

(h) Environmental concerns are having a growing impact on the choice of technology in and the location of highly polluting industries. For example, investment plans for the agrochemicals, investment casting, iron and steel, and the paper and paper-board industries are being markedly affected by more stringent environmental regulations and consequent higher costs of pollution abatement. A relocation of these and other industries to developing countries where pollution controls may be less stringent is thus likely. In some industries such as agrochemicals, the production of lower-technology or standardized products would also be more suited to production in developing countries. In addition, the iron and steel industry is benefiting from scrap iron and other recycled materials;

(i) Concerns have emerged in many industries regarding the outcome of the various agreements being negotiated in the Uruguay Round of GATT. Industries in developing countries whose growth depends on the lowering of trade barriers include, for example, aluminium, synthetic fibres and sugar. In the case of the aluminium industry, tariff escalation by developed countries is exemplified by the increasing tariff rates applied successively to bauxite, alumina and aluminium. Increasing free trade in synthetic fibres will result if the Multifibre Arrangement adopted within GATT can be further liberalized;

(j) Finally, to assess the full impact of any industry (output, income and employment) on the economy at large and on any specific sectors, a

macroeconomic framework must be used in order to capture the direct and indirect cumulative effects of an industrial activity resulting from interindustry transactions. Industry surveys such as those presented in this *Global Report* could only consider direct interindustry linkages and disregard indirect and income-induced linkage effects. This is because the production of each product not only requires direct inputs of various goods and services, but also each of these inputs has its own sets of inputs, and this process continues in ever-decreasing magnitudes in successive rounds. The effect of any industry activity should include not only the direct linkages but also the sum of effects resulting from these interindustry transactions in each successive round. Chapter III of this *Global Report* deals with an assessment of industry-specific full linkage affects, using country input-output tables. The findings of the study show, among other things, that manufacturing industries with reactively high linkage effects include textile and leather goods, food-manufacturing equipment, iron and steel, agro-chemical products, machine tools and transport equipment. For further details, see chapter III.

A. Aluminium (ISIC 372022-372034)*

Aluminium producers always consider their success relative to what they achieved during 1988 and 1989. During each of these two years, the combined net operating income of Alcan, Alcoa, Alumax, Kaiser, Reynolds and Pechiney exceeded the $3.3 billion level. The year 1988 was particularly exceptional since in June of that year, the price of a producer's metal reached a record high of $4,280 per tonne (or $1.96 per pound). Since then, these prices and profits have been considered by most aluminium producers as a financial target. In comparison, the combined profits of the above-mentioned companies dropped by 45 per cent in 1990, while the price of aluminium stood at only one half of the peak level reached 30 months earlier. Not only were aluminium producers disappointed, but had they known the corresponding figures for 1991, they would have considered 1990 as an above-average year. Profits shrunk to almost zero in 1991, while the average London Metal Exchange (LME) price for the fourth quarter reached $1,127 per tonne (or $0.51 per pound).

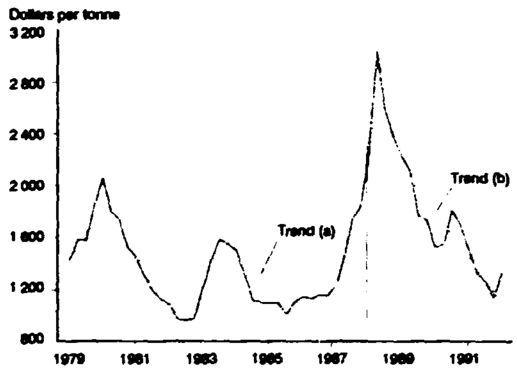
How can this downfall be explained? Have the excess demand levels been erased or gradually expanded? Is the consumption of this metal only influenced by the evolution of industrial production, or are there forces at work which tend to decrease its intensity of use over time? What has been the exact influence of the former USSR aluminium exports on the price of this metal? What role is played by the LME or the New York Commodity Exchange? Has the production capacity of aluminium increased faster in the developing countries than in the developed ones? If so, is this the result of increased natural comparative advantages or, on the contrary, the logical consequence of overinvestment or the adoption of various public policies aimed at modifying their degree of competitiveness? What is the role of Governments in the restructuring of this industry? What are the technological trends in the aluminium sector? Will they affect the competitive position of developing countries in production and international trade? What is the outlook for the next five years? These are the kind of questions important to current and future market prospects for aluminium.

*UNIDO acknowledges the contribution made by Carmine Nappi of the Ecole des hautes études commerciales, University of Montreal

1. *Recent trends and current conditions*

The very high price reached in June 1988 was the result of an extreme market tightness, the consumption of aluminium having increased for two years at a rate significantly above the growth trend. But this peak price was a short-run phenomenon, since the average price between the first quarter of 1979 and the last quarter of 1991 reached only $1,503 per tonne (or $0.68 per pound). Also, as suggested by figure V.1, the general price trend during the 1980s (excluding 1987 and 1988) was a declining one. The price of aluminium is no higher today than what it was in 1979 and 1980. How can such a deteriorating situation for this industry be explained?

Figure V.1. Aluminium prices: London Metal Exchange
(Grade A, cash)



Source: Metal Week, various issues

(a) *Global production and consumption*

Tables V.1 and V.2 indicate that during most of the 1980s, the international aluminium industry has been characterized by excess production. World aluminium production is shown to have been increasing since 1987 at 12 per cent, a faster rate than that of consumption at 2.5 per cent. This discrepancy has been particularly important for developing countries, since their production increased by 30.2 per cent during this five-year period, while consumption was showing a growth rate of 26.5 per cent. In the case of developed countries, the situation had been almost in balance, the consumption growth rate exceeding production growth by a small margin. At a more detailed level, tables V.1 and V.2 indicate that North America (essentially Canada), Eastern Europe and the USSR, Oceania, Latin America, Africa and the centrally planned countries of Asia were the main regions where the increase in production has been more rapid than the increase in consumption. The opposite situation occurred in Western Europe, Japan, Western Asia and the market economies of Asia. The case of Japan needs to be underlined since its production of aluminium has decreased by 85 per cent since the mid-1980s. The drop looks even more important when the actual production level is compared with the one reached at the end of the 1970s, when Japan was the world's third largest producer of aluminium.

Table V.1 implies several other characteristics. First, aluminium production is quite concentrated. The CR4 ratio or index (percentage concentration of the four major countries: United States, USSR, Canada and Australia) exceeds 50 per cent. If the six next most important producers are included, the concentration ratio climbs to almost 75 per cent. Second, four of the 10 largest aluminium-producing countries are from the South (Brazil, China, Venezuela and India). If Bahrain is added to this list, then 16 per cent of world aluminium production is concentrated in these developing countries. Third, world consumption of aluminium is as concentrated as its production. From table V.2, the CR4 index amounted to 52.3 per cent in 1990. The concentration ratio exceeds 70 per cent when the 10 most important consuming countries

Table V.1. World production of aluminium, 1987, 1989 and 1990

Economic grouping, region and country	Production 1987 (thousand tonnes)	Production 1989 (thousand tonnes)	Production 1990 (thousand tonnes)	Percentage change 1989-1990	Percentage change 1987-1990	World percentage share 1987	World percentage share 1990
Developed countries							
United States	3 343	4 030	4 048	0.4	21.1	20.3	22.0
USSR	2 355	2 380	2 380 a/	-	1.1	14.3	12.9
Canada	1 548	1 555	1 567	0.8	1.2	9.4	8.5
Australia	1 024	1 241	1 233	-0.6	20.4	6.2	6.7
Norway	798	859	871	1.4	9.1	4.9	4.7
Germany, Federal Republic of	738	742	720	-3.0	-2.4	4.5	3.9
Developing countries							
Brazil	844	888	931	4.8	10.3	5.1	5.1
China	420	754	750	-0.5	78.6	2.6	4.1
Venezuela	440	546	595	9.0	35.2	2.7	3.2
India	265	423	433	2.4	63.4	1.6	2.4
Bahrain	180	197	212	7.6	17.8	1.1	1.2
A. North America	4 891	5 585	5 616	0.6	14.8	29.7	30.5
Western Europe	3 453	3 945	3 909	-0.9	13.2	21.0	21.2
Eastern Europe and USSR	3 071 b/	2 895	2 895 a/	-	-5.7	18.7	15.7
Japan	227 b/	35	34	-2.9	-85.0	1.4	0.2
Others c/	1 484	1 667	1 652	-0.9	11.3	9.0	9.0
Total, A	13 126	14 127	14 106	-0.1	7.5	79.8	76.6
B. Latin America	1 500	1 699	1 790	5.4	19.3	9.1	9.7
Asia							
Centrally planned economies (including China)	490 b/	754	754 a/	-	53.9	3.0	4.1
Market economies	555 b/	696	901	29.5	62.3	3.4	4.9
Africa	401	435	442	1.6	10.2	2.4	2.4
Western Asia d/	371 b/	399	431	8.0	16.2	2.3	2.3
Total, B	3 317	3 983	4 318	8.4	30.2	20.2	23.4
Total, A and B	16 443	18 110	18 424	1.7	12.0	100.0	100.0

Sources: World Bureau of Metal Statistics, *World Metal Statistics Yearbook 1991* (London, 1991), pp. 14-15; and The Aluminium Association, *Aluminium Statistical Review for 1990* (Washington, D.C., 1991), p. 45.

a/ Data for Eastern Europe and USSR and centrally planned economies of Asia (including China) apply to 1989.

b/ 1985 data.

c/ Australia, Israel, New Zealand and South Africa.

d/ For consumption, only data for the Islamic Republic of Iran are directly available, while for production, the available data cover Bahrain, Islamic Republic of Iran and United Arab Emirates.

Table V.2. World consumption of aluminium, 1987, 1989 and 1990

Economic grouping, region, country and area	Consumption 1987	1989	1990 (thousand tonnes)		Percentage change 1989-1990	1987-1990	World percentage share 1987	1990
Developed countries								
United States	4 536	4 326	4 230		-2.2	-6.7	25.2	22.9
Japan	1 696	2 204	2 414		9.5	42.3	9.4	13.1
USSR	..	1 715	1 715	a/	-	-	-	9.3
Germany, Federal Republic of	1 185	1 290	1 294		0.3	9.2	6.6	7.0
France	685	686	723		5.4	5.5	3.8	3.9
Italy	548	607	693		14.2	26.4	3.0	3.8
Canada	322	459	459		-	42.5	1.8	2.5
United Kingdom	384	455	441		-3.1	14.8	[illegible]	2.4
Developing countries								
China	..	700	700		-	-	-	3.8
India	326	420	420		-	28.8	1.8	2.3
Brazil	432	418	418		-	-3.2	2.4	2.3
Republic of Korea	208	288	373		29.5	79.3	1.2	2.0
Taiwan Province	178	193	198		2.6	11.2	1.0	1.1
A. North America	4 627	4 785	4 858		1.5	5.0	25.7	26.3
Western Europe	4 059	4 721	4 788		1.4	18.0	22.5	26.0
Eastern Europe and USSR	2 805 b/	2 601	2 601	a/	-	-7.3	15.6	14.1
Japan	1 695 b/	2 204	2 414		9.5	42.4	[illegible]	13.1
Other c/	2 141	468	404		-13.7	81.1	11.9	2.2
Total, A	15 327	14 779	15 065		1.9	-1.7	85.1	81.7
B. Latin America	831	694	805		16.0	-3.1	4.6	4.4
Asia								
Centrally planned economies (including China)	683 b/	775	773	a/	-0.3	13.2	3.8	4.2
Market economies	977 b/	1 466	1 577		7.6	61.4	5.4	8.5
Africa	129	132	130		-1.5	0.8	0.7	0.7
Western Asia d/	56 b/	100	100		-	78.6	0.3	0.5
Total, B	2 676	3 167	3 385		6.9	26.5	14.9	18.3
Total, A and B	18 003	17 946	18 450		2.8	2.5	100.0	100.0

Sources: World Bureau of Metal Statistics, *World Metal Statistics Yearbook 1991* (London, 1991), pp. 14-15; and The Aluminium Association, *Aluminium Statistical Review for 1990* (Washington, D.C., 1991), p. 45.

a/ Data for Eastern Europe and USSR and centrally planned economies of Asia (including China) apply to 1989.

b/ 1985 data.

c/ Australia, Israel, New Zealand and South Africa.

d/ For consumption, only data for the Islamic Republic of Iran are directly available, while for production, the available data cover Bahrain, Islamic Republic of Iran and United Arab Emirates.

are taken into account. Fourth, even if China and India are present on the latter list, their consumption represents only 6.1 per cent of the world total. Adding Brazil, Republic of Korea and Taiwan Province to the list of the current largest consumer countries and areas in the South still gives a combined share of under 12 per cent.

Finally, it should be stressed that since 1973 aluminium consumption is no longer increasing at a faster pace than GDP ([1], pp. 217-254). During the 1960-1973 period, the annual growth rate of aluminium consumption was 8.6 p[illegible]e GDP of OECD countries was increas[illegible]g [illegible] an annual rate of 4.8 per cent. The situation was completely modified during the 1973-1987 period, when the annual rate of increase of aluminium consumption shrank to 0.9 per cent, while the GDP growth rate only dropped to 2.5 per cent per annum. The situation has somewhat improved over the past four years, aluminium consumption increasing at an annual pace of 1.9 per cent (except in 1991, when demand for primary aluminium declined by almost 1 per cent). Despite such good news for aluminium producers, this rate still remains below the GDP growth rate experienced by most consumer countries. Although it is true that a decline in GDP or in industrial activity reduces aluminium consumption because a smaller number of cars, houses or cans are purchased, it does not fully explain the atrophy in the consumption of this metal observed since the mid-1970s. Even if industrial activity had remained constant during 1973-1990, a decline of aluminium consumption would still have occurred. This is because the intensity of its use (tonnes consumed per dollar of GDP) has been decreasing during the past 15 years. The material composition of aluminium products, the product composition of income, and hence aluminium consumption have been influenced by the following three factors in particular: other metals or engineering materials offering superior quality for a given price have been substituted for aluminium; there has been a growing use of aluminium-saving technologies (as in the production of beverage cans); and intersectoral shifts have taken place within the economy as a result of changes in consumers' tastes and habits (resulting in an increased importance of the tertiary sector relative to the extractive or manufacturing sector).

(b) Trade

Since aluminium production and consumption activities do not necessarily occur in the same geographic locations, trade is necessary. Tables V.3 and V.4 list the 15 most important exporting and importing countries, their trade volumes, their average world share, the shares by region, and finally the percentage growth of these exports and imports during the 1985-1990 period. These and other aspects of structural adjustment in aluminium trade can be summarized by four points in particular.

Table V.3. Exports of major aluminium trading countries, 1985, 1989 and 1990

Economic grouping, region and country	Volume (thousand tonnes)			Percentage change		World percentage share	
	1985[a]	1989	1990	1989-1990	1985-1990	1985	1990
Canada	1 051	1 159	1 253	8.1	19.2	18.0	16.8
Australia	564	926	910	-1.7	61.3	9.7	12.2
United States	348	655	798	21.8	129.3	6.0	10.7
Norway	644	770	777	0.9	20.7	11.0	10.4
Brazil	177	472	441 [b]	-6.6	149.2	3.0	5.9
Venezuela	383	380	390	2.6	1.8	6.6	5.2
Netherlands	297	345	362	4.9	21.9	5.1	4.9
Germany, Federal Republic of	282	326	314	-3.7	11.3	4.8	4.2
New Zealand	228	233	236	1.3	3.5	3.9	3.2
Yugoslavia	147	167	195	16.8	32.7	2.5	2.6
United Arab Emirates	144	165	171	3.6	18.8	[illegible]	2.3
United Kingdom	129	169	157	-7.1	21.7	2.2	2.1
France	115	122	136	11.5	18.3	2.0	1.8
Indonesia	239	143	126	-11.9	-47.3	4.1	1.7
Hungary	50	77	122	58.4	144.0	0.9	1.6
A. Western Europe	2 155	2 392	2 418	1.1	12.2	36.9	32.5
North America	1 399	1 814	2 052	13.1	46.7	23.9	27.6
Eastern Europe	51	77	122	58.4	139.2	0.9	1.6
Japan	2	3	5	66.7	150.0	-	0.1
Other	882	1 212	1 218	0.5	38.1	15.1	16.4
Total, A	4 489	5 498	5 815	5.8	29.5	76.8	78.1
B. Latin America	660	960	976	1.7	47.9	11.3	13.1
Western Asia	271	250	279	11.6	3.0	4.6	3.7
Asia							
Centrally planned economies (excluding China)	-	-		-	-	-	-
Market economies	302	269	219	-18.6	-27.5	5.2	2.9
Africa	121	164	154	-6.1	27.3	2.1	2.1
Total, B	1 354	1 643	1 628	-0.9	20.2	23.2	21.9
Total, A and B	5 843	7 141	7 443	4.2	27.4	100.0	100.0

Source: World Bureau of Metal Statistics, *World Metal Statistics Yearbook 1991* (London, 1991), p. 17.

a/ January to September.

b/ January to November.

Table V.4. Imports of major aluminium trading countries, 1985, 1989 and 1990

Economic grouping, region, country and area	Volume 1985[a] (thousand tonnes)	1989	1990	Percentage change 1989-1990	1985-1990	World percentage share 1985	1990
Japan	1 576	2 356	2 652	12.6	68.3	26.4	33.5
United States	868	939	976	3.9	12.4	14.5	12.3
Germany, Federal Republic of	722	940	899	-4.4	24.5	12.1	11.3
France	396	484	541	11.8	36.6	6.6	6.8
Italy	320	461	539	16.9	68.4	5.4	6.8
Belgium	308	358	368	2.8	19.5	5.2	4.6
Republic of Korea	160	282	337 [b]	19.5	110.6	2.7	4.3
Taiwan Province	147	223	245	9.9	66.7	2.5	3.1
United Kingdom	147	236	241	2.1	63.9	2.5	3.0
Hungary	165	205	204	-0.5	23.6	2.8	2.6
Netherlands	135	177	190	7.3	40.7	2.3	2.4
Austria	78	130	150	15.4	92.3	1.3	1.9
Switzerland	79	118	105	-11.0	32.9	1.3	1.3
Turkey	59	-	101	-	71.2	1.0	1.3
Norway	35	102	81	-20.6	131.4	0.6	1.0
A. Western Europe	2 408	3 210	3 329	3.7	38.2	40.3	42.0
Japan	1 576	2 356	2 652	12.6	68.3	26.4	33.5
North America	927	1 004	1 007	0.3	8.6	15.5	12.7
Other	2	8	10	25.0	400.0	-	0.1
Total, A	5 078	6 783	7 202	6.4	42.4	82.2	88.3
B. Asia							
Centrally planned economies (including China)	488	176	72	-59.1	-85.2	8.2	0.9
Market economies	528	632	788	24.7	49.2	8.8	9.9
Latin America	38	14	64	357.1	68.4	0.6	0.8
Africa	-	-	-	-	-	-	-
Western Asia	13	-	-	-	-100.0	0.2	-
Total, B	1 067	822	924	12.4	-13.4	17.8	11.7
Total, A and B	6 145	7 605	8 126	7.1	32.5	100.0	100.0

Source: World Bureau of Metal Statistics, *World Metal Statistics Yearbook 1991* (London, 1991), p. 17.

[a] January to September.

[b] January to November.

First, during the past six years, almost 50.2 per cent of world aluminium exports have originated from four developed market economies: Canada (16.8 per cent), Australia (12.2 per cent), the United States (10.7 per cent) and Norway (10.4 per cent).

Second, the importance of developing countries as major world aluminium exporters is largely exaggerated. Only four of them are on the list of the 15 major exporters (Brazil, Venezuela, United Arab Emirates and Indonesia), and their average combined share represents less than 15.5 per cent of total world exports. Despite this fact, their share of world exports is increasing over time; this is particularly true for the share of the Latin American countries.

Third, not listed in table V 3 are the aluminium exports from the former USSR. They went from 170,000 tonnes in 1986 to 270,000 tonnes in 1990. In 1991 exports from the former USSR reached 1 million tonnes, boosting supplies of developed market economies by 5 per cent ([2], p. 75). It is not known whether these exports are coming from stocks or from smelters diverting output to developed market economies to earn hard currency and to find new markets. It is, however, known that they have largely contributed to the surge in world aluminium stocks. Producers now have 3.4 million tonnes of stocks, while LME stocks have overshot the 1-million-tonne mark; neither shows any sign of shrinking, so that these are likely to have even further downward effects on aluminium prices.

Fourth, world aluminium imports are more concentrated than exports, since 57.1 per cent of the former are accounted for by three countries (Japan, United States and the Federal Republic of Germany). If the three next most important importing countries (also from the North—France, Italy and Belgium) are included, this percentage climbs to 75.3 per cent. Finally, only three developing countries and areas (Republic of Korea, Taiwan Province and Turkey) were present in 1990 on this list. Although their combined average world share of imports reached only 8.7 per cent during the 1985-1990 period, this is much larger than in previous years.

(c) *Major companies in the global industry*

The combination of excess production, increased stocks and unexpected exports have reflected the anticipated impact on prices, sales and profits. Figure V.1 has confirmed that the price of aluminium during the fourth quarter of 1991 was not higher than that prevailing during the first quarter of 1979, and that was the lowest price since the trough of 1984-1985. The effects of the recent excess supply on the sales and profits of the main aluminium companies are presented in table V.5. The first nine companies listed, for which data on sales and profits are directly or indirectly available, control 56 per cent of production capacity in developed market economies. The vast majority of government-owned companies are not reported since, in general, they do not publish financial statements or separate annual reports. It would nevertheless be very surprising to observe that their financial performance has been substantially different from that presented for the companies listed on table V.5. The main message is that sales increased between 1987 and 1989, before stabilizing or even decreasing in 1990. Profits also reached their maximum in 1988 or 1989 before plummeting in 1990. Most recent information suggests that sales have greatly suffered from the recession and that profits almost disappeared in 1991. If returns on equity (excluding non-operating gains) are examined, this pattern is repeated. For most of the 1980s (the exception being 1988 and the first half of 1989), their average rate of return on equity has been lower than the Standard & Poor's 400 [3]. This has been the case since 1967. Given the announced expansion plans and aluminium consumption forecasts for the next decade, there is a distinct possibility that the future will not be much brighter.

How can such a stagnant and poor performance be explained? The main reason is that the world aluminium industry at the beginning of the 1990s is only a dim reflection of what it was in the 1960s. Thirty years ago, the industry was growing twice as fast as overall GDP. It was dominated by a group of six producers whose operations were characterized by a high degree of forward and backward integration. The peaks and troughs of demand were then managed by inventory adjustments, varied capacity utilization rates, or—only as a last resort—changes in prices. Today, the growth rate of the industry is below that of overall GDP. The market power of the Big Six (Alcan, Alcoa, Alusuisse, Kaiser, Reynolds and Pechiney) is now greatly reduced, since they have to jostle for their

Table V.5. Sales and profits of main aluminium companies, 1987-1990
(Million dollars)

Company and country	Percentage of capacity under control a/	Sales and operating revenues 1987	1988	1989	1990	Percentage change 1989-1990	Profits or net income 1987	1988	1989	1990	Percentage change 1989-1990
Alcoa (United States)	13.6	7 767	9 795	10 910	10 710	-1.8	200	861	945	295	-68.7
Alcan (Canada)	11.7	6 797	8 529	8 839	8 757	-0.9	433	931	835	543 b/	-35.0
Reynolds Metals (United States)	5.6	4 284	5 567	6 143	6 022	-2.0	220	482	533	297	-44.3
Hydro (Norway)	5.2	1 681	2 167	2 366	2 369	0.1	..	..	..	..	-
Pechiney (France)	5.1	1 517	2 061	2 169	1 919	-11.5	-	210	213	-	-
Kaiser (United States)	4.8	2 003	2 220	2 193	2 095	-4.4	(355)	224	468	379 c/	-19.0
Alumax (United States)	3.5	2 239	2 584	2 531	2 451	-3.2	290	613	480	296	-38.3
Alusuisse (Switzerland)	3.4	2 380	2 860	3 032	3 192 d/	5.3	122	152	199	135 d/	-32.3
VAW/VIAG (Germany)	3.1	2 474	3 045	3 085	3 445 e/	14.9	18	41	43	50 f/	16.0
Venalum (Venezuela)	2.3	..	..	536	..	..	..	..	109 g/	..	..
Alcasa (Venezuela)	1.2	..	..	225	..	..	..	..	63 g/	..	..

Sources: Derived from companies' annual reports, various years.

a/ In 1988; it is assumed that changes have been minor since then. The following basic rules have been followed to determine the control of a given capacity:

1. Full control is allocated to a company holding more than 50 per cent of the equity shares of an operation;
2. Full control is also allocated to a company in a situation where the company holds 50 per cent or less of the equity and is the major shareholder among a number of other companies and other partners not directly participating in the bauxite, alumina and aluminium industry;
3. In a consortium or joint venture between two or more companies in which no one company holds more than 50 per cent of the equity or no one firm is obviously in control, control of the operation is allocated in proportion to the equity shareholdings;
4. In cases where a company or group of companies owns less than 50 per cent of shares in a smelter, while the State is the majority shareholder but is not obviously in control, additional information on, for example, voting power, company supply systems, offtake commitment etc. is used to determine control.

b/ Including a non-operating gain of $196 million.

c/ Operating income.

d/ Assuming that revenues and profits from aluminium represented on average about 70 per cent of group revenues and profits.

e/ Sales are referred to as turnover in the VAW Group annual report.

f/ Net profit after tax.

g/ An estimated $276 million in government export incentives which reportedly was instrumental in putting both Alcasa and Venalum in the black in 1989 is expected to be cut back, if not completely eliminated, in 1990.

share with second-tier integrated producers and independent bauxite, alumina or aluminium producers. Furthermore, State ownership of the mining, refining and smelting capacity in developed market economies has constantly grown and now stands at about 40 per cent. An understanding of the loss of market power by the Big Six can be drawn from table V.6. At the end of the 1980s, the six majors were not only highly integrated, but were also controlling 56 per cent, 66 per cent and 47 per cent of, respectively, bauxite, alumina and aluminium capacity in developed market economies. Even if these concentration ratios look impressive, they have substantially decreased over time; no later than 1980 they were 61 per cent, 69 per cent and 52 per cent, respectively. Given this increase in the degree of competition prevailing in the aluminium industry, it is no surprise that it is marginal transactions on the LME, not the producers, that determine current prices. Prices consequently have become less stable and much more sensitive to changes in the ratio of aluminium stocks to consumption, and profit margins accordingly (which are inversely related to the price-elasticity of demand) have been squeezed.

2. *Manufacturing capacity of developing countries*

Aluminium production takes place today in more than 40 countries, of which 17 of them could be considered developing countries at the end of the 1980s. Their combined percentage of world production was 22 per cent, almost double the level reached a decade earlier. It is important to realize that developing countries have traditionally provided only the raw materials or ores for metals produced in other, mostly developed countries. Table V.7 accordingly reflects the phenomenon; the world production shares of the developing countries were 45 per cent for bauxite and 26 per cent for alumina.

Concerning the structure of aluminium-producing capacity in the developing countries, the following characteristics predominate. First, this capacity has traditionally been concentrated in Latin America (40 per cent), while the Asian countries with market economies and those which are centrally planned each provide 20 per cent of the developing countries' total. The other 20 per cent is divided equally between Africa and Western Asia. Second, aluminium production and capacity in developing countries is concentrated not only in terms of geographical or political regions. As shown in table V.8, the production of only four of these developing countries (Brazil, China, India and Venezuela) represented 66.8 per cent of the total in 1990, almost all of the combined share of aluminium capacity of developing countries. Third, if the country and regional capacity shares are compared with those attained a decade earlier, it can be seen that Latin American economies (with a share of 3 per cent), Asian market economies (7 per cent), and centrally planned Asian economies (3 per cent) have improved their relative position, while the reverse is true for the African economies (−9 per cent) and those of Western Asia (−2 per cent). Among individual countries, the capacity has tripled in Brazil and doubled in China, India and Venezuela. Indonesia's new smelter started its operations in 1982, reaching the full capacity level only in 1984.

Table V.8 also suggests that while Asian aluminium production is directed towards the local market, this is not the case with Latin America, Western Asia and Africa. The production of the latter regions is essentially export-oriented: the export-production ratio exceeds 65 per cent for Africa and Western Asia, while it hovers around 55 per cent in the case of Latin America. With regard to specific countries, major producers such as China and India are totally absent from export markets, while more than 50 per cent of the production of Argentina, Bahrain, Ghana, Indonesia and Venezuela is exported. Brazil, the most important producer of the developing countries, is a special case; given the size of its domestic market, it exported only 47 per cent of its production in 1990.

Finally, the aluminium consumption of a country is highly related to the level of its economic development. It is then no surprise to realize that developing

Table V.6. Concentration and vertical integration: percentage of capacity under control in developed market economies at the end of the 1980s

Bauxite		Alumina		Aluminium	
Company	Percentage	Company	Percentage	Company	Percentage
Alcoa	19	Alcoa	27	Alcoa	14
Comalco	12	Alcan	13	Alcan	12
Alcan	10	Reynolds	8	Reynolds	6
Alusuisse	6	Pechiney	7	Hydro	5
Billiton	5	Kaiser	6	Pechiney	5
Kaiser	4	Billiton	5	Kaiser	5
Pechiney	3	CVG	4	Alumax	4
Reynolds	2	Comalco	4	Alusuisse	3
VAW	2	Alusuisse	4	CVG	3
CVRD	1	Inespal	3	VAW	3
TOTAL	64	TOTAL	81	TOTAL	60

Sources: Derived from: R. Kalpoe, "Ownership and control of smelting capacity in the world aluminium industry: 1980-1990", *International Bauxite Association Review* (September-December, 1987), pp. 15-23; and Commodities Research Unit Ltd., *Competitive Strategy in Aluminium* (London, 1989).

Table V.7. Major bauxite-, alumina- and aluminium-producing countries in the South: percentage of world total, end of the 1980s

Bauxite		Alumina		Aluminium	
Company	Percentage	Company	Percentage	Company	Percentage
Guinea	16	Jamaica	5.5	Brazil	5
Jamaica	10	Brazil	4.0	China	4
Brazil	7	China	4.0	Venezuela	3
India	4	Suriname	4.0	India	2
China	3	India	3.5	Indonesia	1
Suriname	1	Venezuela	3.0	Bahrain	1
Sierra Leone	1	Guinea	1.5	Egypt	1
Guyana	1	Turkey	0.5	Ghana	1
Indonesia	1			United Arab Emirates	1
Venezuela	1			Argentina	1
TOTAL	45	TOTAL	26.0	TOTAL	20

Source: World Bureau of Metal Statistics, *World Metal Statistics Yearbook 1991* (London, 1991).

Table V.8. Aluminium capacity in developing countries, 1989 and 1990

Economic grouping, region, country and area	Capacity 1989 (thousand tonnes)	Capacity 1990 (thousand tonnes)	Percentage share 1990
Latin America			
Argentina	160	160	3.5
Brazil	875	930	20.3
Mexico	65	65	1.4
Suriname	30	30	0.7
Venezuela	600	638	14.0
Asia			
Market economies			
India	582	612	13.4
Indonesia	225	225	4.9
Republic of Korea	-	18	0.4
Taiwan Province	-	-	-
Turkey	60	60	1.3
Centrally planned economies			
China	875	875	19.1
Democratic People's Republic of Korea	20	20	0.4
Western Asia			
Bahrain	205	230	5.0
Iran (Islamic Republic of)	50	50	1.1
United Arab Emirates	170	200	4.4
Africa			
Cameroon	87	87	1.9
Egypt	175	175	3.8
Ghana	200	200	4.4
TOTAL	4 219	4 575	100.0

Sources: Derived from: World Bureau of Metal Statistics, *World Metal Statistics Yearbook 1991* (London, 1991), pp. 14, 15, 17; The Aluminium Association, *Aluminium Statistical Review for 1990* (Washington, D.C., 1991); Carmine Nappi, *China and the Western Mineral Markets: Threats and Opportunities* (Kingston, Ontario, Centre for Resource Studies, forthcoming); and Shearson, Lehman, Hutton, *Annual Review of the World Aluminium Industry* (London, 1990), pp. 65-66.

countries are responsible for 23 per cent of world aluminium production, while their share of consumption is lower than 19 per cent. This consumption is also highly concentrated, since four developing countries (Brazil, China, India and Republic of Korea) are responsible for more than 60 per cent of their group's total. If the consumption figures of these countries are corrected to take into account their population, the low rate of aluminium consumption in the developing world is even more noticeable. Whereas per capita aluminium consumption exceeds 25 kilograms in Germany, Federal Republic of, Japan, and the United States, it is less than 3 kilograms per head on average in all developing countries and areas; several exceptions are Republic of Korea, Taiwan Province and Venezuela where it reaches 7-8 kilograms per head. In cases such as China, Ghana or India, the per capita consumption is even lower, at less than 1 kilogram per person.

Behind these figures are several perplexing questions. For example, even if the weak per capita aluminium consumption of developing countries can be related to their low degree of economic development, how can their production capacity, which is not much larger, be explained? What are the physical, financial and technological factors that may limit the expansion of this capacity? In order to answer these questions it must be recalled that the production of a tonne of aluminium requires almost 2 tonnes of alumina, about 13,500 kWh of energy, labour, various materials (cryolite and aluminium fluoride for the reduction cells, as well as petroleum, coke, pitch and anthracite coal for the anodes), conversion facilities in the form of a cast house, and a variety of other elements. The alumina can be bought quite easily on the world market when there is no shortage, or it may be produced locally. In the latter case, the production of a tonne of alumina will require not only 2 tonnes of bauxite, but also significant quantities of caustic soda, energy, labour and various other materials.

The relative importance of each of those inputs is not identical. For example, in 1990 the average cost structure of a tonne of aluminium was the following: alumina, 25 per cent; electricity, 22 per cent; labour, 11 per cent; other operating costs, 19 per cent; and capital and servicing costs, 23 per cent.* Thus, the production of aluminium is capital-, alumina- and energy-intensive, with the combined share of these three inputs totalling 70 per cent of total production costs. These inputs are not always readily available, at least not necessarily at a low cost. For example, the construction of a greenfield smelter with a capacity of 250,000 tonnes will require an investment of approximately $1.2 billion, or almost $5,000 per tonne of capacity. This cost may look prohibitive to almost all developing countries, in particular to those which realize that this capital- or energy- intensive investment does not make significant use of their abundant labour. If financed by local capital, the opportunity cost of this investment may look even greater when considering the numerous other projects that will have to be postponed, cancelled or carried on with a higher price tag because of the construction of a new aluminium smelter. This is why developing country production has remained largely at the bauxite stage, as shown in table V.7.

Despite its importance capital is a necessary, but not a sufficient, input to aluminium production. Alumina and electricity are also needed. While obtaining the former may not present a great problem, especially in a situation of excess supply (except for the fact that buying alumina on the world market instead of producing it from an inexpensive source of bauxite may affect the aluminium producer's international competitiveness), this may not be the case for the latter. In order to produce aluminium, a developing country will need huge quantities of hydroelectric, nuclear, coal or oil-fired energy (in increasing order of production costs of 1 kWh) at a low price. Lack of abundant, firm and inexpensive supplies of energy represents one of the main constraints for the development of the aluminium industry in any country (with few exceptions). This is even more true for densely populated countries where the opportunity cost of using energy for the production of aluminium may be high. Other constraints on expanding production capacity are environmental expenditures, their impact on the unit production cost of aluminium, and the need to invest in new technology (new processes and new products development) to remain competitive.

3. *Capacity utilization and expansion plans*

Earlier the issue was raised about the prevalence of excess demand for aluminium at the end of the 1980s. What about the supply side of the equation? Has the rate of increase in the aluminium production capacity and capacity utilization rates been uniform among countries, or has it differed significantly among them? How can the persistence of such differences over time be explained? Are the shifts in the locations of the world's smelting activities the result of changes in the natural sources of comparative adv ntages, or have these shifts been facilitated by the policies of the governments of the countries involved? Finally, what are the capacity expansion plans for the years 1991-1995? In which countries will this expansion take place? To what extent will the realization of these expansion plans further deteriorate the situation of excess supply? These are the type of questions dealt with in the following two sections.

Some answers to these questions can be obtained by examining table V.9. First of all, there are only four countries in the developed world where aluminium production capacity has increased during the 1985-1990 period by more than 20 per cent: Australia, Canada, Norway and Yugoslavia. On the other hand, it decreased during the same period by more than 92.5 per cent in Japan, 21.9 per cent in Spain, 13.6 per cent in Switzerland and 12.1 per cent in the United States. As expected, in the case of developing countries, there is not a single country where aluminium production capacity has decreased since the mid-1980s, while it increased by at least 15 per cent in Bahrain, Brazil, China, India, Mexico and Venezuela. Looking broadly at aluminium production capacity, a decrease of about 300,000 tonnes or 1.4 per cent in developed countries and an increase of 1.2 million tonnes or 36.4 per cent in the developing world are observed. This represents a total net increase of 5 per cent in world aluminium capacity for the second half of the 1980s.

Second, between 1985 and 1990, aluminium production increased at a faster pace than capacity. This is true for the total North (11.3 per cent more production, or 1.5 million tonnes) as well as for total South (up by 45.5 per cent, or 1.3 million tonnes). Aluminium production for the world as a whole was up by 18 per cent during this period. In the developed world, this increase was concentrated in countries such as the United States, Canada, Norway, Australia and Yugoslavia; Japan and the German Democratic Republic were the only locations where production declined significantly. In the developing countries, a rise in aluminium production was observed in Brazil, China, India, Mexico, Venezuela and Ghana (in the latter country, production had been curtailed in the past because of a lack of energy), while it diminished in the Republic of Korea and Indonesia.

Third, since aluminium production increased faster than its capacity during the 1985-1990 period, the utilization rate rose. It went up from 86 to 97 per cent in the countries of the North, and from 86 to 92 per cent for the South. This increase was particularly spectacular in North America, suggesting that this was the region with the most flexible aluminium production capacity; it also was the region which had most easily reduced the pace of its production when facing a situation of excess supply. The utilization rate went down only in the case of marginal producing regions such as Eastern Europe, Asia and Western Asia.

Fourth, despite the general rise in the utilization rates observed between 1985 and 1990, the most recent but preliminary data available seem to suggest that the situation has since then deteriorated. The future seems even more gloomy when the expected capacity additions for the years 1991-1995 are taken into consideration. Concerning the evolution of aluminium capacity since 1987 and 1991, table V.10 suggests that total capacity in the North will increase by almost 1.4 million tonnes or 9.3 per cent between now and 1995.

*See [4], table 8.0.

Most of this expansion will take place in Canada (640,000 tonnes or an increase of 35 per cent), Australia (370,000 tonnes), Iceland (200,000 tonnes), New Zealand (130,000 tonnes) and France (110,000 tonnes). Expected capacity reduction in Austria, Italy and most surely in a few countries of Eastern Europe will only to a small extent diminish the impact of this increased capacity. The planned expansion in the developing countries will add more than 1.5 million tonnes of capacity, an increase of 31.3 per cent over four years. This expansion will essentially take place in countries of Western Asia (new smelters in Saudi Arabia and Qatar and a brownfield investment in Bahrain which should double this country's capacity), in Africa (if the greenfield investment expected for Algeria is launched in the coming months), and in Latin America, where at least 400,000 tonnes will be added to the capacity of Brazil and Venezuela.

Finally, if planned capacity expansions in the North and South from now to the year 1995 are combined, then a total world capacity expansion of almost 2.9 million tonnes, or an increase of 14.7 per cent, is obtained. This corresponds to an annual growth rate of 3.7 per cent, without taking into account the growing contribution of secondary aluminium to total world supply. The obvious implication of such a growth rate is that unless the annual closing down of 2 to 3 per cent of the world (high-cost) capacity is repeated, aluminium consumption will have to increase at a compound annual growth rate of at least 3.5 to 4.0 per cent to keep a certain balance between the demand and supply sides of the market. Any rate lower than this target would further deteriorate the market situation, unless part of the capacity expansion plans remains unrealized.

The above discussion reveals that major shifts have occurred in the geographic locations of aluminium production centres. Smelters have closed in Germany, Italy, Japan, Spain, Switzerland and the United States, while new ones were opened in Australia, Brazil, Bahrain, Canada, China, France, India, Norway, Venezuela and Yugoslavia. How can these shifts in the location of smelting activity in the developed market economies be explained? Are they solely the result of changes in the costs of production (energy, alumina, labour etc.), which favour new producers over older, perhaps more costly producers? Has the shift of production to geographic zones with greater comparative advantages been facilitated or held back by the public policies adopted in the countries involved? The answer to these questions can be found by analysing the restructuring and deployment in the aluminium industry.

Table V.9. Aluminium capacity utilization, 1985 and 1990

Economic grouping, region, country and area	Capacity 1985	Capacity 1990	Percentage change 1985-1990	Production 1985	Production 1990	Percentage change 1985-1990	Utilization rates 1985	Utilization rates 1990
	(thousand tonnes)			(thousand tonnes)			(percentage)	
North America								
Canada	1 369	1 665	21.6	1 282	1 567	22.2	94	94
United States	4 648	4 086	-12.1	3 500	4 048	15.7	75	99
Western Europe								
Austria	95	95	-	94	90	-4.3	99	95
France	286	331	15.7	293	326	11.6	102	98
Germany, Federal Republic of	790	727	-8.0	745	720	-3.4	94	99
Greece	148	150	1.4	123	150	22.0	83	100
Iceland	88	88	-	77	88	14.3	88	100
Italy	254	234	-7.9	224	232	3.6	88	99
Netherlands	265	272	2.6	245	270	10.2	92	99
Norway	712	855	20.1	724	871	20.3	102	102
Spain	443	346	-21.9	370	355	-4.1	84	103
Sweden	83	97	16.9	84	96	14.3	101	99
Switzerland	81	70	-13.6	73	72	-1.4	90	101
United Kingdom	292	304	4.1	275	290	5.4	94	95
Yugoslavia	270	347	28.5	271	349	28.8	100	101
Eastern Europe								
Czechoslovakia	60	60	-	66	69	4.5	110	115
German Democratic Republic	85	85	-	66	54	-18.2	78	64
Hungary	76	76	-	74	75	1.4	97	99
Poland	55	55	-	47	48	-	85	87
Romania	263	263	-	247	269	8.9	94	102
USSR	2 540	2 590	2.0	2 300	2 380	-	91	92
Other								
Australia	1 012	1 317	30.1	852	1 233	44.7	84	94
New Zealand	244	260	6.6	244	260	6.6	100	100
South Africa	172	175	1.7	165	160	-3.0	96	91
Latin America								
Argentina	151	161	6.6	140	165	17.9	93	102
Brazil	757	895	18.2	549	931	69.6	73	104

Economic grouping, region, country and area	Capacity 1985 (thousand tonnes)	Capacity 1990 (thousand tonnes)	Percentage change 1985-1990	Production 1985 (thousand tonnes)	Production 1990 (thousand tonnes)	Percentage change 1985-1990	Utilization rates 1985 (percentage)	Utilization rates 1990 (percentage)
Mexico	37	69	86.5	43	68	58.1	116	99
Suriname	29	30	3.4	29	31	6.9	100	101
Venezuela	430	620	44.2	403	595	47.6	94	96
Africa								
Cameroon	80	87	8.8	82	88	7.3	103	101
Egypt	177	180	1.7	178	180	1.1	101	100
Ghana	200	200	-	49	174	255.1	25	87
Western Asia								
Bahrain	180	230	27.8	175	212	21.1	97	92
Iran (Islamic Republic of)	40	50	25.0	43	45	4.7	108	90
United Arab Emirates	152	170	11.8	153	174	13.7	101	102
Asia								
China	395	875	121.5	430	755 a/	75.6	109	86
India	304	612	101.3	266	433	62.8	88	71
Indonesia	225	225	-	217	192	-11.5	96	85
Democratic Peoples' Republic of Korea	20	20	-	20	20	-	100	100
Republic of Korea	18	18	-	18	13	-27.8	100	72
Taiwan Province	50	-	-	-	-	-	-	-
Turkey	60	60	-	54	61	13.0	90	102
North America	6 017	5 751	-4.4	4 782	5 615	17.4	79	98
Western Europe	3 807	3 916	2.9	3 599	3 909	8.6	95	100
Eastern Europe	3 079	3 129	1.6	2 800	2 895 a/	3.4	90.9	66
Japan	453	34	-92.5	227	34	-85.0	50	100
Other	1 428	b/ 1 752	22.7	1 261	1 653	31.1	88	94
Total, A	14 784	14 582	-1.4	12 669	14 106	11.3	86	97
Latin America	1 404	b/ 1 775	26.4	1 164	1 790	53.8	83	101
Asia	1 072	1 810	68.8	1 005	1 474	46.7	94	81
Africa	457	467	2.2	309	442	43.0	68	95
Western Asia	372	460	23.7	371	431	16.2	100	94
Total, B	3 285	4 482	36.4	2 829	4 117	45.5	86	92
Total, A and B	18 069	19 064	5.5	15 498	18 223	17.6	..	..

Sources: Derived from companies' annual reports, various years; and Errol D. Sehnk and Patricia A. Plunkert, "Bauxite, alumina, and aluminium", *Minerals Yearbook* (Washington, D.C., Department of the Interior, Bureau of Mines, 1988), p. 21.

a/ 1989.

b/ 1986.

Table V.10. Capacity expansion plans, 1987-1991
(Thousand tonnes)

Economic grouping, region and country	Actual capacity 1987	1988	1989	1990	1991	Percentage change 1987-1991	Planned capacity for 1995	Percentage change 1991-1995
North America								
Canada	1 577	1 594	1 593	1 665	1 820	15.4	2 463	35.3
United States	3 895	4 046	4 086	4 086	4 103	5.3	4 103	-
Western Europe								
Austria	92	95	95	95	95	3.3	12	-87.4
France	346	332	335	330	344	-0.1	456	32.6
Germany, Federal Republic of	733	735	740	727	729	-	731	-
Greece	145	148	150	150	150	3.4	150	-
Iceland	86	88	88	88	88	2.3	288	227.3
Italy	276	234	235	234	232	-15.9	206	-11.2
Netherlands	266	272	275	275	275	3.4	275	-
Norway	834	840	850	865	865	3.7	887	2.5
Spain	344	346	346	346	346	0.1	346	-

Table V.10. (continued)

Economic grouping, region and country	Actual capacity					Percentage change	Planned capacity	Percentage change
	1987	1988	1989	1990	1991	1987-1991	for 1995	1991-1995
Sweden	91	100	100	100	100	9.9	100	-
Switzerland	72	70	70	70	70	-2.8	70	-
United Kingdom	287	291	291	291	291	1.4	291	-
Yugoslavia	357	367	367	347	347	-2.8	347	-
Eastern Europe								
Czechoslovakia	60	60	60	69	60	-	..	-
German Democratic Republic	85	85	85	85	-	-	..	-
Hungary	76	76	76	76	76	-	..	-
Poland	55	55	55	55	55	-	110	100
Romania	250	250	250	263	263	5.2	..	-
USSR	2 590	2 590	2 640	2 590	2 590	-		-
Other								
Australia	1 012	1 243	1 268	1 307	1 317	30.1	1 686	28.0
New Zealand	244	250	260	260	260	6.6	390	50.0
South Africa	172	175	175	175	175	1.7	175	-
Latin America								
Argentina	150	155	160	160	160	6.7	175	9.4
Brazil	869	874	875	895	1 083	24.6	1 281	18.3
Mexico	66	66	66	69	69	4.5	69	-
Suriname	30	30	30	30	30	-	30	-
Venezuela	430	522	600	620	638	48.4	840	31.7
Africa								
Algeria	-	-	-	-	-	-	220	-
Cameroon	80	85	87	87	87	8.8	87	-
Egypt	170	175	175	180	180	5.9	180	-
Ghana	200	200	200	200	200	-	200	-
Western Asia								
Bahrain	180	180	205	230	230	27.8	460	100.0
Iran (Islamic Republic of)	50	50	50	50	50	-	50	-
Iraq	-	-	-	-	-	80	-	-
Qatar	-	-	-	-	-	-	180	-
Saudi Arabia	-	-	-	-	-	-	214	-
United Arab Emirates	150	155	170	170	190	26.7	235	56.7
Asia								
China	695	875	875	875	975	40.3	1 100	12.8
India	472	528	582	612	612	29.7	612	-
Indonesia	225	225	225	225	225	-	225	-
Democratic People's Republic of Korea	20	20	20	20	20	-	20	-
Republic of Korea	18	18	18	18	18	-	18	-
Turkey	60	60	60	60	60	-	60	-
A. North America	5 472	5 640	5 679	5 751	5 923	8.2	6 566	10.9
Western Europe	3 929	3 918	3 942	3 908	3 932	-	4 159	5.8
Eastern Europe	3 116	3 116	3 166	3 116	3 116	-	..	-
Japan	64	64	35	35	35	-45.3	35	-
Other	1 428	1 668	1 703	1 742	1 752	22.7	2 251	28.5
Total, A	14 009	14 406	14 525	14 552	14 758	5.3	16 127 a/	9.3 a/
B. Latin America	1 545	1 647	1 731	1 774	1 980	28.2	2 395	21.0
Asia	1 490	1 726	1 780	1 810	1 910	28.2	2 035	6.5
Africa	450	460	462	467	467	3.8	687	47.1
Western Asia	380	385	425	450	470	23.7	1 219	159.4
Total, B	3 865	4 218	4 399	4 501	4 827	24.9	6 336	31.3
Total, A and B	17 874	18 624	18 924	19 053	19 585	9.6	22 463	14.7

Sources: Derived from companies' annual reports, various years; and Errol D. Sehnke and Patricia A. Plunkert, "Bauxite, alumina, and aluminum", *Minerals Yearbook* (Washington, D.C., Department of the Interior, Bureau of Mines, 1988), p. 21.

a/ Assuming no increase in the Eastern Europe aluminium smelting capacity.

4. *Restructuring and deployment*

In the wake of the 1973 and 1979 oil crises, the industry has closed considerable high-cost capacity. In the United States, 1.1 million tonnes of annual capacity have been deleted from the industry's books since 1981. In Japan, virtually the entire primary smelting industry has been decimated. This implies a reduction of about 1.6 million tonnes of annual capacity, leaving the United States producers in the unenviable position of owning the world's swing capacity. On the other hand, considerable high-cost European capacity has been kept open even though their profitability is, at least at current prices, quite dubious. Only a few old and usually small smelters were closed during the 1980s in France, Germany, Federal Republic of, Italy, Spain or Switzerland. During the same period, the relative competitiveness of Australia, Brazil, Canada, most Western Asian countries and Venezuela greatly improved. New greenfield investments have thus been made in these countries, some of them have also expanded the capacity of existing smelters (brownfield investments). These shifts in the geographical production centres may largely be explained by the evolution in the costs of production factors.

Earlier it was seen that the production of aluminium is capital-intensive, while alumina is energy-intensive. Even though these inputs cover about 70 per cent of the total costs, the cost of energy is the most important factor, because the cost of producing 1 kWh varies greatly between countries, depending on the energy source used. According to an OECD study, if the cost of producing 1 kWh by means of hydroelectric power is set to 100, then it reaches 163 for nuclear power, 200 for coal and 275 for oil ([5], p. 12). As countries are differently endowed with energy resources, their costs of energy production vary, and this affects the direct cost of aluminium production. Alumina and aluminium capital costs also vary between countries, but their variance is much lower than the one computed for energy. Again, if the variance in energy costs between countries is set at 100, then according to the same OECD study, the variance for the capital costs will reach only 40, while alumina costs would barely exceed 30 ([5], p. 52).

Bearing those facts in mind, it can be asked what is the actual relative position of various countries involved in the production of aluminium at the end of the 1980s. Does their relative position on the aluminium cost curve explain to some extent the variations observed in their share of world production? Table V.11 helps to answer these questions. It suggests that the total aluminium production costs of Latin America and Canada are at least 10 per cent below the corresponding world average. This privileged position on the aluminium cost curve is essentially due, in the case of Canada, to its enviable low energy costs (its alumina and labour costs being higher than the world average). However, the sources of competitiveness in Latin America are more numerous and more diversified. These countries benefit from below-average energy costs as well as low labour and alumina costs.

Australia and New Zealand also have total operating costs below the world average. Such a position is due to low labour costs and, more importantly, to an easily accessible and cheap supply of alumina. But contrary to Canada and to the United States, their capital and servicing costs are so high that they neutralize their other advantages. The same can be observed in Africa (also disadvantaged by high alumina costs) and countries located in the South and

Table V.11. Comparative operating and total costs index for primary aluminium smelters, 1988-1989 (Average = 100)[a]

Economic grouping, region and country	Alumina	Electricity	Labour	Other costs	Operating costs	Total (including capital and servicing costs)
A. North America	107	104	118	103	107	99
Canada	122	41	109	101	92	91
United States	100	130	122	103	113	102
Western Europe	100	96	124	94	101	107
Oceania	94	115	67	102	98	101
Australia	96	117	65	101	99	102
New Zealand	85	101	78	107	94	99
B. Africa	114	68	76	104	93	97
Asia						
East	74	86	107	98	88	104
South	85	118	62	99	95	103
Latin America	91	78	58	100	85	88

Source: Derived from Ricardo Echeverria and Asim Bose, "The expanding aluminium industry of Latin America", paper presented at The Fourth International Arab Aluminium Conference held in Bahrain from 14 to 16 November.

[a] The 1988-1989 average cost structure was the following: alumina, 25.6 per cent; electricity, 21.7 per cent; labour 10.6 per cent; other operating costs, 18.9 per cent; and capital and servicing costs, 23.2 per cent. The total cost (including capital and servicing cost) of producing primary aluminium in 1989 was $1,540.3 per tonne for all the abovementioned regions.

East Asia. Finally, table V.11 provides information on the reasons why the cost of United States and Western European capacity are located so high on the aluminium total cost curve. In the former case, the low capital and servicing costs are more than compensated for by above-average electricity and labour costs. In the case of aluminium companies operating in Western Europe, access to quite low electricity and other costs (mainly chemical products) is not enough to counterbalance the effect of high labour and capital and servicing costs. This information helps to explain why certain aluminium producers have been obliged to shut down or refrain from increasing their production capacities in countries like Japan, the United States and certain European countries, and to open new ones in countries like Canada, Brazil, Venezuela and certain Western Asian countries. Also, it is often mentioned that 920,000 tonnes (6 per cent of world capacity) should be shut down in 1992 to re-establish equilibrium on the international aluminium market ([2], p. 75). The major geographical areas where these closures should take place can be identified from table V.11.

Before completing this section, we must realize that although natural sources of competitiveness are important, they alone do not fully explain the direction and speed of the shifts that have occurred in aluminium production centres. They cannot account for the fact that in certain countries aluminium smelters have been closing at a slower rate (or opening at a faster rate) than might be expected, given the level of their energy costs. To understand what has been happening, other factors, which have generally been termed "policy-induced sources of competitiveness", must be considered. There are essentially government policies which, by modifying electricity prices, profit tax rates, royalty rates on the extraction of bauxite, exchange rates or environmental regulations, either help or hinder the adjustment of private firms to the changes that have occurred in the natural sources of competitiveness.

One example of such policies is the energy discounts that have been granted by countries considered to possess a comparative advantage in the production of aluminium (Australia, Brazil or Canada). These discounts are meant to attract new aluminium investments and provide national benefits from the positive externalities generated by these projects. Such discounts always serve as strong incentives to attract new aluminium smelters because they help increase a company's cash flow during a project's first years, which is a particularly critical period for a capital-intensive investment. The discounts may be given openly (as in Quebec, the north-west United States, Norway, Sweden and Turkey), or they may take rather subtle forms (as in Australia and Brazil) [6].

Such discount sales of energy for a short period of time have now become less common as excess energy capacity has decreased. They have been replaced by a system of variable energy rates in which the rate is linked to the price of aluminium. There are few examples of this practice, but the best known case is that of the Bonneville Power Administration (BPA), servicing the north-west United States. Effective 1 July 1991, BPA has been selling its electricity to aluminium producers at a rate fluctuating between 1.7 cents and 2.9 cents per kWh, depending on the price of aluminium. Hydro-Quebec offers a similar mechanism to aluminium or magnesium producers. It charges below the published rate for power-intensive industries in periods of low metal prices and weak profits, but recoups a good part of the lost revenues during times when the metal prices and profits are high. Iceland and Ghana also offer their aluminium producers variable rates for energy.

5. *Environmental considerations*

Although there has been some government legislation that applies specifically to the alumina or aluminium industry (for example, regulations concerning the disposal of red mud, which is corrosive to the skin and can cause considerable damage to the ecology of water systems, or the emission of fluoride impurities, which in sufficiently large quantities can destroy plant life in the vicinity of smelters), it is legislation concerning energy production that has had the greatest impact on aluminium production costs. The legislation has aimed at reducing or eliminating the environmental effects of the production of energy derived from various primary sources. Thus, for nuclear energy production, Governments have regulated security of operations as well as nuclear waste disposal. In the case of hydroelectric energy, Governments have aimed at controlling the effects of damming rivers, such as alteration of the natural habitat of endangered species and disruption of salmon breeding grounds. For coal-based energy production, Governments are making greater efforts to regulate the sulphur dioxide emissions that are responsible for acid rain. The attitude of government authorities towards the environmental consequences of energy production is often a function of their country's endowment in energy resources, which makes it possible to find alternative competitive sources.

In the industrialized countries, Governments increasingly acknowledge the need to reduce the sulphur dioxide emissions of their coal-burning power stations. In the United States, various effective laws encourage utilities to reduce their dependence on coal, to increase their use of coals with low sulphur content, or to install effective scrubbing systems in their power stations. The effect of these measures is difficult to gauge, for this depends on the exact measures adopted. Nevertheless, some studies tend to suggest that these measures have a negative impact on aluminium smelters. A 1988 study by the United States Bureau of Mines estimated that the average increase in electricity rates for 10 United States smelters located in Indiana, Kentucky, Maryland, North Carolina, Ohio, South Carolina, Texas and West Virginia was between 3.5 and 5.5 mills per kilowatt hour [7]. For the aluminium industry, this implies additional electricity costs ranging from $94 million to $150 million annually. If these additional costs are translated in terms of the price of one pound of aluminium, the result is an increase of 2.5 to 4 cents per pound. Smelters located in West Virginia and Ohio would experience the highest cost increases, ranging from 5.2 to 7.7 cents a pound. Replacing coal-burning power stations with nuclear stations no longer represents an attractive alternative. In the United States and many other countries (with the exception of France and Japan), new nuclear projects are fraught with delays and cost overruns. They also face strong public opposition on environmental grounds, which has become even greater since the nuclear accident at Chernobyl.

In Western Europe there is particularly strong pressure on the German power generation industry, which is based in the Ruhr coalfields. If environmental legislation in Germany becomes even stricter, this will mean an increase in electricity rates for aluminium smelters just at the time when their energy supply contracts with German utilities come up for renewal at increased prices. The effects of environmental legislation can be partly counteracted if Governments simultaneously move to subsidize basic industries whose competitive position has been harmed by the increase of electricity rates because of environmental measures. This will no doubt continue to be done, but the cost of subsidizing is becoming increasingly prohibitive in the case of some old aluminium smelters.

In effect, government legislation aimed at reducing the environmental effects of energy production might cause an increase in electricity rates. Thus, the production costs of the aluminium smelters served by the relevant power stations might also increase. The smelters relying on natural gas or coal-generated electricity are more affected than those relying on hydropower-generated electricity. This weakens the competitive position of the former, and explains in good part their closure or relocation. Furthermore, if the environmental measures have a greater effect on the price of aluminium than of its substitutes, consumers may replace the former by the latter. This could reduce aluminium's market share in many end-use markets, which implies job losses and other economic effects of a production slow-down.

6. *Technological trends*

Primary aluminium is produced by the Hall-Héroult process which, like the Bayer process for alumina refining, dates from the end of the nineteenth century. Even if it is currently the only commercial technology used, it does not mean that the process has not been improved steadily. Given that the Hall-Héroult process is highly energy-intensive, the main target for research and development in this industry has been to reduce its energy consumption. Just after the Second World War, about 265,000 kWh were required to produce a tonne of aluminium. This consumption of energy has since then been cut in half, the most modern 280,000-ampere Pechiney technology only using 129,000 kWh per tonne of metal. The research goes on to further reduce the intensity of energy used in the production of this light metal. The rapidity with which research on smelting technology has progressed during the last years is astonishing: in the first half of the 1980s, the majority of plants had 80,000- to 100,000-ampere cells, but now Alcan, Alcoa and Pechiney can count on technologies in the range of 275-280 kA ([8], p. 40). An increase in productivity has also been observed for labour, as automation and increased efficiency have reduced the number of workers required per tonne of aluminium. Today, only 25 to 30 shift workers are required in a smelter producing 240,000 tonnes per year with the most energy-efficient technology available, compared to the 100 to 110 shift workers required for a 110 kA Soderberg plant.

In the past four years, the largest American aluminium companies have spent between 1.3 and 1.5 per cent of their sales on R and D. This percentage has usually been nearer 2 per cent for Alcoa (between $180 million and $220 million), while in the case of Kaiser Tech and Reynolds the R and D expenses represented between 0.6 and 1 per cent of their sales [9]. It may be safely assumed that these percentages are not very different for the other North American and European producers. All these millions of dollars are not only spent on processing technology aimed at reducing production costs, but also on the development of new alloys and production processes for specific end-uses, and on general materials research. The last two categories have increased their importance during the last decade, as user specifications have become more stringent, necessitating the "tailoring" of materials to specific end-uses ([8], p. 57). Examples of R and D related to the development of new products are numerous. Below some examples of these products are discussed in the three major aluminium end-uses:

(a) *Transportation sector.* This sector accounts for 27 per cent of the aluminium consumption of developed market economies. Aluminium has made significant inroads into the automobile parts manufacturing industry at the expense of steel or cast iron and copper or brass, and it now represents approximately 7-8 per cent of the average total weight of a car (compared to 2 per cent in 1973). In order to increase this share even more, research continues on the production of car bodies made of aluminium. Various technologies already exist, such as Alcan's aluminium-structural-vehicle-technology (ASVT) process which utilizes adhesively bonded sheet aluminium, thus reducing the number of welding spots. In the aircraft industry, in order to counter the trend of replacing aluminium by composite materials (components of resin or plastic-based composites), the aluminium producers have developed aluminium-based composites which have fibres of silicon carbide, alumina or boron carbide in an aluminium matrix, as well as aluminium-lithium alloys. Arall laminates, which use layers of fibre-pre-impregnated resins adhesively bonded between thin sheets of aluminium, are also increasingly used. Inroads by aluminium are also observed in other transport sectors such as buses, trucks and railroad cars, in particular for body panels. For example, in Japan, a new high-speed train currently under development, in which cars will be magnetically levitated using linear induction motors, will most probably utilize aluminium to reduce weight.

(b) *Packaging.* This sector accounts for 20 per cent of aluminium consumption of developed market economies. It is known that aluminium cans have achieved a complete dominance of the United States metal beverage-can market ([1], pp. 217-254). The switch from steel to aluminium since the mid-1970s has been driven largely by total production costs (total filled costs, plus warehousing, distribution, and handling costs). Initially favouring the steel can, these cost differences first narrowed and then turned to the advantage of aluminium. Thinner can body stock and can recycling programmes have also been major contributors. Nevertheless, competition from glass, plastic or steel with tinplate remains strong in most other countries, in particular those with no established can collecting network. Resistance is also very high in the food packaging sector, where the problems to be overcome include: the need to produce cans in several different sizes; the difficulty of spreading the high capital cost of the new filling equipment over a large enough volume; and the necessity to use thicker or differently alloyed can-stock to achieve sufficient rigidity of the cans to hold their shape during high pressure vacuum processing. While some problems such as low internal strength of aluminium food cans may be solved through the nitrogen-injection process, development work for some applications is still ongoing. Finally, the use of aluminium in food packaging has also increased through the use of new technologies for laminating plastic, paper and aluminium foil. These technologies may make it possible to use aluminium in packaging of food for preparation in microwave ovens, and thus provide even more opportunity for growth in aluminium consumption.

(c) Other sectors. Building and construction account for 20 per cent, electrical goods 9 per cent, consumer durables 7 per cent and machinery and equipment for 7 per cent of the aluminium consumption of developed market economies. Company investment in the development of new products has produced the following results for these sectors. Reynolds Metals has developed a new fire-resistant building panel known as Reynobond, which could stimulate the use of aluminium in the building and construction sector. In addition to its fire resistance, this lightweight panel (made of a thermo-lastic compound plastic core between two sheets of aluminium) has been designed to maintain flatness and to offer durability in different weather extremes.* A new product developed by Alcan, known as Duralcan, may imply new applications for aluminium in sporting goods, cast products and small engine components. This new product is made of aluminium reinforced with silicon-carbide ceramic particles. Lighter than steel and less expensive than titanium, Duralcan is expected to be found in numerous applications in the automotive and aerospace industries. Another potential new market for aluminium is in the production of air-cell batteries. Characterized by long shelf-life, low weight before activation and constant power output, the air-cell batteries seem ideal for electric vehicles.

These are the main technological trends aimed at reducing production costs and developing new alloys and production processes for specific end-uses. As the aluminium industry matures, the need to develop new markets will become as important as reducing the energy consumption in the production process.

7. *Short- and medium-term outlook*

What are the future prospects of the international aluminium industry? What will be the main structural characteristics of this industry by the year 1995, or even 2000? The following tentative forecasts are proposed. First, if it is assumed that the trough of the 1991-1992 recession was reached in the first quarter of 1992, and that from that point GDP will have started to increase at a faster rate in most industrialized countries, then there is no doubt that aluminium consumption will have increased in the following months. This will lower stock levels from the ceiling reached because of the recession and because of the Russian exports on the LME; the result will be upward pressure on aluminium market prices. If this scenario makes any sense, then the next question is: by how much will consumption increase? The expected short-run aluminium consumption annual growth rate is something around 2 per cent for most consuming countries. In the medium term, the expected aluminium consumption growth rate is more difficult to determine since it depends on the developments taking place in each of the end-use markets. The growth in the market will come more from an increased use of aluminium in the automobile and other transport sectors (around 4.5 per cent year), and from the growing adoption of aluminium cans in countries other than the United States (5 per cent per year), than from electrical or building and construction sectors (1.5-2 per cent). Taking these different growth rates into account, aluminium consumption is likely to grow at an annual growth rate averaging between 2.5 and 3 per cent from 1992 to 1995-1996.

Second, on the supply side, table V.10 has suggested that aluminium production capacity may increase up to the mid-1990s at an annual growth rate of 3.7 per cent. This excludes the growing importance of secondary aluminium, which represents between 30 and 35 per cent of total supply worldwide. Even if part of the estimated capacity will not be in operation by 1995 (and assuming that the capacity growth rate will rather hover around 3 per cent), the fact remains that aluminium consumption will increase at too moderate a rate to absorb the actual and the future production. The implications of such an observation are obvious: unless a good part of the actual high-cost world capacity is closed, the international aluminium market will remain afflicted by an excess supply.

Third, two possible price scenarios may be envisaged. If the high-cost smelters remain in operation and continue to be subsidized by their governmental authorities, risks are high that average price will not differ much from the actual price level of $1,300 per tonne. This implies a decrease in real price over time. If, on the contrary, the industry is able to restructure itself along the lines suggested earlier (or if consumption increases at a faster rate than expected), then prices will fluctuate around a growing trend. Consequently, the target of $2,200 per tonne experienced up to now for too short a period of time could be reached again. Given the degree of optimism implied in the second scenario, it remains safer to assume that an average market price of $1,900 per tonne may be reached during the period 1992-1996.

Fourth, concerning trade and investments in new capacity, the international aluminium industry will produce a growing percentage of its primary aluminium in Canada, Latin America, Western Asia and perhaps eventually in North Africa. The advantage of

*See [10], chap. 7

these countries and regions, in terms of energy costs, is too high to be neutralized by other possible disadvantages in other inputs such as alumina, labour or capital and servicing costs. Given the fact that aluminium consumption in these countries and regions is lower than their expected production capacity, they will continue to dominate the export market for many years to come. On the other hand, imports by Japan will presently increase at the same rate as its consumption, while Germany, Italy, and the United States and some newly industrializing countries and areas (Republic of Korea, Taiwan Province) will see their imports represent a growing share of total aluminium consumption.

Finally, there is a risk of seeing the world aluminium industry evolving towards a dual structure, with developed countries producing the more sophisticated high-value-added products (Duralcan, Reynobond, Arall, aluminium-lithium alloys, air-cell batteries etc.), and developing-country producers supplying "commodities" or basic standard alloy products (can-sheet, standard extruded products). This risk becomes even bigger if the production of the former products has to be justified by the existence of a large domestic market or the possibility to export towards larger markets. The prospect for the emergence of a new international division of labour needs to be monitored during the following years, since it would imply a return to the situation existing in the 1960s, when bauxite was provided by developing countries and high-value-added products such as alumina and aluminium were then produced in developed countries.

B. Sugar processing (ISIC 3118)*

i. Current situation

The sugar industry entered the 1990s with great promise for producers; demand was high with insufficient supply to satisfy it. Given the drawing-down of stocks during the second half of the 1980s, sugar prices were the highest that they had been for nine years [11]. They appeared to be on an upward trend, as long as they did not induce a strong increase in new supply. However, this expectation was not fulfilled. World production began to outstrip demand and prices have fallen back towards the low levels of the mid-1980s. Among the major underlying causes, China, which had imported raw sugar from the world market in large quantities in the late 1980s, began to concentrate on supplying its home market from domestic production. As a result, Chinese output had increased substantially at the beginning of the 1990s, reducing the need for imports. At the same time, Thailand added to world stocks by rapidly increasing production. Coupled with this growth in world output was a squeeze on demand, particularly in Eastern Europe, whose rapid conversion to a market economy restrained national income and foreign exchange availability, and thereby sugar import demands.

*UNIDO acknowledges the contribution of Landell Mills Commodities Studies Ltd

(a) Production

Over the past five years, rapid expansion among Asian producers helped to propel Asian growth in sugar production above that of all other regions. As shown in table V.12 the most impressive performance in the period between 1985 and 1990 was among the market-oriented Asian countries, which boosted their sugar output by nearly 50 per cent, from 15.6 million tonnes in 1985 to 22.9 million tonnes five years later. Underlying this performance was the extraordinary growth achieved in China, India and Thailand. As a consequence, the market economies of Asia accounted for more than 20 per cent of total world sugar output in 1990. The sugar industries in Africa and the centrally planned countries of Asia also did reasonably well, with the latter posting a 26.5 per cent rise in output, stimulated by China's increase in the late 1980s, and the former moving ahead by around 10 per cent. The only region that did not perform well in the second half of the 1980s was Western Asia, where sugar production fell by around 0.11 million tonnes, about 15 per cent. A large part of the blame for the worse performance was the drop in output by the Syrian Arab Republic.

(b) Factors underlying production

There are many different reasons why a country expands or contracts its output. These may be related to weather, politics or economics. Economic factors have been of primary importance in the expansion of production in Thailand. The country's growth in output during the 1980s is nothing less than phenomenal. Production more than doubled during the decade, rising from 1.7 million tonnes in 1980/81 to 3.7 million tonnes 10 years later. Because of the sugar industry's exposure to higher world sugar prices in the early 1980s, farmers greatly increased production. Indeed, the land area harvested for cane production rose from 0.47 million hectares to 0.66 million hectares in the 10 years between 1980/81 and 1990/91.

The introduction in 1982/83 of a new payment-sharing method between growers and millers provided further impetus for farmers to grow cane. Under the new payment system, growers received 70 per cent of the combined revenues from domestic and export sales of sugar, and mills earned the remaining 30 per cent. Under the new system, the high world prices of the early 1980s (from 1979/80 through 1983/84) meant higher earnings from growing cane, while all growers shared in the profits earned from sales made to the protected domestic market. Given the ability to ratoon cane (whereby a cane plant is harvested over a number of years before being ploughed in), the effects of the high prices upon plantings lasted into the period of low prices in the mid-1980s. While strong world prices benefited farmers, so too did the improvements in efficiency which came about through increased use of fertilizers and the introduction of the tractor on cane lands. These improvements enabled Thai farmers to lower their costs of production among the world's cane-sugar-producing countries from the thirty-third position in 1980/81 to seventh in 1988/89. Improvements in the mills helped the country's overall production costs to achieve a world rank of seventh in 1988/89, compared with forty-fifth in 1980/81. Government policy to reduce import dependence in sugar was responsible for the production

Table V.12. World production of sugar, by region, 1985 and 1990

Economic grouping, region and country	Production 1985 (thousand tonnes, raw value)	Production 1990 (thousand tonnes, raw value)	Percentage change 1985-1990	Percentage share 1985	Percentage share 1990
A. Western Europe (including German Democratic Republic)	19 324	19 946	3.22	19.43	18.07
Eastern Europe and USSR	13 142	13 703	4.27	13.21	12.42
North America	5 475	5 883	7.44	5.50	5.33
Japan	928	982	5.83	0.93	0.89
Other	5 979	5 838	-2.35	6.01	5.29
B. Asia					
Centrally planned economies (including China)	5 270	6 665	26.47	5.30	6.04
Market economies	15 583	22 923	47.11	15.67	20.77
Latin America	28 083	28 230	0.52	28.24	25.58
Africa	4 923	5 550	12.74	4.95	5.03
Western Asia	750	636	-15.20	0.75	0.58
Total, A and B	99 457	110 357	10.96	100.00	100.00

Source: International Sugar Organization, *Sugar Yearbook* (London, 1990).

Table V.13. World's largest sugar-producing countries, 1985 and 1990

Economic grouping, region, country and area	Production 1985 (thousand tonnes)	Production 1990 (thousand tonnes)	Percentage change 1985-1990	Percentage share 1985	Percentage share 1990
Developed countries					
EEC (including German Democratic Republic)	15 762	17 175	8.96	16.03	15.56
USSR	8 261	9 159	10.87	8.40	8.30
United States	5 415	5 743	6.06	5.51	5.20
Australia	3 439	3 612	5.03	3.50	3.27
South Africa	2 540	2 226	-12.36	2.58	2.02
Poland	1 841	1 865	1.30	1.87	1.69
Turkey	1 398	1 565	11.95	1.42	1.42
Japan	928	982	5.82	0.94	0.89
Yugoslavia	933	945	1.28	0.95	0.96
Czechoslovakia	840	717	-14.64	0.85	0.65
Total	41 357	43 989	6.36	42.05	39.86
Developing countries					
India	7 016	12 068	72.00	7.13	10.94
Cuba	7 889	8 445	7.05	8.02	7.65
Brazil	8 455	8 007	-5.30	8.60	7.26
China	4 800	6 200	29.17	4.88	5.62
Thailand	2 393	3 542	48.09	2.43	3.21
Mexico	3 492	3 384	-3.09	3.55	3.07
Indonesia	1 705	2 346	37.60	1.73	3.07
Pakistan	1 410	1 989	19.46	1.43	1.80
Philippines	1 665	1 686	1.26	1.69	1.53
Colombia	1 367	1 593	16.53	1.39	1.44
Total	40 192	49 259	22.56	40.87	44.64
World	98 352	110 357	12.21	100.00	100.00

Source: International Sugar Organization, *Sugar Yearbook* (London, 1990).

growth of China. As shown in table V.13, output rose by 30 per cent between 1985 and 1990 in response to previous decreases in both planted area and sugar, which forced the country to import 3.7 million tonnes of sugar, despite consumption rationing. As a consequence, the area planted to cane increased by 13.5 per cent between 1987 and 1989, and the area planted to beet by 18.7 per cent. By 1990, sugar production had risen to 6.2 million tonnes, higher than the 4.88 million tonnes in 1988.

A combination of climatic and economic conditions helped India to boost production. In the five years between 1985 and 1990, India's output of sugar rose from 7 million to 12.1 million tonnes, assisted by favourable weather conditions. In the mid-1980s, production had fallen back from the 1982 peak of 9.1 million tonnes. With the decline in sugar output, imports rose to 1.7 million tonnes in 1985. The tremendous increase in output over the next five years reversed the large-scale net imports to net exports of 0.05 million tonnes. Apart from the weather, increasing sugar output stems from the rising profitability of cane-sugar relative to more traditional types of sugar, known as *gur* and *khandsari* (produced with old technologies). Depending on the relative price of sugar compared with gur and khandsari, cane is diverted towards or away from mills for white sugar production. As the cane-sugar price received by mills rises relative to the gur price, the ability of modern sugar mills to compete for cane supplies improves, and the share of the crop diverted to them increases. In fact, the relative price of sugar to gur and khandsari has risen in every year, except 1988/89, since 1983/84. Consequently, the proportion of cane sent to mills has followed exactly the same pattern. The increase in sugar prices has been the result of government policies, which have focused on raising the proportion of sugar sold on the domestic free market, relative to that sold at government-determined low prices for purchase by low-income consumers.

(c) Consumption

Over the past five years, the greater degree of responsiveness of sugar demand to income of consumers in the South relative to those in the North helped countries of the South to post larger gains in consumption than those in the North. Tables V.14 and V.15 list the major consumers in the world along with their levels of sugar consumption. The market economies of Asia have seen the largest relative increase in sugar consumption over the past five years, with an increase of 27.51 per cent. The figure for Latin America is also quite dramatic, with demand rising by 11.97 per cent to reach 18.5 million tonnes. The region suffering the greatest decline has been Western Asia, where consumption dropped from 3.4 million tonnes in 1985 to 3.3 million tonnes by 1990. Japan also reduced its consumption over this period, from 2.9 million tonnes to 2.8 million tonnes in 1990.

The average annual growth of 1.7 per cent in global sugar consumption in the 1980s was slower than the 3.9 per cent achieved in the 1960s for two important reasons. The first lies in the nature of sugar as a commodity. As income increased, the rate of growth of sugar consumption slows. For a country with a relatively low GDP, any windfall or decline in its revenues will have a greater impact on its sugar offtake than in the case of a country with a relatively higher GDP. In general, consumers in low-income countries prefer more sugar as their incomes increase. This is much less true of richer countries; there is a level of income beyond which extra income does not encourage greater sugar demand. Since more countries were relatively mature sugar consumers in the 1980s than in earlier decades, it is understandable why the rate of growth of sugar consumption in the most recent decade has been slower.

The second reason for slower growth in sugar demand has been the spread of sugar substitutes [12]. These

Table V.14. World consumption of sugar, by region, 1985 and 1990

Economic grouping, region and country	Consumption 1985 (thousand tonnes, raw value)	Consumption 1990 (thousand tonnes, raw value)	Percentage change 1985-1990	Percentage share 1985	Percentage share 1990
A. North America	8 340	8 909	6.83	8.42	8.27
Western Europe (including German Democratic Republic)	16 876	16 327	-3.26	17.03	15.16
Eastern Europe and USSR	17 743	18 262	2.93	17.91	16.96
Japan	2 891	2 833	-2.03	2.92	2.63
Other	2 552	2 717	6.47	2.58	2.52
B. Asia					
Centrally planned economies (including China)	6 973	7 801	11.87	7.04	7.24
Market economies	17 050	21 741	27.51	17.21	20.19
Latin America	16 552	18 532	11.97	16.71	17.21
Africa	6 725	7 336	9.09	6.79	6.81
Western Asia	3 366	3 250	-3.45	3.40	3.02
Total, A and B	99 068	107 708	8.72	100.0	100.00

Source: International Sugar Organization, *Sugar Yearbook* (London, 1990).

Table V.15. World's largest sugar-consuming countries, 1985 and 1990

Economic grouping, region and country	Consumption 1985 (thousand tonnes)	Consumption 1990 (thousand tonnes)	Percentage change 1985-1990	Percentage share 1985	Percentage share 1990
Developed countries					
USSR	13 200	13 400	1.52	13.50	12.31
EEC (including German Democratic Republic)	12 779	13 067	2.25	13.07	12.00
United States	7 290	7 859	7.80	7.46	7.22
Japan	2 833	2 833	-	2.90	2.60
Turkey	1 348	1 750	29.82	1.38	1.61
South Africa	1 368	1 433	4.75	1.40	1.32
Poland	1 690	1 404	-16.92	1.73	1.29
Canada	1 050	1 050	-	1.07	0.96
Australia	764	864	13.09	0.78	0.79
Czechoslovakia	800	741	2.97	0.82	0.68
Total	43 122	44 401	2.97	44.11	40.78
Developing countries					
India	8 974	11 121	23.92	9.17	10.21
China	6 350	7 100	11.81	6.49	6.52
Brazil	6 080	6 615	8.80	6.21	6.08
Mexico	3 548	4 424	24.69	3.63	4.06
Indonesia	1 794	2 650	47.71	1.83	2.43
Pakistan	1 400	2 290	63.57	1.43	2.10
Egypt	1 600	1 725	7.81	1.64	1.58
Philippines	1 340	1 582	18.06	1.37	1.45
Colombia	1 044	1 195	14.46	1.07	1.10
Thailand	721	1 105	53.26	0.74	1.02
Total	32 851	39 807	21.17	33.58	36.56
World	97 779	108 873	11.44	100.00	100.00

Source: International Sugar Organization, *Sugar Yearbook* (London, 1990).

include high-intensity sweeteners, such as aspartame and saccharin, as well as liquid sweeteners made from starch-containing products such as wheat, potatoes or maize, the latter known as high-fructose corn syrup (HFCS) [13]. During the 1980s, HFCS more than doubled its share of the nutritive sweetener market. At the beginning of the decade, HFCS held 3.1 per cent of the market, but this figure had risen to 7.1 per cent by 1990 [14]. Among the five largest HFCS consumers (North America, the European Community, Japan, Republic of Korea and Argentina), the share of HFCS in the nutritive sweetener market stood at 22.8 per cent also in that year. The consumption of all types of intense sweeteners (which are non-nutritive and thus do not provide calories) rose by more than 50 per cent between 1980 and 1990, from 4.8 million tonnes to almost 7.5 million tonnes (of sugar equivalent).

(d) Prices

Prices of sugar have displayed high volatility and cyclicality for several reasons [15]. The first is the geographic adaptability of sugar. Since sugar can be produced in more than 100 countries around the world, the world market is prevented from being dominated by one or two key producers. However, the existence of many producers does not mean that the world sugar market is highly stable. On the contrary, a good year in one region will result in several countries having a bumper harvest and subsequent greater exports. Secondly, most domestic sugar industries throughout the world are subject to heavy governmental protection. The availability of sufficient sugar for the citizens of a country is seen as an important political objective by many Governments. Thus, hiding behind high tariff or non-tariff barriers, many producing countries sell only residual, or surplus, sugar on the world market, with the majority of sales made to the domestic market.

In countries where sugar prices in the domestic market are relatively high and protected from the world market, sugar producers usually receive some average of domestic and world prices, with sales to different markets combined before revenues are shared among growers and processors. This enables the industry to boost returns at times of high international prices, while offsetting export losses in times of depressed world prices with profits on domestic sales. As long as the average price enables profits to be made in the long term, sugar producers will be cushioned from low world prices. The extent of this cushioning, namely the ability to use such average pricing successfully, depends on the size of domestic market sales relative to exports, as well as on the profitability of such local sales.

This heavy trade protection has important implications for the dynamics of the response of sugar production to changes in world market prices. It can be assumed that countries that pay growers an average of overall revenues will react only gradually to falling international sugar prices; indeed, some countries that are heavily insulated from the world market price by a large and profitable domestic market or a large preferential export quota may barely react at all. Instead, producers in these countries react to changes in domestic prices or to changes in the exposure of their output to world prices.

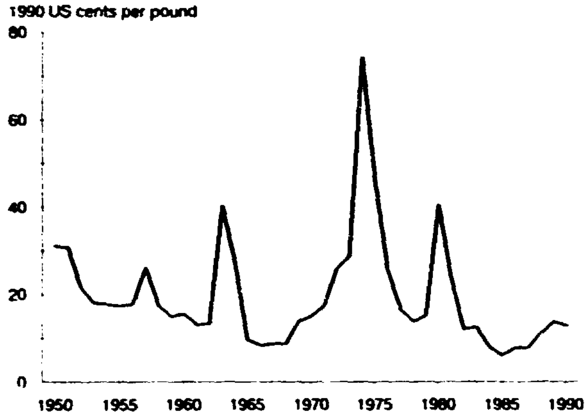
In addition, the long-term nature of the cane-sugar crop prevents a swift supply response to changes in world sugar prices. Because the same cane plant can yield several seasons of production, albeit with lower yields each time, the effect of a one-time response of supply to changing prices will reverberate for several seasons. In other words, an area of cane that is planted during a time of high world prices will continue to yield sugar up to eight seasons later, long after the combined effects of the increased output of several countries has created a supply surplus and thereby lowered prices.

The diminished response of production to lower world prices is delayed by the cushioning of many producers from the world market. It is a well-known feature of the sugar market that only about 25 per cent of annual production is traded internationally, and that only about 65 per cent of this is traded on the free market. The other 35 per cent of international sales is traded under long-term contracts between buyer and seller, often at fixed prices over a long period of time, for example, five years. Thus, changes in world prices may have little or no impact on the output of some individual countries.

The same type of limited responsiveness to changes in market prices is true on the demand side. With the majority of the consumption of an individual country taking place at prices that are not related to world market values, the responsiveness of consumption to changes in world prices is limited. At the same time, given the relatively small amount of free market international trade in sugar, there are other considerations besides price that are involved in the decision of a country to import from the free market. Perhaps the most important factor is foreign exchange availability. A country that has scarce foreign exchange reserves may decide to ration sugar to its consumers rather than using these reserves to secure additional sugar supplies.

The cyclical behaviour of real sugar prices over the past 40 years can be viewed in figure V.2. The movement in sugar prices is dominated by the relatively small proportion of consumption and production that is traded on the free market. As implied above, the typical sugar cycle has been characterized by four or five years of surpluses, followed by a similar number of years of deficits, before the pattern is reversed and surpluses reappear. This reflects the lagged response of sugar production (particularly with producers of cane, who produce several ratoons from one plant) to changes in world prices. The cycle is reinforced by the tendency of consumption growth to accelerate when prices are low and to decelerate when prices are high.

Figure V.2. Real sugar prices
(In 1990 purchasing power)



Source: International Sugar Organization, *Sugar Yearbook* (London, 1990), and World Bank *Quarterly Review of Commodities Markets* (Washington, D.C., September 1991)

2. *Trade*

One of the most misleading issues in world sugar trade is the use of the term "world market" to describe the proportion of sugar sales that is governed by competitive or free market prices. Recently, more than 70 per cent of world output has been consumed where it is produced, leaving less than 30 per cent for world trade; of this 30 per cent, as much as 60 per cent is not traded at the world price. None the less, an increasing number of sugar producers (including Australia and Thailand, as well as many small producers in Central America and Southern Africa) rely heavily on the "world market" to absorb the majority of their output. Accordingly, the major objective of sugar marketing policy in many leading sugar-exporting countries has become the construction of ways and means to reduce their vulnerability to extreme swings in revenues.

The inherent dilemma created for exporting countries is that, by their very attempts to insulate themselves from world price fluctuations, they exacerbate the price swings that are the causes of their anxiety. For example, sugar exporters actively seek to develop long-term contractual commitments with buyers at predetermined, stable prices. However, by doing so, they force the remaining tonnages of sugar being traded at free market prices to become even more of a residual tonnage to be disposed of at lower-than-market price.

The need by major exporters to create these long-term agreements has split the world sugar market into two segments: the preferential market and the free or world market. The former covers all the sugar that is traded internationally between countries under special arrangements. Examples include trade between the EEC and a group of African, Caribbean and Pacific (ACP) countries under the Lomé Convention, and between the United States and its tariff-rate quota partners (nearly all of which are in the developing world), while the free market covers the trade flows of the remaining sugar. One of the fundamental truths of the world sugar market is that very few producers face world prices, and equally few consumers are allowed to benefit from price declines in the world market. Therefore, the economic role of prices in determining appropriate supply and demand balances is greatly reduced.

Besides the segmentation that occurs between contractual and free market trade, world trade is considered to be divided in two other ways. The first is on a regional basis, with the division between the Atlantic and Pacific Ocean zones, and the boundary between the two being the Suez Canal. The second depends on the type of sugar marketed, specifically raw sugar or white sugar.

Regarding the type of sugar that is traded, the market for raw sugar accounts for two thirds of the total of the free market while the market for white sugar represents less. The difference between these markets causes differences in buying and selling behaviour. Developed countries, with specialized industrial sugar-refining facilities, tend to be the main purchasers of raw sugar. These include Canada, Japan, the former USSR, the United States, the EEC and the Scandinavian countries. Algeria, China, Malaysia, Morocco and the Republic of Korea are examples of developing countries with refining industries, and, as such, import significant quantities of raw sugar.

One of the key features of importers of white sugar is that they are typically smaller buyers on world markets, purchasing less than 60,000 tonnes per year. This is caused by the high capital costs required to set up a refinery. The minimum production size feasible for refineries is an output of 90,000 tonnes per annum, operating for a minimum of 300 days per year. Therefore, the small consumer countries, unable to afford such outlays, rely on the importation of whites.

In general, countries that produce and export cane-sugar tend to export almost all of their sugar as raw sugar (Australia, Dominican Republic and the Philippines), or at least a large proportion as raw sugar (Brazil, Cuba and Thailand). Producers and exporters of beet sugar export virtually entirely white sugar Such exporters include Austria, Czechoslovakia, Poland, Turkey and the EEC. Raw sugar exports are relatively the more important of the two, with three of the world's five largest sugar exporters (Cuba, Australia and Thailand) being producers whose exports are predominantly raw sugar. The two exceptions are the EEC and Brazil.

Over the past five years major exporters of raw cane-sugar in the South, the western hemisphere and East Asia have posted bigger gains on the whole than those in the North, while, among the largest importers, North African countries have shown rapid growth. Table V.16 lists the major importers and exporters in the world and the amounts that they trade. Of the five major exporters of the world (Cuba, the EEC, Australia, Thailand and Brazil), only one has seen its level of exports decline significantly since 1985. Brazil sold 2.61 million tonnes of sugar on world markets in 1985, but by 1990, as a result of decreasing production, exports had fallen to 1.58 million tonnes. Thailand experienced the most significant growth among all of the leading exporters, which was facilitated by their rapid output increases. In 1985, only 1.78 million tonnes of Thai sugar reached world markets, but this figure increased to 2.5 million tonnes by 1990.

The biggest rise in imports between 1985 and 1990 occurred in Algeria and the Republic of Korea, where imports grew by 52.07 per cent and 21.48 per cent, respectively. Egypt also showed a substantial rise in imported shipments. The largest reduction in imports over the period occurred in China, whose imports declined by 0.8 million tonnes between 1985 and 1990 to total 1.4 million tonnes at the end of the five-year period. These changes in imports masks one important variable governing the decision of countries to import from the free market. That variable is the oil price and, by implication, the availability of foreign exchange. The oil crises of the 1970s had an important impact on the sugar market in two ways.

First, the rise in oil prices boosted the national incomes of oil-exporting countries. Oil exporters that were also net sugar importers therefore had greater resources to import even greater amounts of sugar. Nigeria, for example, increased its imports by 0.83 million tonnes between 1973 and 1981 to supply the five-fold increase in the country's sugar consumption that occurred during this period. The reason for this

Table V.16. Exports and imports of leading sugar-trading countries, 1985 and 1990

Exporters	Gross exports 1985 (thousand tonnes)	Gross exports 1990 (thousand tonnes)	Percentage change 1985-1990	Importers	Gross imports 1985 (thousand tonnes)	Gross imports 1990 (thousand tonnes)	Percentage change 1985-1990
Cuba	7 209	7 172	-0.51	USSR	4 477	4 082	8.82
EEC (including German Democratic Republic)	4 506	5 373	19.24	United States	2 275	2 110	7.25
Australia	2 651	3 069	15.77	Japan	1 986	1 752	-11.78
Thailand	1 781	2 469	38.63	EEC (including German Democratic Republic)	1 946	1 790	-8.02
Brazil	2 609	1 577	-39.56	Mexico	..	1 552	..
South Africa	1 025	833	-18.71	China	2 214	1 379	37.71
China	250	620	148.00	Republic of Korea	903	1 097	21.48
Mauritius	571	612	7.18	Canada	1 158	949	-18.05
Guatemala	297	549	84.85	Algeria	532	809	52.07
United States	430	464	7.91	Egypt	711	805	13.22
TOTAL	21 329	22 738	6.61	TOTAL	16 202	16 325	0.76

Source: International Sugar Organization, *Sugar Yearbook* (London, 1990).

significant increase was that in countries with a relatively low per capita GDP (as the majority of oil exporters were prior to 1973) any income increases are directed to more sugar consumption, especially relative to richer countries. On the other hand, an increase in wealth for oil exporters implies less income for oil importers. The latter were forced to cut back on their imports, as scarce foreign exchange was used to purchase oil supplies at greatly elevated prices, instead of sugar.

Second, oil-importing sugar producers in general were affected by the two oil crises. The operation of beet-sugar factories and raw sugar refineries requires large amounts of energy. The milling of sugar cane is less dependent on energy from outside sources because the mills use bagasse, a by-product from cane, as fuel. One factor that has tempered the effects of oil shocks on production costs has been the insulation of many domestic sugar industries from the competitive forces of the world market. This meant that regulating authorities ensured that the greater costs implied by the higher energy prices were passed through, so that producers' margins were not squeezed.

The most significant impact on a single country occurred in Brazil, where the hike in oil prices tipped the economic balance between petrol and cane-derived ethanol. This led to the introduction in 1975 of the country's large and now faltering ethanol fuel programme, in which cane juice was used for ethanol distillation rather than the manufacture of sugar. Given the sharp rise in oil prices in 1973-1974, a growth rate in petrol demand of 10 per cent per year, falling world sugar prices, and surplus capacity in the Brazilian sugar industry, such a programme appeared to be a perfect way to preserve foreign exchange, satisfy demand for vehicle fuel and reduce pollution. As a result, the cane area expanded in the centre and south of the country to accommodate the extra cane needed. The Brazilian government, with a system of quotas for ethanol and sugar, made it profitable for growers to supply cane for both sugar and ethanol. Consequently, ethanol production increased from less than 4 billion litres in 1979/80 to a peak of just under 12 billion litres in 1989/90. The number of cars running on 100 per cent ethanol fuel rose from 2,000 vehicles in 1979 to 4.09 million in 1989.

3. *Major companies in the global sugar-processing industry*

The major sugar-processing companies of the world can be separated into several groups. First, there are those countries which do not have private sugar-producing or processing companies as such, but a centrally run authority. This authority will oversee all production within a country, as well as the processing of any output. Such a system can still be found in Cuba, and, in the past, in the USSR. Second, in other countries sugar is produced through cooperatives, which are particularly important in India. The third group includes those companies that are privately owned, and which compete with each other to maximize returns from their investments.

Table V.17 lists the top five processing companies for each region of the world in 1990. It also summarizes the number of factories held by each concern, and the daily processing capacity of beet or cane that can be achieved. The largest government-operated processing industry is in Cuba, with 156 factories that are capable of processing just under 700,000 tonnes of cane per day. The biggest private processor, owned by Ferruzzi of Italy, is the Italian-French group Eridania Zuccherifici Nazionali/Béghin-Say; they manage 21 factories with a daily processing capacity of 204,700 tonnes.

A closer look at the structure of the processing sector of several major producing countries reveals that the EEC prior to German unification had 184 sugar-beet factories, most of which are situated in France and Italy. Average capacity for these factories is concentrated in the range of 4,000 to 6,000 tonnes per day, with the bulk of output accounted for by plants with slicing capacity of over 5,000 tonnes per day. However, there are also factories operating with capacities below 2,500 tonnes per day as well as above 15,000 tonnes. In particular, the Federal Republic of Germany and France are the only countries represented with individual plants exceeding 14,000 tonnes daily. The largest European beet factory is at Connantre in France, with a capacity of 25,000 tonnes per day. Due to the tight regulatory framework under which sugar is produced in the EEC, the distribution of capacity tends to reflect closely the quota allocations among individual countries.

The top five processing companies in North America are exclusively in the United States. Its processing industry is one of the world's largest, with a total of 84 cane mills and beet factories processing 728,000 tonnes of cane and beet daily. Most cane is produced by firms that own and operate processing mills, while beets are grown by individual farmers and sold to a processor.

4. *Analysis of profits, sales and assets of the top companies*

Table V.18 provides a list of the current top five privately owned sugar companies in the world, in terms of processing or refining capacity. Their relative importance is stressed in figure V.3. The largest sugar and sweetener company in the world is Tate & Lyle, located in the United Kingdom. The company runs the largest sugar refinery in the world (with refining capacity of just under 1 million tonnes per year) and refines cane sugar imported into the United Kingdom and Portugal from the ACP States, under the Lomé Convention. Among its many subsidiaries, Tate & Lyle owns the Domino Sugar Corporation in the United States (the largest United States refinery company), the Western Sugar Company (once the largest beet sugar-company in the United States), Redpath Sugars in Canada (a leading refiner), and Bundaberg Sugar in Australia. The company also has interests in the changing face of sugar industries in Eastern Europe, including a 34 per cent stake in the Hungarian sugar firm Kaba. In addition to its sugar interests, Tate & Lyle is involved in manufacturing starch sweeteners and intense sweeteners. The company's new intense sweetener Sucralose, which is made from sugar, has recently been approved for use in its first market, Canada.

Table V.17. Structure of the world sugar industry in 1990

Holding company	Country or area	Number of factories[a]	Processing capacity (tonnes of beets or cane per day)[a]
Africa			
Société des sucrières et de distilleries d'Égypte[b]	Egypt	7	64 500
Tongaat-Hulett Ltd.	South Africa	5	44 900
C.G. Smith Sugar Ltd.	South Africa	6	38 220
Kenana Sugar Company	Sudan	1	17 000
SODESUCRE[b],[c]	Côte d'Ivoire	4	14 500
North America			
Holly Sugar Corporation	United States	8	41 000
Sugar Corporation of Puerto Rico	United States	6	32 500
United States Sugar Company	United States	2	32 000
Amalgamated Sugar Company	United States	4	30 000
American Crystal Sugar Company	United States		
Central America			
Ministerio del Azúcar[b]	Cuba	156	698 724
Azúcar Sociedad anónimo de CV[b]	Mexico	26	144 460
Consejo Estatal del Azúcar[b]	Dominican Republic	10	42 600
Sugar Industry Authority[b]	Jamaica	9	24 960
Corporación Azucarera La Victoria	Panama	4	24 000
South America			
FENDECAAP[d]	Peru	12	35 950
C.V.F. Centrales Azucareros, Compania anónimo	Venezuela	8	28 500
Guyana Sugar Corporation Ltd.	Guyana	10	26 660
Compania Azucarera Concepción Sociedad anónimo	Argentina	1	19 000
Ledesma Sociedad anónimo Agrícola e Industrial	Argentina	1	16 000
Western Europe			
Süddeutsche Zucker/Raffinerie Tirlemontoise	Federal Republic of Germany/Belgium	15	145 100
Eridania Zuccherifici Nazionali/Béghin-Say	Italy/France	21	204 700
Turkiye Seker Fabrikalari AS[b]	Turkey	24	64 600
British Sugar	United Kingdom	12	75 400
Eastern Europe			
Ministry of Agriculture, Forest and Food Industry[b]	Poland	78	160 400
Cukrovarnicky Prumysl, Koncern[b]	Czechoslovakia	62	94 650
Jugosecer[b]	Yugoslavia	23	84 500
Volkseigen Kombinat Zucker[b]/[e]	German Democratic Republic	47	49 000
Service Organization for the Sugar Industry[b]	Hungary	12	45 900
Asia			
Ministry of Light Industry (Sugar Division)[b]	China	27 (Beet) 41 (Cane)	301 826 [f] 301 826 [f]
Taiwan Sugar Corporation	Taiwan Province	23	60 900
Thai Roong Ruang Group of Companies	Thailand	7	58 960
Ban Pong Sugar Company Ltd.	Thailand	6	52 000
Wang Kanai Sugar Group	Thailand	5	50 289
Oceania			
Colonial Sugar Refiners Ltd. - Sugar Division	Australia	8	84 500
Bundaberg Sugar Company Ltd.	Australia	6	46 700
Mackay Sugar Cooperative-Sugar Association Ltd.	Australia	5	46 530
Fiji Sugar Corporation[b]	Fiji	4	23 480
New South Wales Sugar Milling Co-op Ltd.	Australia	3	12 000

Source: F.O. Licht GmbH, *Statistical World Sugar and Sweetener Yearbook* (Ratzeburg, 1990).

a/ Factories with a capacity of more than 1,000 tonnes per day.

b/ Denotes government-run organizations.

c/ SODESUCRE: Société pour le developpement des plantations de canne à sucre.

d/ FENDECAAP: Federacion Nacional de Cooperativas Agrarias Azucareras.

e/ These have been taken over by sugar companies of the Federal Republic of Germany and many have been closed.

f/ Total for beet and sugar factories together.

Table V.18. World's leading sugar companies

Company[a]	Country	Turnover (million dollars)	Operating profit (million dollars)
Tate & Lyle[b]	United Kingdom	5 627	450
Eridania[c/b]	Italy	1 898	270
Südzucker[d/e]	Germany	1 281	192
CSR[c/e]	Australia	850	127
British Sugar[f]	United Kingdom	1 209	177

Source: Derived from table V.17.

a/ Ranked according to total processing capacity.

b/ Data refer to 1989.

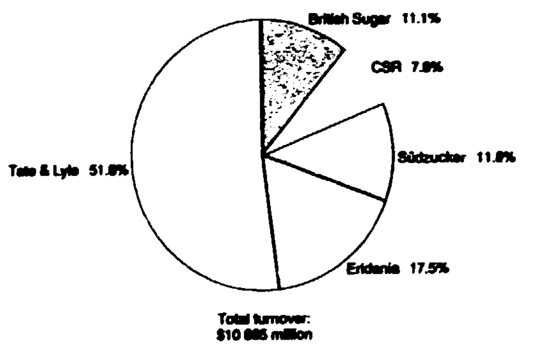
c/ Includes figures only for sugar and sweetener sector of the parent group.

d/ The ranking of Südzucker was based on 1990 processing capacity, before the incorporation of the factories of the German Democratic Republic. In 1991, Südzucker displaced Eridania in second place.

e/ Data refer to 1990.

f/ Data refer to 1988.

Figure V.3. Relative importance of the leading sugar companies of the world



Source *International Sugar Organization, Sugar Yearbook* (London, 1990), and World Bank *Quarterly Review of Commodities Markets* (Washington, D.C., September 1991)

The world's second largest sugar company is Südzucker, the largest beet-sugar company in Germany and the EEC, the main shareholders of which are a cooperative of sugar farmers and Deutsche Bank. It was formed in 1988 by the merger of Süddeutsche Zucker and Zuckerfabrik Franken. With control of Raffinerie Tirlemontoise (in Belgium), Südzucker now produces about 1.8 million tonnes of sugar annually. With the unification of Germany in October 1990, the sugar industry of the Federal Republic of Germany was faced with the task of incorporating production in the eastern part of the country (0.8 million tonnes in 1990/91). Südzucker took the first step by taking over 13 factories of the former German Democratic Republic, and it plans to expand and continue to operate six of them.

The third largest privately-owned company, Eridania, is the sugar arm of the Ferruzzi agro-industrial group. It is the largest sugar company in Italy, with a turnover in 1989 of $1,898 million and operating profits of $270 million. Ferruzzi acquired the controlling interest in Eridania in 1979. Its international links with sugar companies were cemented with the 1986 acquisition of Béghin-Say, the largest sugar producer of France. Like Tate & Lyle, Ferruzzi also owns major starch sweetener interests in Europe.

While the top three sugar companies are found in Western Europe, the fourth largest company is in Australia. The company, CSR, is Australia's leading producer of raw and refined sugar, controlling eight mills with a combined crushing capacity of nearly 85,000 tonnes per day. Prior to the deregulation of the Australian market, CSR had a domestic market share of around 95 per cent. This share has now fallen to around 70 per cent following the opening of a new sugar refinery in New South Wales.

British Sugar is the fifth largest sugar company in the world. The company, formerly part of the Berisford Group, was taken over by Associated British Foods in 1990. British Sugar has a monopoly on beet-sugar processing in the United Kingdom and owns the 10 beet factories in the country. The company also has a major equity interest in two Polish sugar factories.

5. *Manufacturing capacity of developing countries*

Tables V.19 and V.20 show the processing capacity of cane compared to beet sugar for all sugar-producing countries and areas in the South, while table V.21 reports the top five processing companies for each region in those tables. Table V.21 shows the number of factories held by each concern, and the daily processing capacity of beet or cane that can be achieved. As indicated above, the largest government-operated processing industry is in Cuba, with 156 factories capable of processing nearly 700,000 tonnes of cane per day.

Brazil has not been included in the table because a significant proportion of its sugar output is used in the production of ethanol, rather than for direct consumption. Its processing industry comprises 200 mills, with a capacity of approximately 12 million tonnes of sugar per year, operating for 150 days per year, implying a daily production capacity of 80,000 tonnes. The daily crushing capacity of individual mills varies considerably, ranging from 4,000 to 16,000 tonnes, up to a

Table V.19. Processing capacity of cane-sugar industries in developing countries and areas, 1989

Country and area	Total daily capacity[a] (tonnes)	Average daily capacity[a] (tonnes)	Production (thousand tonnes)	Net exports[b] (thousand tonnes)	Cane-sugar consumption (thousand tonnes)	Per capita consumption (kilograms)
Latin America						
Argentina	128 892	5 604	1 017	172	914	27.7
Barbados	10 580	2 645	67	55	13	51.5
Belize	6 100	6 100	94	83	7	40.4
Bolivia	26 400	4 400	170	10	170	23.6
Brazil	1 821 073	9 197	7 326	965	7 401	50.2
Colombia	53 885	4 145	1 523	323	1 163	34.4
Costa Rica	30 820	1 468	220	45	168	58.6
Cuba	698 760	4 479	7 579	7 123	882	68.0
Dominican Republic	73 000	5 615	693	521	244	35.4
Ecuador	24 850	3550	300	(51)	327	31.1
El Salvador	25 750	2 575	196	30	163	31.2
Guatemala	77 140	4 060	735	409	353	39.5
Guyana	21 740	2 718	170	147	34	41.2
Honduras	22 171	2 771	180	22	160	32.3
Jamaica	24 960	2 773	205	62	125	53.0
Mexico	345 452	5 007	3 570	(263)	4 023	47.6
Nicaragua	23 217	3 317	160	67	150	40.1
Panama	35 300	5 883	110	0	100	42.2
Paraguay	8 950	1 279	118	7	110	26.4
Peru	33 218	2 768	625	(119)	750	34.4
Saint Kitts and Nevis	3 050	3 050	25	23	2	37.6
Trinidad and Tobago	15 700	7 850		49	65	51.2
Uruguay	6 000	3 000	63	176	68	22.0
Venezuela	58 160	3 635	569	(259)	706	36.7
Western Asia						
Iran (Islamic Republic of)	21 200	10 600	140	(381)	1 000	18.5
Asia						
Market economies						
Bangladesh	20 774	1 222	130	(84)	275	2.6
Fiji	22 090	5 523	466	404	37	50.6
India	635 525	1 664	9 912	(23)	10 677	13.2
Indonesia	179 830	2 606	2 171	(325)	2 600	14.5
Pakistan	118 000	2 622	2 019	(116)	2 039	19.2
Papua New Guinea	2 800	2 800	30	15	29	8.2
Philippines	189 010	4 610	1 878	218	1 471	24.5
Sri Lanka	7 250	1 813	29	(257)	285	17.0
Taiwan Province	60 260	2 620	665	14	550	27.3
Thailand	366 646	7 801	4 228	3 105	981	17.7
Centrally planned economies						
China	251 826	1 786	4 550	(1 141)	7 200	6.4
Viet Nam	..	..	465	(30)	500	7.6
Africa						
Cameroon	6 000	3 000	35	(5)	40	3.5
Congo	10 000	5 000	35	11	25	12.9
Côte d'Ivoire	14 500	3 625	160	4	160	13.3
Egypt	8 000	2 667	872	(617)	1 650	31.1
Ethiopia	8 000	2 667	183	29	162	3.3
Kenya	17 100	2 850	440	(58)	475	19.1
Madagascar	9 400	1 880	120	76	76	6.5
Malawi	9 000	4 500	173	59	107	12.6
Mauritius	55 480	2 920	602	674	40	37.0
Sudan	39 500	7 900	385	(6)	440	18.0
Swaziland	19 200	6 400	504	407	49	64.7
Uganda	14 100	4 700	40	(16)	70	3.9
United Republic of Tanzania	13 890	2 315	100	1	100	4.0
Zambia	6 000	6 000	132	2	105	13.5
Zimbabwe	19 000	9 500	502	163	283	30.2

Source: International Sugar Organization, *Sugar Yearbook* (London, 1990); and F.O. Licht GmbH, *Statistical World Sugar and Sweetener Yearbook* (Ratzeburg, 1988 and 1989).

a/ Mills with a capacity of more than 1,000 tonnes per day.

b/ Figures in parentheses represent imports.

Table V.20. Processing capacity of beet-sugar industries in developing countries, 1988

Country	Total daily capacity[a] (tonnes)	Average daily capacity[a] (tonnes)	Production (thousand tonnes)	Net exports[b] (thousand tonnes)	Beet sugar consumption (thousand tonnes)	Per capita consumption (kilograms)
Latin America						
Chile	18 500	3 700	443	(44)	466	36.4
Uruguay	4 700	2 350	14	4	78	25.9
Western Asia						
Syrian Arab Republic	19 060	3 177	40	(300)	375	33.1
Iran (Islamic Republic of)	97 240	2 860	500	(280)	1 150	21.7
Asia						
Centrally planned economies						
China	100 000	1 000	1 000	(3 682)	7 700	7.0
Africa						
Egypt	6 000	6 000	851	1 775	34.2	
Morocco	41 400	4 140	590	(276)	756	32.3

Source: International Sugar Organization, *Sugar Yearbook* (London, 1990); and F.O. Licht GmbH, *Statistical World Sugar and Sweetener Yearbook* (Ratzeburg, 1988 and 1989).

[a] Mills with a capacity of more than 1,000 tonnes per day.

[b] Figures in parentheses represent imports.

Table V.21. Top sugar-processing companies in the South, 1990

Holding company	Country or area	Number of factories[a]	Processing capacity (tonnes of beets or cane per day)[a]
Africa			
Société des sucrières et de distilleries d'Egypte	Egypt	7	64 500
Tongaat-Hulett Ltd.	South Africa	5	44 900
C.G. Smith Sugar Ltd.	South Africa	6	38 220
Kenana Sugar Company	Sudan	1	17 000
SODESUCRE[b]	Côte d'Ivoire	4	14 500
Central America			
Ministerio del Azúcar[b]	Cuba	156	698 724
Azúcar Sociedad anónimo de CV[b]	Mexico	26	144 460
Consejo Estatal del Azúcar[b]	Dominican Republic	10	42 960
Sugar Industry Authority[b]	Jamaica	9	24 960
Corporación Azucarera La Victoria	Panama	4	24 000
South America			
FENDECAAP	Peru	12	35 950
C.V.F. Centrales Azucareros, Compania anónimo	Venezuela	8	28 500
Guyana Sugar Corporation Ltd.	Guyana	10	26 660
Compania Azucarera Concepcion Sociedad anónimo	Argentina	1	19 000
Ledesma Sociedad anónimo Agrícola e Industrial	Argentina	1	16 000
Asia			
Ministry of Light Industry (Sugar Division)[b]	China	27 (Beet)	301 826[c]
		41 (Cane)	301 826[c]
Taiwan Sugar Corporation	Taiwan Province	23	60 900
Thai Roong Ruang Group of Companies	Thailand	7	58 960
Ban Pong Sugar Company Ltd.	Thailand	6	52 000
Wang Kanai Sugar Group	Thailand	5	50 289
Oceania			
Fiji Sugar Corporation[b]	Fiji	4	23 480

Source: F.O. Licht GmbH, *Statistical World Sugar and Sweetener Yearbook* (Ratzeburg, 1990).

[a] Factories with a capacity of more than 1,000 tonnes per day.

[b] Denotes government-run organizations.

[c] Total for beet and sugar factories together.

maximum of over 45,000 tonnes of cane at several mills in the State of São Paulo.

Outside Brazil, the largest processor in Latin America is Peru, where twelve cooperative mills (FENDECAAP) with a capacity of 35,950 tonnes per day are controlled by the sugar factory workers themselves, each of whom have an equal vote in the running of the factory. In the Dominican Republic, on the other hand, the mills are controlled by three organizations: Consejo Estatal del Azúcar, a State-owned company, with the remaining four mills being operated by two private firms.

The private processing sectors in Asia and Oceania are dominated by Thailand and Australia. The latter has several private companies operating large numbers of mills with significant capacities. Quotas govern the amount of sugar that mills can process, and are distributed so as to make efficient use of existing mill capacity. The majority of the mills are situated in Queensland, with three in New South Wales. All are run by private enterprise, with approximately two thirds being operated by private companies, and the rest by local farmer-owned cooperatives. The Thai sugar industry consists of 47 mills, most of which are located in the central region of the country. Milling capacity varies considerably, with the central region having the highest concentration of mills with a daily crushing capacity of over 10,000 tonnes. Among the African countries shown, South Africa (though not considered a developing country) is the largest processor, with a total capacity of 103,720 tonnes daily, processed by 16 mills. These include cooperatives, as well as privately run mills. The Government of South Africa, through the Department of Industries, regulates domestic sugar prices and monitors the profitability of the industry. Africa's other large processor, Egypt, has a State-run industry, which operates all of the cane mills, while the one beet mill is run by the Delta Sugar company, with a daily capacity of 6,000 tonnes.

6. *Capacity utilization and expansion plans*

While producers respond to short-term movements in world sugar prices with a delay, countries who face the world market price for exports in the longer term base their output decisions on the profits to be expected from additional production. If the long-term trend in the world sugar price is less than the average production costs of a given country, that country will be very cautious about adding to its export capacity. The opposite is true if the long-term trend in the world sugar price is higher than a country's production costs.

Table V.22 lists world raw sugar prices since 1950 in both nominal and real terms and features two alternative measures of the long-run price trend. The first is simply the arithmetic mean real price extending back to 1950. Over the entire period from 1950 to 1990, the arithmetic mean of the world price was almost 20 cents per pound in 1990 purchasing power. This measure of the real price does not take any account of the underlying technical progress achieved in sugar production in recent years. If such technical progress occurs at a steady rate, the best method for estimating the long-run trend in world prices would be to fit an exponential time trend to the real world price.

Table V.22. Trends in long-term world sugar prices, 1970-1990
(United States cents per pound)

Year	Nominal price of raw sugar	Real price a/ of raw sugar	Arithmetic mean since 1950 b/	Exponential time trend b/
1970	3.68	14.89	18.32	16.90
1971	4.50	17.29	18.27	16.66
1972	7.27	25.63	18.59	16.42
1973	9.45	28.75	19.02	16.19
1974	29.66	74.07	21.22	15.96
1975	20.37	45.76	22.16	15.73
1976	11.56	25.62	22.29	15.51
1977	8.12	16.38	22.08	15.28
1978	7.80	13.67	21.79	15.07
1979	9.66	14.95	21.56	14.85
1980	28.67	40.45	22.17	14.64
1981	16.67	23.81	22.22	14.43
1982	8.42	11.98	21.91	14.22
1983	8.47	12.38	21.63	14.02
1984	5.20	7.74	21.23	13.82
1985	4.06	5.97	20.81	13.62
1986	6.06	7.59	20.45	13.43
1987	6.76	7.73	20.12	13.23
1988	10.21	10.88	19.88	13.04
1989	12.79	13.59	29.72	12.86
1990	12.71	12.71	19.55	12.67

Source: International Sugar Organization, *Sugar Yearbook* (London, 1990); and World Bank, *Quarterly Review of Commodities Markets* (Washington, D.C., September 1991).

a/ Expressed in 1990 purchasing power.

b/ Real prices.

This has been done in the final column of table V.22. It will be seen from that column that the real price of raw sugar has declined at an average annual rate of approximately 1.5 per cent per annum, and the trend value of the real price has fallen over the period from 22.2 cents per pound in 1950 to 12.5 cents in 1990.

For most of the 1960s, world prices were less than average sugar production costs; hence, investment in new sugar production capacity lagged behind the growth in demand. When a shortage occurred in the 1970s, the result was a massive bull market. While the supply response was strong, the long lead times needed to build up to full capacity on new projects meant that only a little of the new capacity was available in time to dampen the 1980 rise in prices. The capacity brought into production in response to the high prices prevailing from the early 1970s until 1981 continued to overhang the market throughout the 1980s, even though new investments were much rarer after 1983.

7. *Technological trends*

Technical progress in field and processing operations is becoming increasingly important for the long-run competitiveness and viability of leading beet- and cane-sugar producers. This has been especially important in recent years, as industries in several countries in the South (such as Argentina and Mexico) have reduced the role of the State and opened their markets up to foreign competition. The need to compete with foreign rivals, amid the rising costs of inputs such as labour and energy, has encouraged producers to seek ways to increase productivity and reduce costs.

The assessment of technical progress in agricultural industries is often quite difficult, since the quality of different inputs may vary over time. This is true not only of agricultural labour, which has tended to become more highly trained as wages have risen, but also of seeds, sprays and machinery. Only a few inputs lend themselves to straightforward quantification, in terms of so many kilograms of use per hectare, for example, or so many hours of input per tonne. The application of fertilizers can be measured in this way, as can the use of fuel per tonne of beet or cane, or the amount of labour time expended on certain tasks. By contrast, it is very hard to know what form of measurement to apply to beet seeds, whose physical productivity is much greater than it used to be. Likewise, new agricultural chemicals have powers that were beyond the reach of their predecessors.

The excellent progress made by many beet processors is illustrated by the experience of France. Since the early 1960s, French beet factories have notched up steady energy savings per tonne of beet; these averaged between 1 and 2 per cent per annum until the late 1970s, but have been close to 3 per cent since then. Process labour has been reduced much more dramatically, with savings of between 6 and 8 per cent per tonne of beets normal for the past 30 years.

8. *Short- and medium-term outlook*

The short-term outlook is for global production to continue to outpace global consumption, keeping world sugar prices at present low levels for the next two seasons, at least. This seems likely to occur despite the maintenance of relatively low prices for more than 12 months, which would be expected in a normal market to reduce supply, increase demand and thereby raise prices. The typical sugar cycle has been characterized by four or five years of surpluses, followed by a similar number of years of deficits, before the pattern is reversed and surpluses reappear. As explained above, this reflects the lagged response of sugar production (particularly cane producers, who produce several ratoons from one plant) to changes in world prices. The cycle is reinforced by the tendency of consumption growth to accelerate when prices are low and to decelerate when prices are high. The world market is currently in its third consecutive year of production surpluses, after four years of deficits, and if the traditional cyclical pattern repeats, the sugar market can expect another one or two years of surpluses, after the crop year 1991/92 has ended.

There are specific factors on both the supply and the demand sides which serve to confirm this view. On the supply side, production is expected to continue to rise in several cane-growing countries, including Australia, Brazil, China, India, South Africa and Thailand. Part of this increase is the result of government policy (such as in China), and part of it is a response to the relatively high prices which prevailed in the late 1980s and the very beginning of the 1990s. The growth in production in cane-growing countries is expected to be dampened by lower output in beet-producing countries, such as the EEC countries, where a small proportion of production (that outside preferential production quotas) can respond more speedily to changes in the world price, and the former USSR, where problems of distribution are substantial.

On the demand side, the disintegration of the former USSR and the disruption of Eastern European economies have had a serious impact on the abilities of these countries to afford imported sugar. Not only are imported supplies restricted by the lack of sufficient foreign exchange, but also domestic demand is limited by relatively low income levels. Other influences tending to dampen the growth in offtake come from South America, notably from Brazil, where the resurgence of high inflation levels is likely to lead to further tough economic policies. The expected fall in output in the former USSR and Cuba could well balance falling demand in the Republics and in Eastern Europe. If the decline in production does indeed come close to matching the reduction in Eastern European offtake, then the net impact on the market of the two influences could be quite small.

In the medium term, all else being equal, the sugar industry would be expected to enter the next phase of the production cycle, one of several consecutive deficit years. That is, production should grow more slowly than consumption, creating a supply deficit that would be maintained over several seasons. Prices are expected to remain relatively low over the next two years, before moving for a while above the long-term trend, which corresponds to a raw sugar price of around 12 United States cents per pound (in 1990 purchasing power). However, there now are signs that the sugar market might break from the mentioned cycle. The first sign is that sugar production in the former USSR could be seriously disrupted with its collapsing economy. It is relatively easy to understand why sugar production could be so severely disrupted by conditions of economic chaos that the cyclical pattern of world production surpluses and deficits could be interrupted, tipping the global sugar balance, and turning the current large production surplus into a deficit. For many years, the sugar sector of the former USSR has been hampered by low beet yields, a poor infrastructure, which has resulted in large beet losses between the field and the factory, and low sugar recovery rates at the factories. At the same time, sugar demand might decline. The factors which are currently damaging sugar production in the former USSR and Cuba are also undermining the distribution of food and eroding already low income levels. The net effect on price of these possible changes in world supply and demand is hard to predict and may be quite muted.

The second sign is that world sugar prices now have a greater impact on production decisions than was the case in the past, because a growing number of countries have increased their exposure to the world market. That is, a greater proportion of world sugar production is now influenced by the movement of world prices than at any other time in recent history. Consequently, it is argued that sugar output is now likely to react more quickly to falling world prices that it has done in the past. It is true that the period of low sugar prices in the mid-1980s left a number of major sugar-exporting countries in severe financial difficulties and led to the restructuring of their sugar pricing systems. The sugar industries in such countries as Australia, the Philippines and South Africa were unable to sustain the losses that they incurred during this period and were forced to remove subsidies on their free market exports. Since then, production levels have been maintained in the low-cost producing countries (Australia and South Africa), but in the medium- and high-cost countries, output has tended to contract to the level of domestic demand plus preferential export demand (the Philippines is a good example of this category).

Since the start of 1990, Argentina, Mexico and Poland have all adopted more liberal pricing systems which increase their exposure to fluctuations in the world price. However, with the exception of Poland, all of the countries which have made great strides towards liberalization produce sugar from cane. Since cane producers respond to changes in sugar prices with a delay, and since two thirds of all sugar is produced from cane, lags in the response of output to world prices are likely to remain a permanent feature of the sugar market.

In addition to these internal factors, there are also external influences which could also change the way that the sugar cycle works. The most important external factor, in the context of the GATT negotiations, could propel most countries into the realm of the free market in the very near future. The GATT proposals put forward at the end of 1991 could, in the extreme, lead to the virtual elimination of all trade barriers by the end of the 1990s. The proposals for sugar, put simply, call for a conversion of all trade barriers to tariffs and then for a gradual reduction of these tariffs and of export subsidies. The proposals are very complicated, but the specific way that is being recommended for adoption could lead to the virtual elimination of all tariff barriers in developed countries by the year 2000, while barriers in developing countries would be lowered more slowly.

If, as is highly unlikely, all tariff barriers are removed by the end of the decade, the impact on the sugar industry would be phenomenal. All sugar trade would be conducted in the free market, and all preferential access for sugar would be eliminated. The location of sugar production would be based on production costs, rather than on preferential selling prices, boosted by trade barriers. This might seem to indicate that the majority of raw cane-sugar production would be concentrated in the countries with very low labour costs, particularly among developing countries in Africa, Asia and Latin America, and away from countries such as Australia, Japan and the United States; beet-sugar production would likely decline in Europe and North America.

A quick examination of the number of sugar industries that could survive at prices in line with long-term trends reveals, however, that low labour costs are far from being a necessary determinant of cost competitiveness. A number of developed country producers of sugar, such as Australia in the cane sector and the United States and parts of the EEC in beet sugar, are consistently able to match production costs in developing countries.

The likelihood of complete liberalization of the sugar market is slim. What is more likely is that previous gradual attempts at liberalization will continue. Even partial liberalization will cause some shake-ups in the global sugar industry. Rationalization of various industries is likely, as is a reduction in the level of self-sufficiency for some countries and a greater reliance on imports. Some sugar industries, such as that of Argentina, are finding the transition to liberalization particularly difficult. It is estimated that during the first year of the liberalization programme of Argentina, as many as half of the sugar mills will become bankrupt.

It is unclear what the exact effects on long-term raw and white sugar prices would be. For some sugar producers, such as Brazil, liberalization would mean higher cane and sugar prices and thus greater supplies of sugar on the world market, thereby depressing the world price of raw sugar. For other producers, such as the EEC, even partial liberalization will mean lower absolute prices (although perhaps not lower relative prices, as prices for all arable crops fall in parallel) for producers and thus fewer supplies for the export market, thereby exerting upward pressure on the white sugar price.

On balance, these various arguments would appear to reject the possibility of a fundamental change in the nature of the world sugar price, and, thereby the global supply and demand cycle. Consequently, as was suggested earlier, the sugar market can expect another one or two years of surpluses after the crop year 1991/92, and can anticipate continued downward pressure on sugar prices so that, in the short to medium term, real prices will lie below $250 per tonne, raw value (in 1990 purchasing power). It also seems clear that the sugar industry will end the 1990s much more rationalized than at the beginning of the decade. The biggest impact of these changes will undoubtedly be felt on producers in the South.

C. Paper and paper-board (ISIC 3411)*

1. Current situation

(a) World consumption and production

The world produced 239 million tonnes of paper and paper-board in 1990, the last year for which there were the most complete figures by early 1992. The 1990 output total was 2.2 per cent higher than 1989. Apparent paper and board consumption increased by 2.3 per cent to 237 million tonnes. With the use of the data reported in table V.23, it is possible to make a reasonable estimate for 1991 and forecast for 1992. One estimate is that about 245 million tonnes of paper and board were produced in 1991, up 3.4 per cent, and the world industry may produce about 253 million tonnes in 1992 ([16], pp. 26-32). This would continue the series of annual output records which began in 1983. The annual rate of growth in the 1990s has not returned to the 5-6 per cent of the mid-1980s. But the annual increases possible in 1991 and 1992 are about one percentage point higher than those of the late 1980s.

As regards the division of production, the North American share of total world paper and board output has continued to decline in recent years, but at a slower rate. It was at 37 per cent in 1990 compared to 39 per cent in 1986. As shown in figure V.4, the share of Europe (Western and Eastern) has also fallen to 32 per cent compared to 34 per cent in 1986. It is the combined share of Asia and Australasia that is increasing. This region took 25 per cent of the total world output in 1990, compared with 21 per cent in 1986. However, even the combined annual growth rate of Asia and Australasia has slowed down, though it is likely to increase by 4.5 to 5 per cent during the 1990s. It is the brightest region of the world paper industry in terms of growth in both production and consumption, though there are problems and the prospect of slower economic growth in Japan.

Though this report concentrates on the paper and board industry, it is worth noting the parallel progress of its main raw material: pulp made mostly from trees, but also from other plants. World pulp output totalled 163 million tonnes in 1990, providing about 68 per cent of the raw material for paper and board production. The other main materials include waste paper and minerals. One estimate is that about 164 million tonnes of pulp were made in 1991, only marginally above 1990 and probably not above the record output of 1989 ([17], pp. 37-38). It could reach 168 million tonnes in 1992, a respectable 2.5 per cent increase. A main reason for the increase in pulp output for 1992 shown in table V.24 is the 12 per cent increase in output forecast for Latin America. Big new Brazilian production capacity is coming on stream as the country enters a new phase of expansion, and more pulp production capacity is starting up in Latin America in the next few years. This raises the longer-term probability that paper production capacity will rise too, as paper machines are added to some of the pulp production lines.

*UNIDO acknowledges the contribution of P. Sutton, editor, Pulp and Paper International.

The importance of different countries and regions in world consumption of paper and board is reflected in table V.25. With the massive increase in consumer interest in recycling, it is no surprise that the proportion of pulp to paper continues to drop. Since the late 1980s it has been steadily taking a smaller share every year of the raw material mix used to make the world's paper, from 72 per cent in 1986 to 68 per cent in 1990, down to probably 66 per cent in 1992. The period between 1986 to 1989 was one of the strongest growth periods for this industry. Figure V.5 shows that consumption also increased worldwide, with the exception of Eastern Europe. In general, all economic variables reflected growth: prices rising with demand; output increasing; profits rising. This led,

Table V.23. World production of paper and paper-board, 1990

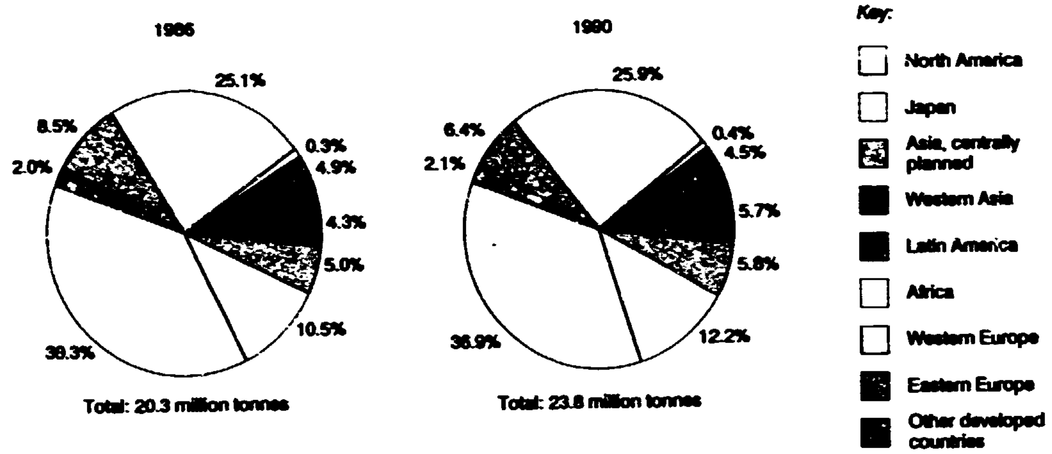
Economic grouping, region, country and area	Production (thousand tonnes)	Percentage share
Developed and developing countries		
United States	71 519	29.9
Japan	28 086	11.7
Canada	15 466	6.9
China	13 719	5.7
Germany, Federal Republic of	11 873	5.0
USSR[a]	9 800	4.1
Finland	8 958	3.7
Sweden	8 426	3.5
France	7 049	2.9
Italy	5 601	2.3
Developing countries[b]		
China	13 719	5.7
Brazil	4 844	2.0
Republic of Korea	4 524	1.9
Taiwan Province	3 337	1.4
India	2 295	1.0
A. North America	87 985	36.7
Western Europe	61 661	25.8
Japan	28 986	12.1
Eastern Europe	15 335	6.4
Other	4 918	2.1
Total, A	198 885	83.1
B. Asia		
Centrally planned economies (inlcuding China)	13 892	5.8
Market economies	13 654	5.7
Latin America	10 770	4.5
Western Asia	1 280	0.5
Africa	855	0.4
Total, B	40 451	16.9
Total, A and B	239 336	100.0

Source: Pulp and Paper International, *Fact and Price Book 1992* (Brussels, Miller Freeman Inc., December 1991).

[a] Estimate.

[b] 1988 data.

Figure V.4. World production of paper and board by region or economic grouping, 1986 and 1990



Source: Pulp and Paper International, *Fact and Price Book* (Brussels, Miller Freeman Inc., 1991).

Table V.24. Pulp output, 1991 and 1992
(Thousand tonnes)

Economic grouping and region	Output 1991[a]	Percentage change 1990-1991	Output 1992[b]	Percentage change 1991-1992
North America	80 445	0.5	81 874	1.8
Western and Eastern Europe	44 451	-1.8	45 338	2.0
Asia and Australasia	28 707	3.9	29 729	3.6
Latin America	7 536	3.9	8 449	12.1
Africa	2 427	1.5	2 506	3.3
TOTAL	163 566	0.6	167 896	2.6

Source: Pulp and Paper International, *Industry in for another tough year* (Brussels, Miller Freeman Inc., January 1992), pp. 26-32.

[a] Estimate.

[b] Forecast.

Table V.25. World consumption of paper and paper-board, 1990

Country, area, region or economic grouping	Production (thousand tonnes)	Percentage share
Developed and developing countries		
United States	77 732	32.8
Japan	28 218	11.9
Germany, Federal Republic of	23 625	1.5
China	14 429	6.1
USSR[a]	9 463	4.0
United Kingdom	9 273	3.9
France	8 755	3.7
Italy	6 954	2.9
Canada	5 724	2.4
Spain	4 341	1.8
Developing countries[b]		
China	14 429	6.1
Republic of Korea	4 310	1.8
Brazil	4 151	1.8
Taiwan Province	3 320	1.4
Mexico	2 982	1.3
A. North America	83 456	35.2
Western Europe	58 663	24.8
Japan	28 218	11.9
Eastern Europe	14 683	6.2
Other	5 444	2.3
Total, A	190 464	80.4
B. Asia		
Centrally planned economies (including China)	14 646	6.2
Market economies	16 099	6.8
Latin America	11 393	4.8
Africa	2 005	0.8
Western Asia	2 349	1.0
Total, B	46 492	19.6
Total, A and B	236 956	100.0

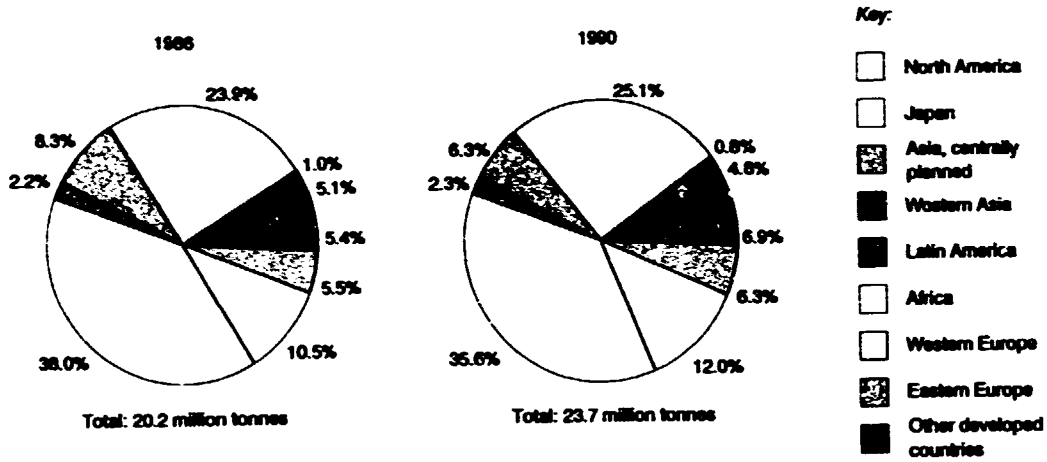
Source: Pulp and Paper International, *Fact and Price Book 1992* (Brussels, Miller Freeman Inc., December 1991).

[a] Estimate.

[b] 1988 data.

inevitably, to many ambitious plans for capital investment to raise production further and, uniquely, to a period of acquisitions and mergers by the major companies in Europe and North America. By the end

Figure V.5. World consumption of paper and board by region or economic grouping, 1986 and 1990



Source: Pulp and Paper International, *Fact and Price Book* (Brussels, Miller Freeman Inc., 1991)

of 1989, however, the first signs of a slow-down were beginning to show through. This developed in 1990 and worsened in 1991; but there were signs of a slow recovery or, at least, no further decline in early 1992. This is reflected in the annual growth in output shown in table V.26. In line with the slower growth of paper and board production, the industry generally experienced slower growth in demand for several major grades of paper and board. This combined with the completion and start-up of new production capacity planned during the late 1980s lead to oversupply in some sectors. Lower prices have also contributed to the poor financial performance of many top companies w rldwide.

The ıall in prices, which occurred for many grades of paper and board during 1991-1992 in Europe, North America and Asia, repeated itself in some sectors in Germany from late 1991. This was despite the fact that growth in demand for paper in Germany was the powerful factor pulling the industry along for most of that year, the result of the new consumer demand in the former German Democratic Republic. But there was still too much paper available. The only good sign was that the rate of the fall in prices had slowed, and some seemed to have reached bottom by early 1992. A more significant sign was that market pulp prices were starting to increase.

Table V.26. Paper and board output, 1991 and 1992
(Thousand tonnes)

Economic grouping and region	Output 1991[a]	Percentage change 1990-1991	Output 1992[b]	Percentage change 1991-1992
North America	89 900	2.2	92 563	3.0
Western and Eastern Europe	77 970	1.3	80 544	3.3
Asia and Australasia	62 983	5.1	65 824	4.5
Latin America	10 861	0.8	11 549	6.3
Africa	2 798	1.4	2 841	1.5
TOTAL	244 512	2.5	253 321	3.6

Source: Pulp and Paper International, *Fact and Price Book 1992* (Brussels, Miller Freeman Inc., December 1991).

[a] Estimate.

[b] Forecast.

(b) Trade

Nearly 1 tonne of paper out of every 4 produced crosses a frontier. Over the period there has not been any major change in the basic trade patterns, though there are some small trends, as reflected in tables V.27 and V.28. The main paper trade routes remain: from

Table V.27. Exports of major trading countries, 1986 and 1990

Country	Exports 1986 (thousand tonnes)	Exports 1990 (thousand tonnes)	Percentage share 1990	Percentage change 1986-1990
Canada	10 479	11 765	27.1	12.3
Finland	7 698	6 163	14.2	-19.9
Sweden	6 775	5 636	13.0	-16.8
United States	5 206	3 689	8.5	-29.1
Germany, Federal Republic of	4 902	3 022	7.0	-38.4
France	1 437	2 194	5.1	52.7
Austria	1 565	2 185	5.0	39.6
Netherlands	1 274	2 040	4.7	60.1
Norway	1 230	1 478	3.4	20.2
Italy	1 094	1 407	3.2	28.6
United Kingdom	630	1 247	2.9	97.9
Belgium	533	928	2.1	74.1
Japan	839	900	2.1	7.3
Spain	437	526	1.2	20.4
China	313	252	0.6	-19.5
TOTAL	44 412	43 432	100.0	-2.2

Source: Pulp and Paper International, *Fact and Price Book 1992* (Brussels, Miller Freeman Inc., December 1991).

Table V.28. Imports of major trading countries, 1986 and 1990

Country	Imports 1986 (thousand tonnes)	Imports 1990 (thousand tonnes)	Percentage share 1990	Percentage change 1986-1990
United States	10 351	11 419	28.2	10.3
Germany, Federal Republic of	4 901	6 779	16.8	38.3
United Kingdom	4 757	5 696	14.1	19.7
France	2 799	3 900	9.6	39.3
Italy	1 787	2 760	6.8	54.4
Netherlands	1 834	2 348	5.8	28.0
Belgium	1 259	1 820	4.5	44.6
Spain	656	1 422	3.5	116.8
Japan	855	1 032	2.6	20.7
Canada	640	1 023	2.5	59.8
China	1 218	962	2.4	-21.0
Austria	341	536	1.3	57.2
Sweden	271	310	0.8	14.4
Norway	250	297	0.7	18.8
Finland	73	122	0.3	67.1
TOTAL	31 992	40 426	100.0	26.4

Source: Pulp and Paper International, *Fact and Price Book 1992* (Brussels, Miller Freeman Inc., December 1991).

the Nordic countries into the European Community, where Germany is a big trading country; and from Canada primarily to the United States, but also to the rest of the world. Exports from the United States have increased significantly, partly as a result of a decline in the value of the dollar and, more recently, due to weaker domestic markets. Japan has also increased exports, mostly within Asia, because of oversupplied home markets; but both imports and exports remain a tiny proportion of the massive paper market of Japan. A new exporting country is Indonesia, where companies have definite aims to increase exports even further and even further afield; some are hoping to join the European market. In the longer term, current big pulp exporters, such as Brazil and soon other Latin American countries, could well increase paper exports following integration of some pulp lines.

When business is poor, the protection of domestic business from importers is more likely to cause trouble. The number of trade disputes in 1991 and early 1992 was increasing: Canadian newsprint pouring into the European Community soon used up its duty-free quota, while United States producers of coated groundwood protested against European imports. The latter case was rejected by the United States International Trade Commission in late 1991, much to the relief of the Europeans whose domestic market is oversupplied and who are now relying on exports to the United States to ease their overcapacity of approximately 400,000 tonnes annually. The cause of the problem is that owners of many new machines and new pulp lines have declared that they are going to rely on export sales to provide an outlet for their excess capacity. Too many companies have been hoping that exports will save them from excess capacity, and inevitably not all of them are getting what they want. More trade complaints, and perhaps more barriers to the paper trade, seem likely, especially if the GATT agreement on paper and pulp fails.

A visit of the President of the United States to Japan at the end of 1991 involved not only an attempt to open the way for United States automobiles; it also included an agreement to increase substantially the market access for foreign paper in Japan. Meanwhile, the Japan Merchants Association launched a "global partnership plan for paper" to help importers. Another factor that may affect future trade is that some Eastern European mills, now free to operate independently, plan to pay back the price of equipment imported from developed market economies for their new production lines by exporting the newly made paper back to those economies. It is reasonable to assume that they would be selling this paper mainly to earn foreign currency. And the new product will presumably not suffer from the quality problems that currently limit the sales of cheaper Eastern European paper in Western European markets. There is at least one big project currently under way in which the equipment supplier is accepting payment in paper that has been sold in Western Europe. If, or when, the quantity of paper arriving from the Eastern Europe reaches a level that hurts domestic markets, or well before that, there may be moves in the EEC to put up barriers against that trade.

2. *Major companies in the global industry*

It is not possible to separate sales of pulp, a primary raw material in the production of paper and paperboard, from paper and board sales. The companies listed in tables V.29 and V.30 thus feature a combination of these outputs, measured in sales value. In North America, Europe and Japan, profits of many of the major companies in the paper industry fell in 1990. Results for 1991 have not shown any improvement. And for some big companies, carrying substantial debt as a result of acquisitions and investment in capital equipment in the late 1980s has been causing severe problems. Most of the big firms in this industry have been acquiring and spending with the aim of competitively positioning themselves for the 1990s. Some of them have been caught by the current economic recession. They see 1992 as a crucial year to determine whether they have positioned themselves correctly. If the economies of Europe and North America do not revive, some companies are going to be in serious trouble. For example, the major Swedish paper makers have already been cutting their workforce, and some other mills have shut down.

For the Nordic countries, the situation has been exacerbated by their poor economic performance and that of one of their main markets, the United Kingdom. Unsurprisingly, the pace of acquisition has virtually stopped and many capital investment plans in North America, Europe and Japan have been delayed indefinitely. For the rest of the world's paper makers, the profit decline, in general, has not been so dramatic, but there has been one.

3. *Capacity utilization and expansion plans*

While reliable figures for annual capacity additions are rare, tables V.31 and V.32 show clearly that many Asian countries and areas have greatly increased both

Table V.29. The largest pulp-, paper- and board-producing companies in developed countries, 1990

Company and country	Pulp, paper and board sales (million dollars)	Percentage change 1989-1990	Net profits after tax (million dollars)	Profit as a percentage of total sales[a]	Percentage change 1989-1990
International Paper (United States)	10 610	15	569	4	-34
Georgia-Pacific (United States)	6 702	66	1 064	8	16
Stone Container (United States)	6 434	5	352	6	-33
Kimberly-Clark (United States)	6 265	11	432	7	2
Stora (Sweden)	5 726	58	802	8	17
James River (United States)	5 400	-9	523	10	4
Scott Paper (United States)	5 356	6	594	11	-2
Arjo Wiggins Appleton (United Kingdom)	4 638	7	277	6	-3
Svenska Cellulosa (Sweden)	4 291	23	499	9	1
Champion International (United States)	4 037	2	223	4	-49
Weyerhaeuser (United States)	3 931	-4	910	10	-26
Oji Paper (Japan)	3 526	-1	386	8	-6
Jujo Paper (Japan)	3 473	3	60	2	-45
MoDo (Sweden)	3 076	-1	143	5	-30
Jefferson Smurfit (United States)[b]	2 919	-	44	2	-

Source: Pulp and Paper International, *Fact and Price Book 1992* (Brussels, Miller Freeman Inc., December 1991).

[a] Total sales in this column, which gives percentage profit margin, are total consolidated sales, include revenue from other business sectors not directly connected to making and converting pulp, paper and board.

[b] Not comparable to previous year due to changes in group structure.

Table V.30. The largest pulp-, paper- and board-producing companies in developing countries, 1990

Company, country and area	Pulp, paper and board sales (million dollars)	Percentage change 1989-1990	Net profits after tax (million dollars)	Profit as a percentage of total sales	Percentage change 1989-1990
Klabin (Brazil)	732	1 069.0	25	3.0	140.0
CMPC (Chile)	486	18.0	183	42.0	29.0
Yuen Foong Yu Paper (Taiwan Province)	482	14.0	9	2.0	-77.0
Chonju Paper (Republic of Korea)	409	27.0	55	13.0	-23.0
Seka (Turkey)[a]	386	41.0	-18	-	-129.0
Suzano (Brazil)	350	5.0	95	26.0	-18.0
Pipsa (Mexico)[a]	297	28.0	12	4.0	98.0
Cheng Loong Co. (Taiwan Province)	279	-10.0	3	1.0	-88.0
Durango (Mexico)	270	27.0	26	8.0	-19.0
Arauco (Chile)	244	-11.0	123	33.0	-89.0

Source: Pulp and Paper International, *Fact and Price Book 1992* (Brussels, Miller Freeman Inc., December 1991).

[a] State-owned.

capacity and output betweer 1986 and 1990, their fastest period of expansion. Generally, their paper industries, though well behind in quantity, have grown faster than those of Western Europe and North America. In Latin America the pattern is more varied, while the growth of the paper industry in Africa is certainly erratic. Here, and in some Asian and Latin American countries, the production capacity of the paper industry can jump from one year to the next when a new paper machine is completed. However, there are many problems, and a new production line may run below capacity, if at all. The supply of raw materials and spare parts, particularly if these have to be imported and paid for in foreign currency, can be a limiting factor. Poor infrastructure, such as poor transport, erratic power and water supplies, can also

Table V.31. Manufacturing capacity of paper and board in developing countries, 1990

Economic grouping, region, country and area	Capacity	Production	Exports	Consumption	Per capita consumption (kilograms)
	(thousand tonnes)				
Asia					
Market economies					
Republic of Korea	5 020	4 524	516	4 310	102
Taiwan Province	3 950	3 337	552	3 320	163
India	3 014	2 295	-	2 575	3
Indonesia	1 716	1 438	190	1 371	8
Thailand	983	877	53	1 192	21
Philippines	577	466	8	563	9
Centrally planned economies					
China[a]	15 500	13 719	252	14 429	13
Viet Nam[a]	100	60	-	66	1
Democratic People's Republic of Korea[a]	100	80	-	80	4
Latin America					
Brazil	5 764	4 844	940	4 151	28
Mexico	3 611	2 871	168	2 982	36
Argentina	1 350	926	56	135	26
Venezuela	839	609	56	688	36
Colombia	611	534	20	609	19
Chile	455	462	121	416	32
Western Asia					
Turkey	1 000	920	39	1 112	20
Iran (Islamic Republic of)	315	211	-	565	10
Iraq	144	75	-	145	8
Lebanon[a]	50	15	-	25	9
Kuwait	25	12	-	52	25
Africa					
Nigeria	230	70	-	320	3
Egypt	220	223	-	581	11
Morocco	130	119	2	216	8
Kenya	130	123	3	145	5
Algeria	128	87	-	230	9
Zimbabwe	90	87	5	97	10

Source: Pulp and Paper International, *Fact and Price Book 1992* (Brussels, Miller Freeman Inc., December 1991).

[a] All or some estimates.

lead to production problems, and occasionally inadequate training of local operators can lead to low quantity and quality of output. This may happen after the departure of the professional, usually foreign, staff brought in specifically to install and start up and, supposedly, to train local operators.

Future capital investment plans by pulp and paper producers make a gloomy forecast worldwide compared to the late 1980s. Each year Pulp and Paper International counts up all the projects currently under way, the level of construction activity and expectations for the three years ahead [2]. Comparing the 1992 review to that of 1991 involves comparing forecasts for 1992-1995 to 1991-1994; between these forecasts, there is an 18 per cent drop in planned new paper and board capacity worldwide of about 13 million tonnes per year. For pulp, it is an even bigger drop, down 22 per cent to 12 million tonnes per year. There is no doubt that many new paper machines and pulp lines started up in the early 1990s; consequently much less is planned for the mid-1990s. Indeed, big projects have been delayed or cancelled, particularly in Europe.

The main reasons for the current slow-down in capital investment plans are slower demand growth combined with the glut of new paper machines which started up towards the late 1980s and early years of the 1990s. These developments have led to overcapacity in sizeable sectors of the market, notably coated and uncoated printing papers, and uncoated wood-free papers (mainly used for business and education) in Europe and Japan, the same holding true for newsprint. It is also true, but to a lesser extent, for market pulp (pulp which is sold to paper makers), though for this product overcapacity problems are growing, despite some big cancellations of new pulp-mill projects.

4. *Restructuring and redeployment*

Locating a remote source of components in low-wage countries by developed countries is not a problem. Usually paper and paper-board are shipped as finished products, or converted to end-products within the same country. There have been examples of

Table V.32. Capacity utilization in the paper industry, 1986 and 1990

Country and area	Capacity 1986	Capacity 1990	Percentage change 1986-1990	Production 1986	Production 1990	Percentage change 1986-1990	Utilization rates (percentage) 1986	Utilization rates (percentage) 1990
North America								
United States	68 601	76 241	11.0	64 307	71 519	11.0	94.0	94.0
Canada	16 690	18 915	13.0	15 261	16 466	8.0	91.0	87.0
Western Europe								
Germany, Federal Republic of	10 602	13 042	23.0	9 407	11 873	26.0	89.0	91.0
Finland	8 305	9 740	17.0	7 549	8 958	19.0	91.0	92.0
Sweden	7 885	9 065	15.0	7 363	8 426	14.0	93.0	93.0
France	5 500	7 400	35.0	5 657	7 049	25.0	102.0	95.0
Italy	5 175	6 300	22.0	4 665	5 601	20.0	90.0	89.0
United Kingdom	4 162	5 360	29.0	3 941	4 824	22.0	95.0	90.0
Eastern Europe a/								
USSR	10 750	11 500	7.0	10 395	9 800	-6.0	97.0	85.0
Yugoslavia	1 600	1 450	-9.0	1 350	1 260	-7.0	84.0	87.0
Poland	1 500	1 600	7.0	1 320	1 064	-19.0	88.0	67.0
German Democratic Republic	1 500	1 000	-33.0	1 327	674	-49.0	88.0	67.0
Czechoslovakia	1 370	1 400	2.0	1 247	1 323	6.0	91.0	95.0
Japan	24 617	30 728	25.0	21 062	28 086	33.0	86.0	91.0
Other								
South Africa b/	1 950	2 100	8.0	1 606	1 904	19.0	82.0	91.0
Australia	1 700	2 500	47.0	1 642	2 011	22.0	97.0	80.0
New Zealand	807	889	10.0	671	810	21.0	83.0	91.0
Israel	160	200	25.0	159	193	21.0	99.0	97.0
Asia								
Centrally planned economies								
China a/	12 000	15 500	29.0	9 986	13 719	37.0	83.0	89.0
Market economies								
Taiwan Province	3 000	3 950	32.0	2 527	3 337	32.0	84.0	84.0
Republic of Korea	2 858	5 020	76.0	2 773	4 524	63.0	97.0	90.0
India b/	2 655	3 014	14.0	1 800	2 295	28.0	68.0	7.06
Indonesia	968	1 716	77.0	610	1 438	136.0	63.0	84.0
Turkey	800	1 000	25.0	661	920	39.0	83.0	92.0
Thailand	646	983	52.0	478	877	83.0	74.0	89.0
Philippines	515	577	12.0	254	466	83.0	49.0	81.0
Malaysia c/	118	258	119.0	82	251	210.0	69.0	97.0
Latin America								
Brazil	4 940	5 764	17.0	4 525	4 844	7.0	92.0	84.0
Mexico	3 316	3 611	9.0	2 470	2 871	16.0	74.0	80.0
Argentina	1 250	1 350	8.0	937	926	-12.0	75.0	69.0
Venezuela	791	839	6.0	612	609	-1.0	77.0	73.0
Chile	433	455	5.0	388	462	19.0	90.0	102.0
Colombia	544	611	12.0	457	534	17.0	84.0	87.0
Africa b/								
Egypt	180	220	22.0	147	223	52.0	82.0	101.0
Nigeria	170	230	35.0	77	70	-9.0	45.0	30.0
Algeria	160	128	-20.0	88	87	-1.0	55.0	68.0
Morocco	126	130	3.0	109	119	9.0	87.0	92.0
Kenya	100	130	30.0	96	123	28.0	96.0	95.0

Source: Pulp and Paper International, *Fact and Price Book 1991* (Brussels, Miller Freeman Inc., 1991).

a/ All capacities estimated.

b/ All estimates.

c/ 1986 estimates.

companies in developed countries building pulp mills in low-wage countries that have a readily available wood supply. This is, in a sense, denying the low-wage country the opportunity to develop a higher-value product, paper. However, this is not widespread, and there are examples where the ownership of such operations have eventually passed to local companies.

5. *Environmental considerations*

In such difficult times for the world's paper industry, there is continuing and previously unprecedented pressure on European paper makers to respond to the consumers' desire for an "environmentally healthy" product. The surge of demand by buyers for chlorine-free printing paper has been sudden and so far largely unsatisfied. Producers are also beginning to understand what they want, namely a paper that they can categorically and proudly tell their customers has been made without the use of any chlorine or chlorine compounds in the bleaching of pulp. This follows the outcry after minute traces of dioxin and other organochlorines were detected a few years ago in the outflow from some pulp mills. Environmental pressure groups have been successful in spreading this message among consumers in Europe and North America, and lately in Japan.

The limited availability of chlorine-free pulp is shown by the arrival of a new higher price for market pulp that had been bleached without the use of elemental chlorine. This arrived on the European market in late 1991 and commonly commands $20 per tonne (c.i.f. Europe) more than its chlorine-bleached counterpart for northern bleached softwood kraft pulp.

The other major environmental factor is the increase in the use of recycled waste paper, or recycled fibre. Although its use is already commonplace in Europe and Japan, and it is a major imported raw material for some Asian countries, the use of recycled fibre is clearly going to increase. Not only is the United States going to use much more of its own waste, but the types of paper and paper-board that contain a proportion of recycled fibre (for some lower qualities that proportion is already 100 per cent) are going to increase, up into the higher-quality grades that today use mostly primary wood-fibre.

Both in the United States and in Europe, there is already legislation to impose both increased collection and the use of waste paper. For example, there is strict new legislation in Germany to recover and recycle packaging. This sets ambitious targets for recycling and makes the producer and user gather their waste back through the distribution chain. It is having a major effect on the big waste-based packaging sector in Europe. This will be even bigger if the attempt by the Commission of the European Community succeeds in applying similar legislation throughout its member States, though there are signs that its proposals are being watered down. And even Germany may ease off its own plans.

A less related environmental problem is that the libraries of the world are filled with books printed on paper with a high acid content. These books for the most part have become almost useless; in some cases the paper is even to brittle to photocopy. The collusion of paper makers and printing and publishing companies in this regard will be receiving greater scrutiny in the future. The potential costs of correcting this ill-conceived and wasteful printing decision will be enormous.

6. *Technological trends*

One of the central technological trends today is to reduce even further the effect of a paper-mill on its environment, or to benefit the environment. This trend is most developed in North America, Europe and Japan; in all three, legislation is already strict and consumer pressure is strongest. But control and pressure is also developing in parts of Asia and Latin America. This is despite the fact that most mills already have the main technology to control their waste, such as waste-water treatment plants. Many mills are seeking to improve the equipment they already have to improve energy and water-use efficiency. Therefore, there is demand for equipment to increase the use of recycled fibre in paper production, technology to reduce the use of elemental chlorine in pulp bleaching, and equipment which further reduces energy and water consumption during production.

Types of paper and paper-board containing a proportion of recycled fibre (already 100 per cent for some lower qualities) will thus increase, up to the higher-quality grades that use mostly primary wood fibre. Less use of any chlorine or chlorine compounds in pulp bleaching may also mean the introduction of less-white paper, and this may be sold and branded as more "environmentally friendly" to consumers.

A related subject is the increasing importance of ISO 9000, the quality assurance standard. This is a guarantee that a product of agreed qualities will be consistently supplied under agreed conditions and on time. It is becoming widespread in the paper industry in Europe where more customers are considering it an essential factor when selecting suppliers. And now it is not confined to suppliers of felts and fabric for paper machines and packaging board mills, both of which initiated the trend, but is spreading to other equipment suppliers, such as white-paper producers, transport companies and market pulp suppliers.

Finally, as explained in section 5 above, there is a need to develop lower-cost, higher-quality white paper to be used in books and professional journals. Despite the increase in computerization of library access to printed documents, it should not be difficult to construct paper of a quality that would last several hundred years.

7. *Short- and medium-term outlook*

The short-term outlook for the paper industry generally reflects the gloomy business conditions of the last years. There is considerable hope and some justification for expecting the market for paper and board to improve gradually through 1992. Its performance is closely related to the economies of Europe and North America; when they improve, paper sales usually increase fairly soon after.

In the medium term, there is an underlying belief that the consumption of paper will continue to increase. The rate of increase is probably going to be higher in Asia and Eastern Europe, and perhaps lower in Latin America, than it is in Western Europe and North America, the two largest markets.

Developments in Eastern Europe, while uncertain at present, offer a tremendous opportunity for both paper production and consumption in the medium and long term. Czechoslovakia, Hungary and Poland are countries where acquisition by companies based in developed market economies is progressing and privatization of the pulp- and paper-mills is under way. Overstaffed, using old—even ancient—machinery, with small paper lines, and highly polluting, many of these mills may not be salvageable. But the better and more modern mills, or parts of mills, are attracting buyers from developed market economies. And some of the mills themselves are seeking foreign partners to carry out ambitious expansion plans. They have the advantages of low-cost educated labor and a growing market for paper. In these three countries, in particular, there is immediate potential for new capital investment. But further east, in the independent republics of the former USSR, the high uncertainty makes the short- and medium-term prospects not good at all. There have been announcements of some big new paper-machine orders, but some of these have run into funding problems as banks in developed market economies are not willing to lend on such projects. But the longer-term prospects for this market are enormous and cannot be ignored.

East Asia continues to be the fastest-growing region for this industry. But even here there have been some setbacks to new capital investment, and some paper markets are oversupplied. The biggest short-term problem is the depth and length of the economic recession in Japan. The prices and profits for major paper grades are down; overcapacity is a problem and there are attempts to coordinate the introduction of new capacity industry-wide, meaning widespread delays in new expansion plans. The poor domestic market was a key reason why paper exports increased in 1991 by about 40 per cent (but from a very low base), while imports remained the same, a mere 4 per cent of total consumption, compared to 14 per cent in the United States.

But while the industry may suffer more in Japan, nearby South-East Asia remains a growth area, as reflected in the production and apparent consumption of the five ASEAN countries. As shown in table V.33, output increased by 18 per cent in 1990, far above the world average, while consumption increased by 24 per cent. The growth situation in the individual countries can be summarized as follows. Indonesia, with paper and board production having grown by over 20 per cent annually in the last few years, has become the twenty-third biggest paper-making country in the world. In 1990 it produced 1.44 million tonnes, and has capacity which is now well over 2 million tonnes per year, and which should rise to over 3 million in 1993. Government restrictions on the build-up of foreign debt to keep the economy from overheating have delayed other major capital investment plans, which could double pulp and paper output by the late 1990s. In Thailand, the demand for paper is set to continue growing at about 15 per cent per year from 1990 to 1994, and to more than double over the whole decade, reaching 2.5 million tonnes by the year 2000. Consequently, new production capacity plans are expected to reach about 2.48 million tonnes per year by the mid-1990s, 150 per cent up on 1990. Packaging-paper expansions are already under way and new machines to make white papers are planned. In the Philippines, paper and board output should have risen by about 17 per cent per year in 1991, with the same rate expected in 1992. A number of expansions are planned for the country's 23 mills, plus some green-field mill projects. Paper and board consumption jumped by about 30 per cent in 1991 alone, although there have been some project delays due to a series of natural disasters that hit the country in 1991. In Malaysia, a 21 per cent growth in paper output occurred in 1991, and another 18 per cent is forecast for 1992. Three new mills are planned with State approval, with further expansion at existing mills. The first newsprint mill is to start up in 1993. To meet its growing demand, imports are set to reach 1.4 million tonnes by 1992, up nearly 60 per cent from 1990.

It is here that the short- and medium-term growth lies, while in much of the rest of the paper-making world such good business conditions do not prevail, though an improvement is expected during 1992.

Table V.33. Production and consumption in the ASEAN countries, 1990
(Thousand tonnes)

Country	Paper production	Paper-board consumption
Indonesia	1 438	1 371
Thailand	877	1 192
Malaysia	278	1 051
Philippines	448	598
Singapore	80	515
TOTAL	3 121	4 727
Change from 1989	18%	24%

Source: Pulp and Paper International. *Fact and Price Book 1992* (Brussels, Miller Freeman Inc., December 1991).

D. Agrochemicals (ISIC 351216)*

Insecticides
Fungicides
Herbicides
Disinfectants
Growth regulators

1. *Current situation*

Agrochemicals comprise a small but important branch of the chemicals industry, having been placed in use only since the Second World War. They are artificial substances used in farming to promote crop growth by neutralizing organisms such as weeds, pests or fungi which can interfere with plant development. Another (fairly small) group of agrochemicals are plant growth regulators which act on the development of crops directly to accelerate or to otherwise alter growth. They do not include fertilizers, which are mainly much older-established substances that work by adding nutrients to farm soil. Another name sometimes used for agrochemicals is crop protection compounds.

Out of total world chemical sales in 1990 of around $1,000 billion, agrochemicals accounted for only a small fraction, amounting to about $26 billion. They are extremely important, however, in the farming industry, where the optimum mix of agrochemicals can have a big impact on agricultural efficiency and

*UNIDO acknowledges the contribution of Peter Marsh of the *Financial Times*.

profits. Although roughly 70 per cent of agrochemicals are used in the major industrialized countries of North America and Western Europe and in Japan, their use is growing in developing countries. Development and sale of agrochemicals is dominated by transnational chemicals corporations based either in the United States or in Europe.

In recent years, agrochemicals have gone through an uneven period in terms of overall growth [18]. With the farm industry in much of the industrialized world hit by overproduction, demand for agrochemicals has been relatively slow. Also, many countries have witnessed an environmental backlash. Over-use of the chemicals has been linked, for instance, with problems of excess soil toxicity. Moreover, some scientists suspect that the products can, after being applied to crops, find their way into the food chain, where even in extremely small quantities it is thought they can produce harmful effects in humans or animals. Such concerns have undoubtedly acted to dampen product sales in recent years, especially in developed market economies. However, it is indisputable that the use of agrochemicals under properly monitored regulations can greatly boost agricultural yields by reducing plant damage caused by pests and weeds. Even today, with a relatively high use of agrochemicals especially in the industrialized world, the World Health Organization estimates that about a quarter of possible world wheat production and roughly one half the rice harvest is lost due to insects, weeds and plant disease.

During the early 1990s the industry is likely to experience growth of no more than a few per cent per year as a result of the weak state of the agriculture sector in many developed and developing countries, and also due to the environmental problems associated with the products [19]. This situation was very different in the 1970s, a boom time for the industry. Steady growth in agricultural production in the main industrialized countries led to a sharp increase in the demand for agrochemicals. Also, in developing countries, including China, India and Pakistan, the introduction of more modern agricultural techniques coincided with a steady rise in agrochemical applications. During the 1970s the agrochemical sector grew at about 6 per cent per year, but this growth abruptly levelled off in the early 1980s.

The products themselves can be split roughly into two categories. One is the older-style chemicals (some of which have been on the market for 30 years or more) which are non-proprietary, that is, not covered by patent. In some cases, patents had existed, but have elapsed. For non-patented or off- patent products, any company is permitted to sell them, often at relatively low prices, as no single organization owns the intellectual property involved in their manufacture. In these cases, the sales and marketing techniques involved in bringing the products to the customer are often the main factors determining total revenues. For example the training of customers in ways to apply the chemicals through novel spraying methods will most likely have a large impact on sales.

The second product category encompasses patented chemicals, where a particular company owns a patent on a novel chemical entity which is the most important ingredient in the agrochemical sold to the user. The existence of a patent grants the company in question a monopoly right over the manufacturing and selling of a specific product. It also enables the company concerned to fix a relatively high selling price, maximizing profit potential. Sometimes, a company with a patented product may enter into joint ventures, in which it will agree to let other businesses sell the product concerned (perhaps in countries where the first company does not have a developed sales and marketing network) in exchange for a fee.

In many countries the patents last 20 years. However, development tests may take seven years, in which case a particular chemical may be on sale only for about 13 years before the patent runs out and other companies are allowed to sell identical products. Many large companies spend up to 10 per cent of revenues on research and development. This amounts to some $2 billion per year for the whole industry. Much of this work is aimed at scientific studies linked to ways in which specific chemicals, possibly made by relatively new biotechnology, can interfere with the growth mechanisms of agents such as weeds or fungi to block their growth. The particular chemical can also be made in such a way that it will not disrupt the growth of the specific crop, such as maize or wheat, that the scientist wants to protect. Work of this kind increasingly relies on genetic engineering, in which specific fragments of biological material are inserted in a laboratory into chemicals to produce desired characteristics. The laboratory effort to identify chemicals which can act in such a way is extremely onerous and is highly expensive, because of the need for high-cost scientific equipment and skilled workers [20].

The above explains the research part of the process in finding new agrochemicals. There is also the development part, in which field trials are used to assess the suitability of a chemical found in laboratory experiments. From this work will be gained some knowledge not only of the degree to which the products do their job (whether to stop a particular kind of weed attack or to prevent the development of a specific fungus that affects, say tomato plants), but also the extent to which they cause environmental impacts. More impacts could include, for example, the degree to which the substances (after they leach into water supplies) could be a danger to people or animals by raising toxicity levels [21]. The large volumes of data that must be collected during development trials to prove that a product works and is also safe again creates large R and D expenditures. Work of this kind is normally done in the richer developed countries, rather than in the poorer, developing countries.

2. *Market composition*

Agrochemicals can be split into the following four basic types: weed-killers which are also called herbicides; insecticides; fungicides; and plant growth regulators. In 1960 the total agrochemical market (according to estimates from County NatWest WoodMac, a United Kingdom stockbroker) was $850 million (at 1960 prices) [22]. Of this fungicides accounted for 40 per cent, insecticides 37 per cent, herbicides 20 per cent, and plant growth regulators 3 per cent. As shown in table V.34, the total world

Table V.34. Sales of agrochemicals, 1989 and 1990

Agrochemicals	1989 (billion dollars)	1990 (billion dollars)	Percentage change 1989-1990	Percentage share 1990
Herbicides	11.2	11.6	4.2	43.9
Insecticides	6.8	7.7	13.2	29.2
Fungicides	4.8	5.5	15.9	20.8
Plant growth regulators and others	1.4	1.6	14.6	6.1
TOTAL	24.2	26.4	9.6	100.0

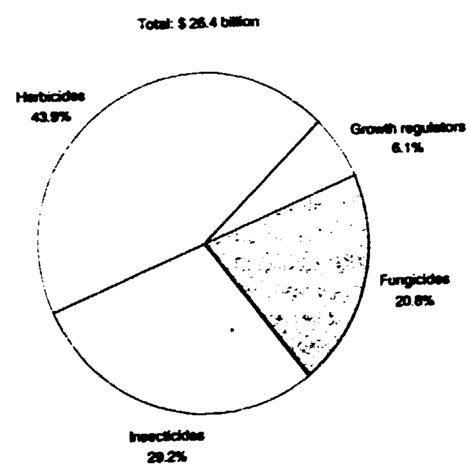
Source: County NatWest WoodMac, *Agrochemical Service* (Edinburgh, 1991); and author's estimates.

market reached $26.4 billion in 1990, however, the breakdown had changed significantly. As shown in figure V.6, the share of herbicides had risen to 43.9 per cent; insecticides had fallen to 29.2 per cent; fungicides took a share of just 20.8 per cent; while plant growth regulators accounted for a similarly small proportion at 6.1 per cent.

Much of the growth in the market over the past 30 years took place in the 1960s and 1970s, when weed-killers in particular were extensively applied in the agriculture industry worldwide. The chemicals have played a big part in the revolution that has affected the industry over this period, reducing the labour element and increasing crop yields. In the past few years, however, growth in the agrochemicals market has slowed. In 1988 the total world market stood at $20 billion; in 1989 it was $24.1 billion; and in 1990 $26.4 billion. Taking into account inflation, that means that overall growth has been negligible.

In terms of a breakdown of sales between different regions, table V.35 shows that Western Europe and North America account for just over one half of total sales between them; East Asia accounts for a further fifth. The shares for other regions are given in figure V.7. In the different regions, sales can be broken down further depending on the types of specific agrochemicals that are sold in each area. Here, there are marked dissimilarities between regions, due to the great variations in farming practices and

Figure V.6. Sales of agrochemicals, 1990



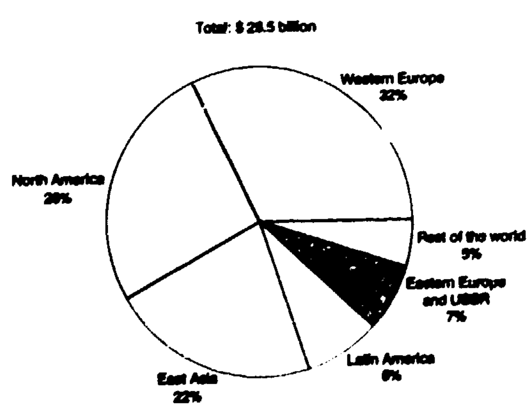
Source County NatWest WoodMac, *Agrochemical Service* (Edinburgh, 1991), and author's estimates

Table V.35. World agrochemical sales by region, 1990

Region	Percentage share	Sales (billion dollars)
Western Europe	32	8.4
North America	26	6.9
East Asia	22	5.8
Latin America	8	2.1
Eastern Europe and USSR	7	2.0
Rest of the world	5	1.3
TOTAL	100	26.5

Source. County NatWest WoodMac, *Agrochemical Service* (Edinburgh, 1991); and author's estimates.

Figure V.7. World agrochemical sales by region, 1990



Source County NatWest WoodMac, *Agrochemical Service* (Edinburgh, 1991), and author's estimates crops grown in different parts of the world. Thus, in non-industrialized countries, which include many tropical or semi-tropical areas where insect pests are a great nuisance to farmers, insecticides are highly used. On the other hand, North America, and to a lesser extent Western Europe, are heavy users of herbicides in their large and intensively worked farms.

Table V.36 shows that out of the 1990 world herbicide market of $11.6 billion, about one third is accounted for by sales in the United States alone. Western Europe accounts for nearly 30 per cent and East Asia 15 per cent. The picture is completely different for insecticides, where only 18 per cent of the $7.6 billion market stems from the United States. Sales in Western Europe take up a fifth of this market, while East Asia accounts for the largest share at 30 per cent. In fungicides (total market $5.5 billion), the United States is the leader in terms of sales, with sales accounting for about half the total.

Because of great differences in the types of crop grown in specific parts of the world and due to particular climatic conditions in the individual regions, some parts of the globe are much more likely to require larger quantities of certain types of agrochemicals than others. Thus in East Asia, herbicides, insecticides and fungicides for rice, a staple crop of the region, are all extremely important. However, few agrochemicals are used for cereals in this region, because cereals form only a small proportion of the crop base. Herbicides and fungicides for cereals are extremely important in North America and Western and Eastern Europe and the USSR. Insecticides and herbicides for cotton are significant in the United States and in much of East Asia, but not in Western Europe, where cotton is not an important crop (small volumes are sold in Eastern Europe and the former USSR).

3. *Major companies in the global industry*

The leading agrochemical companies in terms of sales are all from the North and long-established. The industry has shown remarkable stability over the past 10 years, with very few changes among the top firms. Between 1980 and 1990 there has been just one change in terms of companies leaving the top 10: Schering of Germany has entered this group in place of Royal Dutch/Shell, the Anglo-Dutch chemicals company. It is also notable that all except one of the top 10 companies are divisions of chemical transnational corporations, which obtain the rest of their sales from various other types of chemical products. The exception is DowElanco, the sixth biggest company, which was formed in 1989 in a merger of the agrochemicals divisions of Dow Chemical and Eli Lilly, two United States chemicals firms.

As indicated in table V.37, the largest company is Ciba-Geigy of Switzerland with just over 15 per cent of the world market. The next biggest is Imperial Chemical Industries (ICI) of the United Kingdom, with 13.1 per cent. Then comes Bayer of Germany and Rhône-Poulenc of France, both of which have about 12 per cent of the world market. Of the top 10 companies, none, except DowElanco, has more than about a quarter of its total revenues coming from agrochemicals. DowElanco is a speciality player in the agrochemicals field and produces agrochemicals exclusively. The fact that all the other companies derive only a relatively small part of their overall sales from this product illustrates that most big companies in agrochemicals view this product field as one that is highly compatible with the other kinds of materials they sell.

The profitability of the industry is difficult to assess because most of the large companies in the field do not break down profits between different divisions of their total businesses. However, in the 1960s and 1970s, profitability was known to be high as the market for agrochemicals was expanding rapidly and companies could gain large financial returns on products that had emerged from development and which were legally protected by patents. In the early 1980s there was some attempt at rationalizing the business, with a number of take-overs. For example, ICI bought Stauffer of the United States, a chemicals group which combined a large agrochemical operation. Also, Rhône-Poulenc bought the agrochemical units of two United States companies, Mobil and Union Carbide, and Du Pont bought Shell's agrochemical operations in the United States. More recently, however, much of this merger activity has ground to a halt. The only major merger of note was that between the agrochemical operations of Eli Lilly and Dow Chemical. Sandoz of Switzerland and Schering of Germany agreed in 1989 to a similar venture, but the two sides reversed their decision, after failing to settle terms.

Table V.36. Geographical diversity between agrochemical groups and regions, 1990

Country and region	Herbicides		Insecticides		Fungicides	
	Billion dollars	Percentage share	Billion dollars	Percentage share	Billion dollars	Percentage share
United States	3.7	33	1.4	18	2.7	48
Western Europe	3.1	26	1.7	22	1.5	28
East Asia	1.7	15	2.2	30	0.3	6
Latin America	1.1	9	0.6	9	0.4	7
Eastern Europe and USSR	1.1	9	0.5	7	0.2	4
Rest of the world	0.9	8	1.2	14	0.4	7
TOTAL	11.6	100	7.6	100	5.5	100

Source: County NatWest WoodMac, *Agrochemical Service* (Edinburgh, 1991); and author's estimates.

Table V.37. Top 10 companies in agrochemicals, 1990

Company and country	Sales (billion dollars)	Percentage share
Ciba-Geigy (Switzerland)	2.8	15.9
ICI (United Kingdom)	2.3	13.1
Bayer (Germany, Federal Republic of)	2.2	12.5
Rhône-Poulenc (France)	2.0	11.4
Du Pont (United States)	1.7	9.6
DowElanco (United States)	1.5[a]	8.5
Monsanto (United States)	1.5	8.5
Hoechst (Germany, Federal Republic of)	1.4	8.0
BASF (Germany, Federal Republic of)	1.3	7.4
Schering (Germany, Federal Republic of)	0.9	5.1
TOTAL	17.6	100.0

Source: County NatWest WoodMac, *Agrochemical Service* (Edinburgh, 1991); and author's estimates.

[a] Refers to sales of Eli Lilly alone as DowElanco was formed only in 1989.

In the late 1980s profitability fluctuated, because of the slow-down in the world agriculture industry, environmental problems and tougher competition between companies. In the 1990s, many in the industry expect Japanese companies, which at present are only minor players in the world business, to play a more dominant role. The main way they could progress is through joint venture deals and marketing arrangements with established United States or European companies. In this way the leading Japanese agrochemical companies, including Sumitomo, Mitsui Toatsu, Nippon Kyaku, Kumiai, Hokko and Takeda, may be able to get a foothold in other parts of the world beyond their local East Asian markets. If this happens, these companies would be following in the footsteps of Japanese pharmaceutical companies, which are attempting to gain foreign partners to help them to market their products in Western Europe and North America.

4. *Manufacturing capacity of developing countries*

(a) *Countries without manufacturing facilities*

Developing countries can be classified according to the stage of development of their pesticide industry. Countries with a small domestic market usually belong to this group. The low level of pesticide utilization or a geographically limited area of use prevents any economical manufacturing activity. If the specific consumption is low, but the potential size of the market large enough, prospective inventors should import and distribute pesticide preparations, and start acquiring experience in registration and quality control procedures.

(b) *Countries with formulation plants*

Where the use of pesticides has reached a certain level, depending on the size of the pesticide market and specific consumption, local formulation is established. Many countries are hampered by the lack of availability of active ingredients.

(c) *Countries with active ingredient manufacture*

Production of inorganic pesticides is not regarded as active ingredient manufacture, because this can be done in nearly any country where demand exists and raw materials are available. The small number of countries that belong to this group suggests that a relatively developed organic chemicals industry is a prerequisite for the domestic production of pesticide active ingredients. A few of those countries already export, and are building up a regional market presence.

(d) *Countries with research capabilities for the development of new active ingredients*

Research is costly, time-consuming and concentrated in the large research centres of market-leading enterprises [23]. To move from the manufacturing of active ingredients to the development of original products is the first step from a domestic to an international industry. Some of the developing countries engaged in pesticide chemical production might have the capability to discover new active ingredients, but none has the venture capital or professional expertise needed to develop full pesticide products for worldwide marketing.

(e) *Countries with capabilities for worldwide marketing activity*

International trade is even more concentrated than production, and it is very expensive to build up an international marketing organization. Enterprises in developing countries might increase their moderate exports to surrounding countries, but none will reach global sales status in the coming decade.

5. *Link with agro-industry*

The $26 billion market in 1990 for agrochemicals can be split up mainly between eight big-selling crop types [18]. Table V.38 lists them in descending order of importance: fruit and vegetables including vine, cereals, rice, cotton, maize, soy beans, sugar beets and

Table V.38. World sales value of agrochemicals for different crop types, 1990

Crop	Total value of applied agrochemicals (billion dollars)	Percentage share
Fruit and vegetables	6.3	24.0
Cereals	4.6	17.8
Rice	3.0	11.7
Cotton	2.7	10.3
Maize	2.4	9.3
Soy beans	1.8	7.1
Sugar beet	0.9	3.3
Rape-seed oil	0.5	1.9
Other	3.8	14.6
TOTAL	26.0	100.0

Source: County NatWest WoodMac, *Agrochemical Service* (Edinburgh, 1991); and author's estimates.

rape-seed oil. As shown in table V.39, it is possible to give a rough breakdown for each crop type of the value of all agrochemicals used each year, split between the three main agrochemical groups—herbicides, insecticides and fungicides. In considering the breakdown of sales for the three main agrochemical groups split between different crop types, herbicides stand out with a relatively even spread between the individual crops. Of the total herbicides market, cereals account for the biggest share at 20.5 per cent. After this, fruit and vegetables, maize and soy beans all account for a roughly equal share of around 14 per cent. Then rice, cotton, sugar beet and rape-seed oil each have somewhat smaller shares.

For insecticides, the position is much more skewed. Fruit and vegetables account for nearly one third of the total insecticide market, with cotton taking up just under a quarter. With these two crop types accounting for slightly more than a half of the total insecticide market, rice is the next largest crop in terms of sales, accounting for 16.3 per cent. The rest is shared out in fairly small proportions mainly between maize, soy beans, cereals and sugar beets, with sales of insecticide applied to rape-seed oil not being particularly significant. In the case of fungicides, the breakdown of sales is still more uneven. Just three crop types, fruit and vegetables, cereals and rice, account for nearly 90 per cent of the total fungicides market. The two crop types consisting of fruit and vegetables and of cereals each account for more than 30 per cent of the total market.

Another way to view the industry is to consider the main types of products, split up in terms of sales of a specific crop and its related agrochemical type. The top 14 types given in table V.40 account for roughly three quarters of world sales. While it is important to look in further detail at the above major crops, there are hundreds of different agrochemicals, split between many particular uses or combination of uses among these crops. Figure V.8 illustrates the more important crop and chemical combinations. For example, some agrochemicals are specifically herbicides for application with wheat, while some combine a role as fungicide for maize with one of acting as a fungicide with another crop such as soy bean. Each agrochemical has a generic or chemical name. This describes the

Table V.39. Breakdown of agrochemical markets by crop type, 1990

Market and crop	Percentage of world sales	Value (billion dollars)
Herbicide market		
Cereals	20.5	2.4
Maize	15.7	1.8
Fruit and vegetables	14.4	1.7
Soy beans	15.7	1.5
Rice	7.8	0.9
Sugar beet	4.4	0.5
Cotton	4.3	0.5
Rape-seed oil	2.6	0.3
Others	16.8	1.9
TOTAL	100.0	11.5
Insecticide market		
Fruit and vegetables	28.5	2.2
Cotton	22.8	1.7
Rice	16.3	1.2
Maize	7.1	0.5
Cereals	4.0	0.3
Sugar beet	2.9	0.2
Soy beans	2.9	0.2
Others	15.1	1.1
Total	100.0	7.4
Fungicide market		
Fruit and vegetables	39.4	2.2
Cereals	33.0	1.8
Rice	14.5	0.8
Others	12.7	0.7
Total	100.0[a]	5.5

Source: County NatWest WoodMac, *Agrochemical Service* (Edinburgh, 1991); and author's estimates.

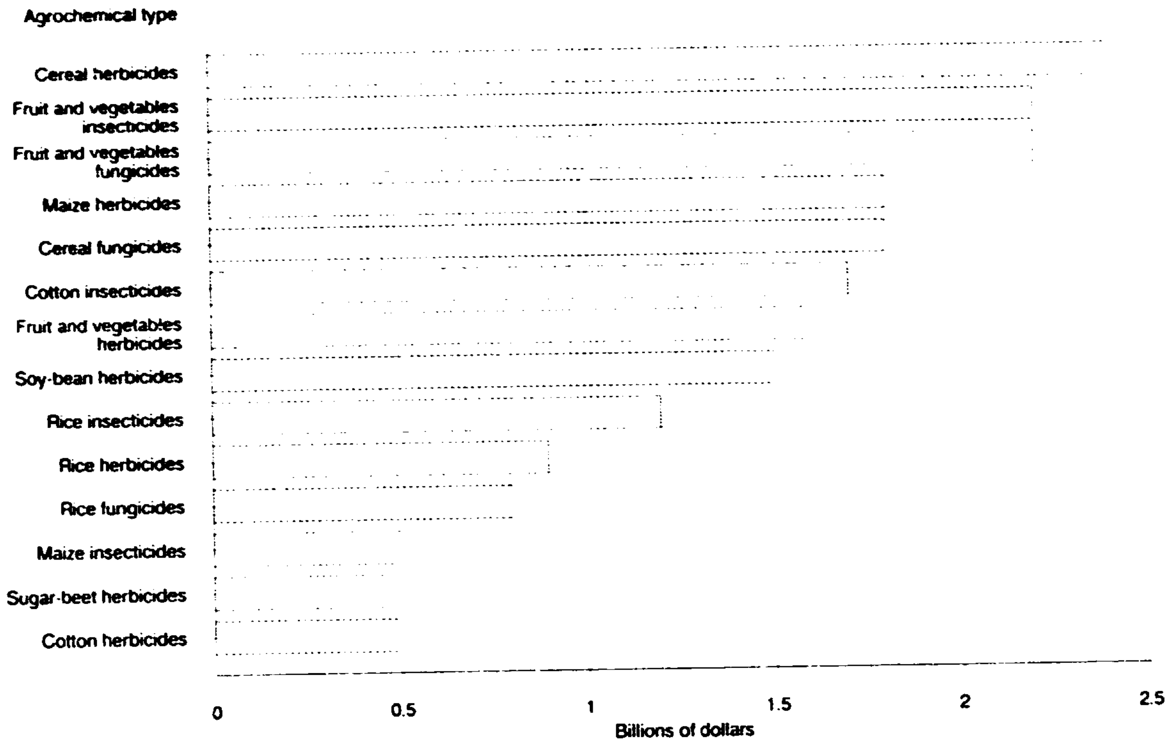
[a] Figure may not add to total due to rounding.

Table V.40. Main crop and agrochemical combinations, 1990

Agrochemical type	Sales (billion dollars)
Cereal herbicides	2.4
Fruit and vegetables insecticides	2.2
Fruit and vegetables insecticides	2.2
Maize herbicides	1.8
Cereal fungicides	1.8
Cotton insecticides	1.7
Fruit and vegetables herbicides	1.6
Soy-bean herbicides	1.5
Rice insecticides	1.2
Rice herbicides	0.9
Rice fungicides	0.8
Maize insecticides	0.5
Sugar-beet herbicides	0.5
Cotton herbicides	0.5

Source: County NatWest WoodMac, *Agrochemical Service* (Edinburgh, 1991); and author's estimates.

Figure V.8. Main crop and agrochemical combinations, 1990



Source: County NatWest WoodMac, *Agrochemical Service* (Edinburgh, 1991), and author's estimates

material scientifically. It may also have a commercial name given to it by the company marketing the material. That applies especially if the product is proprietary or covered by a patent, in which case the company selling the material is likely to market it vigorously and attach particular importance to the choice of its commercial name. Finally, the product is likely to belong to a particular class of chemicals, which provides it with yet another name.

To take an example, one of the top-selling agrochemicals with world sales in 1987 of $640 million is atrazine, an off-patent herbicide made by a number of companies, including Ciba-Geigy. It first went on sale in 1957 and belongs to the general chemical class of the triazines. A second illustration is glyphosphate, a herbicide made by Monsanto and on sale since 1972. In 1987 it had sales estimated at $620 million and was the world's biggest-selling proprietary agrochemical. Its commercial name is Roundup and it belongs to the organophosphorus class. Roundup has only recently gone off patent. Another big-selling chemical is methyl parathion, an old-established material which first went on sale in the late 1940s. This is another organophosphorus material, which is sold by Bayer together with a number of other companies. A fourth example is paraquat, which has been given the commercial name gramoxone and is sold by ICI. Its chemical class is the bipyridyl family.

(a) Fruit and vegetables

Fruit and vegetables can be considered the most important crop in terms of sales and use of agrochemicals. In 1990 they accounted for about a quarter of total world agrochemical sales, because of the large spread of types of crops grown and their relatively high value. Particularly in the industrialized world, farmers find it cost-effective to apply agrochemicals in a rigorous fashion to boost yields, particularly for high-value crops such as vines and citrus fruit. All the main agrochemical types, insecticides, fungicides and herbicides, are highly important in this sector, and they each account for roughly a third of the total market for agrochemicals used in producing fruit and vegetables.

In 1990, total world fruit and vegetable production came to some 1.5 billion tonnes, according to industry estimates. Of this, 40 per cent was roots and tubers (mainly potatoes), 30 per cent other vegetables, 25 per cent fruits of various descriptions, and 4 per cent pulses such as peas. Of the $6.3 billion world market in 1990 for agrochemicals applied to fruit and vegetables, vines accounted for the largest single share, about 18 per cent [1]. The next most important crop in terms of agrochemical application in this category was citrus fruit with a 13 per cent share. Apples take up 11 per cent, as do potatoes. The large amount of agrochemicals that are channelled to potatoes is mainly due to the extremely large volumes of these crops produced each year, rather than to their high value.

Concerning the regions of the world that are the most important users of agrochemicals applied to fruit and vegetables, Western Europe is the largest, accounting for a third of all agrochemical consumption. Next is East Asia with 24 per cent, followed by the United

States with 18 per cent: Eastern Europe and the former USSR takes up 10 per cent.

Insecticide use in the production of fruit and vegetables has grown extremely quickly in recent years and is now roughly equal in volume to fungicides, a field which a few years ago was the dominant sector. Both these areas in 1990 accounted for world sales of about $2.2 billion. Vines account for about 30 per cent of total fungicide sales. Apples, potatoes, citrus fruits and nuts are next in importance. The main markets are in Europe and Japan, where weather conditions aid the development of the type of fungi that attack important fruit and vegetable crops. The kinds of fungal attack that agrochemicals of this sort can act against include the following: potato blight, stem canker and root rot, which affect many kinds of vegetables; apple scab and greasy rot, which affect citrus fruit; and nut scab and downy mildew, which are harmful to grapes. Until the mid-1970s the main types of fungicide for fruit and vegetables had to be sprayed on the plants in advance, if they were to have any real effectiveness. They thus offered protection only, and had virtually no power to cure a plant which had already been subject to fungal attack. Since then, however, agrochemical producers have developed so called "systemic" products that act directly on fungal disease. These systemic products have taken a large share of the market in recent years.

The old, purely protective type of products were simple to make and low in value, based on substances such as sulphur, inorganic copper-based compounds, and organic products containing sulphur. In this last category come dithiocarbamates and captan. Such materials are still used in large quantities, particularly in vine-growing. Dithiocarbamates, which also are used on a large scale to protect against potato blight, constitute the biggest single type of fungicide for fruit and vegetables. In 1990, sales of these products were about $550 million. Organic fungicides (another non-systemic category) are the next most important class, with sales in 1990 valued at $380 million.

Important systemic products developed recently include carbendazim-type chemicals such as Benlate (Du Pont), Bavistin (BASF), Derosal (Hoechst) and Nimrod (ICI). Particularly important has been the introduction of a specific type of fungicide to cure downy mildew in vines, which at one time damaged a large percentage of vines in Europe. Chemicals aimed at this disease include Aliette (Rhône-Poulenc), Curzate (Du Pont) and Fongarid (Ciba-Geigy). One problem with systemic products of this kind is that specific crop strains can develop resistance to the chemicals, which acts as a spur to new research to find alternatives. One fairly new class of systemic fungicides includes the so-called triazoles, which act directly against a range of fungal diseases. Such products include Score (Ciba-Geigy), Folicur (Bayer), Anvil (ICI), Punch (Du Pont) and Alto (Sandoz). This class of systemic fungicides is the fastest-growing area; roughly two fifths of the market in fruit and vegetable fungicides are accounted for by such products.

When we speak of fruit and vegetable insecticides, the breakdown or spread between different crops is similar to that of fungicides. Citrus fruits, however, are marginally more important in this area than vines, apples and potatoes, since they account for nearly one fifth of the total market for fruit and vegetable insecticides. In terms of geographical spread, East Asia takes up 30 per cent of total sales, with Western Europe accounting for 25 per cent and the United States 18 per cent.

About a quarter of the market for fruit and vegetable insecticides with sales of $500 million includes products that are specifically used to ward off attack by mites. They do this by attacking mites in their various stages of life, from larvae through various development phases to adulthood. While established organophosphorus compounds such as dimethoate and ethion are important in this area, their use is subject to growing restrictions, on the grounds that such chemicals can be health hazards if they find their way in large concentrations into the human food chain. Other important classes of products in the insecticide sector include carbamate compounds, including alicarb, carbofuran, carbosulfan and methomyl. These are normally applied to the soil to kill off insects that breed and live there, and are used to protect a range of crops including potatoes, citrus, vines and nuts.

Also important are the pyrethroids, which are applied generally to leaves. Compared with other kinds of insecticides, they last for a relatively long time after spraying and thus involve labour costs. Chemicals in this category include cyfluthrin, fenvalerate, fluvalinate and permethrin. A pyrethroid called Rody, made by Sumitomo, is considered to be a highly promising product in this sector, particularly in the Japanese vegetable market. Other pyrethroids include Asana (Du Pont/Sumitomo), Bulldock (Bayer), Force (ICI), Scount (Hoechst), Talstar (FMC) and Trevon (Mitsui Toatsu).

Fruit and vegetables herbicides are less important than either the fungicides or the insecticides. None the less they are still very big in the overall agrochemicals industry, with total world sales at $1.7 billion in 1990. Western Europe accounts for about a third of sales in this field. They are split fairly evenly among big-selling crops including vines, apples, nuts, potatoes and citrus. Generally, farmers have not bothered too much with weed control applied to these crops; however, awareness in recent years has resulted in regularly increasing sales. Typically, farmers have started to use herbicides for fruit and vegetables that had previously been developed for other crop types, such as soy beans, cotton and rice. These older style herbicides have found uses controlling weeds for such crops as nuts, grapes and potatoes. Triazine products, including ametryne, atrazine and metribuzin, and simazine are included in this category. They are used for apples, potatoes, soft fruits and citrus in particular. Other relatively long established herbicides include the urea series. These encompass products such as chloroboromuron, diuron, fluomenturon and linuon. More recent products applied to this sector include toluidine-type chemicals, including trifluralin and pentimethaline. Orchards (soft fruit and apples) make extensive use of products such as terbacil and norflurazon. Herbicides used for weed control in nuts include bentazone, pendimethalin, and trifluralin.

Regarding geographical breakdown, Western Europe accounts for about a third of the total market for herbicides used for fruit and vegetables. In France, in particular, the market is large. For instance about 80 per cent of all vines in France are said to be treated with weed-killer. The citrus industry in Western Europe also consumes large amounts of these products.

(b) Cereals

Just under a fifth of all agrochemicals used worldwide are applied to cereals. The herbicide sector is easily the most important, accounting for annual sales of $2.4 billion in 1990, one half the total value of all agrochemicals applied to cereals. Fungicides are also extremely important, accounting for nearly 40 per cent of agrochemical sales of cereals. Insecticides are relatively unimportant with a share of just 7 per cent. In 1990 total areas planted in cereal came to 430 million hectares. Of this nearly a quarter was in the former USSR. India accounted for 15 per cent, China and the United States each 9 per cent, and Western Europe and Canada each about 8 per cent. In terms of production, the splits are slightly different. Total cereal production in 1990 is estimated at 900 million tonnes. Of this the former USSR accounted for a fifth, Western Europe some 16 per cent, China 12 per cent, the United States 11 per cent, India 8 per cent and Canada 5 per cent. The share of Western Europe in the total value of agrochemicals applied to cereals is far higher than these figures would suggest. This is because the intensive farming practices applied in this region lend themselves to concentrated use of agrochemicals. Just over one half of the $4.7 billion worth of agrochemicals applied to cereals in 1990 were used in Western Europe. The next most important regions were Eastern Europe and the former USSR (13 per cent), North America (12 per cent) and Latin America (6 per cent).

Wheat is easily the most important cereal, accounting for about 60 per cent of total world cereal production. Next in importance is barley (19 per cent), sorghum (6 per cent), and rye and oats (both 4 per cent). Two thirds of all agrochemicals applied to cereals are used on wheat. Barley takes a fifth, with the others accounting for the remaining 14 per cent. In recent years agrochemical sales applied to cereals have grown modestly at about 3 per cent per year. Fungicides have seen the biggest growth, of up to 10 per cent per year.

In the area of herbicides, the sector has been dominated by developments in Western Europe and North America, which have been the scene of recent new product and marketing efforts by the biggest companies in the sector. Of the $2.4 billion annual sales in the sector, just over 33 per cent are in Western Europe and 31 per cent in North America. Eastern Europe and the former USSR is the next most important region, accounting for 12 per cent of sales. Different types of weed-killers are used depending on the kind of weeds to be controlled, for example grasses or broadleaf plants such as clover. Also, particular kinds of herbicides lend themselves to application at different stages in the growth of a weed. In the grass weed-killer area, Tribunil (Bayer) and Illoxan (Hoechst) are among the largest sellers. Relatively new chemicals introduced in recent years include Ally (Du Pont), a type of sulphonyl urea, and Assert (American Cyanamid).

In the area of cereal fungicides, the world market is dominated by Western Europe, which accounted for more than three quarters of total sales of $1.8 billion in 1990. This region is home to a large portion of the total world effort in growing wheat, barley and oats. Also, intensive farming practices and the fact that many kinds of fungal diseases thrive in the temperate climate of the region lead to a large market in products for resisting fungal attack. Only in those parts of the world where crop yields are high is it generally cost effective to apply fungicides at the required concentration levels. The costs come both in the chemicals themselves and in the know-how and labour that are needed. Average wheat yields in Western Europe are very high at perhaps 6 tonnes per hectare. That compares with the average yield in parts of Africa of just 0.35 tonnes per hectare. Much of the knack of applying fungicides lies in matching the type of disease to be countered with a specific chemical which may be tailored to combat that particular condition. A farmer also has to know at what particular stage of the development season for the crop in question to apply the agrochemical. Increasingly, fungicides are being developed for preventive treatment, for use at the time of seed planting or soon after.

The types of fungal attack that are important for cereals are many and varied, particularly fungi that attack the stems and roots of cereals. In this category are brown foot-rot, eye-spot, and sharp eye-spot. Diseases that affect leaves include barley yellow dwarf virus, brown rust, powdery mildew, septonia leafspot, snow rot and yellow rust. Particularly damaging are forms of fungal attack which strike at the ears of barley, wheat and oats. Such forms may make their appearance at a relatively late stage of the growing season, when the farmer may be least expecting it. Fungi of this sort include black mould, ear blight, ergot, glume blotch, grey mould, loose smut and powdery mildew. Among the best known fungicides for use with cereals are Bayleton (Bayer), which is effective against mildew and rust disease; Tilt (Ciba-Geigy) and Radar (ICI), which control cereal foliar diseases such as glume, leaf blotch, mildew, net blotch and rusts; Sportak (Schering) which can be used to treat seeds prior to planting and wards off attack by eyespot; and others, such as Impact (ICI), Calixin (BASF), Punch (Du Pont) and Patrol (ICI).

Within the dominant Western European market for these products three countries are easily the most important, namely France, Germany and United Kingdom. Of the total Western European market of $1.4 billion in 1990, France accounted for $580 million, the Federal Republic of Germany $330 million and the United Kingdom $220 million.

(c) Rice

Rice is a crop found predominantly in East Asia, so it is unsurprising that the largest use of agrochemicals for the rice plant is in this region. However, within this region there are interesting discrepancies between countries in terms of their use of agrochemicals for this crop. Japan is responsible for only a small part of world rice production, but uses a large volume of agrochemicals to boost yields. In the years between

1960 and 1990 the global area given over to rice planting has increased by a fifth. That rate of increase will probably continue in the future, as more production is required to feed a rapidly rising population. Over the 30-year period, rising yields have caused the production of the crop to double. This has been the result of a greater use of agrochemicals, together with better general cultivation techniques.

Of the total area (146 million hectares) used worldwide for rice-growing in 1990, India accounted for 29 per cent, China 22 per cent, Bangladesh, Thailand and Indonesia each 7 per cent, and Japan just 1 per cent. Total world rice production in the same year was estimated at 350 million tonnes. Out of this the share of China was 37 per cent, India 21 per cent, Indonesia 8 per cent, Bangladesh 5 per cent, Thailand 4 per cent and Japan 3 per cent.

Total rice agrochemical sales were $3.1 billion in 1990, with Japan accounting for 47 per cent, China 8 per cent, India 7 per cent and Indonesia 5 per cent. Although the United States accounts for less than 1 per cent of the global planted area, it maintained 4.6 per cent of the agrochemical rice market in terms of sales. The Republic of Korea is responsible for 8 per cent of sales despite having a very small area of rice planting.

The key agrochemical product is insecticides, which accounts for 40 per cent of the total market. Herbicides account for 30 per cent and fungicides 25 per cent. Of the total insecticide market of $1.2 billion, Japan accounts for about 35 per cent, with China and India each responsible for about 14 per cent. There are many kinds of rice insect pests, some of which are especially virulent. They include black rice bugs, green leafhoppers, leaf beetles, leaf-miners, leaf-rollers, rice gall midges, rice skippers, stem borers, stem maggots, stalk borers, water weevils, yellow rice borers as well as many varieties of beetles, caterpillars, maggots, mites and rootworms. The single most important pest is the brown planthopper, particularly in India, Indonesia, Japan and northern Australia.

Different kinds of pests lend themselves to control by specific insecticides. Hence borers are best eradicated by organophosphate products. Hoppers can be killed relatively easily using carbamate insecticides. Large-selling organophosphates include diazinon or Basudin (Ciba-Geigy); fenitrothion, a generic product of which there are several trade names, including Folithion (Bayer) and Sumithion (Sumitomo); and phenthoate. Useful carbamate products include carbaryl, cartap, otherwise known by its trade name of Padan (Takeda) and isoprocarb. Important companies in the rice insecticides market include Hokko, Kumiai, Mitsubishi, Sumitomo and Takeda, all of which are in Japan. Others are Bayer, Ciba-Geigy, Rhône-Poulenc and Shell.

Weed-killers for use in rice production accounted for sales of about $1 billion in 1990. Of this 60 per cent was in Japan. Among the biggest-selling products are Londax (generic name: bensulfuron-methyl; made by Du Pont), Machete (butachlor; Monsanto), Ordram (molinate; ICI and Kashima), Ronstar (oxadiazon; Rhône-Poulenc and Showa Rhodia) and Saturn (thiobencarb; Kumiai). Such materials can be sprayed on rice paddies at various times after rice is planted, with different chemicals applied at different times. Sometimes mixtures are used to obtain optimum control of specific types of weeds.

In the fungicide market, Japan accounted for approximately one half the total sales of $750 million in 1990. Common rice diseases include bakanae, blight, bordered sheath blight, brown sclerotium disease, discoloured grain, leaf blast, murenae, sheath brown rot and stem rot. In the 1950s such diseases were countered in Japan with organomercury compounds, most of which have since been withdrawn following health scares. To replace these, manufacturers have introduced effective compounds such as antibiotics, organochlorines and organophosphates. However, in some cases the insects that have been earmarked for control by these products have developed resistance to the chemicals, again causing problems to farmers. Rice is the third largest market (after fruit and vegetables and wheat) for fungicides. Important products include Bean (generic name: tricyclazole; made by DowElanco), Fuji-One (isoprothiolane; Nihon Nohyaku), Hinosan (edifenphos; Bayer), Kitazin-P (IBP; Kumiai), Moncut (flutolanil; Nihon Nohyaku), Monguard (dicolmezine; Sankyo), Oryzemate (probenazole; Hokko) and Tachigaren (hymexazole; Sankyo).

(d) Cotton

Cotton is an extremely important cash crop for many developing countries. About four fifths is grown in virtually every country between the latitudes of 40° north and 20° south. The crop is important not just as a way of providing hard-currency export earnings, but, especially in China and India, as an input to the local textile industry. China, the United States, the former USSR and India are the most important areas for cotton production. In 1990 world production was estimated to be 19 million tonnes. Of this, 22 per cent was from China, 17 per cent from the United States, 14 per cent from the former USSR and 12 per cent from India. Among smaller producers, Pakistan accounted for 8 per cent, Brazil 4 per cent, and a large number of other countries 23 per cent. As might be expected, the United States accounts for a much larger share of agrochemical use than other regions. The United States was responsible for a quarter of world sales of cotton agrochemicals, totalling $2.7 billion in 1990. Next came the former USSR with 18 per cent, then India (11 per cent), China (9 per cent), Pakistan (5 per cent) and Brazil (4 per cent). Insecticides are by far the largest selling agrochemicals, accounting for 64 per cent of total sales of agrochemicals for cotton. Herbicides account for 18 per cent and fungicides just 4 per cent, with other types of agrochemicals (mainly plant growth regulators) responsible for the remainder. Cotton plant growth regulators are among the most important chemicals of this type.

Total sales of insecticides in 1990 were $1.7 billion. The United States and the former USSR each accounted for roughly 20 per cent of this, and both China and India 12 per cent. There is a long list of insects that attack cotton, including aphids, bollworms, caterpillars, cotton borers, green vegetable bugs, leafworms, spider mites, thrips and white flies. Large-selling insecticides for this crop include methyl and ethyl parathions, which are an early kind of organophosphate product sold by several companies, among them Bayer. They work by killing insects such as the boll-weevil after digestion. Another old product available cheaply in developing countries is DDT, an organochlorine-based product. It is similar in operation to Endrin (Shell). A more modern organophosphate is monocrotophos, one form of which is sold under the trade name Nuvacron (Ciba-Geigy). Other forms are called Azodrin (Shell and DuPont), Zolone (phosalone; Rhône-Poulenc), and Curacron, an organophosphate made by Ciba-Geigy, that works best against mites and other pests that damage plants by chewing into stems or by slow sucking.

Among the most modern and fast-growing products are the pyrethroid insecticides, which demonstrate great flexibility in attacking a wide range of insecticides. Among the companies selling these products are Bayer, ICI, Shell and Sumitomo. One problem about the pyrethroid products, however, is that some important insects have started to develop resistance to them. Difficulties of this sort have been reported in the 1980s in Australia, Colombia, Thailand, Turkey and the United States.

Cotton herbicides are far less important than the insecticides. This reflects the fact that in many developing countries where cotton is grown, weeding is done by hand. Of the total world market of $500 million in 1990, nearly two fifths are accounted for by the United States and one quarter by the former USSR. The main products can be divided into three types: toluidines (also called dinitroanillines), arsonates and ureas. The toluidines include Treflan (DowElanco) and Prowl, which is sometimes called Stomp, and is sold by a variety of companies. Among the arsonates are monosodium acid methanearsonate and disodium methanearsonate, sold by a variety of companies. The ureas include diuron (trade name Karmex; made by Du Pont), fluometuron (Cotoran; Ciba-Geigy) and norflurazon (Zorial; Sandoz).

(e) Maize

Maize is highly important as a human food (especially in many developing countries), as a feed material for the manufacture of corn syrup and sweeteners and maize flour, and as an animal food. In 1990 total production was 470 million tonnes. About 40 per cent of this was in the United Sates and 17 per cent in China. Africa, Latin America, the former USSR and Western Europe each accounted for about 7 per cent. Total sales of agrochemicals for this crop in 1990 was $2.2 billion, 60 per cent accounted for by the United States and 22 per cent spread between Europe and the former USSR. Africa, Brazil and China were also large markets. Herbicides constitute the most important part (roughly 75 per cent) of overall sales of agrochemicals applied to maize.

Among important products in the herbicide sector with total sales in 1990 of about $1.8 billion are atrazine (trade name Aatrex; sold by Ciba-Geigy) and alachlor (Lasso; Monsanto). Other products are bromoxynil (Buctril; Rhône-Poulenc), cyanazine (Bladex; Shell/Du Pont), metolachlor (Dual; Ciba-Geigy) and pendimethalin (Prowl; American Cyanamid). Most of these products are aimed at the two basic types of weed that are found to have a big disruptive effect on maize growth, grass and broad-leaved plants such as clover. Often these herbicides are used in mixtures so that their application can be tailored to suit particular problems of varieties of weeds growing in specific climates.

Maize insecticides (total sales in 1990 of $500 million) include carbofuran, one type of which is called Furadan and is sold by FMC. Another type is called Curaterr, sold by Bayer. The latter is effective against soil insects such as rootworm and also leaf insects including borers and flea beetles. Also important are fonofos (Dyfonate, ICI), terbufos (Counter, American Cyanamid) and Lindane (Rhône-Poulenc).

(f) Soy beans

The world production of soy beans in 1990 was 105 million tonnes. Of this half was in the United States, 17 per cent in Brazil and 10 per cent each in China and Argentina. The areas where soy beans grow are often the same latitudes where maize is produced, and farmers often grow the two crops in adjacent fields. Soy beans are grown both for food production and for oil. The oil can be used in a variety of edible and inedible products. In terms of agrochemical usage, the United States dominates, accounting for 60 per cent of the $1.8 billion sales of soy-bean agrochemicals in 1990. Herbicides account for four fifths of total sales, insecticides 12 per cent, and fungicides 6 per cent. The large-selling herbicides include alachlor (Lasso; made by Monsanto), acifluorfen (one form of which is marketed as Blazer by BASF and another as Tackle by Rhône-Poulenc), bentazone (Basagram; BASF), imazaquin (Scepter; American Cyanamid), metribuzin (Secor; Bayer) and trifluralin (Treflan; DowElanco).

(g) Sugar beets

About 40 million tonnes of sugar beets were produced globally in 1990. Eastern Europe (including the former USSR) and Western Europe each accounted for about 40 per cent of the total, with the United States and China accounting for relatively small fractions of about 8 per cent and 2 per cent, respectively. Total agrochemical sales were $900 million, and of this herbicides accounted for 60 per cent, insecticides 30 per cent and fungicides 10 per cent. Of the total market for agrochemicals, Western Europe makes 60 per cent of the sales, Eastern Europe 20 per cent, and the United States 9 per cent. Principal sugar-beet herbicides are clopyralid (trade name: Lontrel; made by DowElanco), diallate (Avadex; Monsanto) and metamitron (Goltrix; Bayer). Such products are particularly good at controlling the various grass types that can hinder sugar-beet growth.

(h) Rape-seed oil

Total world production of rape-seed oil was 23 million tonnes in 1990, split between China (27 per cent), Western Europe (25 per cent), India (16 per cent), Canada (14 per cent), and Eastern Europe and the former USSR (9 per cent). Western Europe accounted for about 60 per cent of the $500 million total sales in

1990 of agrochemicals aimed at this crop. Herbicides accounted for 60 per cent of all sales, with fungicides responsible for 19 per cent and insecticides 13 per cent. Principal rape-seed herbicides include carbetamide (trade name: Legurame, made by Rhône-Poulenc), diclofop methyl (Hoegrass; Hoechst), haloxyfop ethoxethyl (Verdict; DowElanco), propaquizafor (Agil; Dr. Maag) and propyzamide (Kerb; Rohm and Haas).

5. *Main agrochemical types*

This section provides a break down of the agrochemical market into broad categories classed in chemical terms, rather than in terms of the application to specific kinds of crops. Many of the products will be those mentioned in the last section, but they now are discussed in the context of their chemical operation [1].

(a) Herbicides

The total world market in 1990 was $11.6 billion. The main types are discussed below.

Triazines had an estimated market of $1.7 billion in 1990. They are generally applied directly to soil, and are relatively old-established materials, the patents on which have elapsed or will do so over the next few years. As more companies are permitted to make and sell these products, their prices will come down. Key products include 1,2,4-triazine derivatives, such as Lexone (Du Pont) and Lotix and Sencor (both Bayer). These products are extensively used to control weeds affecting maize, pineapple, sorghum, sugar cane and sugar beet. While Bayer, Du Pont and Shell are important in this field, Ciba-Geigy is the main manufacturer, being responsible for ametryne, prometryne and simazine. These are mature products with a real growth rate between 1972 and 1990 estimated at 1.9 per cent per year.

The amides market was $1.2 billion in 1990. These are sprayed on soil for control of grasses and broad-leaved weeds. Most of the main products are covered by patents, thus making profitability high. However, many other products feature patents that have run out in recent years, and sales are expected to contract in the 1990s. The main markets are in United States and South-East Asia. More than 20 products are available, half of which are important commercially. Dominant chemicals are propachlor (trade name: Ramrod, made by Monsanto), Machete (made by Monsanto) and alachlor (Lasso; Monsanto). Other key companies include Bayer, Ciba-Geigy, Rohm and Haas, Shell, Shell and Rhône-Poulenc and Uniroyl. Sales grew by 5.3 per cent per year (real growth rate, taking into account inflation) between 1972 and 1990. In 1990s they are expected to fall by 2.5 per cent per year.

The carbamates market was $1.1 billion in 1990. The United States accounted for about a third of total, Japan and Eastern Europe were also important. The introduction of new products in the 1980s have increased the size of this group, many of which are off patent. ICI is one of the main companies, selling products such as ethyl dipropylthiocarbamate (Eptam) and buylate (Sutan). Another large-selling chemical is diallate (Avadex, Monsanto). These chemicals are especially important in the rice market in Japan, where the materials mainly sold include thiobencarb (Saturn; Kumiai). Another important relatively new product is phenmedipham (Betanal; Schering). For many of these products, patents have or soon will elapse. Growth in the past 30 years has averaged 3.3 per cent per year, but during the 1990s growth rates are likely to be near zero in real terms.

The ureas market was $840 million in 1990. Given a wide application range and being fairly cheap, the earliest members of the family were invented by Du Pont in the 1960s. Hoechst and Ciba-Geigy are also important. Key products include diuron, monuron, fluomeuron, chloroxuron, methabenzthiazuron and chlorotoluron. Sales over the past 30 years have grown at about 0.5 per cent per year, in the 1990s, however, growth rates are expected to be negative.

Toludine sales amounted to $830 million in 1990. They are mainly used for soy bean and cotton, especially in the United States (60 per cent of market), Brazil and Europe. Treflan (generic name: trifluralin, made by DowElanco); and Sonalan are two large-selling products; Prowl, sometimes marketed as Stomp, (pendimethalin; American Cyanamid) is also important. Between 1972 and 1990 sales grew at 3.9 per cent per year, but in the 1990s sales are expected to decline at about 2.5 per cent per year.

Sales of hormone-acting products, which interfere with the hormonal balance of plants, rose to $660 million in 1990. They can be extremely selective by interfering with only specific types of weeds, due to the way these products can be targeted at particular hormonal structures. These are mainly inexpensive products with growth over the past 30 years amounting to 0.4 per cent per year. However, an expected decline of 3.9 per cent was anticipated in the 1990s.

The diazines market experienced sales of $750 million in 1990. Relatively new entrants with high profitability, they are used for rice, soy beans, cotton, cereals, vines and nuts. Regular usage is concentrated mainly in the United States, Japan and Brazil. The four main products areas include bentazone (BASF), methazole (Sandoz), oxadiazon (Rhône-Poulenc) and pyrazolate (Sankyo). Growth during the 1980s of about 14 per cent per year was reached, but the market is now stagnant. A decline of about 1 per cent per year is thought likely during the 1990s.

Diphenyl ether sales reached $590 million in 1990, with further growth in the soy bean and rice crops anticipated. There are about 7 major products with annual sales of $20 million or more. They include Blazer (BASF), X-52 (Nihon Nohyaku), MO (Mitsui Toatsu) and Hoelon (Hoechst). Many of these products are protected by patents making them expensive and profitable. During the 1980s sales grew by an estimated 14 per cent per year, with a growth of about 3 per cent per year likely in the near future.

Sulphonyl ureas, with sales of $530 million in 1990, provide broad-based protection against weeds that affect cereals, soy beans and rice. Markets are mainly in the United States (soy beans and cereals), Western Europe (cereals), East Asia (rice) and Australia (cereals). Important products include Glean or chlorsulfuron (Du Pont) and Logran or triasulforon (Ciba-Geigy). Other relatively new products include Beacon (Ciba-Geigy) and Gratil (Hoechst). Other companies doing R and D in this product area include Bayer, Ishihara, Shell, Schering and Takeda. Sales have only started to become significant in the past few years, but a very high forecast of growth up to 15 per cent per year is expected for the 1990s.

Recent sales of imidazolinones have amounted to $405 million per year. Scepter, the first of this class, was introduced in 1984, used largely on soy beans. The maker was American Cyanamid, and it continues to dominate the market for the products, others of which made by the same company include Pursuit and Assert. These products have had good sales because they are highly selective in terms of killing weeds but leaving crops alone. Also, they require only low levels of application in terms of weight of agrochemicals per hectare. Sales growth during the 1990s, during which most of the products will continue to enjoy patent protection, are likely to be considerable, at about 11 per cent per year.

(b) *Insecticides*

The total sales in 1990 of insecticides reached $7.7 billion. The most important of these are organophosphates with sales in 1990 of $2.8 billion. It is an old-established chemical covering about 70 major products, but has drawbacks because of worries about toxicity. Old and off-patent products (sold by many manufacturers) include dimecron, malathion and parathion. More recent products are Bolster (Bayer), Counter (American Cyanamid), Curacron (Ciba-Geigy) and Karphos (Sankyo). Growth during the past 30 years was about 3 per cent per year, but this is likely to be reduced during the 1990s to 0.9 per cent per year.

Pyrethroids sales stood at $1.4 billion in 1990. First introduced in 1976, considerable competition exists, as a result of large number of companies entering the market. Especially used in cotton, fruit and vegetables, the products are based on synthetic chemicals that replicate the insecticidal properties of naturally occurring flower-heads. They were initially developed in the United Kingdom and patented by the National Development Research Corporation. Among the leading products are fenveleerate, sold under various trade names by Du Pont, Shell and Sumitomo, fenpropathrin (Danitol; Rody and Meothrin by Sumitomo) and fluvalinate (Mavrik; Sandoz). Growth in the 1990s is likely to be about 2 per cent per year.

The carbamates market experienced sales of $1.7 billion in 1990. They are used for a wide range of crops and can often be used against insects that have acquired resistance to other insecticides such as organochlorine and organophosphate products. Major products include Furadan (FMC), Lannate (Du Pont) and Sevin and Temik (Rhône-Poulenc). Their growth rate during the 1980s of some 3 per cent per year is likely to slow down during 1990s to 0.5 per cent per year.

Organochlorines sales reached $500 million in 1990. Their use has been affected by worries about long-term persistence in soil and possibilities of the chemicals entering the food chain, but because of their low cost they are still used extensively in developing countries. The major products include aldrin, chlordane, DDT, endrin, lindane and toxaphene. Rhône-Poulenc and Shell are among the makers. Sales are likely to decline during the 1990s by about 5 per cent per year.

(c) *Fungicides*

With a total market in 1990 of $5.5 billion, there are mainly three different types of fungicide. The 1,2,4-triazoles reached sales of $1 billion in 1990. Though recent entrants to the market, they attack a broad variety of fungal types and are used for cereals, fruit and vegetables. The most successful products include Baycor, Baytan and Bayfidan (all Bayer), Punch (Du Pont) and Tilt (Ciba-Geigy). The growth in sales expected for the 1990s is 4 per cent per year.

Dithiocarbamates are mature chemicals and off patent. There are many producers throughout the world, with sales of $890 million in 1990. A stagnant growth of 0.2 per cent per year in recent years is likely to change to a decline of 5 per cent per year in the 1990s. Major producers include Bayer, BASF, Du Pont, Rhône-Poulenc and Rohm and Haas. Finally, sales of inorganics stood at $600 million in 1990. In the form of elemental sulphur they are a large-selling product, as are copper-based fungicides. Many of these have toxicity problems.

(d) *Other agrochemicals*

Other agrochemicals accounted for sales of $1.6 billion in 1990, of which $660 million stemmed from fumigants and related compounds based on propane, bromine and other material. Shell is one of the major producers. The other main type in this category is plant growth regulators, with sales in 1990 of $915 million. These include dessicants, defoliants and other compounds that change the physiology of plant growth, for example, to speed up growth prior to harvesting or to alter the way that particular kinds of plant develop to make them more useful in a marketing sense. Among the main kinds of plant growth regulators are maleic anhydride, made by BASF, Nihon and Nohyaku. Others are used to remove suckers and control sprouting in crops such as onions, potatoes and tobacco. These comprise Ethephon, made by Rhône-Poulenc and used to control boll opening in cotton and also to increase the fruit size in tomato plants; Polaris, made by Monsanto and used to increase sugar yields in sugar cane; Pix, made by BASF and used to reduce excess growth in cotton and shorten stems in barley; thidazuron, made by Schering and used as a cotton defoliant to reduce leaf growth and increase yields; and Baronet, made by Bayer and used to reduce growth of rice stems.

7. *Technological trends*

R and D is an extremely important part of the agrochemicals industry, accounting for about 10 per cent of sales. When agrochemicals first became important commercially in the 1950s and 1960s, most of the products were obtained by "hit-and-miss" methods. For example, agricultural workers discovered perhaps by trial and error that particular substances interfered with weed growth or killed certain insects, tried them out on crops, and decided on the basis of such tests that the materials would be worth making available commercially. Today, the tone of product development has changed completely. The emphasis is much more on scientific studies to examine the mechanisms by which (for instance) a specific kind of fungus first develops and survives and then moves on to attack a particular plant. From such studies a scientist can devise a rational approach to halting the development of the fungus, or at least reducing the effects of its action in interfering with the growth of a specific crop. In this way, strategies to make a new type of fungicide present themselves. Much the same applies to herbicides and insecticides.

After honing the theory of how such a product would work in the laboratory, the scientist has to translate this into a production routine so that the substance can be made on a large scale. Also, the scientist has to arrange for large-scale testing on plants in fields to work out the exact effect of the material both chemically and agriculturally, and to spot potentially unpleasant side-effects, for example, excess toxicity which could reduce the commercial success of a product.

Biotechnology is becoming increasingly important in agrochemical R and D. Biotechnology is a set of new scientific processes that involve ways to alter growth of plants or animals by interfering with the genetic composition of biological materials, for example proteins. By swapping or replacing genetic fragments of such materials, scientists can work out how a specific chemical can be programmed using genetic engineering techniques to operate in a specific way, for instance, attacking a particular kind of insect or fungus. At the same time, strategies can be devised using genetic engineering to ensure that a material of this sort (a new insecticide or fungicide) does not have a harmful effect on the crops that the scientist is seeking to protect. The agricultural worker can also ensure using such methods that the amount of agrochemical required for the job is minimized, to reduce the potential side-effects that may emerge through the substance finding its way into the food-chain. Similar procedures can be devised to develop efficient and safe-acting herbicides.

During the R and D cycle for a new agrochemical product, a firm can spend up to $50 million to ensure that just one product has the properties required to go on the market and is safe. Up to 10,000 compounds per year are likely to be tested in the laboratories of a single large agrochemical business such as ICI or Ciba-Geigy, and out of this eventually only perhaps three or four will find their way on to the market as full-fledged products.

The product cycle has several main phases, totalling up to 10 years. In early purely scientific work, scientists devise theoretical strategies for how new agrochemicals might work, in the way described above. Then they will need to try them out in initial evaluations of their action against fungi, etc. in a greenhouse. Then this work will need to be replicated in crops grown in fields and exposed to the weather. Often several sets of such tests are required under different climatic conditions. They may take place in the United States, Europe and East Asia to learn how the chemicals operate in different environments. Assuming a particular material appears to show some of the required actions in terms of combating insect or fungal attack or curbing weed growth, much more rigorous trials are then started. These involve applying the materials under different climatic, soil and growing conditions and for different crops and carefully observing their effect during several planting and harvesting cycles. At the same time as noting how these materials influence plant growth, scientists will gather data about their environmental effects [24]. The latter include the degree to which the chemicals leach into water streams, their take-up in plant or animal species that at some later point can work their way into the food-chain, and their direct chemical or biological impact on animal species (to test for toxicity). A further period of gathering data for registration purposes may be required; in most countries new agrochemicals have to meet severe regulatory standards before they are permitted to go on sale. These standards are set by government authorities to ensure that agrochemicals both work as advertised and are safe [25].

8. Short- and medium-term outlook

The agrochemical industry is at a difficult phase in its development. During the 1990s, there seems to be little chance that it will experience the high growth rates of the 1970s and early 1980s. The overproduction in the agricultural sector in many developed economies has meant that relatively small amounts of agrochemicals will be required during this period in developed countries. As far as the less developed countries are concerned, shortages of hard currency will make it less likely that many of them will have the resources to pay for imports of materials from developed countries where most agrochemicals are produced. The high costs of R and D and the specialized production facilities required for most forms of agrochemicals make it unlikely that in the near future many developing countries will acquire an indigenous agrochemical development and manufacturing capability. Environmental problems, too, cast a shadow over the future of the industry as many of the chemicals have shown themselves to be harmful to the environment. This relates particularly to the older-established materials, especially if they are applied using less than rigorous safety standards.

None the less, over the longer term few would dispute that the industry has good potential to boost crop yields and to help food production in virtually all areas of the world. The achievement of such an end would be facilitated by the development of new, efficient and safe chemicals that could be applied to aid agricultural production in the future.

E. Investment casting (part of ISIC 3710 and 3720)*

1. Current situation

Casting provides the shortest route to the manufacture of a metal component; metal or alloy is melted and poured into a prepared mould cavity, where it is allowed to solidify and cool [19]. The process is one of the most important of all metal-forming processes,

*UNIDO acknowledges the contribution of R.F. Smart, British Investment Casting Trade Association

and castings find application in virtually all manufacturing sectors. There are many types of casting processes in industrial use, including sand, shell, permanent mould, pressure die, centrifugal and investment casting processes. Each of these process types has its own characteristics, strengths and limitations, and their products are often directed towards well-defined and specific market sectors. Thus, a large proportion of the production of grey iron castings and of aluminium die castings has traditionally been sold to the automotive industry to produce components for cars and trucks. These two sectors of the foundry industry thus depend critically on the markets for the latter.

The total output of castings for 1990 has been estimated at 64.7 million tonnes, based upon a recent survey of production in 25 countries [20]. These figures represent a 4 per cent decline in casting output compared to 1989. Indeed, the foundry industry in most advanced countries has diminished during the last decade. In the United States (the third-largest producer of castings), for example, the number of casting plants in operation has decreased by 30-35 per cent between 1978 and 1990, sand foundries has decreased by 40 per cent, while the output of iron castings has dropped by 45 per cent [21].

Growing economic pressures and constraints have not, of course, been limited to the foundry industry during the last 10 years; they have been felt in all parts of the global manufacturing industry. One response is that designers have focused attention on "near-net-shape" forming methods, which generally have the capability of producing metal parts close to desired shapes and dimensions. As such, this approach minimizes the need for costly post-forming operations. Though many of these precision forming methods have been available for many years, only recently has expansion occurred. Investment casting, in particular, has benefited, because it approaches precision forming. Not only does it minimize (or in some cases eliminate) the need for raw castings to be machined to size, it also reduces wastage of often expensive metals and alloys. Moreover, the technique offers great design flexibility and can be used with virtually any metal or alloy combination.

The output of investment castings in terms of weight is modest; worldwide annual production is believed to be less than 500,000 tonnes, a mere 0.8 per cent of world casting production [22]. However, investment castings are widely used for high-value-added applications, and the value of such castings forms a significantly greater portion of world casting production than their weight. In the United States or the United Kingdom, the value is about 15 per cent of total casting shipments. Moreover, investment castings find wide use in aircraft and defence applications, so that the industry has a disproportionately high strategic value.

(a) *Investment casting defined*

The process of investment casting is based on the use of expendable patterns and ceramic slurries which form moulds that accurately replicate the pattern and have smooth surfaces. The first stage is to produce a replica of the part to be made, usually by injecting a wax mixture into a pattern die; the wax patterns are then connected, singly or in groups, to form an assembly (with suitable channels to allow subsequent passage of molten metal) which is "covered" or "invested" with a fine refractory slurry mixture.

In the block mould technique, the mould is produced in a single operation by pouring the slurry around the assembly, which is positioned in a flask or container. This technique is still used for specialized applications, but more versatile ceramic shell techniques are now used for a variety of parts manufacture. This requires covering the pattern assembly with a thin refractory layer which can be dried, after which the process is repeated; in this way, successive layers of ceramic are built up to form a shell of adequate thickness (5 to 10 layers being typical). The wax is then removed, usually by steam autoclaving, and this leaves a mould with an accurate internal cavity. This latter operation is normally associated with the historical name of "lost wax casting", although nowadays the wax is generally collected and reconstituted for subsequent use in parts of the pattern assembly. The mould is then fired to enhance its strength and the molten metal or alloy poured into it and allowed to solidify and cool. The mould is removed by breaking it open and the castings (after removal of the runner and riser system) can be suitably finished to the customer's requirements.

The use of expendable patterns of this type allows very accurate reproduction of shape and dimensions, so that precise shapes can be produced while tight tolerances can be maintained, especially from "casting to casting" in a batch. The process offers great design freedom, especially when use is made of the specialized techniques developed for the incorporation of cores in the pattern; it also has material freedom in the sense that it can be used for any alloy that can be melted and cast. Many of its applications are chosen not because it is the cheapest method of producing a "raw" casting, but because it couples lowest total component cost with casting quality and integrity.

(b) *History*

Lost-wax (or, in French, "cire perdue") casting has been used for at least six millenniums for sculpture and for jewellery applications [23]. To these specialized uses were added, about 100 years ago, its application for dental inlays and, somewhat later, for early surgical implants. It was the demands of the Second World War that transformed this ancient craft into a modern metal-forming process; especially, it was the introduction of gas turbines for military aircraft propulsion that proved the stimulus. To improve engine efficiency, designers specified increased gas temperatures, which place great thermal demands on the materials from which turbine blades and vanes are produced. Initially, forged alloy steels were used for these blades, but soon more heat-resistant alloys were sought; this led to the development of special nickel-base (and to a lesser extent cobalt-base) alloys, which became known under the generic name of "superalloys". As further development of these alloys proceeded, to allow turbine operation at even higher temperatures and greater efficiencies, the materials used became more refractory and less forgeable by traditional methods, while becoming more costly to machine (particularly to the very demanding aerofoil configuration).

It was against this background that attention turned to the lost-wax casting technique to produce accurate blades cast to shape. However, in meeting this challenge, the traditional process had to address the following four new requirements:

(a) There had to be reproducibility of castings within close dimensional limits;

(b) Castings had to be produced in high-melting-point alloys;

(c) There had to be high standards of metallurgical quality;

(d) Castings had to demonstrate lower costs over alternative manufacturing techniques.

It was the successful solution of these problems that laid the foundation for the modern investment casting industry. Established first in the United States and then the United Kingdom, the industry was mainly allied to aircraft and military applications. The introduction of the jet engine for civil applications after the war proved a real opportunity for investment casting and strengthened its link with high-quality, critical-component manufacture.

Expansion continued through the 1950s, with a growing list of applications being met by investment casting, and this period saw the beginning of a general commercial market, mainly for high-value-added components. However, the overall growth of the industry was initially quite slow. In the United States total output had reached $70 million per year by 1958, and it was only during the 1970s that shipment value became a significant part of overall foundry production; Thys [24] has shown that the peaks and troughs in output correlate with sales of aircraft in the United States.

In the United Kingdom, growth was also slow, with the total output value reaching $9.6 million (current dollars) in 1958 and $49.8 million (current dollars) in 1972. As in the United States, it took until the 1970s for output to become significant [25]. During the late 1970s and early 1980s, production in the United States and the United Kingdom continued to increase as well as in Western Europe and Japan. As shown in table V.41, total output from the four geographical regions (Japan, North America, United Kingdom and Western Europe for 1982 data) has been $1,865 million per year from 384 investment casting foundries employing about 16,800 people.

2. *Production and consumption*

The investment casting industry has grown significantly during the second half of the 1980s, a decade that has seen the decline of the traditional foundry industry. Total sales of investment castings have been variously estimated. For shipments in 1990, figures from as little as $3,500 million [26] to $6,663 million [27] have been estimated. The latter figure almost certainly seriously overestimates the sales of investment castings, making the lower figure more appropriate. Most of the known production of investment castings has been centred on three geographical areas: North America, Western Europe and the Pacific.

(a) North America

North America is the predominant producer of investment castings. There are an estimated 380 investment casting foundries, of which 350 are in the United States. Thys [24] reported United States output to be $2,200 million per annum in 1989 and this represents about 55 per cent of total world output. Gibson [28] has charted the change in United States shipments during the decade 1981-1990, on the basis of 1981 constant prices. United States output for 1990 was estimated to be between $2,200 million and $4,000 million. The higher value reflects growth during the second half of the decade, given a possible growth rate of 28 per cent between 1985 and 1990. The sales data presented in figure V.9 suggest that the United States industry has made significant advances in market penetration in the last decade. During the same period, the United States foundry industry decreased in size (a trend also observed in many other countries).

Table V.41. Comparative world investment casting output: 1982 and 1991

Country and region	Turnover (million dollars)[a] 1982	Turnover (million dollars)[a] 1991	Number of foundries 1982	Number of foundries 1991	Number of employees 1982	Number of employees 1991	Output in pound sterling per employee 1982	Output in pound sterling per employee 1991	Non-commercial output (percentage) 1982	Non-commercial output (percentage) 1991	Commerical output (percentage) 1982	Commerical output (percentage) 1991
Japan	90	425	35	70	3 500 [b]	7 000	25 000	60 714	10 [c]	20	90	80
North America	1 400	..	240	..	2 300	..	60 000	..	40 [d]	..	60	..
United Kingdom	175	530	49	60	5 000	6 500	35 000	81 338	67 [e]	70	33	30
United States	..	2 200	..	350	..	30 000	..	73 333	..	60	..	40
Western Europe[f]	200 [b]	600	60	80	6 000 [b]	7 500	33 000	80 000	30 [b]	65	70	45

Source: G. Could and C.G. Baker, "Investment casting industry - current and future market trends", paper No. 17 presented at the 6th World Conference on Investment Casting, held in Washington, D.C. in October 1984; and R.B. Williams, "Update on market trends in the investment casting industry", paper No. 1 presented at the 22nd EICF Conference on Investment Casting, held in Paris in April 1992.

[a] August 1984 exchange rate.

[b] Estimate.

[c] Aerospace and weapons.

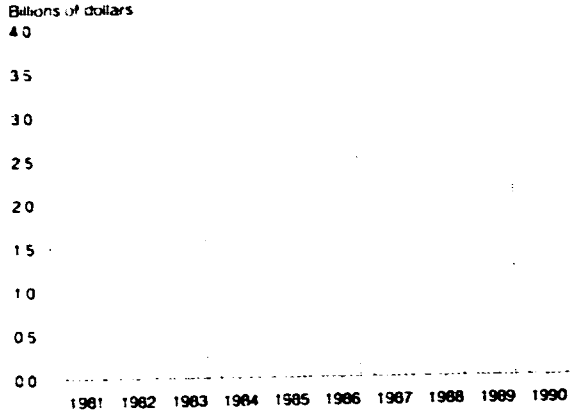
[d] Blade and vane output only.

[e] "Released".

[f] Excluding the United Kingdom.

Figure V.9. Investment casting sales in the United States

(In 1981 constant prices)



Source T Gibson, "The US metal casting industry", *The future for foundry casting — special report industrial minerals* (1991), pp 9-17

The number of foundries dropped from 4,829 in 1978 to 3,405 in 1990, a decline of nearly one third [21]. Comparison of casting production shows a similar trend, for most sectors of the United States foundry industry, with declines of 39 per cent for iron and 32 per cent for steel. Even aluminium castings showed only a modest 20 per cent increase [21]. It is difficult to make a direct comparison of these data with investment casting output, since the industry (except in Japan) does not report detailed tonnage outputs but only output values. The practice has arisen because of the large discrepancy in metal costs in different types of alloy cast and because of the high value-added of the castings. However, without going into detailed comparison, it is clear that investment casting has greatly increased its relative position.

The situation affecting the general foundry industry has been caused by a number of factors and has led to a number of changes. A major cause has been the strong dependence of the industry on automotive markets, which themselves have suffered considerable decline during the 1980s. Structural change in the foundry industry has led to a reorientation of companies and to a substantial reduction in the number of large captive casting operators. As recently as the mid-1980s captive plants accounted for nearly half of all metal casting production, whereas they currently account for less than a third [21]. There has, moreover, been an industry-wide trend to close down immediately unwanted or unneeded foundries. These trends, none the less, have not generally carried over to precision forming processes, which have benefited as a group from customer demand for more accurate components from their suppliers. This demand, apparent for some time, has only recently been recognized. Precision requirements have focused on the following three distinct areas [21]:

(a) Near net shape: this requires improving casting dimensional properties and reducing the total weight and cost of the supplied part;

(b) Improved surface finish: this is becoming a greater priority with the purchaser, even for applications where this improvement may not be functionally necessary;

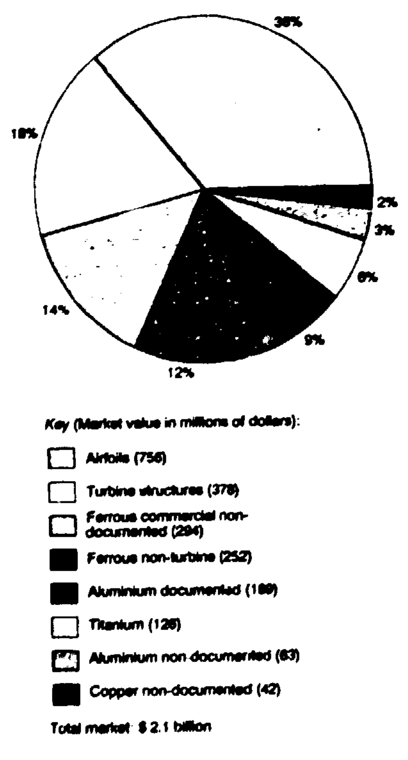
(c) More complex designs: this requires the ability to produce, in the supplied part, design features of considerable complexity which improve part performance or minimize the need for further work by the customer.

Investment casting has along with precision forming processes (such as powder metallurgy) benefited from these trends, while it has been further stimulated by rapid growth of its main markets.

Investment castings are widely used for aircraft parts (both military and civil) and for general commercial applications. In the former category may be listed airframe castings for wings and other surfaces, engine parts such as turbine blades, vanes and nozzles, and miscellaneous parts such as support structures, valves, pumps and instrument housings. In the United States, these are generally termed "documented" castings and others are termed "commercial" castings.

On the commercial side, applications include valves and pumps and stators for land-based turbines, electronic and electric chassis, boxes and very many other parts. Figure V.10 shows the estimated breakdown of the main applications for 1988 (the most recent year for which such data are available) [29]. Aircraft applications generally account for 60 per cent by value of United States investment casting output, but only 25 per cent when measured in tonnage. The applica-

Figure V.10. Distribution of the United States investment casting market by application, 1988

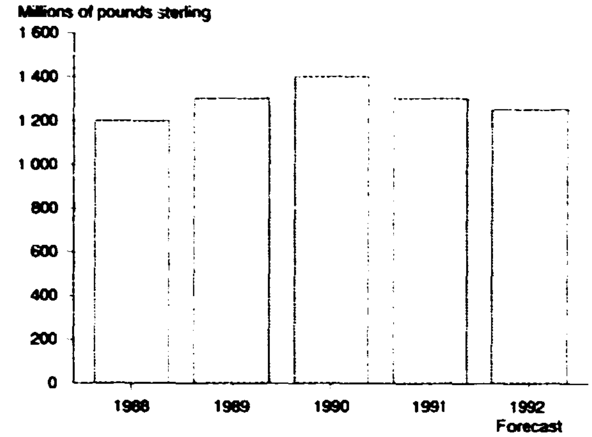


Source T. N. Thys, "Investment casting in the USA", keynote address at the 36th meeting of ICI, held at Nashville, Tennessee, in October 1988 tions are moreover serviced by only about 15 per cent of foundries (57 out of 385 or 65 out of 415 in North America). The commercial sector accounts for 40 per cent by value of output (but 75 per cent by weight), and this is serviced by the remaining 350 investment casting foundries in the United States (or 380 in North America). Profits in the investment casting industry thus rely heavily not only on the prosperity of the automotive industry (like most of the foundry sectors), but also on the aircraft industry. Between 1985 and 1990, new orders for United States-built aircraft, missiles and related parts increased by nearly 60 per cent [28], while more sophisticated systems in military and civilian aircraft required more intricate castings with greater added value.

Though aircraft has been the biggest single stimulus to investment casting, the general commercial market has not remained static. This is an extremely diverse market, its largest segment being valves and pumps, the latter having made inroads against sand castings as well as supplying a growing market. Other markets that have spurred demand in the late 1980s include rotors and stators for land-based turbines, scientific instruments, electronic equipment and computers, food processing, medical equipment and prostheses and golf equipment. The growth in land based turbine blade requirements has also been particularly striking in recent years.

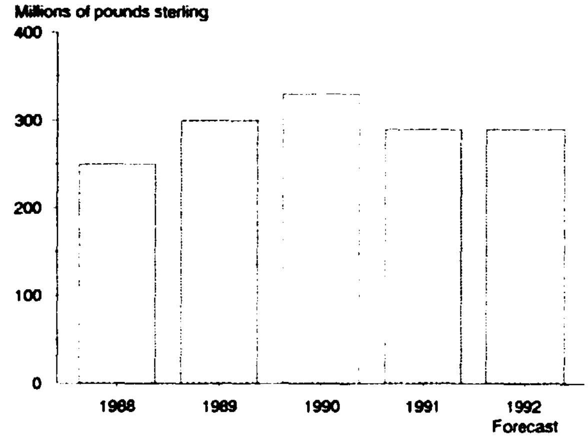
While "investment casting" has gained relative to other casting processes, such as sand casting as well as forging and fabrication, it has lost market shares to other processes and materials, such as sintered parts and plastics. The main thrust in the growth of the industry is not due to changes among forming processes, but rather to the expansion of markets (especially for aircraft). Unlike other sectors of the casting industry, "investment casting" does not rely heavily on automotive markets. Data produced by the United States Investment Casting Institute [30] have indicated that output increased by only about 2 per cent in 1989 compared with 1988, and fell by about 7 per cent in 1991 compared with 1990. This overall fall was due to a drop in aerospace sales of 13 per cent, which could not be compensated by a 3 per cent increase in commercial sales. However, as shown in figure V.11, shipments increased by 8 per cent in 1989 and a further 7.5 per cent in 1990, before falling back in 1991 to the 1989 level.

Figure V.11. Turnover in the United States investment casting industry, 1988-1991



Source: R. B. Williams, "Update on market trends in the investment casting industry", paper No. 1 presented at the 22nd EICF Conference on Investment Casting, held in Paris in April 1992.

Figure V.12. Turnover in the United Kingdom investment casting industry, 1988-1991



Source: R. B. Williams, "Update on market trends in the investment casting industry", paper No. 1 presented at the 22nd EICF Conference on Investment Casting, held in Paris in April 1992.

(b) *Western Europe*

The largest single investment castings producer in this region has been the United Kingdom. As shown in figure V.12, Williams [25] estimated that sales had reached £300 million by 1989, and in 1990 sales reached a maximum of £330 million before falling back by some 20 per cent in 1991, as the effects of the recession became evident. The United Kingdom ratio of released castings (non-commercial to commercial) is high at about 70:30, and this ratio has changed little during the last decade. In the aircraft sector, nickel-based superalloys provide castings for gas-turbine engine blades, nozzle guide vanes and carcass parts; these materials require vacuum melting and casting, and in some cases, advanced casting techniques. Such refinements of the investment-casting manufacturing process, together with the extreme stringency of the necessary quality-assurance control techniques, are not cheap and require substantial capital investment. The production of such castings, therefore, tends to be the province of a few of the large companies, which may (or may not) be part of large (transnational) groups. A detailed breakdown of United Kingdom alloy usage by the industry is not published, but general estimates suggest that, by value, steels (of all types) account for 30 per cent of investment casting output, superalloys for 60 per cent, and other non-ferrous alloy castings (mainly aluminium) for the remaining 10 per cent [31].

In dealing with application areas, the importance of the land-based turbine market should be noted as complementary to the aircraft turbine market; another notable point is the relative scarcity of applications in the automotive industry (except for the single and important exception of turbocharger components). There are a number of historic reasons for the poor penetration of the general automotive market, but recent trends suggest a growing awareness by designers in that industry of the need to evaluate total component costs and not only raw casting costs. On the basis of the most recent information [26], the United Kingdom has currently 60 investment casting foundries devoted to the production of engineering castings, with about 6,500 workers, an increase of 500 over the last four years.

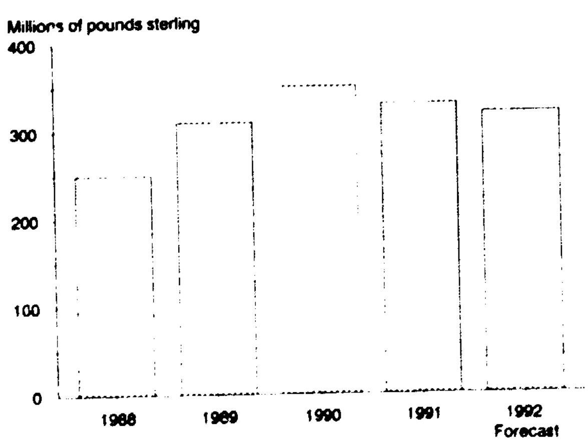
Regarding aircraft applications, the engine contractors make extensive use of investment casting facilities. There has been an increase in exports of United Kingdom investment castings from 10 per cent in the mid-1970s to 25 per cent in 1982, and currently to as much as 50 per cent of total production. Within the rest of Western Europe, the investment casting market is serviced by some 80 foundries. From an estimated 1989 output of £310 million, figure V.13 shows that sales have climbed to reach a peak of £350 million in 1990 before declining slightly in 1991. This decline in sales has been less than that of the United Kingdom. The largest country producers in this region are France and Germany, which together account for over 60 per cent of total Western European output.

(c) *Pacific area*

The major recognized producer of investment castings in the Pacific area is Japan, where output reached £190 million per annum by 1988 [24]. The most recent survey by Williams [26] suggests that turnover continued to rise in 1989, and reached a maximum of £235 million in 1990 and 1991. As shown in figure V.14, a decrease is predicted in 1992. This output is based on 70 foundries employing 7,000 people. Millgate and Williams [32] believe that market shares for Japanese investment casting are roughly 15 per cent for aerospace castings (typically released or documented data) and 85 per cent for general commercial castings.

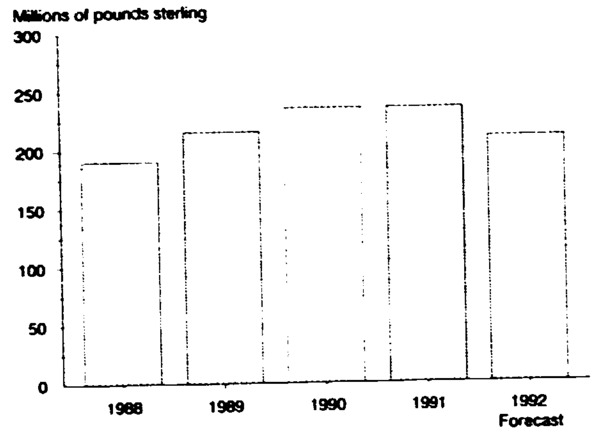
Figure V.13. Turnover in the European investment casting industry, 1988-1991

(Excluding United Kingdom and Eastern Europe)



Source: R. B. Williams, "Update on market trends in the investment casting industry", paper No. 1 presented at the 22nd EICF Conference on Investment Casting, held in Paris in April 1992.

Figure V.14. Turnover in the Japanese investment casting industry, 1988-1991



Source: R. B. Williams, "Update on market trends in the investment casting industry", paper No. 1 presented at the 22nd EICF Conference on Investment Casting, held in Paris in April 1992.

This ratio conflicts strongly with that observed in the United States or the United Kingdom. Output of precision castings in 1990 was 10,645 tonnes, an increase of 10.6 per cent over 1989, or 46,895 million yen, an increase of 11 per cent on the previous year [33]. It should be noted that these totals refer to precision castings, which are further divided into lost-wax, plaster and ceramic-mould castings. The total lost-wax casting output for 1990 was 7,323 tonnes, an increase of 7 per cent over the previous year. The output of precision castings in Japan has experienced much less dramatic growth during the second half of the 1980s than that experienced in either the United States or the United Kingdom. Indeed, the increase from 1985 to 1990 was only 22 per cent in tonnage terms, which is little different from other sectors of the Japanese foundry industry. A breakdown of end usage of lost-wax castings shows that castings for industrial machinery account for 32.9 per cent of the total value of investment castings produced in 1990 (compared with 30 per cent in 1989); this is the single largest identified sector.

Two other sectors merit special attention. Arms and airplanes castings accounted for only 161 tonnes in 1990, valued at $40 million. These represent 2.2 per cent of tonnage and 13.8 per cent of value of output, percentages which have changed little since 1989. The other sector of particular interest is automotive applications, which accounted for 21.5 per cent of total tonnage of lost-wax castings in 1990, an increase of 0.8 per cent over the previous year.

Consideration of these data suggests an explanation of why the Japanese investment casting industry has shown a different pattern of growth than the North American or European industries. On the one hand, the low value of products intended for aircraft application suggests that Japan would not benefit from the increase in world aircraft sales experienced between 1985-1990. On the other hand, the large dependence on automobile applications has been less damaging than might have been expected, due to the relative buoyancy of the overall Japanese car and truck industry.

Of the other Pacific countries and areas, both Taiwan Province and the Republic of Korea have recently achieved prominence with manufacture and exports (especially to the United States). These tend to be castings aimed at the general commercial market. However, no further information on the size of industry and output is available, although Millgate and Williams [32] report that Taiwan Province has some 50 to 60 investment casting foundries and the Republic of Korea approximately 10. Safety and environmental controls are, according to that report, matters of much less concern to founders in the Republic of Korea.

The final country that should be mentioned in the Pacific area is China, which according to one recent reliable report [20] produced no less than 60.720 tonnes of "investment castings" in 1990, based on 517 investment casting foundries. Despite the fact that the majority of these foundries are likely to be very small in terms of employees, these are still remarkable figures.

(d) *Other areas*

It is known that industrial investment casting production is carried out in at least 15 countries and areas in addition to those already mentioned, but no detailed information is available for most of them. Table V.42 suggests that the number of investment foundries in these countries and areas reached about 100, but this is probably an underestimate, not least because it does not include any estimates for the newly independent States of the former USSR. The countries of Eastern Europe have for long been interested and involved in precision casting and there are established industries in a number of them, notably Czechoslovakia. As companies in Western Europe become more involved in the Eastern European industry, so the level of precision casting activity in these countries is likely to build up.

The precision-casting industries established in Africa, Asia and India tend to be based upon small units. As an example, there are 13 investment casting plants in India producing only about 850 tonnes of castings per year [34]. Of these, only two foundries (producing 10 tonnes per year of castings) are involved in defence, while a further two (with an output of 250 tonnes per year) are captive foundries. The rest are involved in general commercial casting production. In materials terms, 85 per cent of that output is based on basic materials and 10 per cent on non-ferrous alloys, such as aluminium. In the most recent survey by Williams [26], the total output of countries outside the United States, the United Kingdom and the rest of Western Europe and Japan is put at $400 million per annum for 1991, or 9 per cent of total known world production, an increase of 25 per cent on the estimate for 1988. However, it is felt that these estimates seriously underestimate the overall production of investment casting, particularly if China and the Republics of the former USSR are included.

(e) *Regional differences*

In concluding this review, it may be useful to briefly compare the characteristics of the four principal producing areas, the United States, the United Kingdom, the rest of Western Europe and Japan. Figure V.15, based on Williams [26], shows the estimated shares of investment casting production and this highlights the preponderance of United States producers. Table V.41 provides further data on these regions covering turnover, number of foundries, number of employees and ratio of commercial to non-commercial castings (the latter ratios should only be used as a general guide, since the definition of what constitutes commercial and non-commercial castings varies slightly from country to country). It is interest-

Table V.42. Estimated number of investment casting foundries, 1991

Region, country and area	Number of foundries
Western Europe[a/]	80
Eastern Europe[b/]	40
China	517
United States	350
Japan	70
United Kingdom	60
Taiwan Province	55
Canada	30
India	13
Republic of Korea	10
Australia	7
South Africa	6
Mexico	6
Iran (Islamic Republic of)	6
Brazil	5
Israel	5
New Zealand	2

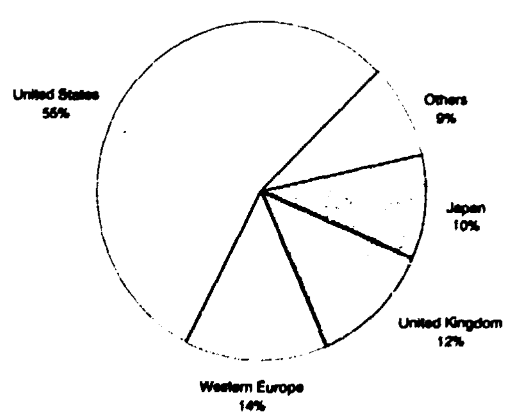
Source: Private information communicated to the author.

a/ Excluding the United Kingdom.

b/ Excluding the former USSR.

Figure V.15. Distribution of turnover in the world investment casting market, 1991

(Excluding China, Eastern Europe and the former USSR)



Source: R. B. Williams, "Update on market trends in the investment casting industry", paper No. 1 presented at the 22nd EICF Conference on Investment Casting, held in Paris in April 1992.

ing that turnover per foundry varies only in a small way among the countries quoted, and the number of employees per foundry is remarkably similar, varying only from 86 to 108. The ratio of non-commercial to commercial casting is similar for the United States, the United Kingdom and Western Europe; only in Japan is the output per employee significantly lower. In fact, on the basis of these figures, there appears to be a relationship between mix of work (non-commercial versus commercial ratios) and employee output. This would be expected but was not found in the 1982 figures shown in table V.41.

3. *Technological trends*

The growth of the industry, in the face of severe competition, has depended upon continued technical development allied to the maintenance of high standards of quality assurance. Some of the more important developments are outlined below [35].

(a) Ceramic shell technology

While the block mould process is still used for certain specialized applications, the use of the ceramic shell process is almost universal throughout the industry for the production of investment castings for engineering applications; this is because of its greater versatility. The ceramic shell process has been "tailored" so that optimum shells can be obtained for different markets, including aeroengine blades, electronic components and general engineering components. This is important since the quality—and especially the consistency—of the investment casting depends initially upon the control of the shell moulding materials and process. Ceramic shell systems are compositionally and structurally very complex and, until recently, their control was more an art than a science. Scientific evaluation, carried out during the 1980s on commercial shell systems, has given a better understanding of shell formation and chemistry, and this has permitted improved control of existing shell systems as well as helping the development of advanced systems. This area of work, initially pioneered in the United Kingdom [36], has recently become active worldwide.

(b) Preformed ceramic cores

An associated advance, dating from the time of the introduction of ceramic shells, is the development of preformed-ceramic-core techniques which allow castings to incorporate a labyrinth of fine internal passages, these being especially useful for castings that require internal cooling. Core technology has probably reached its most advanced stage in the manufacture of superalloy turbine blades, with the incorporation of very complex cooling channels in advanced manufacturing technology. Research is likely to continue on a still more effective use of internal air cooling passages.

(c) Mechanization and automation

There has been a well-recorded move in the industry towards more widespread automation, manifested particularly in a growing use of robots for the production of shell moulds. Whereas early robots and mechanical handling equipment had a payload capacity of up to about 65 kilograms, United Kingdom foundries today use robots with payloads of up to 350 kilograms. In the United States, robots have been brought into use with payloads in excess of 1,000 kilograms, and this trend will continue. Robots have also promoted greater reliability and consistency in the shell compared with earlier hand-shelling processes. To support these developments, the formulations for waxes and for refractory shell systems have been continually improved by proprietary development. The overall effect of these changes has been to extend the size and weight capability of the investment casting process as well as to promote the use of thinner section castings. Whereas investment castings were originally generally very small components, the process now encompasses the manufacture of castings up to sizes well in excess of a 1-cubic-metre envelope. Mechanization of wax pattern production has also been considered and, following initial difficulties, much progress has been made in automating the process. Automatic wax injection machines are widely used either for large production runs or for manufacturing items for stock.

(d) Vacuum melting

While many investment castings are produced by air melting and casting, the reactive nature of some of the alloying elements in superalloys has made vacuum melting and casting techniques essential for quality output, and this approach is now very well-established. Recent trends towards cleaner castings had led to an increasing use of vacuum melting and casting for steel investment castings and, very recently, for high-quality aluminium castings.

(e) Hot isostatic pressing

During the last decade, the technique of hot isostatic pressing (known as hipping or HIPping) has become and important adjunct to casting. The process involves the simultaneous application of pressure (typically, by an inert gas such as argon) and elevated temperature to a part held in a sealed chamber. By careful control of the parameters, internal micro-porosity can be eliminated and metallurgical bonding of the adjacent surfaces achieved to give a fully sound structure with enhanced mechanical properties. Originally considered as a technique for rectifying flawed castings, hipping is now being used in its proper role to improve the integrity of well-produced castings. In the case of investment casting, it has proved extremely useful in allowing their full property potential to be realized.

(f) Superalloys

Gas-turbine-engine blades and nozzle guide vanes are components exposed to very demanding applications. They have, over the years, led to some of the most advanced materials and process developments; such applications are now a major outlet for vacuum cast superalloys. Modern superalloys operate near their inherent melting-point, and the scope for redevelopment of more refractory alloys, at least those based on the traditional superalloy base, is limited. Moreover, it became clear some years ago that low values of the property known as creep ductility in blading were limiting aircraft gas turbine developments, and this was found, upon investigation, to be due to voids in transverse grain boundaries in the superalloy structure. This limitation was overcome by the development of directionally solidified blades and, later, single crystal blades. The absence of grain boundaries allowed certain grain boundary strengthening elements to be removed from the alloy composition and, since these elements depressed the melting-point of the matrix, their omission increased the inherent temperature capability of the superalloy. DS and SC techniques are now used cost-effectively in volume production, and this represents a real metallurgical achievement, although it is still true that most precision-cast aerofoil components downstream of the highest temperature and pressure stages continue to be based on equi-axed castings.

A major development during the last decade has been the use of investment casting to produce large and complex, thin-wall engine carcass parts (diffuser housings and combustor castings) with castings of up to 1,500 millimetres in diameter by 600 millimetres in depth. These are replacing sheet metal fabrication, not only because they are more cost-effective, but also because they provide a high-rigidity monolithic component with superior service characteristics.

Investment-cast, integrally-bladed turbine wheels for smaller turbine engines offer considerable cost savings over mechanical fabrications, but originally they suffered from poor mechanical properties due to compromises made in the casting process. Metallurgical development has allowed the properties to be dramatically improved and caused integrated wheels to be much more widely adopted. While much of the interest in superalloy investment castings has inevitably centred on gas turbine blading, other fields of applications should not be ignored. As an example, there is a long-established market for hip replacement prostheses made from cobalt-based superalloys formed by investment casting, and these are under continuing technical development.

(g) *Steel investment castings*

As designers and engineers have become aware of the potential of investment castings, so the variety of steels used and of components cast has increased dramatically. The industrial base spans aerospace, armament, automotive, food, petrochemical, valve and pump, nuclear, textile and other general engineering components. Applications encompass a diverse range of products from golf club heads to gearbox parts for automotive applications, bicycle cam forks or a variety of gears and cam components in various wear-resistant steels. Recent R and D on high-integrity steel investment castings has proved particularly useful in increasing their fatigue strength (a traditional area of concern with all castings). By the use of optimized processing techniques allied to hot isostatic processing, high-integrity castings have been produced with fatigue performance equal to that given by forgings measured longitudinally. The total cost of the finished component can be as much as 40 to 70 per cent below that for parts made from forgings or fabrications. These developments are opening up new markets for investment castings in dynamically loaded applications; already they are the recommended manufacturing route for a range of artillery castings [36].

(h) *Aluminium and titanium investment castings*

Investment castings are now accepted for a wide variety of aluminium alloy components, and they find current use in such fields as electronics, avionics, aerospace, pump and valve applications and military command equipment. Whereas originally only small light-alloy castings were common, now much larger sizes are regularly cast with sided envelopes of 800 to 1,000 millimetres not being uncommon. Wall thickness has also been progressively reduced in order to minimize weight by the use of improved shell systems and casting techniques. There has been considerable work to develop techniques for producing "premium-quality" aluminium alloy castings, with improved and more consistent properties (and performance). This has been successful and has given casters the confidence to offer premium-quality castings for demanding applications, such as airframe components.

Investment-cast titanium alloys are now available based on the development of less-reactive ceramic shell moulds, chemically milling to remove the crack structure surface and hipping to seal internal voids. Castings are in production for static structural applications that require metallurgical integrity with high levels of resistance to crack propagation. Work is also advanced on titanium castings for rotating structures; in the United States, hollow compressor blades of 300 to 450 millimetres in length and investment cast in titanium alloy are under development.

4. *Environmental considerations*

A major factor now facing investment casters in all developed countries is the impact of environmental protection legislation, and this impact is likely to increase in the years up to 2000, as concern about the environment grows. The investment casting sector will possibly encounter rather fewer problems than the rest of the foundry industry because it tends to be a cleaner process. However, one area of difficulty, peculiar to investment casting, involves the limitations on emissions of volatile organic compounds (VOCs) and ammonia. In discussing this subject, it is necessary to consider that the ceramic shell system comprises refractory material (stucco), filler and binder. No single formation will give all the characteristics desired in the ideal shell, so that material choice is inevitably a compromise; alumino-silicates, fused silica and zircon are widely used refractory materials in shell manufacture.

A crucial constituent of the shell system is the binder, of which there are two main types. Ethyl silicate binders are prepared by reactions involving alcohol; when a suitable catalyst (typically ammonia) is added, a series of chemical reactions occur; this produces cross-linking and polymerization and a gel is formed; firing of the shell will then harden the structure. Alcohol (ethanol and isopropyl alcohol) and ammonia can be emitted to the atmosphere during the manufacturing operation. Silica sols, comprising silica particles in an alkaline aqueous solution, can be converted to a gel by adjusting the pH from alkaline to acid; in this case, heating of the gel produces a strong bond. There are also hybrids of the two main types. While most investment foundries use water-based binders to produce the primary shell coat, practice varies as far as backup is concerned. In the United States, the trend has been towards using all water systems. In Europe, most foundries have traditionally backed up with ethyl silicate solutions. However, there are notable exceptions to this; thus, in the United Kingdom two of the largest aircraft component investment casters undertaking the highest-quality work use water soluble shell chemistry and have done so for a considerable time. That both systems work, therefore, is beyond dispute.

However, in terms of environmental concern it is clear that the binders containing ethyl silicate have the potential for emitting alcohol and ammonia to the atmosphere. In countries such as the United States and member countries of the EEC, which have a developed environmental policy, there are generally quite strict limits on permissible emissions of VOCs and ammonia, since they are considered to be contributors to the formation of low-level photochemical ozone.

The regulations regarding VOCs and ammonia vary from country to country even where, as in the EEC, they stem from a single directive and are intended to give equality among member companies. However, the precise limits placed on particular VOCs and ammonia vary considerably among European countries. Thus, German legislation allows up to 150 milligrams per cubic metre for alcohol emissions (determined on a standard test), while the United Kingdom allows only 50 milligrams per cubic metre. Since emission results indicate that at least some investment foundries are emitting within the range of 50 to 150 milligrams per cubic metre, the commercial significance of these two national limits is obvious. The same arguments apply with still more force to countries that have not yet developed a comprehensive environmental policy.

In general, investment casters have the following three distinct options, if they already use ethyl silicate binders:

(a) To continue to use these binders and, if necessary, to install abatement equipment to remove prohibited emissions or reduce them to acceptable levels. Such equipment (for example, biofiltration or incineration units) tends not to be cheap, although work is now in progress to develop cheaper versions that will meet the needs of industries like investment casting;

(b) To turn to low-alcohol binders, which are being developed and are claimed to give the benefits of ethyl silicates with low emissions. However, prohibited emissions may still be produced, and these may require the installation of some abatement equipment;

(c) To change to water-based solutions for shell manufacture. This requires, in most cases, the development of a new technology, possible changes in design practice, and possible revalidation of critical parts. All of these are likely to be expensive, but the need for VOC abatement equipment will be avoided.

Each foundry will decide for itself which option is best, but there are signs of movement toward water-based solutions across the industry. This is most evident in the United States, possibly because of the existence of strong environmentalist pressures. It is believed that the environmental factor could be one of the major determinants in the way the investment casting industry develops in the coming decade.

5. *Related processes*

There are several processes akin to investment casting which rely on the use of ceramic moulds to receive and contain the molten metal. However, to be strictly comparable, only processes that use expendable patterns allied to ceramic moulds should be considered, and this restricts the comparison essentially to plaster mould and to evaporative pattern casting [37]. The former is based upon the investing of a wax pattern with plaster of Paris to produce a plaster block mould; for large items, use may also be made of rubber patterns. The plaster process is well suited for certain applications that require particularly fine surface finish with good dimensional control, and it is commercially used for the production of turbocharged impellers for commercial vehicles and passenger cars.

Evaporative pattern casting has received considerable recent attention in the Replicast CS process. This uses a cellular foam, typically expanded polystyrene as the pattern, and it enables large, lightweight patterns of any realistic section thickness to be produced at reasonable cost. The shell-build-up procedure is similar to that employed with traditional investment casting, with a series of refractory coats being applied to produce the requisite shell. The expanded-polystyrene pattern is removed before casting, and the shells, which are usually quite thin, are backed up with sand before casting is undertaken.

When it was first introduced, it was suggested that Replicast-type processes could give the results obtained by lost-wax casting at reduced cost. However, it has become clear that the process is not competitive with the lost-wax process, but rather complementary to it. In particular, when the highest quality of surface finish is required, the expanded-polystyrene process is not as good, nor are tolerances quite as tight. However, Replicast has built up a market, especially for large castings, where it competes successfully with traditional sand casting.

6. *Short- and medium-term outlook*

As indicated earlier, there is some conflict regarding the published statistics that describe the size of the investment casting industry. However, without going into the precise output figures, it is clear that the industry has grown very substantially during the 1980s and, in this, it has performed better than the majority of the other branches of the foundry industry. This growth, it is suggested, is directly linked to the growth during the last decade of the aircraft market, the biggest single outlet for investment castings. While the industry has suffered during the recent worldwide recession, it is believed that the above-average performance will be reasserted as the 1990s progress, and investment casting growth will out-perform that of other foundry branches.

Investment casting as a preferred forming technique is selected by designers on the basis of cost and ability to produce complex shaped parts and general component quality. Recent economic pressures have intensified the need for designers (and buyers) of engineering parts to find the most cost-effective manufacturing route for any given component. This philosophy is not new, but recent economic conditions have given it a greater urgency. This theme is going to run through engineering design in the next decade and such a prospect can only auger well for investment casting.

Recent technical developments have made it possible for the process not only to produce repetitively accurate castings of high quality, but also through the use of hipping, to supply castings without microporosity and with assured fatigue properties. This offers the industry a new range of markets from which castings have been traditionally excluded. These cover applications in which components have to withstand fluctuating stresses and which traditionally have been served by forgings or fabrications. While hipped investment castings may compete on technical grounds with forgings and fabrications, they also offer considerable cost advantages. Such applications could thus provide a major growth area.

In looking to the short-term future, it seems likely that 1992 and possibly 1993 will show little improvement over 1991 in terms of sales output. Indeed, Williams predicts reduced sales in three of the four geographical areas of his survey for 1992 compared with the previous year [26]. The reductions predicted are 4 per cent for the United States, 3 per cent for Western Europe (excluding the United Kingdom) and 11 per cent for Japan. The output of the United Kingdom is expected to remain stationary.

Over the longer term, Williams believes the prospects for continued growth are good, and recognizes the continued crucial role of the aircraft industry in maintaining the health of the investment casting industry. Ageing aircraft fleets must be replaced, while noise and environmental regulations will encourage (or indeed require) the development and production of advanced aircraft designs which will tend to require components of greater complexity and greater added value. Even today, as much as 50 per cent of the value of the well-designed aircraft engine can be comprised of investment castings. While there may be some recovery in 1992 and 1993 arising from the spares market, Williams believes that growth in new engine business cannot be expected before 1994 and 1995 [26]. On the technical side, there seems little threat in the foreseeable future to the established nickel-based superalloys from other materials, although there could be an increase in the use of directionally solidified or especially single crystal blading, which currently accounts for only a small percentage of total turbine blade output. Over the next four to five years this could increase to as much as 15 per cent.

Gibson takes a broadly similar view [28]. His analysis of the potential for investment casting was prepared in the light of the recent recession and recognized the effects of the political and economic changes in Eastern Europe and of the war in the Persian Gulf. He concluded that, following a decline in military aircraft sales in 1991, the market would begin to recover with strong export sales and some United States procurement; however, any improvement would take until 1993 to become significant. Translated into figures, these predictions suggest a minor increase (of 2.8 per cent) in 1992 compared with the previous year and a further growth of 5.4 per cent in 1993. However, overall growth is only expected to average 0.8 per cent per annum for the decade from 1991 to 2000. These predictions, if confirmed, would limit the scope for growth of investment casting markets in this area, although the actual growth may be rather greater than expected. This is because military aircraft markets will demand increasing sophistication of instrumentation, weapons and other systems, and these trends should favour the use of complex investment castings.

Regarding civilian aircraft, the demand is expected to remain strong, with a considerable backlog of orders for new aircrafts. A rise of 9.5 per cent in 1992 compared with 1991, and a further increase of 6.5 per cent in 1993 compared with 1992, are predicted. Gibson also reports that Boeing is forecasting 5.2 per cent annual growth over the next decade [28]. As in the military sector, it would be expected that investment castings could benefit to a greater extent than the percentages suggest, as product sophistication increases.

The general commercial markets are expected in coming years to become even more diverse and to grow considerably. Particularly good prospects are forecast for the land-based turbine component market, and for valve and pump applications. The latter may take considerable business from sand castings because of the near-net-shape capability combined with improved surface finish.

These overall considerations led Gibson to predict a 39 per cent increase for aircraft and aerospace investment castings by the end of the century, a 48 per cent increase for commercial investment castings, and a 43 per cent increase for all investment castings [28]. These data compare with predicted growth rates for other types of castings over the same period ranging from zero growth for iron castings to 30 per cent for aluminium alloy sand castings. It is possible that aircraft applications may lose a little of their dominance worldwide as the general commercial markets grow relatively more quickly. This change could be fuelled by a greater production and export of commercial castings from countries of the Pacific area and from Eastern Europe.

With regard to the future, a considerable uncertainty hangs over the greater use of investment castings in the automotive industry. With the possible exception of Japan, it seems that none of the traditional investment casting countries has capitalized on the potential for the process in routine automotive parts. Substantial pressures are building up in the United States to reduce energy consumption of cars, and this has led to a concentration on reducing weight and to "downsizing". This is moving automobile designers away from iron and steel components to a greater use of aluminium alloys, and this could offer considerable opportunities to investment casters, particularly in North America and in Europe. However, it should be cautioned that earlier forecasts of the great potential for investment castings in automotive outlets have failed to materialize (except in Japan), and it is difficult to know whether the present opportunity will be seized in the next few years.

One major factor in the progress of the industry during the next 10 years will be the impact of environmental legislation. On the one hand, companies in the United States, Europe and many other countries will be faced with hard and expensive choices to meet new environmental standards. This additional requirement could lead to further amalgamations in the industry, so that the average size of investment casting companies could increase. At the same time, it will be necessary for these companies to compete with imports which may be produced in countries with a more relaxed environmental policy. This in itself could lead to significant changes in the structure of the industry.

In the light of this uncertainty, it is difficult to predict in detail how the investment casting industry will be structured by the year 2000. What does seem likely is that, provided the industry is willing to continue to carry out technical development and to undertake suitable training of personnel, it will continue to grow to meet the opportunities that arise for precision components of good quality.

F. Powder metallurgy (part of ISIC 3710 and 3720)*

1. *Current situation*

The powder metallurgy (PM) industry is a little-known sector operating at the leading edge of new technology. The industry is a producer of precision metal components that allows for more efficient design of consumer and industrial products consisting of any metal or alloy. The products are the source of new high-performance materials and alloys such as superalloys, tool steel, powder-wrought aluminium alloys, dispersion-strengthened metals, rapid-solidification-rate materials, and metal matrix composites. PM constitutes the leading edge of new manufacturing processes for improved product quality and productivity. Industry products save valuable raw materials through recycling and elimination of costly secondary machining through net and near-net shape design. They are the only way of forming vital metals into products such as tungsten carbide, dispersion-strengthened materials and self-lubricating bearings. The results are improvements in industrial productivity by eliminating manufacturing steps and by better automation, precision and special properties such as self-lubrication and controlled filtration. These products also allow the more efficient design of complex parts for products such as automobile engines and transmissions, aircraft turbine engines, riding lawn-mowers, business copying machines, power tools and oil or gas well drilling equipment.

The PM parts and products industry in North America has sales of over $2 billion.* It is comprised of 150 companies that make conventional PM parts and products from iron- and copper-base powders. There are also 50 companies that make speciality PM products such as superalloys, tool steels, porous products, friction materials, strips for electronic applications, high-strength permanent magnets, magnetic powder cores and ferrites, tungsten-carbide cutting tools and wear parts, rapid-solidification-rate products and metal-injection-moulding (MIM) parts. The industry is international in scope with growing industries in all of the major industrialized countries. As shown in table V.43, annual worldwide PM production exceeds 800,000 tonnes.

The most common metals available in powder form are iron, tin, nickel, copper, aluminium and titanium, as well as refractory metals such as tungsten, molybdenum and tantalum. Alloys such as bronze, brass, stainless steel and nickel-cobalt superalloys are also available in powder form. Figure V.16 illustrates the relative importance of these materials in world PM shipments. Iron and steel are by far the largest at 72.8 per cent, with aluminium the next at 12.1 per cent. Powder particles are specific in size and shape. They are not merely ground chips or scraps of metal. Among the major methods for making metal powders are the atomization of molten metal, their reduction to oxides, electrolysis and chemical reduction. Concerning the variety of end-uses, iron powder is used as a carrier for toner in electrostatic copying machines. The United States also consumes about 907,000 kilograms of iron powder annually in iron-enriched cereals and bread. Copper powder is used in anti-fouling paint for boat hulls and in metallic pigmented inks for packaging and printing. Aluminium powder is used in solid fuels for rockets such as booster rockets for the space shuttle programme.

Basic PM processes use pressure and heat to form precision metal parts and shapes. Powder is squeezed (room temperature) automatically in a rigid precision

Table V.43. Estimated world powder-metallurgy shipments, 1990
(Thousand tonnes)

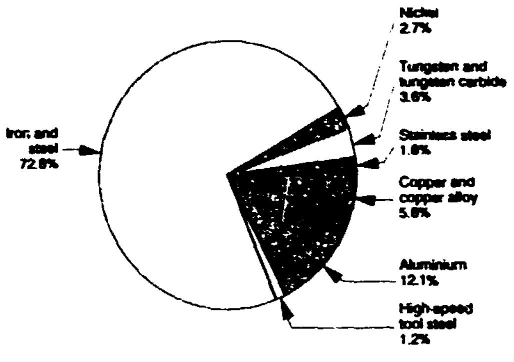
Material	Shipments
Iron and steel	600
Aluminium	100
Copper and copper alloy	48
Tungsten and tungsten carbide	30
Nickel	22
Stainless steel	15
High-speed tool steel	10
TOTAL	825

Source: Metal Powder Industries Federation, Princeton, New Jersey.

*UNIDO acknowledges the contribution of Ken Stanford of FMJ International Publications Limited

*Based on information drawn from databases of the Metal Powder Industries Federation (MPIF) and the American Powder Metallurgy Institute (APMI), Princeton, New Jersey

Figure V.16. Composition of world powder-metallurgy shipments by material, 1990



Source Metal Powder Industries Federation, Princeton, New Jersey

die at up to 50 tonnes per square inch into an engineered shape, such as a gear. The equivalent of 50 compact cars stacked vertically indicates the pressure it takes to press the powder automatically in a mechanical or hydraulic compacting press. After the mass of powder is squeezed into a shape and ejected from the press, it is fed slowly through a special high-heat controlled atmosphere furnace to bond the particles together. They are metallurgically fused without melting, a phenomenon called "sintering".

Other processes are also used to consolidate powders into finished shapes such as cold or hot isostatic pressing, direct powder rolling, forging, injection moulding and gravity sintering. In contrast to other metal-forming techniques, PM parts are shaped directly from powders, while castings are formed from metal that must be melted, and wrought parts are shaped by deformation of hot or cold metal, or by machining.

Among applications for powder metallurgy parts, they are used in a variety of end-products such as lock hardware, garden tractors, snowmobiles, automobile automatic transmissions, washing-machines, power tools and hardware, sporting arms, copiers and postage meters, off-road equipment, hunting knives, hydraulic assemblies, X-ray shielding, oil- and gas-drilling wellhead components, fishing rods and Walkman radios. Coinage such as Canadian nickels are made from strip-rolled, pure nickel powder.*

The typical five- or six-passenger car made in the United States contains about 24 pounds of PM parts, a figure that could go much higher within the next several years. Automobile engines, transmissions and chassis assemblies include hardworking, high-integrity PM parts. Precision, functional PM parts are used also in the aircraft, agricultural, off-road machinery, business machine, hardware instrument and hydraulics industries, to name a few. Economics and better performance have convinced engineers to design PM parts to replace many sand-cast, stamped, die-cast, screw-machined, plastic moulded and even forged parts in these industries.

*Based on information drawn from MPIF and APMI databases

2. *Producing and consuming regions and countries*

(a) North America

Though undergoing transition, the PM industry in North America has not remained static. Consolidations, internationalization, commercialization of technologies, plant expansion and the addition of new capabilities are continuing.* Of significance in this overall activity are the new European corporate players. While there has been a marked Japanese presence for some years, within the last few years MAAG of Switzerland and Krebsoge of Germany have joined with ICM to form ICM/Krebsoge. In addition, Brico in the United Kingdom has bought Supermet; Pleuco from Germany has purchased Partnership Powder Metallurgy; and recently, Sinterstahl (owned by Thyssen of Germany and Metallwerk Plansee in Austria) has purchased a portion of Sintermex in Mexico. As PM technology becomes more accepted worldwide, there will be continued consolidations, acquisitions and expansions of existing facilities.**

In 1990, the Metal Powder Industries Federation forecast a 7 per cent annual increase in metal powder consumption; however, this figure has not been realized, nor has its forecast of an increase in iron and steel powder consumption. Such forecasts have been based on several events which needed to take place but as yet have not been realized. These include: the increased global use of PM in car-making, increased use of powder-forged parts, a growing MIM market, developments of high-performance and low-density alloys, and the development of altogether new alloys. But the most significant deterrent to PM growth in 1991 has been the recession and the subsequent drop in automobile production.** Other forces that are impeding the growth of the PM industry are the following:

(a) The non-availability of a full-range of alloy powders needed to produce fully dense products;

(b) The need to improve properties;

(c) Ever-increasing competition and competing processes;

(d) Design changes requiring different production methods.

Nevertheless the PM industry has enjoyed favourable growth during the past several years, and table V.44 shows that North American PM shipments were slightly up in 1990 to 298,800 tonnes, despite the fact that domestic car sales were on a downward path.***

Concerning the individual metals iron powder shipments in 1990 showed only a minimal advance with an increase of 0.52 per cent.** Even though this was the second best year on record, it is still below the 1988 high of almost 237,000 tonnes. The PM parts share is the largest, accounting for 85.29 per cent of total shipments of 219,200 tonnes. Other major

*Based on information drawn from databases of the European Powder Metal Federation (EPMA), Brussels, and the British Powder Metal Federation (BPMF), Shrewsbury. See also [38].

**Based on information drawn from MPIF and APMI databases.

***Based on information drawn from EPMA and MPMI databases. See also [38].

Table V.44. North American powder-metallurgy shipments, 1988 to 1990
(Tonnes)

Material	1988	1989	1990	Percentage change
Iron and steel	236 900	218 000	219 000	0.45
Aluminium	29 000	33 500	36 400	8.66
Copper and copper base	22 000	20 300	19 200	-5.42
Nickel	10 800	10 200	10 000	-1.96
Tungsten carbide	5 200	5 300	5 000	5.66
Stainless steel	3 300	3 200	3 000	-6.25
Tungsten	2 400	2 100	2 500	19.05
Molybdenum	2 000 [a]	2 000 [a]	2 500 [a]	25.00
Tin	1 100	1 000	1 000	-
TOTAL	312 700	295 600	298 800	1.08

Source: Database of the Metal Powder Industries Federation, Princeton, New Jersey.

[a] Estimate.

markets are welding electrodes and cutting, scarfing and lancing, electronics, and chemical and miscellaneous uses. Shipments of copper and copper-base powders in 1990 dipped by 5.75 per cent to 19,200 tonnes from 20,300 tonnes in 1989. The PM parts and bearing segments of this total was down by 5.88 per cent to 16,251 tonnes. The stainless-steel powder business was stable in the range of 3,000-3,400 tonnes, but it is dependent on two major PM parts applications, namely sensors for car mirror buttons and anti-lock braking systems (ABS).

The recession that developed in 1991 was further aggravated by the Persian Gulf war and downturn in a number of countries. The war ended but the industrial recession did not. Car production and sales also took a steeper dip than expected. As a consequence, the PM industry in North America suffered further layoffs, short work weeks and the drying-up of customer orders. Highly leveraged companies financed from the easy-money days of the 1980s were now fighting to stay alive. None the less, the North American PM industry is still alive and capable of bouncing back. With a range of new quality powders available which allow higher-performance parts, more sophisticated compacting presses and sintering furnaces, a turnaround is expected. Worldwide, the PM industry shares a common bond: a dependence on the automotive market. In North America, this market accounts for at least 65 per cent of the conventional PM parts business; in Japan it represents 80 per cent; and in Germany it is close to 60 per cent. Despite the automotive downturn, the "Big-Three" United States car makers are actively designing PM parts for use in new engines and products such as air-bag units and ABS assemblies. Though PM is continuing to provide new parts, certain factors such as new fuel regulations could cause some future problems. With the necessity to go to a new 85-per-cent methanol fuel, new materials and new alloys need to be developed to improve efficiency. Though the regulations may change, it is estimated that 20 per cent of automobile engines produced by 1995 will need to be compatible with these new fuels, approximately 2.5 million to 3 million vehicles per year.

As indicated, metal matrix composites are being considered for automobile engine parts. Successful applications of aluminium matrix composites include drive shafts and pistons. Also the use of aluminium PM parts has generated considerable interest in the automotive industry, the relatively high cost of PM composites is a limiting factor. There is talk of possible cost-effective uses of aluminium and magnesium PM composites in demanding engine applications, such as connecting-rods. Research into automotive applications for micro-alloyed, high-strength, low-alloy steel forging techniques continues; for example, the commercial production of forgings made in third-generation micro-alloyed steels having niobium additions for control of grain size and recrystallization has began in the United States.

New emissions and fuel consumption requirements, as well as demands by more sophisticated consumers are forcing manufacturers to rapidly investigate new designs and materials. For example, engine builders want to increase power and torque per unit of displacement, to reduce noise, to decrease weight, to improve durability, to enhance appearance and to cut costs. Plastics and particularly reinforced plastics have the potential to satisfy many of these needs, which explains their increased acceptance. An example is the hybrid-material connecting-rod that combines carbon-fibre reinforced plastic with a titanium alloy. The rod weighs 30 per cent less than a PM forged rod. Though currently not feasible for mass production, the experience gained from such research may help materials specialists develop other more commercially promising engine applications for carbon-fibre reinforced plastics.

Concerning applications in other car parts, the addition of ceramic reinforcements to aluminium can provide properties unobtainable with other alloys. For example, the refined grain size and better control of intermetallics and second and third phases tend to delay fatigue crack initiation, while carbon-fibre reinforced plastics may satisfy many needs. In addition, General Motors is expected to introduce PM steel connecting-rods within the next two years, along with the increased use of PM forging in transmissions. General Motors is also looking at some MIM applications. In response, Ford plans to increase its use of PM by introducing composite PM camshafts in its new V8 engine, adding another 1 kilogram of PM parts to an engine that already uses some 6.8 kilograms of PM parts. Ford is also planning to introduce other new PM parts into engines, such as connecting-rods, cam and crank sprockets, valve guides, and oil pump components.

(b) Western Europe

The PM industry in Western Europe has maintained a steady growth of some 5-6 per cent per year ([39] and [40]). Changes in business cycles, have influenced this growth. Increasing recession has made overall development for the year 1991 not too impressive. One exception is Germany, where the effect of unification has been superimposed on the normal course of the business cycle, resulting in a much higher growth in national income than was expected. The effect of German unification will among other things generate greater opportunities for growth and cooperation between the surviving Eastern European PM producers and their enterprising Western European cohorts. Until recently, PM in Eastern Europe suffered no outward competition. Now it must increase productivity, improve quality and reduce costs. Most Eastern European PM companies are thus looking for cooperation with companies in developed market economies. MIBA of Austria, for example, has already risen to the challenge and established a joint venture in Czechoslovakia. The European Powder Metallurgy Association, in fact, is proposing to make it possible also for companies from Czechoslovakia, Hungary and Poland to become full members.

The Western European car industry represents 68 per cent of PM markets, followed by electrical appliances, power tools, office equipment and general machinery. The top three PM-parts-producing countries are Germany, Italy and Spain. While there was a market downturn in capital equipment sales to the Western European PM industry in 1991, this situation should improve in 1992. PM part manufacturers will face both opportunities and challenges as a result of the EEC single market at the end of 1992. Quality assurance is one such challenge, and the need to be more flexible in terms of smaller lot size production is another. The boom in new car sales in Germany in 1991 has benefited both German and non-German component suppliers, including PM producers. However, it is acknowledged that the level of usage of PM parts in Western European vehicles is still too low, and that the PM parts industry in Western Europe, which average 86,000 tonnes, lags behind that of Japan (over 100,000 tonnes) and North America (around 180,000 tonnes), despite the fact that Western Europe is the largest car-producing region. It is estimated that the market for PM parts grew by 5 per cent in 1989 and by 4 per cent in 1990, and no change was forecast for 1991.

Greater R and D is needed to develop new materials and products and to replace sales lost to lower-cost alternative products, such as composite PM parts where multiple-functions can be offered to the user. Powder forging and metal injection moulding are also fields which offer new opportunities for the PM industry, and Europe is certainly lagging behind North America and Japan on both counts. The cemented carbide industry, particularly important in Sweden, has also been hit by the current recession in most Western European countries, with cutting tools particularly affected by the downturn in car production. The tonnage of tungsten carbide produced in Western Europe has been kept fairly constant over the past 15 years, due to a sharp increase in productivity offered by tool manufacturers through coatings, new tool geometries etc. Drilling tools have seen similar developments, but at the same time lower sales.

There is a constant demand for improved materials, and in order to compete in the market place, PM companies must cover the broadest possible range of materials in terms of synthesis, design, and properties ([41], [42] and [43]). Among recent new materials are refractory metals with a melting-point above 1,900° C such as tungsten, molybdenum, rhenium and niobium. The global production of refractory metal powders solely for use in PM mill products (sheet, rod, bar etc.) is now about 7,500 tonnes, including 3,000 tonnes for molybdenum, 2,000 tonnes for tungsten, and 3-4 tonnes for rhenium. This translates into around 5,800 tonnes per annum of finished products. There are also growing applications in the micro-electronics industry for high-purity refractory metals, but here any growth in volume has been offset by continuing miniaturization.

Probably the fastest-growing sector of powder metallurgy in Europe is PM semi-products. These include tool steels and high-speed steels, high- strength high-alloy steels, stainless steels, nickel-base alloys, cobalt-base alloys and aluminium alloys. The total market for these products in Western Europe is estimated at some 20,000 tonnes, with a sales value of $131 million. Growth over the past five years is estimated at 30-50 per cent. The longest established PM semi-products are tool steels and high-speed steels, but a wide range of new semi-products have emerged. These include: high-speed steels for machining, tool steels for dies and punches, high-strength steels for steam turbines, alloyed-powder-metal chromium-aluminium steels for heating elements, superduplex stainless steels for offshore uses, nickel-base superalloys for aircraft engines, nickel-base oxide-dispersion-strengthened alloys for high-temperature corrosion-resistance, cobalt-base alloys for wear and abrasion resistance, aliminium oxide-dispersion-strengthened alloys for aircraft structures, and spray-forming alloys for a variety of applications.

The current average use of PM parts in cars in Western Europe is 4.4 kilograms, in Japan 5.4 kilograms, and in the United States 11 kilograms. This represents an annual increase of around 6 per cent in Europe and 9 per cent in Japan. The latter has been a result of the introduction of multi-valve engines, ABS, pollution control devices etc. The use of PM parts in Western European cars is forecast to rise to 5 kilograms by 1995. The iron powder market in Western Europe is estimated at 100,000 tonnes [43]. The PM share of this production is estimated at 65,000 tonnes. Observers saw the market growing at 5-8 per cent in 1990. Also important, the copper and copper-alloy powder market in Europe has been estimated at approximately 123,000 tonnes per annum. However, the aluminium PM market in Europe has usage of only about 275 tonnes per annum. The future looks bright for the Western European MIM markets. There are seven companies commercially producing MIM parts, having an estimated combined annual sales total in excess of $6 million.

(c) Japan

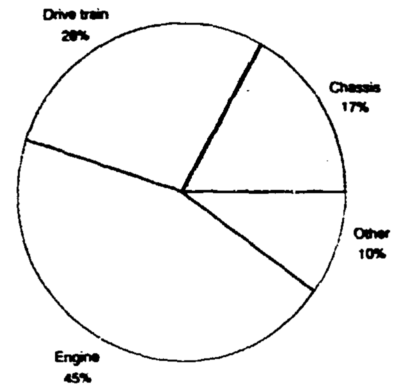
Table V.45 shows PM production in Japan for 1990, excluding cemented carbide products. Total production has been estimated at 182,512 tonnes, or 3.6 per cent more than in 1989 ([44] and [45]). In terms of individual production, PM machine parts amount to 81,000 tonnes, about 6.9 per cent more than in 1989; PM bearings contribute about 9,000 tonnes, a 13.5 per cent increase; PM hard magnetic materials are about 47,000 tonnes, a 2.8 per cent decline; and PM soft magnetic materials are about 44,000 tonnes, an increase of approximately 3.1 per cent.* These four groups of products share about 98.8 per cent of all PM output in Japan.

Regarding shifts in the production of machine parts and bearings from 1980 through 1990, the ratio of machine parts to bearings has been increasing [44]. Machine parts have been continuously increasing during the past 15 years, with a major transition occurring in the consumer fields. The machines of most importance are automobiles, followed by air-conditioners, electric hand tools, refrigerators and stepping motors, as well as industrial machines such as office, agricultural and textile machines. The automobile machine share has been increasing annually, having reached 85 per cent in 1989. As in the United States, material for machine parts derives mainly from iron materials, while the use of other materials such as copper, stainless steel, aluminium and titanium base is limited. As shown in figure V.17 the breakdown of machine parts in automobile production is as follows: engines, 45 per cent; drive trains, 28 per cent; and chassis, 17 per cent.

Table V.46 shows PM machine parts production according to consumer industries. The production for transport machines increased 17.4 per cent more in 1988 than in the previous year, about 13.2 per cent more in 1989 than in 1988, and 9.7 per cent more in

*Based on information drawn from databases of the Japan Powder Metallurgy Association (JPMA) and the Ministry of International Trade and Industry, Tokyo. See also [46].

Figure V.17. Breakdown of powder-metallurgy parts in Japanese cars, 1989



Source: Database of the Japan Powder Metallurgy Association, Tokyo.

1990 than in 1989. This high ratio was driven primarily by the automobile industries. The production levels of powder metal parts greatly outstripped the production of automobiles between 1980 and 1990. Two reasons are suggested for this. First, the Japanese automobile market has tilted towards bigger cars, with higher performance and higher quality. Among the PM demands, there has been an increase in the ratio of cars with automatic compared to manual transmissions (excluding imported cars and mini-vehicles) from 26.8 per cent in 1980, to 57.1 per cent in 1986, and to 72.5 per cent in 1990. The numbers of automatic cars are still increasing sharply in Japan. In addition, cars equipped with power steering increased with the progress of automobile engineering; here the ratio increased from 20 per cent in 1980, to 82 per cent in 1986, and to 94.3 per cent in 1988. While no statistics are available, it is believed that most cars are now equipped with air-conditioners. Trucks will also shortly be equipped with them. The quantity of PM parts also has increased due to the higher performance demanded from engines, most

Table V.45. Japanese production of powder-metallurgy products, 1990[a/]

Product	Production (tonnes)	Percentage change 1989-1990	Percentage market share
Machine parts	81 074	6.9	44.4
Bearings	8 947	13.5	4.9
Friction materials	585	6.8	0.3
Electrical contacts	205	7.3	0.1
Electric bulb materials	764	-0.9	0.4
Electrical connectors	325	23.1	0.2
Magnetic materials (hard)	46 675	-2.8	25.6
Magnetic materials (soft)	43 654	3.1	23.9
Other	283	-16.3	0.2
TOTAL	182 512	3.6	100.0

Source: Database of the Ministry of International Trade and Industry of Japan.
a/ Cemented carbides excluded.

Table V.46. Japanese machine-parts production for consumer industries, 1988 to 1990
(Tonnes)

Consumers	1988 Production	1988 Percentage change 1987-1988	1989 Production	1989 Percentage change 1988-1989	1990 Production	1990 Percentage change 1989-1990
Transport machines	55 537	17.4	62 871	13.2	68 988	9.7
Electrical machines	8 484	15.6	7 451	12.8	6 473	-13.1
Industrial machines	4 244	8.2	4 194	1.2	4 410	5.2
Other	1 298	46.0	1 302	0.3	1 203	-7.6
TOTAL	69 563	17.0	75 818	8.0	81 074	6.9

Source: Database of the Ministry of International Trade and Industry of Japan.

recently changes in the overhead cam system and the multi-valve system. Also, the multicylinder engine increases the fuel ratio, while keeping the same exhaust volume. According to the Japanese Automobile Industries Association, the production share of larger cars of over 2,000 cubic centimetres was 5 per cent in 1987, 6 per cent in 1989 and 13 per cent in 1990.*

The second reason is that the Japanese PM industries have been coping with the various demands of users for higher precision, higher performance, more complicated shapes, larger sizes etc. by promoting their own technologies. Results of such technologies include iron-base-segregation preventive premixed powders, high-compressibility low-alloy steel powders, and high-compatibility alloy steel powders. Also important is highly functional and high-performance production equipment, leading to a reduction of set-up time using numerically controlled presses. And finally, products of complex shapes have been achieved by sinter-bonding technologies, and complicated shape and high-precision products have been achieved through improved technologies for moulds production.

Table V.47 shows Japanese shipments of iron and copper powders in 1990. Iron powder shipments were 155,123 tonnes, or 7.9 per cent more than in the previous year, while PM products totalled 103,981 tonnes, or 8.4 per cent more. Copper powder shipments were 7,244 tonnes, or 3.1 per cent more than in the previous year, and PM products totalled 5,818 tonnes, or 3.4 per cent more. The latter are used primarily for bearings, PM friction materials and PM machine parts. Figures V.18 and V.19 describe Japanese shares of iron and copper powders in the manufacture of consumer goods. The production of stainless steel powders was 860 tonnes in 1985, 1,260 tonnes in 1987 and 1,510 tonnes in 1989; these figures indicate a gradual increase in production of materials for PM machine parts and filters.

The Japanese PM industry acknowledges that it must innovate production technologies in order to address current market changes. With environmental considerations being of global importance, reductions in vehicle weight and fuel ratios are seen to be vital countermeasures. In this respect the PM industries are developing new technologies and design improvements by advancing new lighter materials (aluminium- and titanium-based) and by reducing part size and volume. New manufacturing technologies also have been developed in response to car consumers in Japan for increased safety, quality design etc.

Other emerging technologies in Japan include rapid solidifications of aluminium alloy powders using atomization, and the practical use of PM aluminium alloys by hot extrusion or hot forging. These have been used to improve compressor vanes and rotors, lowering the weight of car parts. In addition, mechanically alloyed powders facilitate the uniform mixing of alloys not possible to produce by any other route. Applications are expected for amorphous materials, functionally gradient materials and composites. Commercial applications of MIM has begun for small complex-shaped and magnetic parts for applications such as watches, sewing-machines and electronic components. Powder forging operations are attractive as development of greater part strength continues.

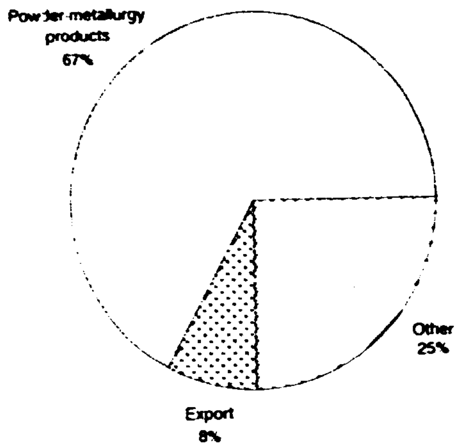
*Based on information drawn from JPMA database.

Table V.47. Japanese iron and copper powder-metallurgy shipments, 1990
(Tonnes)

Application	Iron Shipment	Iron Percentage change 1989-1990	Copper Shipment	Copper Percentage change 1989-1990
PM products	103 981	8.4	5 818	3.4
Export	11 632	8.5	264	3.5
Other	39 510	3.8	1 162	1.3
TOTAL	155 123	7.9	7 244	3.1

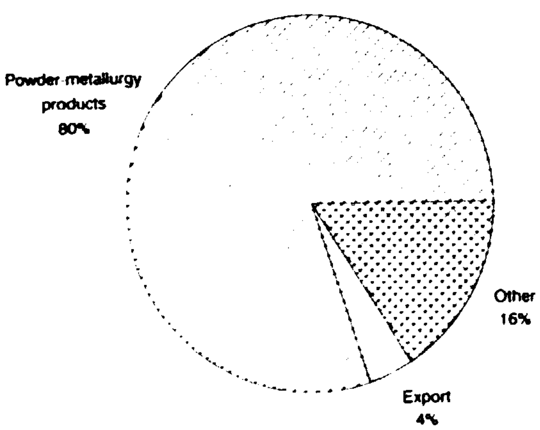
Source: "Powder Metallurgy in Japan", *International Journal of Powder Metallurgy*, Vol. 28, No.1 (January 1992), p. 87.

Figure V.18. Percentage distribution of iron-powder-metallurgy uses in Japanese manufacture of consumer goods, 1990



Source: Database of the Japan Powder Metallurgy Association, Tokyo

Figure V.19. Percentage distribution of copper-powder-metallurgy uses in Japanese manufacture of consumer goods, 1990



Source: Database of the Japan Powder Metallurgy Association, Tokyo

particularly for automatic manufacturing systems and light metals. The Japanese are also considering PM soft magnetic components, especially for motors, automobile electronics and computer-related applications.

(d) Other Asia

Table V.48 presents an estimate of PM production in other Asian countries in 1990. According to this table, the 10 major Chinese companies produced 3,000 tonnes, though the total figure is unknown. In the Republic of Korea, 15 companies produced 7,000 tonnes; in Taiwan Province, 30 companies produced 8,000 tonnes; in Singapore and Malaysia, 4 companies yielded 1,000 tonnes; and in India, 15 companies generated 5,000 tonnes. In the Asian countries and areas, the PM market is thus seen to be

Table V.48. Asian powder-metallurgy market for machine parts and bearings estimate, 1990

Country and area	Number of companies	Production [a] (tonnes)
Japan	60	90 000
Taiwan Province	30	8 000
Republic of Korea	15	7 000
India	15	5 000
China [b]	10	3 000
Singapore and Malaysia	4	1 000

Source: "Powder Metallurgy in Japan", *International Journal of Powder Metallurgy*, vol. 28, No.1 (January 1992), p. 87.

[a] Estimates.

[b] Large companies only.

smaller on an international scale. But it is expected to expand as the engineering manufacturing industries in the Asia-Pacific region develop.

(e) Australia

Although small by world standards, the Australian PM industry has been active in producing shaped powder-metal components for almost 50 years.* Initially, the industry concentrated on the production of self-lubricating bronze bearings, but now it has extended its capabilities to many fields, including structural, custom-made products, and components produced in large quantities for a variety of applications such as automotive parts, household appliances, powder and garden tools, locks, instruments and clock mechanisms. As shown in table V.49, the major industrial branches supplied include the automotive, white goods, agricultural equipment, building, and general engineering industries. In 1968/69, the industry consumed 358 tonnes of material. Twenty-two years later there is a strong industry producing in excess of 2,500 tonnes each year.

*Based on information drawn from database of the Powder Metal Industries Association of Australia, Canberra.

Table 49. Principal markets for Australian powder-metal products, 1990 to 1991
(Percentage)

Industry	Export	Total
Automotive	33	42
White goods	54	31
Powder tools and garden equipment	-	1
Building	-	1
General engineering	13	23
Other	-	2
TOTAL	100	100

Source: D. Whittaker, Metal injections moulding, *Metallurgia*, vol. 51, No. 1 (January 1992).

Results from the most recent annual survey for the year to June 1991 indicate that, like Australian industry generally, the current recession, has made it a very difficult year for PM. Employment fell by 14 per cent over the period, while estimates of powder usage have shown a 13 per cent fall [47]. Plant utilization for compacting presses and for sintering has been low overall. This latter result reflects in part the installation of a number of new furnaces. Sales for the year to June 1991 have also displayed a fall, although in past years there has been a strong growth trend evident. Export of PM products increased by 41 per cent over the year, reflecting the industry's increased marketing and R and D efforts.

(f) *World summary*

Worldwide the metal powder industry is quite substantial, with estimated production shipments in 1990 of 825,000 short tons. Metal powder manufacturers are diligently working to upgrade materials [43] and [44]. Industry observers see the gap in properties between PM products and wrought materials to be narrowed because of improvements in metal powders and processing practices. However, there is still a need for developing new materials that provide higher densities and improved dynamic properties such as fatigue and impact strengths. Austenitic stainless steels should emerge in the 1990s with greatly improved corrosion resistance. Ferritic stainless steels will also come into use with magnetic properties comparable to wrought products. Companies are developing advanced techniques for producing intermetallic alloys and offer nickel and iron aluminized metal powders. Iron aluminides, based on their intermetallic compounds, have a potential to replace stainless steels. Tests have shown that iron aluminides resist high-temperature oxidation damage in sulphur-containing environments, and have excellent resistance to static aqueous corrosion. Nickel aluminides offer high-temperature strength and excellent corrosion and oxidation resistance.

The world market value of PM or sintered products and components is currently in the region of 7,500 million Australian dollars, with North America currently accounting for 50 per cent, Western Europe 20 per cent and the East Asia, largely Japan, 30 per cent. Japan has, in fact, overtaken Western Europe in the past five years. The PM process is clearly quite flexible and open to further innovation. For example, recent and on going technological developments are quickly widening the choice of materials available to manufacturers. This means that the choice of materials to use in PM components is becoming more critical in determining the competitiveness of any product. As an illustration, a new "anchor-bond" material is being developed which is suitable for particular applications requiring a high strength requirement, for example, in a part with a big flange and long shank. A company in Tasmania has released a new H-Jet powder product, that is, a bronze powder having increased radial crush properties with a low sintered growth rate.

These choices of material are further widened by the blurring of boundaries between the three main categories of engineering materials: ceramics, polymers and metals. This is due to the development of many different kinds of composites and compounds and the different techniques used to produce them. Perhaps the most significant aspect of recent developments in advanced materials is the capability to tailor properties to applications. Developments in advanced materials add a further dimension to developing high-technology PM solutions to customer problems.

3. *Technological trends*

A positive aspect of PM has been the rapid increase in technical activities over the past few years ([47] and [48]). Such continuing R and D in process and equipment technologies is vital for PM to remain competitive. Advances are evident on a broad front. There is a clear move to finer powders, typically in the higher-performance materials, and these are being consolidated to high final densities. The aim is to boost PM part properties, especially fatigue and impact strengths. The consolidation is either through higher sintering temperatures or the application of stress during sintering (for example, by hot isostatic compaction, hot pressing, hot extrusion or hot forging). These trends are coupled with demands for improved powder quality and purity, including uniform characteristics between production lots. The shaping of these powders depends on powder injection moulding as the most rapidly growing approach.

MIM is a rapidly growing forming technique, based on powders, and one which is steadily being adopted worldwide ([49] and [50]). There has been a surge of interest in composites, but future growth will depend more on infusion of technology into the basic PM operations, largely in order to better control the final product attributes and to improve product quality. These will require parallel advances in process control, monitoring and instrumentation, and the improved maintenance of process technology.

Other important breakthroughs that will carry the industry forward include the following: improved manufacturing processes such as hot isostatic pressing (hipping), PM forging, injection moulding and direct powder rolling; fully dense PM products for improved strength properties and quality in automobiles, diesel and turbine engines, aircraft parts and industrial cutting and forming tools; commercialization of technologies such as MIM, rapid solidification, PM forging, high-temperature vacuum sintering and both cold and hot isostatic pressing; the use of PM hot-forged connecting-rods in automobiles and a PM camshaft for four- and eight-cylinder automobile engines; PM wrought-aluminium alloys made by rapid solidification techniques to provide greater strength, fracture toughness, corrosion and fatigue resistance through improved chemical and metallurgical structures; and development of rare cobalt magnetic materials that offer superior properties [38].

4. *Short- and medium-term outlook*

Worldwide growth in the PM industry was confirmed from reports presented at the Powder Metallurgy '90 Conference held in London in July 1990.

The international iron powder market should continue to grow at about 3 per cent per year. The following is a breakdown of estimated 1990 production in major regions: North America, 200,000 tonnes; Western Europe, 100,000 tonnes; Eastern Europe and the USSR, 60,000 tonnes; and Japan and other countries in the Pacific region, 185,000 tonnes. Total world production of iron powder in 1990 was about 545,000 tonnes.

The estimated breakdown of the international copper and copper-alloy powder market is as follows: North America, 16,300 tonnes; Europe, 12,000 tonnes; Japan and other countries of the region, 10,000 tonnes; and the rest of the world, 5,000 tonnes. Total 1990 world production of copper and copper alloys was 43,400 tonnes. The annual international tool-steel powder market is estimated at between 8,000 and 10,000 tonnes and experiencing rapid growth. The annual growth rate is between 10-20 per cent, and the worldwide nickel market looks good because of growth in mechanical alloying, superalloys and nickel-alkaline battery production. The worldwide nickel powder market, excluding powder production for briquettes, is estimated at 20,000 tonnes. Annual market growth is forecast to be approximately 5 per cent.

It is estimated that the worldwide market for carbonyl iron MIM parts is approximately 250,000 kilograms. The market for alloy MIM powder amounts to approximately 45,000 kilograms. Although not an important element in the international PM industry, cobalt is used mainly in powder form in the cemented carbide industry (for tooling), and also for magnets and more recently for producing strip from powder. Analysis of market segments shows the hard metals (carbides) share of the cobalt market as around 4.5 per cent in 1950, or 5,800 tonnes, rising to 12 per cent of a 27,500-tonne market in 1990. In fact, PM tooling seems to have fought off the predicted take-over by ceramic (and other) tooling, and the new coating techniques to apply titanium carbide (and other alloys) have restored such tooling to its leading position.

The "step-from-powder" process developed originally by British Steel in the late 1960s has been patented and developed by a United Kingdom company, Mixed Alloy of Mold-North Wales. They are making progress into the weld-cladding market by making thin strip of many alloys, both cobalt- and nickel-based, which can be applied by submerged arc welding at very high rates (up to 50 kilograms per hour). Their process is entirely powder-metal-based and virtually unique.

Important trends for the 1990s include new electronic controls for mechanical and hydraulic press systems. Further electronic-hydraulic integration work will be designed into mechanical presses with the use of hydraulically driven, microprocessor-controlled multi-platen tool systems allowing for production of more complex parts to near-net shapes. High-temperature sintering is another important trend. The use of this technique is accelerating as PM parts producers add ceramic belt furnaces and continuous vacuum sintering equipment. When combined with new low-alloy steel powders, high-temperature sintering will open up new markets for higher-strength PM structural components. Longer sintering times will probably be in the order of 1,150° C.

The MIM market continues to grow in North America, Japan and Western Europe, and offers exciting promise to the PM industry generally. Powder makers are providing improved raw materials with enhanced processing characteristics such as flowability and better shrinkage rates and improved properties for higher-part strengths. New growing markets include orthodontic devices, firearms, business machines and printers, ordnance, automotive parts, medical and dental instruments, recreation and hobby equipment, hand tools, hardware, motors and controls, household appliances and electronic packages.

As the PM industry seeks to attain better properties for new higher-strength applications, new markets should open up. But the industry cannot be complacent. It must attract capital for new and improved equipment and continue to upgrade quality at all levels. If it is to compete on an international level, it must have consistent product quality. Achieving a "quality-supplier" status with leading international customers is not easy; however, it is recognized to be an investment that must be made. Quality, zero defects and service have replaced price at the top of the customer shopping list. Delivering quality is very difficult and expensive, when striving to achieve reasonable profit levels.

In addition to achieving quality, the industry must consider new products and new applications. Raw materials and new techniques need to be investigated and developed. More research and marketing are necessary, while direct sales are a must. New testing procedures need to be developed to help determine the right product for the right job, and more technical personnel should be assigned to the field to assist in product fit and evaluation.

The North American PM industry needs research funding to attack generic problems that have plagued metallurgists and production engineers for years. Various areas to be addressed include enhanced PM standards, compaction, process modelling and process control, sintering process monitoring and control systems, enhanced dynamic properties, lubrication methods and materials, and non-destructive test methods. A variety of areas can be identified, where there is a technical synergy between high-technology end-user applications and basic PM technologies. These include atomization, cold isostatic and hot isostatic pressing, die compaction, powder injection moulding, sintering, and powder forging.

The North American PM industry recognizes that in the 1990s it must not limit its horizons to North America and must think more globally. Overall strategies must look beyond domestic borders, since, for example, most of the industry's largest customers in the United States such as General Motors, Ford, IBM and Xerox are now sourcing components worldwide. Other materials and processes are competing with PM technology. By sharing information for upgrading standards, safety and health, providing more data for design engineers, and solving generic technical problems, the PM industry should achieve full global status. An overriding consideration should be to upgrade quality at every stage of the production process.

G. Synthetic fibres (ISIC 3513)*

Non-cellulosic staple and tow
Cellulosic staple and tow
Non-cellulosic continuous fibres
Cellulosic continuous filaments
Fibres intermediates

The main synthetic fibres are polyester, polyamide (nylon) and acrylic. Polypropylene fibres have also been gaining popularity, particularly for carpets. Cellulose-based fibres include acetates and rayons. In all cases, fibres are further categorized according to their physical form. Filament is a continuous polymer that has been extruded in its molten state through fine holes and then solidified by cooling. It is spun on to various packages for shipment from the factory. Staple is chopped into smaller lengths and can be made into yarns on conventional machinery designed for natural fibres. Often this type of fibre has characteristics that are more like natural fibres.

1. *Current situation*

(a) Production

Table V.50 shows trends in the production of non-cellulosic fibres between 1968 and 1990, and includes projections for 1991 and 1995. Between 1968 and 1990, most of the fibre groups shown in that table experienced positive growth: acrylics at 5.4 per cent, nylon filament at 3.3 per cent, nylon staple at 6.6 per cent, polyester filament at 11.8 per cent and polyester staple at 8.8 per cent. Among fibre groups that declined, acrylics was reduced by 0.1 per cent in the United States. These and other declines can be explained by the fact that markets have been saturated in recent years and consumer tastes have changed.

With regard to changes in production patterns worldwide, figure V.20 illustrates the shifts that occurred among the major countries and regions between 1977 and 1990. The shares of the major producers, the United States, Western Europe and Japan, are shown to have declined relative to that of other countries. The regional allocation of the total by major synthetic-fibre type is provided in figure V.21. Country shares are shown to differ among polyamides, polyesters and acrylics.

(b) Consumption

The broad end-use orientation of the various synthetic fibres, based on the experience of the United States, is shown in table V.51. This tabulation displays major application consumption patterns for all the important fibres during 1986. The volume is given in million pounds and as a percentage of total fibre consumption for each fibre in each category. The nature of these end-uses is as follows.

(a) Acrylics are consumed primarily in apparel, in such end-uses as sweaters, men's hosiery and slacks. A large volume is also consumed in home furnishings, particularly in carpets and blankets. The acrylic markets compete directly against traditional wool-fibre uses;

(b) Nylon filament yarns and fabrics are used in the three broad trade areas of apparel, home furnishings and industrial goods. Nylon filament is primarily consumed in women's lingerie fabrics, hosiery, linings, carpets, tyre cord and other applications. The predominant use of nylon staple is in carpeting and also in some industrial end-uses;

(c) Polyester filament is used primarily in apparel (in textured form in slacks) and in industrial applications such as tyre cord, ropes, industrial hose and others. Polyester staple is predominantly used in blends with cotton and other fibres. Its target markets are the traditional cotton end-uses, such as shirts, dresses, slacks, sheeting and the like.

(d) For the period 1978-1991, additional demand data are available from UNIDO for the important fibre groups. These include cotton, wool, jute, linen, silk, rayon and acetate in filament and staple forms. Other synthetic fibre data is available for nylon filament and staple, polyester filament and staple, acrylics (staple), olefin fibre and textile glass.

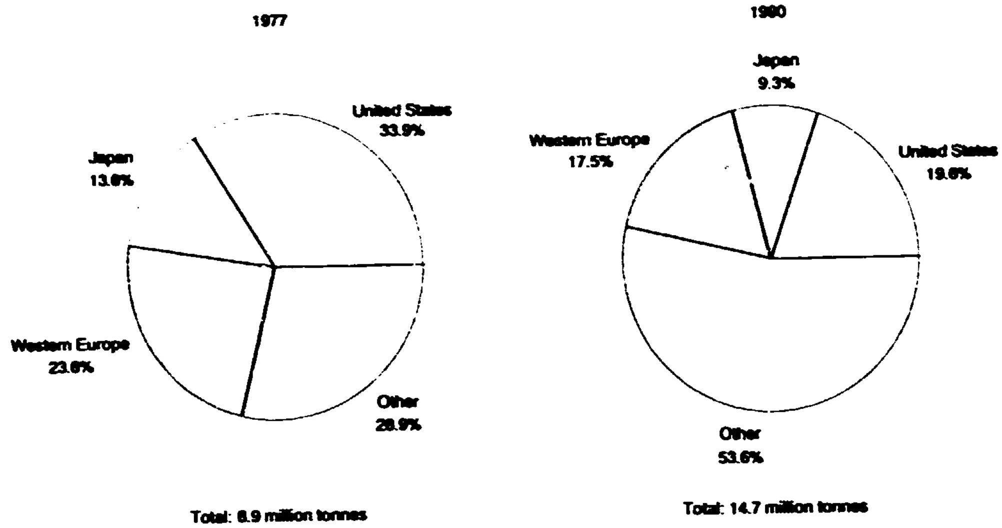
(c) Trade

Over the years there has been an international transfer of synthetic fibre technology, basically from North to South. Along with the advancement in technology and expansion in capacities within the South, there came the realization that a major portion of output had to be exported. The global trade in synthetic fibres for 1989 is shown in table V.52. It appears that most of the international synthetic-fibre trade occurs between and within the same country groupings. Developed countries export and import to and from other developed countries; developing countries similarly trade with other developing countries. One possible explanation for this pattern might stem from the impact of the Multifibre Arrangement (MFA) on these regions. The background to this important Arrangement is briefly summarized in Box V.1. The basic objective of the MFA was to promote the orderly and equitable development of international trade, and at the same time to minimize disruptive effects in individual markets. Prior to the MFA some of the major attractive markets in the North were inundated by imports from many countries in the South. At the same time, many of the exporting countries, particularly in the South, had established protective barriers to their own markets. The barriers came in many forms. They consisted of higher duties and various types of regulations or limits. In many cases, both of these market-restraining factors prevented the flow of imports to the South.

The creation of the MFA, none the less, brought some structured order to international trade. That is, under the Arrangement, markets could not be disrupted by a surplus of imports. To this date, MFA is still playing a regulatory role in international commerce, primarily within the major markets, such as the United States and the EEC. However, its influence is

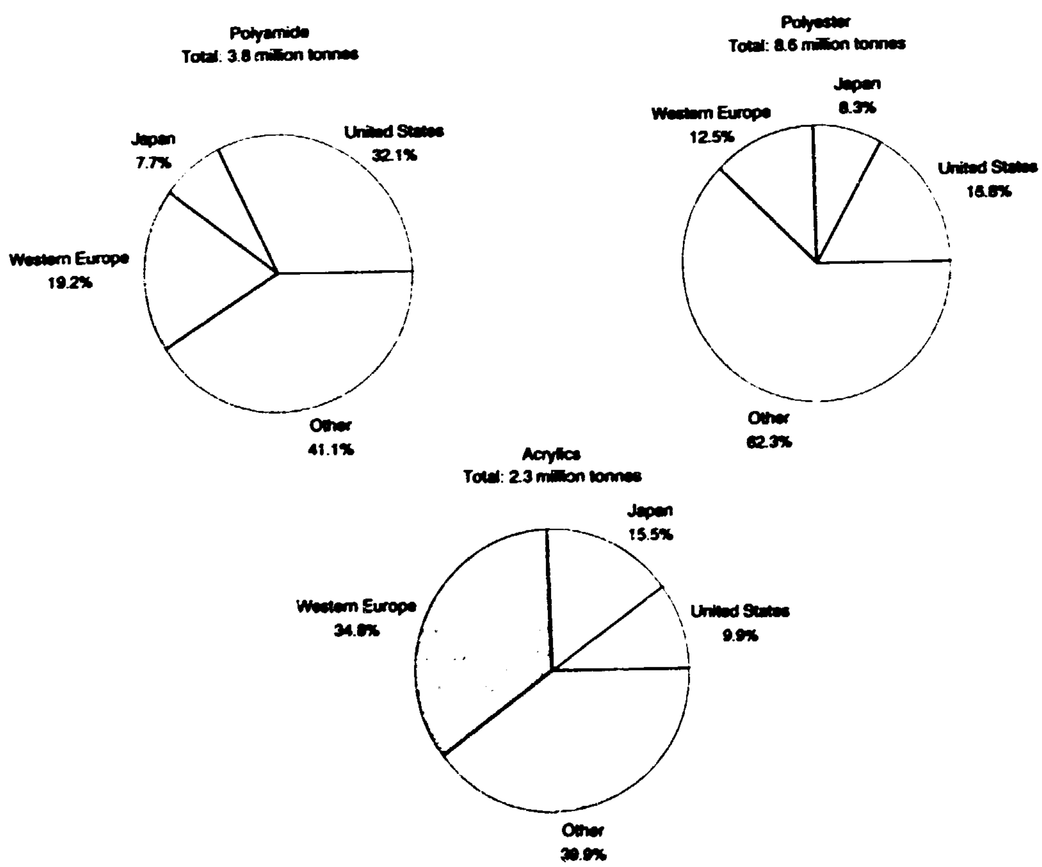
*UNIDO acknowledges the contribution of Jordan P. Yale, President, Statistikon Corporation.

Figure V.20. World production of synthetic fibres, 1977 and 1990



Source Historical data from *Textile Organon*, various issues

Figure V.21. World distribution of synthetic fibre production 1990



Source *Fiber Organon*, (June 1991)

Table V.50. World non-cellulosic fibre production, 1968 to 1990, and projections from 1991 to 1995[a]
(Thousand tonnes)

Fibre type and producing region and country	1968	1977	1987	1990	Annual growth rate 1968-1990	Projections[a] 1991	1995	Annual rate[a] 1991-1995
Acrylic and modacrylic								
Americas								
United States	236	321	268	229	-0.1	229	257	2.3
Other	10	82	181	157	13.3	197	231	8.0
Western Europe	270	651	948	807	5.1	928	1 076	5.9
Eastern Europe and USSR	44	184	277	287	8.9	314	366	5.0
Japan	160	335	404	359	3.7	384	436	4.0
Other	11	189	439	489	18.8	576	672	6.6
Total	731	1 762	2 517	2 328	5.4	2 628	3 038	5.5
Nylon filament								
Americas								
United States	539	686	770	758	1.6	710	800	1.1
Other	90	178	216	210	3.9	234	264	4.7
Western Europe	466	568	518	532	0.6	457	480	-2.0
Eastern Europe and USSR	128	390	575	562	7.0	665	763	6.3
Japan	201	292	262	274	1.4	249	264	-0.7
Other	40	269	561	681	13.8	713	826	3.9
Total	1 464	2 383	2 902	3 017	3.3	3 028	3 397	2.4
Nylon staple								
Americas								
United States	74	369	450	449	8.5	430	535	3.6
Other	6	20	23	22	6.1	24	28	4.9
Western Europe	64	117	137	153	4.0	140	165	1.5
Eastern Europe and USSR	22	31	100	99	7.1	134	145	7.9
Japan	14	16	17	15	0.3	19	19	4.8
Other	2	3	8	9	7.1	10	11	4.1
Total	182	556	735	747	6.6	757	903	3.8
Polyester filament								
Americas								
United States	116	722	535	502	6.9	494	623	4.4
Other	11	186	216	210	14.3	248	298	7.3
Western Europe	136	369	451	511	6.2	482	551	1.5
Eastern Europe and USSR	8	98	249	267	17.3	306	354	5.8
Japan	62	279	323	406	8.9	378	447	1.9
Other	5	236	1 313	2 008	31.3	1 862	2 146	1.3
Total	338	1 890	3 087	3 904	11.8	3 770	4 419	2.5
Polyester staple								
Americas								
United States	375	930	1 071	948	4.3	1 046	1 253	5.7
Other	32	123	275	256	9.9	303	353	6.6
Western Europe	177	407	510	570	5.5	566	654	2.8
Eastern Europe and USSR	29	234	473	447	13.2	579	673	8.5
Japan	120	294	283	311	4.4	322	366	3.3
Other	10	355	1 730	2 179	27.7	2 328	2 669	4.1
Total	743	2 343	4 342	4 711	8.8	5 144	5 968	4.8

Sources: Historical data from *Textile Organon*, various issues.
[a] Calculations and projections by Statistikon Corporation.

Box V.1. Brief summary of the Multifibre Arrangement

The progress report submitted in June 1972 by a Committee set up by the GATT Council in order to regulate the international flow of synthetic fibres and textiles made up from them served as the basis for what is now known as MFA.

The basic objectives of MFA are: "... to achieve the expansion of trade, the reduction of barriers to such trade and the progressive liberalization of world trade in textile products, while at the same time enduring the orderly and equitable development of this trade and avoidance of the disruptive effect in individual markets and on individual lines of production on both importing and exporting countries".

The initial (1962) short-term Arrangement was accepted by 16 countries that accounted for over 90 per cent of the cotton textiles trade of global market economies. The following long-term Arrangement regarding international trade in cotton textiles was finalized in 1962 and extended twice, and by 1973 it was accepted by 82 countries. Today there are only 17 countries applying restrictions under the MFA, namely Austria, Canada, Finland, Norway, United States and EEC member countries. Japan does not apply any restrictions under the MFA. Sweden abrogated all its restrictions on 31 July, 1991.

Originally the treatment of restrictions was set out in Articles 2, 3 and 4, which formed the core of the MFA. Subsequently, many other types of restrictions were developed, a sample of which is provided below:

(a) Article 2 deals with the phasing out of the pre-MFA restrictions;

(b) Article 3 covers situations of actual market disruptions, and can, in the event that a mutually agreed solution is not possible, involve the unilateral imposition of import restrictions;

(c) Article 4 deals with situations involving a real risk of market disruption;

(d) Article 6 concerns restraints on exports of new entrants and small suppliers and establishes guidelines in this regard, permitting restrictions on imports from least developing countries to be "significantly more favourable" than restraints on imports from other sources.

Articles 7 and 8 deal with authorization, licensing, consultation and administration agreements.

Source: GATT, *Textiles and Clothing in the World Economy* (Geneva, 1984), pp. 74-75.

Table V.51. United States fibre consumption by fibre type and major end-uses, 1986
(Million pounds and percentage)

Fibre type	Apparel		Home furnishings		Industrial		Total weight	Percentage share of all fibres
	Weight	Percentage	Weight	Percentage	Weight	Percentage		
Rayon								
Filament	5.0	0.04	3.4	0.03	25.9	0.22	34.3	0.29
Staple	98.4	0.84	107.8	0.92	157.1	1.34	363.3	3.09
Acetate								
Filament	145.8	1.24	13.4	0.11	0.6	0.01	159.8	1.36
Staple	0.5	..	0.5	..	..	..	1.0	0.01
Nylon								
Filament	303.3	2.58	921.9	7.84	369.0	3.14	1 594.2	13.55
Staple	25.0	0.21	924.7	7.86	12.5	0.11	962.2	8.18
Polyester								
Filament	721.3	6.13	129.7	1.10	332.5	1.83	1 183.5	10.06
Staple	844.8	7.18	526.6	4.48	155.2	1.32	1 526.6	12.98
Acrylic								
Staple	478.0	4.06	67.7	0.58	8.3	0.07	554.0	4.71
Polypropylene								
Filament	-		661.5	5.62	199.5	1.70	861.0	7.32
Staple	-	..	206.2	1.75	46.0	0.39	252.2	2.14
Pandex								
Filament	25.0	0.21			..	..	..	..

Table V.51. (continued)

Fibre type	Apparel		Home furnishings		Industrial		Total	Percentage share of all
	Weight	Percentage	Weight	Percentage	Weight	Percentage	weight	fibres
Glass	..	..	4.0	0.03	124.0	1.05	128.0	1.09
Cotton	2 125.3	18.07	1 031.8	8.77	327.0	2.78	3 484.1	29.62
Wool	157.9	1.34	33.4	0.28	14.7	0.12	206.0	1.75
Linen	80.0	0.68	60.0	0.51	..	..	140.0	1.19
Jute	..	..	270.0	2.30	..	..	270.0	2.30
Silk	16.0	0.14	-	..	..	..	16.0	0.14
Total	5 026.3	42.72	4 962.6	42.18	1 772.3	15.07	11 736.2	100.00

Source: Statistikon Corporation.

Table V.52. World synthetic-fibre trade, 1989[a/]
(Thousand tonnes)

Fibre and economic grouping	Exports (A)	Imports (B)	Net trade (A)-(B)
Non-cellulosic fibres			
Developed economies	2 344	2 058	286
Developing economies	700	912	-212
Total	3 044	2 970	74
Cellulosic fibres			
Developed economies	541	487	54
Developing economies	61	228	-167
Total	602	715	-113

Source: International Cotton Advisory Committee, *Cotton: World Statistics* (Washington, D.C., 1991), p. 99.

a/ Classification and estimates by Alexander Yelcyenides, Attorney (Athens, Greece, private correspondence, February 1992).

waning. As of 1991, only 17 countries have applied restraints on international trade under the MFA, compared to 82 countries that were doing the same thing approximately 20 years ago. In other words, over the mentioned period there has been a liberalization of international textile trade.

Today there are still some obstacles to free trade within the present GATT system. One of the major obstacles is the set of relatively high tariff rates imposed by many developing countries. Table V.53 lists tariff barriers among the two major economic groupings, developed and developing, along with a number of specific countries and areas within those two groupings. The tabulation indicates a relative uniformity of tariff rates imposed by the major developed countries in the North for the same product descriptions. However, among developing countries and areas there is greater disparity. For instance, Mexico, the Republic of Korea and Taiwan Province have relatively low tariff rates, while China, Costa Rica, India and Indonesia have higher rates.

Another trade problem is the degree of trade restrictions imposed on imports by many countries. The restrictions listed in table V.54 have been identified according to major importing countries (United States, Canada and EEC), and their exporting suppliers (Brazil, China, Colombia, Costa Rica, India, Indonesia, Mexico, Republic of Korea and Taiwan Province). The tabulation reveals that with the exception of Colombia, which has no constraints on its exports to the major importing countries, all the others are subject to some form of barrier. In general, most of the major countries in the North have barriers, while despite these barriers, many of the economies of the South remain competitive. While it might be anticipated that most of the economies of the South would erect import barriers, these economies have no need for imports; they face more trying marketing problems when they attempt to ship exports at lower prices to the North.

(d) *Major companies in the global industry*

The world's leading fibre-producing companies can be viewed from two perspectives. Table V.55 lists the affiliations in developing countries and areas of the major transnational corporations, as well as their location. All the transnational corporations included have significant affiliations and capital ownership in the South. Raw material sourcing for local production is still frequently undertaken by the parent, as supplies are insufficient in developing countries. Nearly all new production plants for either synthetic fibres or chemical raw materials are based on technology acquired from the North. A few companies, typically from Germany, dominate the supply of fibres technology. A significant trend among the European companies has been the acquisition of firms in the United States, such as the purchase by BASF of American Enka. In addition, Japanese companies have moved more and more into Europe; in early 1989 Toray Industries, one of the world's largest polyester producers, bought Samuel Courtauld, a textile subsidiary of the United Kingdom group, Courtaulds.

There has been a retrenchment of investment by some producers in both the North and South, even though transnational corporations have more investments in the South. It appears that the predominant places for investment are within Latin America, and for the first time there is fibre investment by transnational corporations in China. Among the world's leading fibre producers in the North are E.I. Du Pont de Nemours, Monsanto Chemical, Toray Industries,

Table V.53. Rates of duty on synthetic-fibre products imposed by developed and developing economies in recent years
(Percentage *ad valorem*)

		Countries and areas									
		Developed economies			Developing economies						
		EEC	Canada	United States	China	Costa Rica	India	Indonesia	Mexico	Republic of Korea	Taiwan Province
SITC	Product description	1991	1991	1992	1989	1989	1989	1988	1988	1992	1992
55401 00 00	Sewing thread of synthetic filaments, whether or not for retail sale	9	10a/	13	70-90	..	200b/	..	15	9	5
5401 10 90	Products for retail sale	6	10a/	..	70-90	..	200b/	..	..	9	3
5402 00 00	Synthetic filament yarn (other than sewing thread) not for retail sale, including synthetic monofilament of less than 67 decitex	9	10a/	9.12-10	70-90	..	200b/	5-30c/	5-15	9	..
5402.31	Textured yarn	..	10a/	9.12-10	35-40	18.6-41.7	200b/	30c/	15	9	3
5403 00 00	Artificial filament yarn (other than sewing thread), not for retail sale, including artificial monofilament of less than 67 decitex	9.5	9.9a/	..	80-130	..	200b/	5	15	9	5-10
5404 00 00	Synthetic monofilament of 67 decitex or more, of which no cross-sectional dimension exceeds 1 mm; strip and similar material (for example, artificial straw) of synthetic textile of an apparent width not exceeding 5 mm	5.8-6.3	10a/	3.1-7.8	80-130	..	200b/	5-40	15	9	4-5
5407 00 00	Woven fabrics of synthetic filament yarn, including woven fabric obtained from material under heading No. 5404	11	25d/	16-17	130	32.4-78.4	100	50-60c/	5-15	9	10
5408 00 00	Woven fabrics of artificial filament yarn, including woven fabric obtained from material of under heading No. 5404	11	25d/	..	130	..	100	50-60	15	9	10

Sources: "Report of the Textiles Surveillance Body to the Textile Committee" (Geneva, GATT, 1991).
Note: Decitex is the weight in grams of 100 metres of yarn.
Tabulations by Statistikon Corporation.

a/ Plus 0.11 Canadian dollars per kilogram.
b/ Plus 30 rupees per kilogram.
c/ Plus 10 per cent value added tax.
d/ British Preference Tariff: 20.2 per cent.

Table V.54. Current trade restrictions imposed by major importing countries and areas on synthetic-fibre products

Source of materials (exporters)	Destination of materials and description of restrictions		
	United States	Canada	EEC
Brazil	There are restraints on staple yarn and on a few clothing categories	Two products that may be synthetic fibres are under restraint	There are restraints on a specific synthetic-fibre category, and several categories where synthetic-fibre products may be affected
China	A large number of categories are under restraint	A large number of products that may be synthetic	A large number of products that may be synthetic fibres are under restraint
Colombia	No restrictions	No restrictions	No restrictions at all
Costa Rica	There are restraints on one combined cotton and synthetic fibres category	No restrictions at all	No restrictions at all
India	A few categories are under restraint	A few items that may be man-made fibres are under restraint	A few restrained products may be synthetic fibres
Indonesia	There are restrictions on fabrics and on a few clothing categories	A few items that may be man-made fibres are under restraint	There are restraints on a specific synthetic-fibre category and very few other restrictions
Mexico	Several categories are restricted	No restrictions at all	No restrictions at all
Republic of Korea	A large number of categories are under restraint	Some products specifically made of synthetic fibres are under restraint as well as others that may be synthetic fibres	A large number of products that may be synthetic fibres are under restraint
Taiwan Province	A large number of categories are under restraint	Some products specifically made of synthetic fibres are under restraint as well as others that may cover synthetic-fibre products	No information available

Source: Private correspondence from GATT.
Note: Tabulations by Statistikon Corporation.

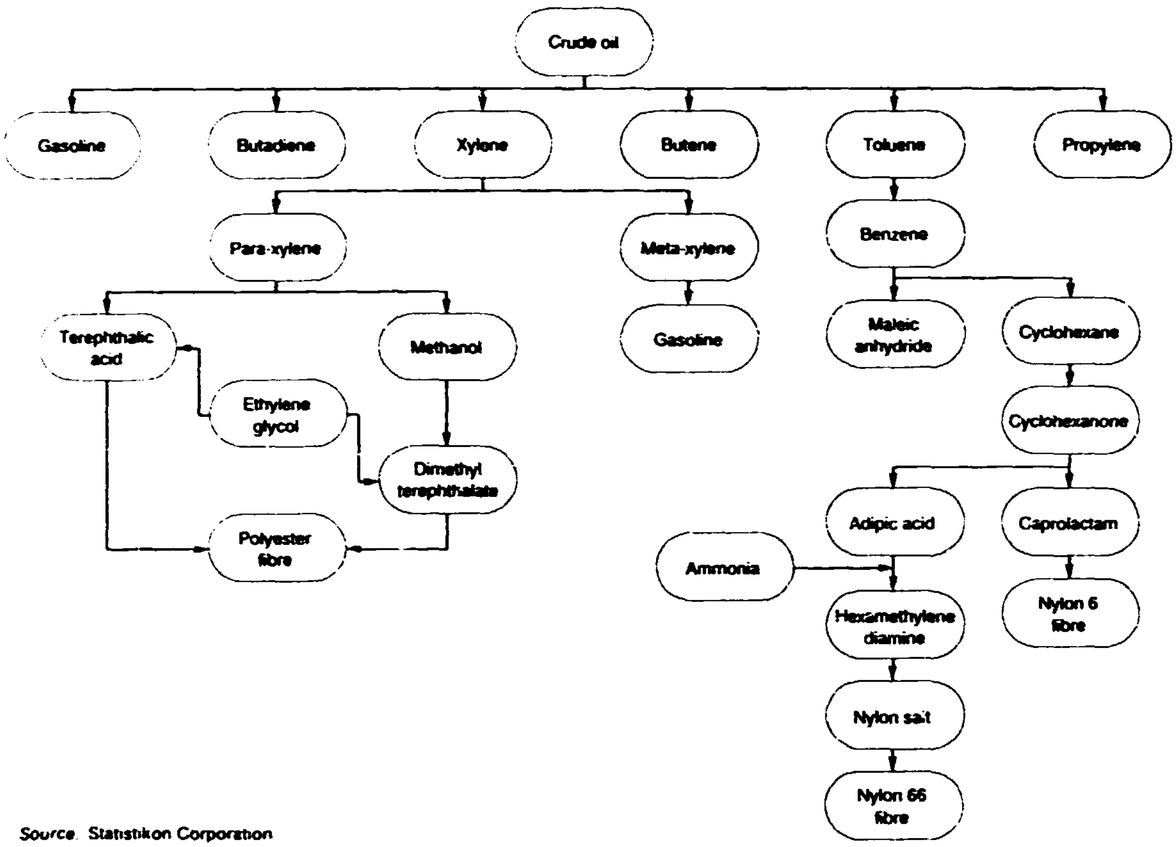
Montefibre Enimont, and Hoechst A.G. The major companies in the South are Chinese State-owned enterprises, Far Eastern Textile and Nan Ya Plastics Corporation (both Taiwan Province), Fibras Sinteticas (Mexico), and Hanil Synthetic Fiber Industrial Company (Republic of Korea). Companies in the United States, Japan, Germany and Italy are shown to have investment leadership in the North. While in the South, China, Mexico, Republic of Korea and Taiwan Province have the leading firms.

(e) Linkages to the petrochemical industry

Synthetic fibres are heavily dependent on petrochemicals, which in turn are derived from crude oil and liquefied petroleum gas. Figures V.22 and V.23 identify the sequential path in the conversion process from fuel materials to monomers and particularly to synthetic fibres. Figure V.22 shows the source petrochemicals for the production of polyester fibres (starting with xylene and also ethylene in figure V.23), and nylon fibres (starting with toluene). Figure V.23 displays the process path for the manufacture of acrylic and polypropylene fibres from polypropylene, acetate fibres from acetic acid, and ethylene glycol from ethylene.

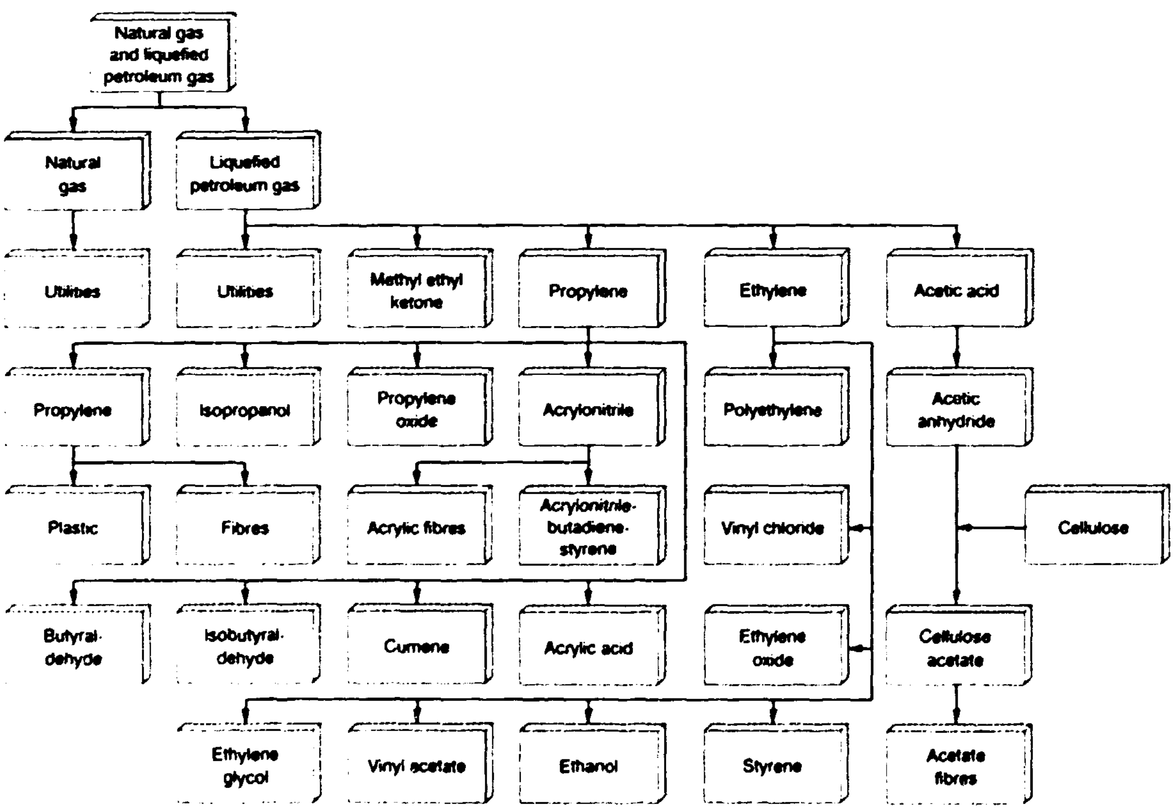
Since petrochemical prices have a significant impact on the costs of producing synthetic fibres, it is important to understand the impact on the fibre material costs of a change in the price of a barrel of crude oil. For example, computations [52] have been made to show the impact on the petrochemical cost of producing nylon (66) filament by increasing the price of a barrel of crude oil by $1. The cost figures reflect only the converted weight or the amount used, and do not include other costs such as that of transformation, depreciation and administration. On the basis of crude oil price of $20 per barrel and the conversion factors, the cost of the various derivative petrochemicals can be estimated. In this case, the cost of the equivalent

Figure V.22. Synthetic-fibre petrochemical flow chart, A



Source. Statistikon Corporation

Figure V.23. Synthetic-fibre petrochemical flow chart, B



Source Statistikon Corporation

Table V.55. Ownership of transnational synthetic-fibre corporations, 1990

Corporation	Home country	Plant location: Developed economy	Plant location: Developing economy	Affiliate companies, percentage ownership	Fibre types
Akzo N.V.	Netherlands	Germany		Enka (97 per cent), public (3 per cent)	NF, PF, RF
			Brazil	Companhia Bahiana de Fibras (82 per cent), other (18 per cent)	NF, PF
				Polyeska (51 per cent), other (49 per cent)	PF
			Colombia	Enka de Colombia (49 per cent), other (51 per cent)	NF, PF and S
			Ecuador	Enkador (49 per cent), other (51 per cent)	PF
			India	Century Enka (40 per cent), other (60 per cent)	NF, PF
			Mexico	Fibras Químicas (40 per cent), Alfa Group (60 per cent)	NF, PF
		Netherlands		Enka (100 per cent)	Aramid, NF, PF and S, RF
		Spain		La Seda (58 per cent), other (42 per cent)	NF and S, PF and S, RF.
Amoco Chemicals	United States	Australia		Amoco Chemicals	Olefin F
			Brazil	Propex do Brasil Prd, S. Lida (100 per cent)	Olefin F
		Canada		Amoco Fabrics and Fibers Ltd. (100 per cent)	Olefin F
		Germany		Amoco Deutschland G.m.b.H (100 per cent)	Olefin F
		United Kingdom		Amoco Fabrics (United Kingdom) Ltd. (100 per cent)	Olefin F
		United States		Amoco Fabrics and Fibers Co. (100 per cent)	Olefin F
Asahi Chemical Industries Co. Ltd.	Japan		India	Baroda Rayon Corp. (1 per cent), local interest (89 per cent), other (10 per cent)	NF, PF, RF
			Indonesia	P.T. Indo. Asahi Chem. (51 per cent), other (19 per cent), local (30 per cent)	NF
		Ireland		Asahi Synthetics Fibres (Ireland) (85 per cent), other (15 per cent)	Acrylic S
		Japan		Asahi Chemical (100 per cent)	Acrylic S, NF and S, PF and S, RF and S, Saran, Spandex
			Republic of Korea	Tong Yang Polyester (50 per cent), Tong Yang Nylon (50 per cent)	NF, PF
Bayer A.G.	Germany	Belgium		Bayer Antwerpen N.V. (100 per cent)	NS
		Germany		Bayer A.G. (100 per cent)	Acrylic S, NF, Spandex
				Faserwerke Lingen G.m.b.H. (100 per cent)	Acrylic S
Courtaulds, PLC	United Kingdom	France		Courtaulds Fibres S.A. (100 per cent)	
		Italy		Novaceta S.p.A. (50 per cent), Snia (50 per cent)	Acetate F
		Spain		Courtaulds España S.A. (100 per cent)	Acrylic S
				INACSA (12 per cent), public (88 per cent)	Acetate F
		United Kingdom		Courtaulds Fibres Ltd. (100 per cent)	Acrylic S, Modacrylic, S, Polyacrylate S, R, S, Acetae F, Triacetate F
		United States		Courtaulds Fibers Inc. (100 per cent)	RS
		Canada		Courtaulds Fibres Inc. (100 per cent)	RS

E.I. Du Pont de Nemours	United States		Argentina	Ducilo (82 per cent), Bunge and Born (18 per cent)	NF, Spandex
			Brazil	Du Pont do Brasil (100 per cent)	Spandex
		Canada		Du Pont Canada (75 per cent), public (25 per cent)	NF and S, Spandex
			China	Nantong Cellulose Fibers Co. Ltd.	R
		Germany		Du Pont de Nemours (Deutschland) (100 per cent)	NF and S, PF and S
		Japan		Toray-Du Pont (50 per cent), Toray Ind. (50 per cent)	Spandex
		Luxembourg		Du Pont Fibres (100 per cent)	Olefin
			Mexico	Nylon de Mexico (40 per cent), Alfa-Group (51 per cent), public (9 per cent)	NF and S, PF and S, Spandex
		Netherlands		Du Pont de Nemours (Netherlands) (100 per cent)	Spandex
			Turkey	Du Pont (50 per cent), Sabanci Group (50 per cent)	NF, PF
		United Kingdom		Du Pont (United Kingdom) (100 per cent)	Aramid, Soandex
		United States		Fibers Department (100 per cent)	Aramid F and S, NF and St, PF and S, Spandex
				Polymer Products Department (100 per cent)	Nylon 6/66/612 and polyester
Enichem Fibre S.p.A. (Italy)	Italy	Italy		Alcantara S.p.A. (51 per cent), Toray Japan (49 per cent)	P
				Enichem Fibre S.p.A. (100 per cent)	Acrylic, PS
				Fibre Acriliche S.r.l (100 per cent)	Acrylic
				Fibre Poliestere S.r.l. (100 per cent)	PF
				Montefibre S.p.A. (100 per cent)	Acrylic, PF and S
				Terbond S.p.A. (99 per cent)	Polyester spun-bonded
		Spain		Montefibre Hispania S.A. (100 per cent)	Acrylic
Firestone Tire and Rubber Company	United States	Canada		Firestone Textiles Co. (100 per cent)	NF
		United States		Firestone Fibers and Textiles (100 per cent)	PF
Hoechst A.G. (Germany)	Germany	Austria		Austria Faserwerke, Hoechst Austria (51 per cent), Lenzing (49 per cent)	PS
		Belgium		Hoechst Celanese (100 per cent)	Acetate F, Triacetate F
			Brazil	Hoechst Do Brasil Quimica a Farmacautica S.A. (100 per cent)	PF
		Canada		Celanese Canada Inc. (56 per cent), public (44 per cent)	
			China	Natong Cellulose Fibers Co. Ltd.	RF, Acetate
		Germany		Hoechst A.G. (100 per cent)	Acrylic, PF and S, RS
				Zehlendorf (97 per cent), others (3 per cent)	
			Mexico	Celanese Mexicana S.A. (51 per cent), public (49 per cent)	Acetate F and S, NF and S, PF and S
		Portugal		Hoechst Fibras S.A. (100 per cent)	PS
				Hoechst Portuguesa S.A.R.L. (100 per cent)	NF
		South Africa		Hoechst South Africa (100 per cent)	PS
		United Kingdom		Hoechst Fibre Industries (100 per cent)	PF
		United States		Hoechst Celanese Corp. (100 per cent)	Acetate F and S, NF, PF and S, polybenzimidazole, polycarbonate
Imperial Chemical Industries Ltd.	United Kingdom	Germany		ICI Europa Fibres G.m.b.H. (100 per cent)	
			India	Chemicals and Fibres of India Ltd. (55 per cent)	PS
			Pakistan	ICI Pakistan Manufacturers (70 per cent)	PS
		South Africa		South African Nylon Spinners (through AECI Ltd.) (38 per cent)	NF, PF
		Spain		Nurel S.A. (100 per cent)	NF and S, PF and S
		United Kingdom		ICI Fibres (100 per cent)	Biconstituent, NF and S, PF

Table V.55 (continued)

Corporation	Home country	Plant location: Developed economy	Plant location: Developing economy	Affiliate companies, percentage ownership	Fibre types
Mitsubishi Rayon (Japan)	Japan	Japan			Acetate F and S, acrylic, PF, triacetate F
		Portugal		FISIPE (8 per cent), Mitsubishi Corp. (13 per cent), Quimica (64 per cent), other (15 per cent)	Acrylic
			Taiwan Province	Tong Hwa (19 per cent), Mitsubishi Corp. (12 per cent), other (69 per cent)	Acrylic
Montefibre S.p.A. (Italy)	Italy	Italy		Industrie Tessili Vercelli S.p.A. (100 per cent)	Acetate F
		Spain		Montefibre Hispania S.A. (100 per cent)	Acrylic
Owens-corning Fiberglas Corp.	United States	Belgium		Owens-Corning Fiberglas Europe (100 per cent)	Fiberglas
			Brazil	Fiberglas Fibras (100 per cent)	Fiberglas
		Canada		Fiberglas Canada (100 per cent)	Fiberglas
		France		Owens-Corning Fiberglas Europe (100 per cent)	Fiberglas
		Japan		Asahi Fiber Glass (28 per cent) Asahi Glass Co. Ltd. (72 per cent)	Fiberglas
			Mexico	Vitro-Fibras Glass (28 per cent), Vitro Group (60 per cent)	Fiberglas
		Netherlands		Owens-Corning Fiberglas Netherlands (100 per cent)	Fiberglas
		Norway		Owens-Corning Fiberglas Europe (100 per cent)	Fiberglas
		Spain		Owens-Corning Fiberglas Europe (100 per cent)	Fiberglas
		Sweden		Owens-Corning Fiberglas Europe (100 per cent)	Fiberglas
		United States		Owens-Corning Fiberglas (100 per cent)	Fiberglas
PPG Industries	United States	Netherlands		Silenka (100 per cent)	Fiberglas
			Taiwan Province	PPG Fiber Glass (50 per cent), Nan Ya Plastics (50 per cent)	Fiberglas
		United Kingdom		PPG Fiber Glass Ltd. (100 per cent)	Fiberglas
		United States		PPG Fiber Glass Products (100 per cent)	Fiberglas and rubber reinforcement
			Venezuela	Sudamtex (51 per cent)	Fiberglas
Pilkington Brothers	United Kingdom		Argentina	VAGA (99.7 per cent), Glaverbel/Boussois/local interest (0.3 per cent)	Fiberglas
			India	Fibreglass Pilkington (50 per cent, plus one share), Indian interest (50 per cent, minus one share)	
		South Africa		Fibreglass South Africa (24.5 per cent), Owens-Corning Fiberglas (United States) (24.5 per cent) Plate Glass and Shatterprute Industries Ltd. (51 per cent)	
		United Kingdom		Fibreglass PLC (100 per cent)	Fiberglas
Rhône-Poulenc S.A.	France		Argentina	Rhône-Poulenc Argentina S.A. (100 per cent)	Acetate F, PF
			Brazil	Rhodia S.A. (100 per cent)	PS
		France		Rhône-Poulenc Fibres (100 per cent), Cellatex (100 per cent), Rhovyl (100 per cent)	NF and S, PF and S, Vinyon F and S

		Germany		Rhodia A.G. (100 per cent)	Acetate tow, NF and S, PF
		Spain		Rhône-Poulenc Fibras S.A. (100 per cent)	NF and S, PF
		Switzerland		Rhône-Poulenc Viscosuiss A.G. (100 per cent)	NF and S, PF
Saint-Gobain	France	France		Saint-Gobain Industries (100 per cent)	Fiberglas
		Germany		Gevetex-Textiglas (100 per cent)	Fiberglas
		Italy		Vetrotex Italia (100 per cent)	Fiberglas
		Spain		Cristalería Española S.A. (69 per cent)	Fiberglas
		United States		Certain Teed Corp. (55 per cent), other (45 per cent)	Fiberglas
Snia Fibre (Italy)	Italy	France		Ets. Nysam (100 per cent)	NF
		Italy		Carpol S.p.A. (100 per cent), Industrie Tessili Vercelli S.p.A. (99.8 per cent) Liba S.p.A. (100 per cent), Novaceta S.p.A. (50 per cent), Courtaulds (United Kingdom) (50 per cent), Nuova Raion Italia S.p.A. (41.2 per cent), other (58.8 per cent)	PF, acetate F, NF and S, Rayon F
Synthetic Industries, Inc.	United States	Ireland		Synthetic Industries (Ireland) Ltd. (100 per cent)	Olefin
		United Kingdom		Synthetic Industries Ltd. (100 per cent)	Olefin
		United States		Synthetic Industries, Inc. (100 per cent), Fibron Co. (100 per cent)	
Teijin Ltd.	Japan		Indonesia	P.T. Tifico (65.8 per cent), Toyo Menka (16.5 per cent), local interest (17.7 per cent)	PF and S
		Japan		Teijin (100 per cent) NF, PF and S, Vinyon F	Acetate F, Aramid F and S,
			Republic of Korea	Sunkyung Fibres (1.8 per cent), local interests (98.2 per cent)	Acetate F and tow, PF and S
			Thailand	Teijin Polyester (45 per cent), local interest (55 per cent)	PF and S.
Toray Industries, Inc.	Japan		Indonesia	P.T. Indonesia Toray Synthetics (59 per cent), other (41 per cent)	NF and S, PF and S
		Japan		Toray Industries (100 per cent), Toray-Monofilament (100 per cent) Toray-Du Pont (50 per cent)	Acrylic, NF and S, Nylon 6/66 copolymer F, NF, PF and S
			Republic of Korea	Cheil Synthetic Textiles (22.8 per cent), other (77.2 per cent) Kolon Industries (19.3 per cent), other (80.7 per cent)	PF and S, Spandex F
			Malaysia	Penfibre SDN Berhad (100 per cent)	NS, PF and S
			Thailand	Toray Nylon Thai (30 per cent), other (70 per cent)	PF, NF
Wellman, Inc.	United States	United States		Man-Made Fibers Division (100 per cent), Fibers Industries Inc. (100 per cent)	NS, PS
		Ireland		Wellman International (100 per cent)	NS, PS

Source: *Fiber Organon*, vol. 62, No. 6 (June 1991), pp. 127-128 and 130-158.
Note: Tabulations by Statistikon Corporation. Key: F = filament; NF = nylon filament; NS = nylon staple; PF = polyester filament; PS = polyester staple; RF = rayon filament; S = staple.

feedstock required to produce 1 pound of toluene would be $0.1440 per pound. On the same basis, the cost of benzene would be $0.1771, cyclohexane $0.1647, and cyclohexanone $0.2679; finally, the cost of the petrochemical in the fibre would be $0.2474 per pound. If the crude oil price is increased from $20 to $21 per barrel, the cost of the final petrochemical share of the fibre would be $0.1547 (as compared with $0.1474). This is a net increase of $0.0074, or in round numbers $0.01 per pound. Assuming a slightly larger price increase to $25 per barrel, the petrochemical cost of nylon would rise to $0.1842 per pound, which is a net of increase of $0.0368 per pound over that of the base case.

From the above it can be concluded that for every $1 increase in the crude oil price, the cost of the chemical content of nylon is likely to increase by roughly $0.01 per pound. If all other cost factors at the various stages of petrochemical conversion, such as labour, depreciation and other costs, are considered, then a $0.01 per pound increment could have a major impact. Also, the fact that raw materials are consumed in large volumes adds to the significance of the cost changes, particularly in today's highly competitive global markets. Although not included here, the impact of crude oil prices can also be considered by comparing them to the prices of wood pulp, another major source of feedstocks for the fibres industry.

2. *Manufacturing capacity of developing countries*

There has been a significant shift in the potential of world synthetic fibre production. Today, most of the installed synthetic fibre production capacity is located in the South. However, the measure used for installed capacity is not synonymous with actual production. The important variable that enters here is the degree of utilization of such capacity. World synthetic fibre-producing capacities for 1992 are shown in table V.56, which divides capacities between non-cellulosic and cellulosic fibres according to filament, staple and total for each producing country and area. It can be seen that economies in the South possess the majority of the non-cellulosic fibre capacities. They have 53.3 per cent of total world installed capacity, with 50.5 per cent of filament and 55.4 per cent of staple. Since staple fibres require more processing steps than filament fibres during the conversion from a fibre into a fabric, staple fibres are more suitable for developing countries where textile mill labour rates are lower. While the North has 62.7 per cent of cellulosic fibre capacity, the South has the remaining 37.7 per cent. Cellulosic fibres are losing their market significance. Staple fibres such as polyester also have proven suitable for blending with cotton fibres. Since cotton is in ample supply in many developing countries, producing synthetic staple fibres provides an additional advantage for these countries.

Some of the economies in the South also have a major petroleum base, and a developed or developing petrochemical industry. On this basis, countries and areas such as Brazil, China, India, Indonesia, Mexico and Taiwan Province are becoming major players in the production of non-cellulosic fibres. In fact, the greatest number of new fibre plant installations are in the South. Particularly, the concentration of new plant erections are in China, India, Indonesia, Republic of Korea, Taiwan Province and Thailand. This high level of concentration could create a problem for these economies. Without an appropriate market development effort, many plants in the South could become underutilized, dissipating any possible labour cost advantage.

3. *Capacity utilization and expansion plans*

(a) *Capacity levels*

In fibre manufacturing there is a need to employ large production capacities and continuous processes in order to achieve cost reductions. In the case of the synthetic fibre industry, as the production volume increases, the cost per unit decreases, with the benefit of the cost reduction being more pronounced at lower volume levels than at higher ones. Other factors also can contribute to the cost reduction. For instance, process integration from petrochemicals all the way to fibre spinning would have a favourable impact on costs. An additional factor is capacity utilization: a small plant operated at a higher utilization rate will have a cost advantage over a larger plant operated at a lower rate. Traditionally a synthetic fibre plant operating at 70-75 per cent capacity utilization would be considered operating at a break-even point.

Recognizing the impact of capacity size on cost, a question arises as to whether there is a difference in installed synthetic fibre plant capacities between the South and North. To help answer this question, table V.62 in the annex to this section lists all fibre-producing countries and areas, the number of plants, and total and average capacity. From this data, the following conclusions can be drawn regarding installed capacities for the major fibres.

(i) *Cellulosic fibres*

Acetate. While data for this fibre are not extensively available, it is safe to assume that the number of firms in the field as well as installed capacities are decreasing. This can be seen as a result of both high costs of production and intense competition from other fibres such as nylon and polyester filaments. The Republic of Korea is the only country to report an increase in firms.

Rayon. There has been an overall decline in the number of plants between 1978 and 1991; however, the remaining plants are larger, except in Asia. The main reason for the reduction is the reduced demand for rayon fibres, due to higher prices and consequent substitution of nylon and polyester for rayon. Another important factor is the need for a high volume of water for rayon, leading to high costs of pollution abatement. In Asia, particularly in China, there has been an increase in the numbers of plants; however, these new plants are much smaller. This region is able to offset the high cost of production through lower wages and possibly lower pollution control requirements.

Table V.56. World non-cellulosic and cellulosic fibre production capacities, 1992
(Thousand tonnes)

Country and area	Non-cellulosic fibres Filament	Staple	Total	Cellulosic fibres Filament	Staple	Total
Developed economies						
Australia and New Zealand	22.0	1.5	23.5	..	..	..
Austria	-	22.0	22.0	..	..	135.0
Benelux[a]	123.5	81.5	205.0	..	..	43.0
Canada	108.4	73.0	181.4	24.5	38.0	62.5
Czechoslovakia	101.4	87.0	188.4	17.0	44.0	61.0
Finland	0.5	-	0.5	..	..	70.0
France	82.0	68.0	150.0	..	..	3.0
Germany	521.1	659.0	1 180.1	..	..	224.8
Greece	17.0	-	17.0	..	..	8.0
Hungary	8.5	35.0	43.5	10.0	10.0	20.0
Japan	877.0	913.0	1 790.0	117.4	214.9	332.3
Ireland	36.0	95.0	131.0	..	..	-
Italy	234.0	410.0	644.0	..	..	44.0
Israel	15.0	-	15.0	..	..	-
Poland	110.2	75.0	185.2	23.0	45.0	68.0
Portugal	-	74.5	74.5	..	..	1.0
South Africa	60.8	49.7	110.5	..	..	-
Spain	112.0	227.0	339.0	..	..	42.0
Sweden	..	..	-	..	..	26.0
Switzerland	85.0	33.0	118.0	..	..	-
United Kingdom	100.0	171.0	271.0	..	..	76.0
USSR[b]	606.0	592.0	1 198.0	315.0	374.0	689.0
United States	1 561.3	1 929.1	3 490.4	99.3	147.4	246.7
Total	4 759.7	5 593.6	10 378.0			2 152.3
Developing economies						
Albania	2.0	5.0	7.0	..	..	..
Algeria	-	15.0	15.0	..	..	..
Argentina	42.6	36.6	79.2	4.0	-	4.0
Bangladesh	4.6	14.0	18.6	6.5	5.0	11.5
Brazil	199.1	1 535.0	1 734.1	20.0	41.7	61.7
Bulgaria	61.0	98.0	159.0	5.0	-	5.0
Chile	7.7	11.0	18.7	1.5	5.4	6.9
China	589.3	1 275.0	1 864.3	65.0	170.0	235.0
Colombia	60.4	41.5	101.9	3.5	-	3.5
Costa Rica	8.0	-	8.0	..	..	..
Cuba			-	1.5	11.0	12.5
Ecuador	7.2	-	7.2	..	..	..
Egypt	23.0	94.0	117.0	8.0	5.4	13.4
India	430.0	323.0	753.0	71.2	176.5	247.7
Indonesia	321.0	226.0	547.0	-	145.0	145.0
Iran (Islamic Republic of)	48.0	60.0	108.0	..	..	..
Iraq	..	..	-	3.5	6.5	10.0
Kenya	15.8	3.0	18.8	..	..	..
Malaysia	26.0	70.0	96.0	..	..	..
Mexico	217.8	331.0	548.8	21.1	-	21.1
Nigeria	21.0	3.0	24.0	..	..	..
Pakistan	61.0	71.0	132.0	3.0	-	3.0
Peru	16.5	39.0	55.5	1.7	-	1.7
Philippines	92.0	72.0	164.0	-	25.0	25.0
Republic of Korea	942.4	667.0	1 609.4	18.0	21.0	39.0
Romania	89.1	222.0	311.1	11.0	120.0	131.0
Sri Lanka	3.3	-	3.3	..	..	..
Taiwan Province	1 059.7	1 090.0	2 149.7	4.0	149.7	153.7
Thailand	231.7	250.0	481.7	-	55.0	55.0
Turkey	173.0	250.0	423.0	..	..	11.2
United Republic of Tanzania	5.0	-	5.0	..	..	..
Uruguay	1.7	4.8	6.5	1.9	-	1.9
Venezuela	15.0	38.1	53.1	1.5	-	1.5
Yugoslavia	77.0	112.0	189.0	17.0	63.0	80.0
Total	4 851.9	6 957.0	11 808.9			1 280.3

Source: *Fiber Organon*, vol. 62, No. 6 (June 1991), pp. 112-115.

[a] Belgium, Netherlands and Luxembourg.

[b] Data relate to the former USSR.

(ii) *Non-cellulosics*

Acrylics. This fibre has seen a reduction in the number of plants; however, the remaining factories have larger capacity. The exception to this is in Asia, where the number of plants has increased, while their average size has decreased. There has been a major shift in the production of acrylics with Du Pont, one of the leading companies in the field, having withdrawn from the acrylic market. Possibly the main reason for this decision was that its fibre was primarily used in the apparel field, which has suffered from severe import competition. It appears that in most other regions, acrylic fibres are selling relatively well.

Nylon filament and staple. The average nylon capacity has increased between 1978 and 1991. In Western Europe, particularly the United Kingdom, however, there has been a significant reduction in the number of nylon plants during that period. This is possibly a reflection of the shift in consumers' taste to other fibres.

Polyester filament and staple. There was a consistent increase in the global plant capacity between 1978 and 1991; none the less, this growth reflects conflicting trends. Some countries experienced growth, while others suffered a decline. While polyester filament along with nylon filament seem to have reached saturation point, polyester staple still has growth potential in blends with cotton and some other fibres.

All non-cellulosics. There has been a global increase in average plant size during the period 1978-1991. At the same time, however, there has been a decrease in the number of plants in Western and Eastern Europe and in the Americas. During the same period there was an increase in Asia and Western Asia, and in Africa and Oceania. Regarding the possibility that developing countries might have smaller fibre plants than developed countries, this is true for cellulosic and acrylic fibres as well as for nylon. In the latter case, a number of Asian countries have large capacities, while some Western European countries have small capacities. Polyester production also has gone towards smaller plants, particularly in Africa, Oceania and Western Asia. However, polyester plants in Asia are as large as in the North.

Textile glass. Even though it is a mineral fibre and falls outside the classification of synthetics, textile glass is important since its industry has been expanding both in the number of plants as well as in the average size of its installed capacity. Textile glass is primarily used for home furnishings (drapery) and industrial applications (tyre cord and geotextile fabrics).

(b) *Utilization rates*

The most important factor in reducing costs of production is the level of output of the plant where the critical break-even rate for capacity utilization mentioned above is in the range of 70-75 per cent. As the utilization rate declines, costs increase, and with a weakness in price, profitability suffers. At the same time, higher utilization rates do not necessarily reflect a strong trend in fibre demand. Frequently, higher rates could reflect a reduction in the size of installed capacity.

Table V.57 shows the capacity utilization rates by type of fibre and major producing region or country in 1990. Looking at the totals for each geographic area, four out of the five groups operated at rates of less than 80 per cent, only nylon staple having a rate of 82.2 per cent. Polyester staple has operated at 73.8 per cent, the lowest rate. Rates vary within each fibre group; for example, within the acrylic fibre group, the United States utilization rate of 106 per cent is unusual.

Assuming the existence of a three-tier system of capacity utilization rates, the following interpretation would apply: at 80 per cent and above, a plant would be considered as operating at a strong rate; at between

Table V.57. World synthetic-fibre capacity utilization, 1990, and forecasts for 1991-1993
(Thousand tonnes)

Fibre type and producing region and country	Production in 1990	Capacity in 1990-1993	Utilization in 1991 (percentage)
Acrylic and modacrylic			
Americas			
United States	229	216	106.02
Canada	-	-	-
Other	151	251	60.16
Western Europe	807	1 051	76.78
Eastern Europe and USSR	287	430	66.74
Asia			
Japan	363	432	84.03
China	115	170	67.65
Other	355	431	82.37
Africa, Oceania and Western Asia	19	25	76.00
Total	2 326	3 006	77.38

Fibre type and producing region and country	Production in 1990	Capacity in 1990-1993	Utilization in 1991 (percentage)
Nylon filament			
Americas			
United States	758	909	83.39
Canada	56	97	57.73
Other	154	243	63.37
Western Europe	582	673	79.05
Eastern Europe and USSR	562	728	77.20
Asia			
Japan	274	328	83.54
China	112	140	80.00
Other	516	704	73.30
Africa, Oceania and Western Asia	53	92	57.61
Total	3 067	3 914	77.08
Nylon staple			
Americas			
United States	449	512	87.70
Canada	16	24	66.67
Other	7	14	50.00
Western Europe	153	190	80.53
Eastern Europe and USSR	99	122	81.15
Asia			
Japan	15	27	55.56
China	2	10	20.00
Other	6	8	75.00
Africa, Oceania and Western Asia	1	3	33.33
Total	748	910	82.20
Polyester filament			
Americas			
United States	502	620	80.97
Canada	9	11	81.82
Other	207	304	68.09
Western Europe	511	619	82.55
Eastern Europe and USSR	267	407	65.60
Asia			
Japan	406	515	78.83
China	384	428	89.72
Other	1 566	1 966	79.65
Africa, Oceania and Western Asia	58	110	52.73
Total	3 910	4 980	78.51
Polyester staple			
Americas			
United States	948	1 179	80.41
Canada	35	49	71.43
Other	221	350	63.14
Western Europe	570	690	82.61
Eastern Europe and USSR	447	692	64.60
Asia			
Japan	311	361	86.15
China	622	881	70.60
Other	1 469	2 019	72.76
Africa, Oceania and Western Asia	88	164	72.76
Total	4 711	6 385	73.78

Source: *Fiber Organon*, vol. 62, No. 6 (June 1991).

70-79 per cent, the operation would be considered average; and at 69 per cent and less, it would be considered weak. It appears that within each group of fibres there is a diversity of rates, falling within each one of the above three performance categories. Considering all the fibre groups, among regions, other Americas, other Asia and Western Asia, Africa and Oceania, have average to weak performance rates. The rest of the regions have stronger rates.

The regrouping of the various geographic areas in terms of developed and developing countries shown in table V.58 suggests that developed countries operate at higher rates, while developing countries operate their synthetic fibre plants at average or weak utilization rates. The exception is with polyester filament, which at 78 per cent could be considered an efficient rate. When considering combined or world capacities on average and since 1988, there has been a decline in the utilization rates for the majority of the indicated fibres. In recent years synthetic fibre management has learned how to improve utilization rates by discontinuing or cutting back on excess capacity. Over the years this strategy was used in the management of nylon, polyester, acrylic, rayon and acetate plants. This is why acetate has experienced such a strong rate of growth.

4. *Restructuring and redeployment*

(a) *Industry life cycles*

The original idea behind the development of what came to be known as the synthetic fibre industry was the replacement of a natural process with a synthetic process. This replacement first began with a search for new raw materials, processes and fibres [51]. As the industry was growing, this search involved new end-use applications. At present, increasing global competition is forcing management to become more efficient through the reduction of product lines as well as the need to develop new target market orientation. For instance, some fibre producers are specializing only in home furnishings and industrial markets.

The cellulosic fibres, and specifically viscose rayon, were the first generation of synthetic fibres. Over the long run, these fibres found application in many end-uses where silk was previously used, such as hosiery, blouses and linings. Rayon at first was used in the same applications, but eventually it was also employed in other uses, and thus made significant penetration in such markets as tyre cord and other industrial products.

The development of nylon represented the start of the second generation of fibres. The strategy of the second generation of synthetic fibres was at first to replace rayon by nylon, and then to develop additional new markets. At first, nylon filament penetrated the traditional rayon filament markets, cited above. But eventually nylon filament became important in new applications such as textured men's hosiery, carpets and sport shirts.

The third generation of synthetic fibres, represented by polyester, followed the same strategy as the second. Polyester filament could be elongated, which represented a unique advantage over nylon, but its tendency to pile was a disadvantage. Polyester, therefore, became successful in certain markets and not in others. For instance, nylon filament has dominated the warp knit markets, while polyester filament has become strong in circular knits (double knits), tyre cord and rope markets. Also, textured polyester filament has become a major component of slack and suit end-uses. It seems that now, at least in developed economies, major synthetic fibres such as cellulosics, acrylics, nylon and polyester, have reached a stage of maturity in their growth. Some of these fibres, such as the cellulosic fibres, however, have already started their decline.

In terms of restructuring, the industry appears to have reached the final or mature stage of what can be considered an industry life cycle. At this late date most synthetic fibres have penetrated nearly all of their intended target markets. At the same time, there has been an improvement in natural fibres; as a result,

Table V.58. Selected major synthetic fibres: production and capacity utilization, 1990
(Thousand tonnes)

Fibre type	Developed economies: Production	Capacity	Utilization (percentage)	Developing economies: Production	Capacity	Utilization (percentage)
Acrylic						
Filament	4	6	66.7	..	..	..
Staple	1 535	1 908	80.5	783	1 092	71.7
Nylon						
Filament	1 901	2 371	80.2	1 116	1 543	72.3
Staple	682	814	83.8	66	96	68.8
Polyester						
Filament	1 562	1 969	79.3	2 348	3 011	78.0
Staple	2 088	2 625	79.5	2 623	3 760	69.8

Source: *Fiber Organon*, vol. 62, No. 6 (June 1991).
Note: Classifications and calculations by Statistikon Corporation.

these fibres have partially recaptured some of their previously lost markets. There are, however, some remaining strong market areas within the total group of industrial end-uses, such as geotextiles and pond liner.

In recent years the global competitiveness of the synthetic fibre business has intensified. The growth path to be followed by a fibre producer has become more difficult. Today, fibre management has to intensify its efforts to find new and profitable opportunities. An exception to this relatively stagnant scenario is the long-term growth opportunity offered by the newly established, market-oriented economies in Eastern Europe.

(b) *Prices and costs*

The redeployment of the synthetic fibre industry to certain developing countries has caused differences in production costs, and these, in turn, have stimulated price competition. The magnitude and direction of these differences depend on the actual fibre concerned. For example, in the United States between 1989 and 1991, nylon and acetate filaments and high-modulus and regular rayon staple have shown price strength, while polyester filament, polyester staple and acrylics have experienced lower prices. Although Taiwan Province recently has been offering the lowest prices, the same area was previously offering polyester staple at nearly top prices. Prices in the United States seem to be the most stable, while prices in many other countries fluctuate more violently. An explanation for this pattern could be the more regular supply of petrochemicals available in the United States.

The major components of fibre prices are mainly raw material and labour costs, as shown in table V.59. These two components represent slightly more than 64 per cent of the total cost of fibre in the North, and close to 55 per cent in the South. The major advantage to the South is labour cost. For example, it is estimated that hourly labour rates at a fibre plant in Taiwan Province in 1991 were $3.25 per hour, compared to $10.50 per hour in the United States. This implies that economies in the South hold a strong raw material (petrochemical) advantage in combination with relatively low labour rates. Polyester staple, for example, has been offered at $0.45 per pound in Taiwan Province, as compared with $0.75 per pound in the United States. This price differential is unusually large and cannot be attributed to labour cost savings alone. Nevertheless, the significant point is that developing countries that possess a strong base in petrochemicals are potentially better able to compete within world markets for synthetic fibres.

(c) *Employment*

The reason why labour costs alone do not dominate fibre pricing is that the production process is capital- rather than labour-intensive; employment in the global synthetic fibre industry is thus estimated to be relatively small. Some notion of employment levels in a small group of economies for which data are available can be obtained from table V.60. It appears that employment has been reduced in most countries and areas with the exception of the Republic of Korea and possibly Taiwan Province. While these negative employment trends imply reduced business activity, this can be misleading, since the global synthetic fibre industry is not declining but growing. This is true even though there are some soft spots such as acrylics in the United States and nylon filament in Western Europe. Differences between employment reduction and output growth are most likely due to productivity improvements, a consequence of the adoption of new technologies.

5. *Technology trends*

Technological innovation has been the mainstay of the synthetic fibre industry. Historically, the main source of innovation has been the fibre producer, but now other sources have become important, such as machinery manufacturers, engineering firms, universities and textile mills. Innovation is the end result of the research efforts of fibre producers, with a time lag usually between research expenditures and innovations. Most of the major fibre producers are highly integrated firms with investments in chemical plants, pharmaceuticals, plastics and other related businesses. It is therefore impossible to dissect the portion of these expenditures that relate only to fibres. During

Table V.59. Selected fibre manufacturing costs, 1992
(Percentage distribution)

Cost component	In United States: Polyester staple	In Western Europe: Nylon filament	In Western Europe: Polyester filament	In Western Europe: Acrylic	In Pakistan: Polyester staple
Raw materials	55.5	65	51	53	53.0
Labour	13.8	11	17	11	2.0
Energy	9.2	4	3	10	9.4
Maintenance	4.5	4	7	8	2.1
Depreciation	7.7	6	7	7	11.5
Other	9.3	10	15	11	22.0
TOTAL	100.0	100	100	100	100.0

Source: Statistikon Corporation.

Table V.60. Employment and productivity in the synthetic fibre industry, 1976 and 1986

Country and area	1976 Employment	1976 Synthetic fibre production (thousand tonnes)	1976 Production per employee (tonnes per year)	1986 Employment	1986 Synthetic fibre production (thousand tonnes)	1986 Production per employee (tonnes per year)	1976-1986 Percentage change in employment	1976-1986 Percentage change in productivity
Austria	5 114	133	26.0	..	..	..	..	..
Benelux	14 845	207	13.9	..	..	..	..	..
Finland	1 800	33	18.3	..	..	..	..	..
France	18 400	334	18.2	6 070	188	31.0	-67.0	70.3
Germany, Federal Republic of	40 200	876	21.8	26 200	867	33.1	-34.8	51.8
India	..	188	..	54 480	361	6.6	-	-
Italy	38 300	484	12.6	16 440	607	36.9	-57.1	192.9
Japan	71 810	1 600	22.3	45 235	1 676	37.1	-37.0	66.4
Netherlands	9 698	..	..	..	..	..	..	..
Norway	380	..	..	..	..	..	..	..
Portugal	3 400	16	4.7	..	..	..	..	..
Republic of Korea	17 865	330	18.5	21 055	876	41.6	17.9	124.9
Spain	12 231	216	17.7	8 550	313	36.6	-30.1	106.8
Sweden	765	31	40.5	..	..	..	..	..
Switzerland	4 800	81	16.9	..	..	..	..	..
Taiwan Province	17 627	341	19.3	15 757	1 412	89.6	-10.6	364.2
United Kingdom	43 000	548	12.7	8 530	266	31.2	-80.2	145.7
United States	105 500	3 127	29.6	57 250	3 200	55.9	-45.7	88.9

Sources: Raw employment data from the Comité international de la rayonne et des fibres synthétiques, Paris; synthetic fibre production data from *Textile Organon*, June 1985 and June 1991 issues.

Table V.61. Impact of technologies on synthetic fibre production

Process affected	Period and innovations: Up to 1955	Up to 1965	Up to 1975	Up to 1985
I. Polymer production				
Polymerization	Transesterification process in small-size autoclaves	Transesterification process in autoclaves of larger size	Introduction of continuous polycondensation (esterification) with direct spinning for staple fibres and industrial yarns	Continuous polycondensation with direct spinning for all processes
Chip production	Casting ribbons and cutting to cube-shaped chips or pellets	Evaluation of underwater granulation of chips	Commercially used underwater chip cutters for the production of chips for textile filament	Chip production is phased out
Drying (chips)	Discontinuous process in tumbling driers	Introduction of continuous drying	Continuous	Phasing-out process
Transport (chips)	Manually or via conveyor to suspended silos for gravity feed to spinning machines	Use of air-blowing system for direct transport of chips to spinning silos; problem of dust and abrasion	Introduction of pulse conveying process to eliminate dust and abrasion	Phasing-out process
II. Synthetic fibre spinning				
Spinning and winding	Nylon speeds up to 1,200 metres per minute Polyester speeds up to 1,600 metres per minute Take-up at grid spinning-machine	Preoriented yarns at speeds up to 3,200 metres per minute Nylon needs heated spinning ducts	Nylon speeds to 5,200 metres per minute; does not need heated ducts Polyester speeds up to 4,100 metres per minute	Trend towards direct spinning; preoriented yarns at speeds of 6,000 metres per minute
Conditioning of spinning bobbins	Bobbins need conditioning	Bobbins do not need conditioning		
Dry twisting	Yarns are draw-twisted from spinning bobbins on to cops	Draw-twisting of flat yarn and twisted yarn directly onto cops	Spin-drawing fully drawn yarns onto bobbins	Spin-drawing of flat yarn
Texturizing	Commercial process outside the plant	Partial draw-texturizing process	Commercial draw-texturizing process	Draw-texturizing
Twisting	Separate process	Separate process	Separate process	Separate process
Warping	Separate process	Separate process	Introduction of draw-warping	Draw-warping
Spinning positions				
(1) Spinnerets and position	1-4	4-8	8-16	8-16
(2) Number of ends	Single end, two ends with take-up godets, non-automatic process	Two ends, many without godets; non-automatic process	From two ends up to four ends without godet, with preoriented yarn; partially oriented yarn; partially automated process	From four ends up to eight ends without godets; preoriented yarns
Bobbin weight	1-2 kilograms	4-8 kilograms	8-12 kilograms, possibly up to 35 kilograms	Greater automation; 30-35 kilograms
Grid and extrusion	Grid	Extruder	Partly integrated	Fully integrated

Sources: Basic data from L. Riehl, "Developments of the melt-spinning process in the past and future", *Man-Made Fibre Yearbook*, 1987 (Frankfurt am Main, Chemiefasern Textilindustrie, 1987); additional data from trade sources.

the infancy of the synthetic fibre industry, the major fibre producers devoted approximately 13 per cent of their sales to R and D development. Today, however, the high degree of global competition and the ease of transfer of technology have lowered this proportion. Management now believes that there is a great risk that a firm will quickly lose to others any innovative market position it gains, and thus global average expenditures on R and D have been reduced to only 1 per cent of fibre sales. Earlier it was calculated that the global fibre industry (acrylics, nylon and polyester fibres) had estimated sales of $26.5 billion in 1990. On the basis of this figure and the 1 per cent rate, estimated global synthetic-fibre R and D expenditures for 1990 would be $264 million. This amount represents only the research budget of the fibre producers. An additional $40 million would also be spent by the other sources mentioned earlier. Total estimated R and D would then amount to approximately $300 million.

The key technological trends that became dominant after the Second World War and depicted in table V.61 suggest that there has been a shift to continuous processing as in polycondensation. However, "in-place" batch processes, which exist in both developed and developing countries, are becoming obsolete. There has also een greater use of more complete and integrated processes for the conversion of raw materials into a fibre or yarn form by means of equipment for direct spinning, drawing, texturizing and warping. The development of new machinery made possible the use of high speeds in spinning and winding as well as an increase in the number of spinnerets per spinning position. The introduction of new technologies resulted in the production of larger-sized bobbins and other yarn carriers. The availability of partially oriented yarns, fully oriented yarns and other yarn forms provided the market with yarn alternatives which offer potential savings and improved products. The consequence of these various innvoations is that they have transformed modern synthetic fibre production to an automatic process, reducing costs through greater labour productivity and improved product quality.

The major new synthetic-fibre products are as follows:

(a) Microfibres represent very fine fibres and yarns that can be converted into a fine woven or knit fabric with a sheen and a feel that resembles silk. The primary markets for this product are leisure wear, jackets, coats, blouses, sport shirts and other end-uses;

(b) Highly oriented yarn is a modified yarn spun at high speeds with a modified structure. These yarns are more stable than partially oriented yarns;

(c) Super-speed yarns, which provide more stable yarns are also important;

(d) Fully oriented yarns, which are more suitable for industrial applications;

(e) Dimensionally stable polyester yarns have application in industrial end uses, particulary in tyre cord fabrics;

(f) A new process has been developed for the production of a polybutylene-terephthalate bulked continuous filament suitable for carpets.

6. *Short- and long-term industry outlook*

It is expected that as the fibre, textile and apparel industries (particularly the latter two) shift from a labour-intensive to a capital-intensive manufacturing process, regional labour-cost advantages will be minimized. Other factors will come into play, such as marketing and administrative skills, product quality and performance. On this basis, it is anticipated that international trade will become more freely competitive, and consequently there will be greater compliance among countries with the GATT system of tariffs. At that time there will be no further need for MFA.

Fibre growth expectations for the years 1990-1995, shown in table V.50, indicate that production will increase, but at a reduced pace. However, there will be some growth variation within regions. It is anticipated that nylon filament will experience a decline in Western Europe and Japan. In reality, the growth rates for all the fibre groups shown in table V.50, should be considered good. A major demand-driving force is w ·ld population growth; fibre growth would be expected to continue as long as the population growth rate, which stood at 1.9 per cent in 1990-1991, hovers around 2 per cent. In the short run, however, fibre production along with general textile business conditions will continue to vary with overall economic fluctuations.

Currently, the global textile market is in recession. Expectations are that the industry will recover in 1992 and 1993. The short-run changes in apparel and textile activities have been estimated for a selected countries and areas [53]. During 1991 apparel production was weak for nearly all the listed countries and areas, and improvements are expected in 1992 and 1993. Production activity for textiles is also expected to be stronger in 1992. A parenthetical note of interest is that in the recent past, the textile industry has served as one of several leading indicators of national economic recovery.

Annex

STATISTICAL DATA ON SYNTHETIC FIBRE PLANTS

Table V.62. World synthetic-fibre-producing plants and plant capacities, 1978 and 1991

(Thousand tonnes)

Part I

Economic grouping, region, country and area	Cellulosic fibres												Non-cellulosic fibres											
	Acetate						Rayon						Acrylic						Nylon					
	1978			1991			1978			1991			1978			1991			1978			1991		
	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity
Western Europe																								
Austria	..	..	..	..	..	..	2	115.0	57.5	3	135.0	45.0	1	2.0	2.0	-	..	..	..	..	..	..	..	..
Belgium and Luxembourg	1	8	..	1	..	..	1	67.1	16.8	1	43.0	10.8	1	25.0	25.0	-	..	..	4	40.0	10.0	3	20.0	6.7
Denmark	..	..	..	..	..	..	-	-	-	..	-	-	..	..	..	..	..	..	1	1.0	1.0	-	-	..
Finland	..	..	..	..	..	..	1	46.3	46.3	1	70.0	70.0	..	..	..	1	1.0	1.0	-	-	..	..	..	..
France	..	-	..	..	..	..	6	100.0	16.7	1	2.0	2.0	2	80.0	40.0	-	..	..	10	90.0	9.0	8	64.0	8.0
Germany, Federal Republic of	1	..	..	1	..	..	4	124.0	24.8	4	139.0	27.8	3	170.0	56.7	3	200.0	66.7	11	270.0	24.5	11	240.0	21.8
Greece	..	..	..	..	..	..	1	8.0	8.0	1	8.0	8.0	1	15.0	15.0	-	..	..	2	10.0	5.0	2	10.0	5.0
Ireland	..	..	..	..	..	..	..	..	..	..	-	-	1	40.0	40.0	1	50.0	50.0	2	9.0	4.5	1	5.0	5.0
Italy	3	..	..	2	..	..	6	132.0	14.7	2	43.0	10.8	6	356.0	59.3	4	400.0	100.0	16	210.0	13.1	17	200.0	11.8
Netherlands	-	..	..	..	..	..	2	..	..	2	..	..	1	3.0	3.0	-	..	..	1	50.0	50.0	1	40.0	40.0
Norway	..	..	..	..	..	..	1	31.0	31.0	-	-	-	..	..	..	..	..	..	..	..	..	..	..	..
Portugal	..	..	..	..	..	..	2	9.4	4.7	1	1.0	1.0	1	3.0	3.0	1	3.0	3.0	1	4.0	4.0	1	4.0	4.0
Spain	1	..	..	..	..	..	4	68.0	13.6	2	42.0	21.0	2	150.0	75.0	2	160.0	80.0	6	115.0	19.2	7	120.0	17.1
Sweden	..	..	..	1	..	..	1	37.0	37.0	1	25.0	12.5	..	..	..	..	..	..	1	2.0	2.0	-	-	..
Switzerland	..	..	..	..	..	..	1	5.0	5.0	-	-	-	..	..	..	..	..	..	3	55.0	18.3	5	60.0	12.0
United Kingdom	5	..	..	3	..	..	4	220.0	24.4	1	75.0	18.8	4	215.0	53.8	2	238.0	119.0	11	200.0	18.2	7	100.0	14.3
Total	11	8	..	8	..	..	36	962.8	19.6	20	583.0	20.8	23	1 059.0	46.0	14	1 052.0	80.8	69	1 056.0	15.1	63	863.0	13.7
Eastern Europe and USSR																								
Albania	-	..	..	..	..	..	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulgaria	..	..	..	..	..	..	1	47.0	47.0	1	5.0	5.0	1	22.0	22.0	1	22.0	22.0	1	14.0	14.0	1	20.0	20.0
Czechoslovakia	..	..	..	..	..	..	5	81.7	16.3	5	64.5	12.9	-	-	-	-	-	-	3	57.0	19.0	3	100.0	33.3
German Democratic Republic	..	..	..	..	..	..	8	183.5	22.9	8	143.8	18.0	3	56.0	18.7	1	20.0	20.0	3	60.0	20.0	3	100.0	33.3
Hungary	..	..	..	..	..	..	1	10.0	10.0	2	16.0	8.0	1	14.0	14.0	1	14.0	14.0	1	13.4	13.4	1	30	30.0
Poland	..	..	..	..	..	..	6	102.5	17.1	4	68.0	17.0	2	61.0	30.5	1	31.0	31.0	1	82.0	82.0	1	100.0	100.0
Romania	..	..	..	..	..	..	3	10.0	3.3	2	131.0	65.5	1	35.0	35.0	1	35.0	35.0	1	32.0	32.0	1	32.0	32.0
USSR	5	60	..	4	..	..	15	600.0	30.0	15	689.0	36.3	1	107.0	107.0	3	286.0	95.3	12	192.0	16.0	12	433.0	36.1
Yugoslavia	..	..	..	..	..	..	2	16.0	8.0	2	77.0	38.5	1	22.0	22.0	1	22.0	22.0	2	25.0	12.5	2	40.0	20.0
Total	5	60	..	4	..	..	41	1 050.7	25.6	39	1 194.3	27.8	10	317.0	31.7	9	430.0	47.8	24	475.4	19.8	24	855.0	35.6

Table V.62 (continued)

Cellulosic fibres

Economic grouping, region, country and area	Acetate 1978 Number of plants	Acetate 1978 Total capacity	Acetate 1978 Average capacity	Acetate 1991 Number of plants	Acetate 1991 Total capacity	Acetate 1991 Average capacity	Rayon 1978 Number of plants	Rayon 1978 Total capacity	Rayon 1978 Average capacity	Rayon 1991 Number of plants	Rayon 1991 Total capacity	Rayon 1991 Average capacity
Americas												
Argentina	1	..	..	1	..	..	2	20.0	6.7	-	4.0	4.0
Brazil	1	..	..	1	..	..	4	54.9	11.0	2	58.7	19.6
Canada	3	..	..	1	..	..	1	46.1	11.5	1	62.5	31.3
Chile	..	..	..	..	..	..	2	7.4	3.7	1	6.9	6.9
Colombia	1	..	..	1	..	..	-	3.7	3.7	-	3.5	3.5
Costa Rica	..	..	..	..	..	..	-	-	-	-	-	-
Cuba	..	..	..	..	..	..	1	8.0	8.0	1	12.5	12.5
Ecuador	..	..	..	..	..	..	-	..	-	-	-	-
Guatemala	..	..	..	..	..	..	-	..	-	-	-	-
Mexico	1	..	..	1	..	..	2	33.5	11.2	1	21.1	10.6
Peru	1	..	..	1	1.7	1.7	1	2.7	1.4	-	-	1.7
United States	5	..	..	3	..	..	5	484.9	48.5	3	249.5	41.6
Uruguay	1	..	..	1	1.9	..	0	1.5	1.5	-	-	1.9
Venezuela	2	..	..	1	..	..	-	4.0	2.0	-	1.5	1.5
Total	16	..	..	11	..	..	18	666.7	19.6	9	420.2	21.0
Asia												
Bangladesh	..	..	..	..	..	..	1	2.4	2.4	2	11.5	5.8
China	..	..	..	..	..	..	2	177.5	88.8	10	235.0	23.5
India	1	..	..	1	..	..	12	162.0	12.5	11	247.7	20.6
Indonesia	..	..	..	..	..	..	1	3.0	3.0	3	125.0	41.7
Japan	3	..	..	4	..	..	16	513.0	27.0	11	332.3	22.2
Malaysia	..	..	..	..	..	..	..	-	-	5	..	-
Pakistan	1	..	..	1	3.0	..	..	3.3	3.3	-	-	3.0
Philippines	..	..	..	..	..	..	..	-	-	1	25.0	25.0
Republic of Korea	1	..	..	1	..	..	1	27.2	13.6	1	39.0	19.5
Sri Lanka	..	..	..	..	..	..	..	-	-	-	-	-
Taiwan Province	..	..	..	..	..	..	3	75.0	25.0	3	153.7	51.2
Thailand	..	..	..	..	..	..	1	12.8	12.8	1	55.0	55.0
Total	6	..	..	7	..	..	37	976.2	22.7	48	1 224.2	22.3
Africa, Oceania and Western Asia												
Algeria	..	..	..	..	..	..	..	-	-	-	-	-
Australia	..	..	..	..	..	..	1	2.4	2.4	-	-	-
Egypt	..	..	..	..	..	..	2	12.4	6.2	2	13.4	6.7

Non-cellulosic fibres

Economic grouping, region, country and area	Acrylic 1978 Number of plants	Acrylic 1978 Total capacity	Acrylic 1978 Average capacity	Acrylic 1991 Number of plants	Acrylic 1991 Total capacity	Acrylic 1991 Average capacity	Nylon 1978 Number of plants	Nylon 1978 Total capacity	Nylon 1978 Average capacity	Nylon 1991 Number of plants	Nylon 1991 Total capacity	Nylon 1991 Average capacity
Americas												
Argentina	1	16.0	16.0	1	16.0	16.0	10	34.0	3.4	6	20.0	3.3
Brazil	2	27.0	13.5	2	27.0	13.5	13	82.0	6.3	16	110.0	6.9
Canada	-	-	-	-	..	-	3	77.0	25.7	3	121.0	40.3
Chile	..	..	-	-	..	-	2	7.0	3.5	2	40.0	20.0
Colombia	..	..	-	-	..	-	3	19.0	6.3	3	22.0	7.3
Costa Rica	..	..	-	-	..	-	-	-	-	-	-	-
Cuba	..	..	-	-	..	-	-	-	-	-	-	-
Ecuador	..	..	-	-	..	-	-	-	-	-	-	-
Guatemala	..	..	-	-	..	-	1	2.0	2.0	1	2.0	2.0
Mexico	3	98.0	32.7	3	98.0	32.7	9	60.0	6.7	9	80.0	8.9
Peru	1	24.0	24.0	2	35.0	17.5	3	6.0	2.0	4	7.0	1.8
United States	6	350.0	58.3	4	216.0	54.0	38	1 275.0	33.6	37	1 421.0	38.4
Uruguay	..	..	..	-	..	-	2	0.6	0.3	2	0.6	0.3
Venezuela	..	..	..	-	..	-	5	4.0	0.8	2	1.5	0.8
Total	13	515.0	39.6	12	392.0	32.7	89	1 566.6	17.6	85	1 825.1	21.5
Asia												
Bangladesh	-	-	-	1	4.0	4.0	1	2.0	2.0	1	5.0	5.0
China	3	40.0	13.3	10	170.0	17.0	7	46.0	6.6	13	150.0	11.5
India	2	30.0	15.0	5	70.0	14.0	14	42.0	3.0	16	200.0	12.5
Indonesia	..	..	-	1	10.0	10.0	2	8.0	4.0	4	35.0	8.8
Japan	10	456.0	45.6	7	432.0	61.7	12	393.0	32.8	11	355.0	32.3
Malaysia	..	..	-	-	-	-	-	-	-	-	-	-
Pakistan	..	..	-	-	-	-	3	2.0	0.7	3	20.0	6.7
Philippines	..	..	-	-	-	-	2	13.0	6.5	2	25.0	12.5
Republic of Korea	2	30.0	15.0	2	15.0	7.5	6	80.0	13.3	5	200.0	40.0
Sri Lanka	..	..	-	-	-	-	-	-	-	1	7.0	-
Taiwan Province	..	..	-	2	20.0	10.0	11	128.0	11.6	9	200.0	22.2
Thailand	..	..	-	1	5.0	5.0	3	15.0	5.0	3	20.0	6.7
Total	17	556.0	32.7	29	726.0	25.0	61	729.0	12.0	68	1 217.0	17.9
Africa, Oceania and Western Asia												
Algeria	-	..	-	-	-	-	-	-	-	-	-	-
Australia	-	..	-	-	-	-	2	20.5	10.3	2	24.0	12.0
Egypt	-	..	-	-	-	-	1	5.6	5.6	1	7.0	7.0

Iran (Islamic Republic of)	..	..	..	..	..	..	..	-	-	-	-	-	1	20.0	20.0	1	20.0	20.0	2	11.7	5.9	2	14.0	7.0
Iraq	..	..	..	..	..	..	1	10.0	10.0	1	10.0	10.0	-	..	-	-	-	-	-	-	-	-	-	-
Israel	..	..	..	..	..	..	..	-	-	-	-	-	1	10.0	10.0	-	-	-	1	8.4	8.4	1	10.0	10.0
Kenya	..	..	..	..	..	..	..	-	-	-	-	-	-	..	-	-	-	-	1	8.0	8.0	2	15.0	7.5
Nigeria	..	..	..	..	..	..	..	-	-	-	-	-	-	..	-	-	-	-	-	-	-	-	-	-
South Africa	..	..	..	..	..	..	..	-	-	-	-	-	-	..	-	-	-	-	1	22.0	22.0	3	45.0	15.0
United Republic of Tanzania	..	..	..	..	..	..	..	-	-	-	-	-	-	..	-	-	-	-	-	-	-	-	-	-
Turkey	..	..	..	..	..	..	1	8.7	8.7	1	11.2	11.2	3	47.0	15.7	3	47.0	15.7	6	29.6	4.9	5	50.0	10.0
Total	..	..	..	..	..	..	5	33.5	6.7	4	34.6	8.7	5	77.0	15.4	4	67.0	16.8	14	105.8	7.6	16	165.0	10.3
Total, Part I	38	68	..	30	..	..	139	3 689.9	21.5	120	3 456.3	23.0	68	2 524.0	37.1	68	2 667.0	39.8	257	3 932.8	15.2	256	4 925.1	19.2

Part II

Economic grouping, region, country and area	Non-cellulosic fibres																		Textile glass					
	Polyester						Other						Total non-cellulosic fibres											
	1978			1991			1978			1991			1978			1991			1978			1991		
	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity	Number of plants	Total capacity	Average capacity
Western Europe																								
Austria	1	61.0	61.0	1	70.0	70.0	-	..	..	1	..	..	2	63.0	31.5	2	70.0	35.0	-	..	..	-	..	..
Belgium and Luxembourg	1	4.0	4.0	1	4.0	4.0	-	..	..	..	..	..	6	69.0	5.8	4	24.0	3.0	2	..	..	2	..	..
Denmark	..	..	..	..	..	..	-	..	..	..	..	..	1	1.0	1.0	-	-	-	-	..	..	-	..	..
Finland	..	..	..	..	..	..	-	..	..	..	..	..	1	1.0	1.0	-	-	-	1	..	..	1	..	..
France	6	170.0	28.3	3	150.0	50.0	2	..	..	1	..	..	20	340.0	17.0	12	214.0	17.8	2	..	..	2	..	..
Germany, Federal Republic of	12	326.0	27.2	11	300.0	27.3	4	..	..	4	..	..	30	766.0	25.5	29	740.0	25.5	3	..	..	3	..	..
Greece	2	11.0	5.5	3	25.0	8.3	-	..	..	..	..	..	5	36.0	7.2	5	35.0	7.0	-	..	..	-	..	..
Ireland	1	34.0	34.0	2	45.0	22.5	-	..	..	..	..	..	4	83.0	20.8	4	100.0	25.0	-	..	..	-	..	..
Italy	10	200.0	20.0	11	240.0	21.8	2	..	..	2	..	..	34	766.0	22.5	34	840.0	24.7	4	..	..	2	..	..
Netherlands	2	37.0	18.5	1	20.0	20.0	2	..	..	2	..	..	6	90.0	15.0	4	60.0	15.0	1	..	..	1	..	..
Norway	..	..	..	..	..	..	-	..	..	..	..	..	-	-	-	-	-	-	1	..	..	1	..	..
Portugal	1	18.0	18.0	1	25.0	25.0	-	..	..	..	..	..	3	25.0	8.3	3	32.0	10.7	-	..	..	1	..	..
Spain	4	135.0	33.8	5	150.0	30.0	1	..	..	..	..	..	13	400.0	30.8	14	430.0	30.7	1	..	..	1	..	..
Sweden	-	-	..	..	-	..	-	..	..	..	..	..	1	2.0	2.0	-	-	-	1	..	..	-	..	..
Switzerland	2	74.0	37.0	3	90.0	30.0	-	..	..	..	..	..	5	129.0	25.8	8	150.0	18.8	-	..	..	1	..	..
United Kingdom	8	155.0	19.4	5	140.0	28.0	5	..	..	4	..	..	28	570.0	20.4	18	478.0	26.6	6	..	..	6	..	..
Total	50	1 225.0	24.5	47	1 259.0	26.8	16	24.0	1.5	14	30	..	159	3 341.0	21.0	137	3 203.0	23.4	22	285.0	13.0	21	500.0	0.4

Table V.62 (continued)

Economic grouping, region, country and area	Non-cellulosic fibres: Polyester 1978 Number of plants	Polyester 1978 Total capacity	Polyester 1978 Average capacity	Polyester 1991 Number of plants	Polyester 1991 Total capacity	Polyester 1991 Average capacity	Other 1978 Number of plants	Other 1978 Total capacity	Other 1978 Average capacity	Other 1991 Number of plants	Other 1991 Total capacity	Other 1991 Average capacity	Total non-cellulosic fibres 1978 Number of plants	Total non-cellulosic fibres 1978 Total capacity	Total non-cellulosic fibres 1978 Average capacity	Total non-cellulosic fibres 1991 Number of plants	Total non-cellulosic fibres 1991 Total capacity	Total non-cellulosic fibres 1991 Average capacity	Textile glass 1978 Number of plants	Textile glass 1978 Total capacity	Textile glass 1978 Average capacity	Textile glass 1991 Number of plants	Textile glass 1991 Total capacity	Textile glass 1991 Average capacity
Eastern Europe and USSR																								
Albania	-	-	-	1	5.0	5.0	-	..	..	..	..	..	-	-	-	1	5.0	5.0	-	..	..	-	..	..
Bulgaria	1	31.0	31.0	1	40.0	40.0	-	..	..	..	..	..	3	67.0	22.3	3	82.0	27.3	-	..	..	-	..	..
Czechoslovakia	2	67.0	33.5	2	70.0	35.0	-	..	..	..	..	..	5	124.0	24.8	5	170.0	34.0	2	..	..	2	..	..
German Democratic Republic	3	81.0	27.0	3	90.0	-	1	..	..	..	..	..	10	197.0	19.7	7	210.0	30.0	1	..	..	1	..	..
Hungary	-	-	-	-	-	-	-	..	..	..	..	..	2	27.4	13.7	2	44.0	22.0	-	..	..	-	..	..
Poland	3	100.0	33.3	3	150.0	50.0	2	..	..	..	..	..	8	243.0	30.4	5	281.0	56.2	2	..	..	2	..	..
Romania	4	152.0	38.0	4	180.0	45.0	-	..	..	..	..	..	6	219.0	36.5	6	247.0	41.2	-	..	..	-	..	..
USSR	5	265.0	53.0	5	504.0	100.8	-	..	..	..	..	..	18	564.0	31.3	20	1 223.0	61.2	..	95.0	..	11	200.0	..
Yugoslavia	5	49.0	9.8	5	60.0	12.0	-	..	..	..	..	..	8	96.0	12.0	8	122.0	15.3	1	..	..	1	..	..
Total	23	745.0	32.4	24	1 099.0	45.8	3	17.0	5.7	..	..	..	60	1 554.4	25.9	57	2 384.0	41.8	6	136.0	22.7	17	..	..
Americas																								
Argentina	4	11.0	2.8	3	80.0	26.7	1	..	..	..	..	..	16	61.0	3.8	10	116.0	11.6	1	..	..	1	..	..
Brazil	11	100.0	9.1	10	200.0	20.0	1	..	..	..	..	..	27	209.0	7.7	28	337.0	12.0	1	..	..	1	..	..
Canada	3	90.0	30.0	1	60.0	60.0	1	..	..	..	..	..	7	167.0	23.9	4	181.0	45.3	1	..	..	1	..	..
Chile	4	8.0	2.0	3	20.0	6.7	-	..	..	..	..	..	6	15.0	2.5	5	60.0	12.0	-	..	..	-	..	..
Colombia	5	35.0	7.0	4	50.0	12.5	-	..	..	..	..	..	8	54.0	6.8	7	72.0	10.3	1	..	..	-	..	..
Costa Rica	1	6.0	6.0	1	10.0	10.0	-	..	..	..	..	..	1	6.0	6.0	1	10.0	10.0	-	..	..	-	..	..
Cuba	-	-	-	-	-	-	-	..	..	..	..	..	-	-	-	-	-	-	-	..	..	-	..	..
Ecuador	3	7.0	2.3	3	19.0	6.3	-	..	..	..	..	..	3	7.0	2.3	3	19.0	6.3	-	..	..	-	..	..
Guatemala	-	-	-	-	-	-	-	..	..	..	..	..	1	2.0	2.0	1	2.0	2.0	-	..	..	-	..	..
Mexico	9	160.0	17.8	8	200.0	25.0	2	..	..	..	..	..	23	318.0	13.8	20	378.0	18.9	1	..	..	1	..	..
Peru	6	11.0	1.8	4	25.0	6.3	-	..	..	..	..	..	10	41.0	4.1	10	67.0	6.7	-	..	..	-	..	..
United States	41	2 093.0	51.0	37	1 799.0	48.6	15	10.0	0.7	..	..	..	100	3 728.0	37.3	78	3 436.0	44.1	14	..	..	16	823.0	..
Uruguay	2	4.0	2.0	2	20.0	10.0	-	..	..	..	..	..	4	4.6	1.2	4	20.6	5.2	-	..	..	-	..	..
Venezuela	3	12.0	4.0	3	30.0	10.0	-	..	..	..	..	..	8	16.0	2.0	5	31.5	6.3	-	..	..	-	..	..
Total	92	2 537.0	27.6	79	2 513.0	31.8	20	11.0	0.7	..	..	..	214	4 629.6	21.6	176	4 730.1	26.9	19	439.0	23.1	20	908.0	..
Asia																								
Bangladesh	-	-	-	-	-	-	-	..	..	..	..	..	1	2.0	2.0	2	9.0	4.5	-	..	..	-	..	..
China	10	220.0	22.0	24	1 309.0	54.5	-	..	..	..	..	..	20	306.0	15.3	47	1 629.0	34.7	..	35.0	..	3	110.0	..
India	10	60.0	6.0	26	900.0	34.6	-	..	..	..	..	..	26	132.0	5.1	47	1 170.0	24.9	1	..	..	-	..	..

Indonesia	3	53.0	17.7	11	700.0	63.6	-	..	..	..	..	..	5	61.0	12.2	16	745.0	46.6	-	..	..	-	..	..
Japan	21	745.0	35.5	19	876.0	46.1	21	64.0	3.0	..	..	..	64	1 658.0	25.9	37	1 663.0	44.9	15	146.0	9.7	12	380.0	..
Thailand	1	35.0	35.0	11	250.0	22.7	-	..	..	..	..	..	1	35.0	35.0	11	250.0	22.7	-	..	..	-	..	..
Malaysia	3	27.0	9.0	11	600.0	54.5	-	..	..	..	..	..	6	29.0	4.8	14	620.0	44.3	-	..	..	-	..	..
Pakistan	2	34.0	17.0	2	85.0	42.5	-	..	..	..	..	..	4	47.0	11.8	4	110.0	27.5	-	..	..	-	..	..
Philippines	-	-	-	-	-	-	-	..	..	..	..	..	-	-	-	1	7.0	7.0	-	..	..	-	..	..
Republic of Korea	10	130.0	13.0	12	750.0	62.5	-	..	..	..	..	..	18	240.0	13.3	19	965.0	50.8	-	..	..	-	..	..
Sri Lanka	20	140.0	7.0	18	500.0	27.8	-	..	..	..	..	..	31	268.0	8.6	29	720.0	24.8	-	..	..	-	..	..
Taiwan Province	4	60.0	15.0	6	200.0	33.3	-	..	..	..	..	..	7	75.0	10.7	10	225.0	22.5	-	..	..	-	..	..
Total	84	1 504.0	17.9	140	6 170.0	44.1	21	64.0	3.0	..	..	..	183	2 853.0	15.6	237	8 113.0	34.2	16	..	..	15	..	..
Africa, Oceania and Western Asia																								
Algeria	-	-	-	1	4.0	4.0	-	..	..	..	..	..	..	..	..	..	..	..	-	..	..	-	..	..
Australia	4	6.0	1.5	2	10.0	5.0	-	..	..	..	..	..	6	26.5	4.4	4	34.0	8.5	1	..	..	1	..	..
Egypt	3	26.0	8.7	2	40.0	20.0	-	..	..	..	..	..	4	31.6	7.9	3	47.0	15.7	-	..	..	-	..	..
Iran (Islamic Republic of)	-	-	-	1	15.0	15.0	-	..	..	..	..	..	3	31.7	10.6	4	49.0	12.3	-	..	..	-	..	..
Iraq	-	-	-	-	-	-	-	..	..	..	..	..	-	-	-	-	-	-	-	..	..	-	..	..
Israel	-	-	-	-	-	-	-	..	..	..	..	..	2	18.4	9.2	1	10.0	10.0	-	..	..	-	..	..
Kenya	-	-	-	5	25.0	5.0	-	..	..	..	..	..	1	8.0	8.0	7	40.0	5.7	-	..	..	-	..	..
Nigeria	1	10.0	10.0	5	50.0	10.0	-	..	..	..	..	..	1	10.0	10.0	5	50.0	10.0	-	..	..	-	..	..
South Africa	4	43.0	10.8	4	25.0	6.3	-	..	..	..	..	..	5	65.0	13.0	7	70.0	10.0	1	..	..	-	..	..
United Republic of Tanzania	-	-	-	1	5.0	5.0	-	..	..	..	..	..	-	-	-	1	5.0	5.0	-	..	..	-	..	..
Turkey	6	76.0	12.7	8	135.0	16.9	-	..	..	..	..	..	15	152.6	10.2	16	232.0	14.5	-	..	..	1	..	..
Total	18	161.0	8.9	29	309.0	10.7	-	-	-	..	..	..	37	343.8	9.3	48	547.0	11.0	2	..	..	2	100.0	..
Total, Part II	267	6 172.0	23.1	319	11 350.0	35.6	60	116.0	1.9	14	..	..	653	12 745.8	19.5	642	18 941.1	29.5	65	1 153.0	17.7	75	2 298.0	30.6

Sources: *Textile Organon*, June 1978 issue; *Fiber Organon*, vol. 62, No. 6 (June 1991); and Man-made Fibres of Japan 1983-1984 (Tokyo, Chemical Fibres Association, 1984).
Note: Estimates, calculations and tabulations by Statistikon Corporation.

H. Iron and steel (ISIC 371)*

1. *Current situation*

(a) *Production and consumption*

The steel-producing countries can be roughly divided into the following three main groups: developed market economies, which have experienced a year of severely depressed prices and significant reductions in tonnages of the order of 0.7 per cent overall; developing countries, which have new steel industries, lower costs and growing economies, and which in 1991 enjoyed growth of 6.8 per cent over the level of 1990; and the countries of Eastern Europe and the former USSR, which in 1991 suffered a very substantial production decline of 18 per cent from the level of 1990. These circumstances have had a profound negative effect on global output figures. According to the International Iron and Steel Institute, as reflected in table V.63, world crude steel production in 1991 amounted to 980.9 million tonnes, a 2.8 per cent drop from the 1990 level of 1,009.1 million tonnes [54]. Production in developed market economies fell by less than 1 per cent to 489.4 million tonnes, although the largest of those economies, the United States, experienced a 10.7 per cent drop to 79.4 million tonnes. Output in the EEC and Japan was virtually static, although examination of the monthly figures for Japan indicate a slow-down in the second and third quarters. Within the EEC, output showed large discrepancies; the United Kingdom experienced a 7.4 per cent drop, while Germany posted a 9.8 per cent rise (although this figure is distorted by the inclusion of the former German Democratic Republic). By contrast the total production of Asian countries rose to 60.6 million tonnes, an increase of about 9 per cent. And in Latin America, a 10 per cent rise in Brazilian output pulled the region's crude steel figures up by 3 per cent overall to 39.3 million tonnes.

The growth in consumption measured in terms of crude steel in table V.64 is shown also to have declined worldwide, by −5.2 per cent between 1990

*UNIDO acknowledges the contribution of Brian Cooper, *Steel Times International*

Table V.63. World production of crude steel, 1986-1991

Rank in 1991		Economic grouping, region, country and area	Production (million tonnes) 1986	1990	1991	Percentage change 1986-1991	1990-1991	Percentage share 1986	1991
1		USSR	160.5	154.4	133.6	-16.8	-13.5	17.4	13.6
2		Japan	98.3	110.3	109.6	11.5	-0.6	10.7	11.2
3		United States	74.0	88.9	79.4	7.3	-10.7	8.1	8.1
4		China	52.2	66.3	70.7	53.2	6.6	5.7	7.2
5		Germany, Federal Republic of[a/]	37.1	38.4	42.2	13.7	9.8	4.0	4.3
6		Republic of Korea	14.6	23.1	26.0	78.1	12.4	1.6	2.7
7		Italy	22.9	25.5	25.0	9.2	-2.0	2.5	2.5
8		Brazil	21.2	20.6	22.6	6.6	9.9	2.3	2.3
9		France	17.9	19.0	18.4	2.8	-3.1	1.9	1.9
10		United Kingdom	14.7	17.8	16.5	12.2	-7.4	1.6	1.7
11		India	12.2	15.0	16.4	34.4	9.6	1.3	1.7
12		Canada	14.1	12.3	13.0	-7.8	5.8	1.5	1.3
13		Spain	11.9	12.9	12.9	8.4	-0.5	1.3	1.3
14		Czechoslovakia	15.1	14.9	12.3	-18.5	-17.5	1.6	1.2
15		Belgium	9.7	11.4	11.3	16.5	-0.7	1.0	1.2
16		Taiwan Province	5.5	9.7	11.0	100.0	12.4	0.6	1.1
17		Poland	17.1	13.6	10.3	-39.8	-24.2	1.9	1.0
18		South Africa	8.9	8.6	9.5	6.7	10.3	1.0	1.0
19		Turkey	5.9	9.3	9.3	57.6	0.3	0.6	0.9
20		Mexico	7.2	8.7	8.0	11.1	-8.0	0.9	0.8
	A.	Developed market economies	432.5	492.7	489.4	13.2	-0.7	47.0	49.9
		Eastern Europe and USSR	221.8	203.6	167.0	-24.7	-18.0	24.1	17.0
		EEC (12)	125.7	136.9	137.4	9.3	0.4	13.7	14.0
		Total, A	780.0	833.2	793.8	1.8	-4.7	[illegible]	80.9
	B.	Developing countries	80.6	102.3	109.2	35.5	6.[illegible]	[illegible]	11.1
		China and other Asian centrally planned economies	59.2	73.6	77.9	31.6	5.8	6.4	7.9
		Total, B	139.8	175.9	187.1	33.8	6.4	15.2	19.1
		Total, A and B	919.8	1 009.1	980.9	6.6	-2.8	100.0	100.0

Source: International Iron and Steel Institute press release, 21 January 1992.

a/ Including the former German Democratic Republic in 1991 only.

and 1991. However, as shown above, regional differences do exist. While the United States and the EEC reported declines of −10.0 and −4.1 per cent, respectively, Japan posted a gain of 2 per cent, and all of Latin America, 11.1 per cent.

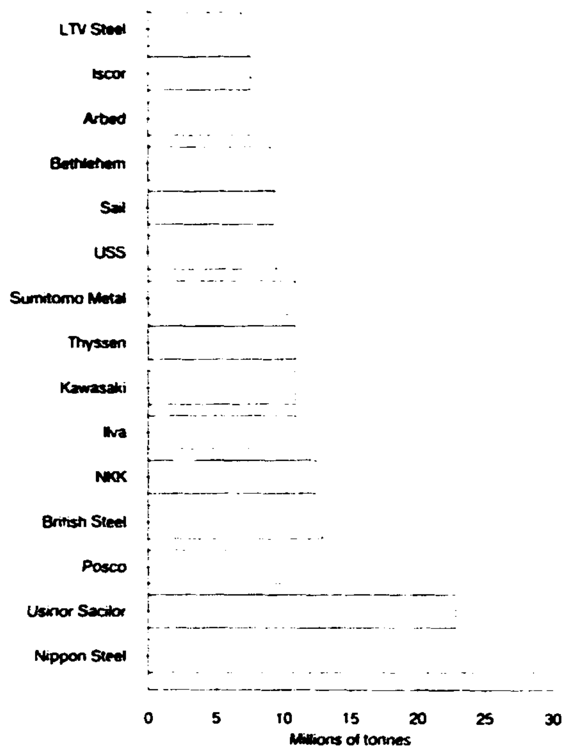
(b) *Major companies in the global industry*

Among the major companies in the global industry, table V.65 presents a list of the 40 top steel-producing companies in the world. Figure V.24 ranks the top 15 according to output. The five largest of these are spread among the major industrialized countries. In 1990, these included France, Japan, Republic of Korea, United Kingdom and United States. However, by 1991 United States Steel had dropped from fifth to tenth place. There is some question as to whether high-cost and highly subsidized firms such as Usinor Sacilor of France should appear among the top companies. Such subsidized companies are currently under scrutiny by the EEC. Among the top 10 companies in 1991, four were Japanese companies. As in the case of the French companies, the placing of these Japanese companies in the top 10 is dubious, because of the high tariff protection they are afforded in Japan. In other words, they only have become big-league players by violating the free trade rules of market competition.

2. *Iron ore inputs*

Iron ore, coking coal and scrap steel constitute the main raw-materials requirement for steelmaking. Their respective application and utilization to produce steel involve delicate economic and geographic considerations. Generally speaking, the iron ore industry is in overcapacity, coking coal is approaching undercapacity, and the use of scrap is entirely supply- and demand-controlled. However, many complicating factors make it difficult to interpret equilibrium in these markets.

Figure V.24. World's 15 leading steel-producing companies, 1991



Source: *Metal Bulletin*, No. 7657 (17 February 1992), p. 17

(a) *Production*

Ore is, in one form or another, the largest-tonnage raw material for steelmaking, and forms a significant part of world shipping trade. The reasons are simple. High-quality iron ore is not readily available at major production centres. It was not always so. In the early days of modern steelmaking around a century ago,

Table V.64. Apparent world steel consumption, 1986-1991, with forecasts to 1995

Economic grouping, region and country	Consumption 1986	1990	1991	1992	1995	Percentage change 1986-1991	1990-1991	Percentage share 1986	1991
	(Million tonnes)								
A. Eastern Europe and USSR	217	192	160	160	155	-26.3	-16.7	30.4	21.8
EEC	104	123	118	119	130	13.5	-4.1	14.6	16.1
United States	99	100	90	94	100	-9.1	-10.0	13.9	12.2
Japan	71	99	101	95	93	42.2	2.0	9.9	13.7
Other	..	47	42	44	50	-	-10.6	-	5.7
B. Asia (excluding China)	..	84	88	91	98	-	4.8	-	12.0
Latin America	30	27	30	33	37	-	11.1	4.2	4.1
China and other centrally planned economies	80	80	81	82	89	1.2	1.2	11.2	11.1
Western Asia	10	12	13	14	15	30.0	8.3	1.4	1.8
Africa (excluding South Africa)	10	11	11	11	11	10.0	-	1.4	1.5
TOTAL	713	775	734	743	778	3.1	-5.2	100.0	100.0

Source: International Iron and Steel Institute (IISI), *"Report of the Secretary General"*, presented at the IISI Annual Conference, held at Montreal in October 1991.

Table V.65. Output of major steel-producing companies, 1990 and 1991
(Millions of tonnes)

Rank in 1991	Company and country or area	Output in 1990	Output in 1991	Percentage change 1990-1991
1	Nippon Steel (Japan)	28.76	28.63	-0.5
2	Usinor Sacilor (France)	23.30	22.80	-2.1
3	Posco (Republic of Korea)	16.22	19.09	17.7
4	British Steel (United Kingdom)	13.75	12.94	-5.9
5	NKK (Japan)	12.11	12.45	2.8
6	Ilva (Italy)	11.51	11.00	-4.4
7	Kawasaki (Japan)	11.12	10.91	-1.9
8	Thyssen (Germany)	11.14	10.90	-2.2
9	Sumitomo Metal (Japan)	11.14	10.90	-2.2
10	USS (United States)	12.35	9.55	-22.7
11	Sail (India)	8.63	9.38	8.7
12	Bethlehem (United States)	9.91	9.09	-8.3
13	Arbed (Luxembourg)	7.67	7.63	-0.5
14	Iscor (South Africa)	6.34	7.59	19.7
15	LTV Steel (United States)	7.44	6.94	-6.7
16	Kobe Steel (Japan)	6.56	6.50	-0.9
17	China Steel (Taiwan Province)	5.89	5.86[a]	-0.5
18	BHP (Australia)	6.15	5.72	-7.0
19	Hoogovens (Netherlands)	5.18	4.94	-4.6
20	National Steel (United States)	5.20	4.76	-8.5
21	Cockerill Samber (Belgium)	4.37	4.40	0.7
22	Inland (United States)	4.84	4.24	-12.4
23	Usiminas (Brazil)	3.54	4.23	19.5
24	Hoechst (Germany)	4.10	4.20	2.4
25	Peine-Salzgitter (Germany)	4.23	4.14	-2.1
26	Voest Alpine (Austria)	4.13	4.10	-0.7
27	Sidex SA (Romania)	5.40	4.00	-25.9
28	HKM (Germany)	3.58	3.93	9.8
29	Ensidesa (Spain)	4.10	3.92	-4.4
30	VSZ Kosice (Czechoslovakia)	4.40	3.90	-11.4
31	Nucor (United States)	3.14	3.82	21.7
32	Huta Katowice (Poland)	4.63	3.69	-20.3
33	Tokyo Steel (Japan)	3.48	3.66	5.2
34	CSN (Brazil)	2.90	3.60	24.1
35	Dofasco (Canada)	3.79	3.52	-7.1
36	Riva (Italy)	..	3.50[b]	..
37	Nisshin Steel (Japan)	3.60	3.47	-3.6
38	Stelco (Canada)	2.53	3.36	32.8
39	Klöckner (Germany)	3.36	3.35	-0.3
40	Sidor (Venezuela)	2.67	3.30[b]	23.6

Source: *Metal Bulletin, No. 7657* (17 February 1992), p. 17.
[a] Year ends 30 June 1991.
[b] Estimate.

ironworks and steelworks were established in those locations where raw materials were readily available, creating centres of industrial development. This occurred in many countries of the world, and reflected geological conditions. In some favourable locations, iron ore and coking coal supplies could be found in proximity with each other, yielding the economic advantages of reduced transport costs. However, as local supplies diminished, the steelmaking sites rapidly lost their favoured status; coastal sites were preferred, since they could accept large bulk carriers at deep water ports. This same pattern exists today, and to build a non-coastal integrated steelworks would now be considered inconceivable.

Iron ore is a naturally occurring material which unfortunately tends not to present itself in the form that is most convenient for use. The modern blast-furnace requires very particular raw material control to maximize its productivity. It can use ore in lump form, provided there is adequate consistency in its chemical analysis and physical size, but ore mined directly from the ground in this state tends to be expensive, and is becoming less readily available. Mineral-processing techniques tend to break ore down into smaller pieces, and considerable tonnages of fines are generated. Fines can only be used if they are treated in a sinter plant where the material is agglomerated into sinter, or if it is pelletized. Both these processes produce ore in a consistent form which provides adequate permeability in the blast-furnace stack. Table V.66 summarizes world iron ore production by country and region over the period 1981-1990; equivalent data on sinter and pellet production are available from the UNIDO secretariat.

The main iron ore producers in the world, as depicted in figure V.25, are Australia, Brazil, China,

Table V.66. World production of iron ore, 1981-1990
(Thousands of tonnes)

Economic grouping, region and country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
A. Developed market economies										
EEC of which:	34 207	30 307	26 859	25 837	24 036	21 170	18 098	15 953	15 583	13 407
France	21 489	19 670	16 180	15 030	14 480	12 560	11 566	9 872	9 319	8 720
Greece [a]	1 280	515	1 300	1 452	1 712	1 500	1 500	1 500	1 500	1 500
Other	11 438	10 122	9 379	9 355	7 844	7 111	5 032	4 581	4 764	3 187
Western Europe, non-EEC	39 329	32 012	30 179	35 875	38 000	39 219	37 741	36 934	35 060	34 545
All Western Europe	73 536	62 319	57 038	61 712	62 036	60 389	55 887	52 887	50 643	47 952
Australia [b]	84 661	87 694	71 485	89 046	97 447	94 015	101 748	96 084	105 810	112 000
Canada	51 985	35 592	33 326	39 930	39 798	36 679	36 520	40 409	41 142	35 775
South Africa	25 300	24 600	16 605	24 647	24 414	24 483	22 008	25 248	29 958	30 291
United States	75 188	36 000	38 574	52 097	49 277	39 613	46 992	56 444	57 872	55 468
Other (including Western Europe)	77 457	65 661	59 536	64 333	64 916	64 042	58 834	45 416	53 294	49 458
Total, A	314 591	249 547	219 526	270 053	275 852	258 382	266 102	273 701	288 076	282 992
B. Developing market economies										
Africa										
Algeria	3 481	3 892	3 684	3 664	3 376	3 359	3 382	3 118	2 748	2 930
Egypt	2 015	2 155	2 007	1 955	2 066	2 013	1 112	2 274	2 493	2 420
Liberia	19 540	18 000	15 410	16 100	16 120	15 600	13 806	12 808	12 300	3 981
Mauritania	8 473	8 210	6 600	9 000	9 203	9 262	9 120	9 782	12 114	11 416
Other	1 859	1 587	2 093	2 225	1 936	2 012	2 214	1 592	1 787	1 821
Total	35 368	33 844	29 794	32 924	32 701	32 246	29 634	29 574	31 442	22 568
Asia										
India	41 618	42 752	38 089	42 310	44 090	51 169	51 335	49 961	51 434	50 000 [c]
Other	1 114	1 111	843	832	1 967	2 840	3 948	5 243	6 405	6 295
Total	42 732	43 863	38 932	43 142	46 057	54 099	55 283	55 204	57 839	56 295
Latin America										
Brazil	97 850	93 147	88 695	111 311	128 200	129 500	134 700	145 040	153 740	154 370
Chile	7 650	5 760	5 170	5 590	5 840	6 326	6 131	7 295	8 112	7 811
Mexico	8 736	8 795	7 888	10 544	8 103	7 581	7 374	7 987	7 538	8 114
Peru [b]	6 069	5 931	4 225	4 031	4 992	5 195	5 567	4 158	3 935	3 307
Venezuela	15 531	11 701	9 449	13 055	14 764	16 207	17 196	18 473	18052	20 199
Other	815	1 053	1 046	1 013	1 033	1 311	1 459	1 792	1 880	1 939
Total	136 651	126 387	116 473	145 544	162 932	166 120	172 427	184 745	193 257	195 740
Total, B	214 751	204 094	185 199	221 610	241 690	252 465	257 344	269 523	282 538	274 603
C. Centrally planned economies										
Eastern Europe and USSR, of which:	248 751	250 273	251 147	253 192	253 992	256 379	256 842	253 605	246 748	239 572
USSR	242 416	244 410	245 189	247 104	247 700	249 976	250 900	248 000	241 348	236 200
China	104 590	107 320	113 660	126 710	137 835	149 450	161 430	167 700	171 854	179 344
Democratic People's Republic of Korea	8 000	8 000	8 000	8 000	8 000	8 000	8 000	9 500	9 500	9 500 [c]
Total, C	361 341	365 593	372 807	387 902	399 827	413 829	426 272	430 805	428 102	428 416
World, A, B and C	890 683	819 234	777 532	879 565	917 369	924 676	949 718	974 029	998 716	986 011

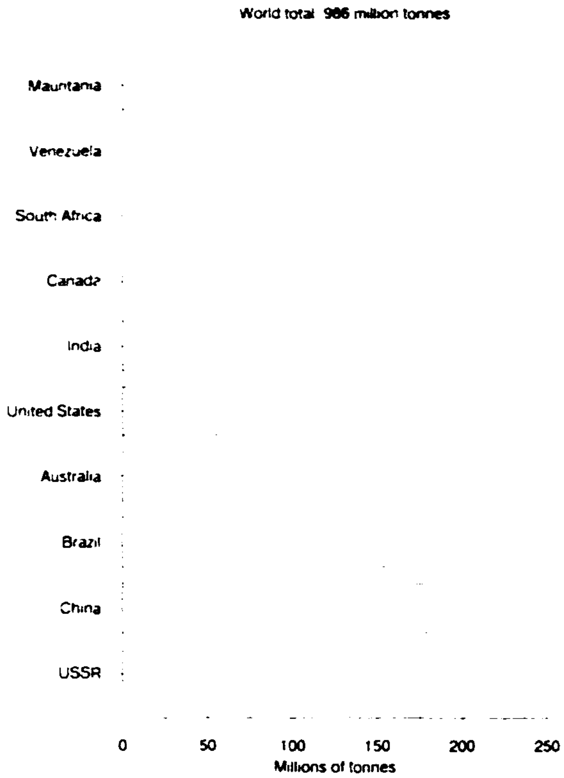
Source: International Iron and Steel Institute, *Steel Statistical Yearbook 1991*, vol. 4 (Brussels, 1991).

a/ Estimates, 1986-1990.

b/ Dry weight.

c/ Estimate.

Figure V.25. Major iron-ore-producing countries, 1990



Source: International Iron and Steel Institute, *Steel Statistical Yearbook 1991*, vol. 4 (Brussels, 1991).

and the former USSR (in particular the Russian Federation and Ukraine), all with over 100 million tonnes of production. Countries in the range of 50 million to 100 million tonnes comprise India and the United States. A third but still important group comprising Canada, South Africa, Sweden, Mauritania and Venezuela all produce between 10 million and 50 million tonnes and play a minor role in world trade. Until 1989 Liberia would have been included in this group, but political problems in that country have reduced iron ore production to a trickle, and it is quite likely that Liberia will never recover this once profitable international trade. The cost of restoring the mining equipment and the transport infrastructure is unlikely to be met by profit on ore in the present market climate, which is destined to last for the medium term at least.

(b) *Price*

The price of ore is determined at the world level by the Australian and Brazilian producers in negotiations with the Japanese and European consumers, limiting the role of developing countries despite their quite significant tonnages. China and the countries of the former USSR are not involved in world iron ore trading, while the United States primarily supplies its own domestic requirements. Sweden has been closing capacity and promoting pellet production at the mine sites in order to add value to their ores, with some degree of success, while Venezuela has carved out a position as the world's most effective producer of direct-reduced iron pellets, another specialized market (see discussion of direct reduced iron in section 5 below). Canada has had the advantage of geographic proximity to the United States market, while for South Africa iron ore remains a relatively low-cost, low-priced natural resource. In a period when steel production worldwide is growing in single-figure percentage terms, and iron-ore-buying centres of Europe and Japan are stagnant, negotiations over world iron ore prices have been understandably difficult. By mid-1992 prices had already dropped by nearly 5 per cent from the 1991 level, as the supply and demand balance tipped in favour of the steelmakers. It is a very necessary part of the steelmakers' cost-cutting exercises to maintain market shares against other materials such as aluminium and plastics. Raw materials costs are 50-60 per cent of cost per tonne of steel shipped, and material cost advantages are marginal, with only 15 per cent separating the most efficient from the least.

But how does this price reduction affect the suppliers? The answer is, not quite as dramatically as might be expected, but only because of the local performance of the economies of Australia and Brazil. Iron ore is traded in United States dollars, and for many years the Australian dollar and Brazilian cruzado have been falling against the United States dollar. The real price of iron ore has thus fallen systematically over time in real terms by about 4 per cent per year, after allowing for the impact of world steel output changes. Meanwhile, the supplying company shareholders have been able to enjoy ever-increasing profits in local currency, as that depreciates against the dollar. Profit conditions for the steelmaker and iron-ore mining companies have been favourable, but for those supplying countries they have been a disaster as the cost of imported goods rises rapidly. This can be seen in the current high interest rates, high unemployment, and high inflationary conditions now existing in both Australia and Brazil.

(c) *Trade*

Tables V.67 and V.68 report world iron ore exports and imports by countries and regions for the period 1981-1990. Because of increasingly higher transport costs, those countries whose export and import centres are nearest to coastal ports have the main trade advantages. For example, Australian ore mines are favourably sited in the north of the country near to dedicated deep-water ports, and are attractive for Japanese and other East Asian consumers. The Brazilian mines all have good port access, and the major ore sources near Carajas have the benefit of an 800-kilometre rail link to the coast. Ore can be loaded directly into very large bulk carrier vessels for transport to the main ports of Japan and Europe. Because of increasing shipment costs, there is little danger of the massive resources of iron ore in the Russian Federation and Ukraine being made available to the developed market economies, simply because of the logistics of transport. Venezuela cannot move very large carriers up the Orinoco river to the railheads, and has either to use smaller vessels or transship in the estuary. Nor are the Indian mines conveniently placed to take advantage of massive world trade opportunities.

Table V.67. Iron ore exports, 1981 to 1990
(Thousands of tonnes)

Economic grouping, region and country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
					A. Developed market economies					
EEC, of which:	7 819	7 878	6 647	6 759	6 843	6 021	5 851	6 263	5 244	5 022
Spain	1 147	1 869	1 579	1 973	2 128	1 791	1 991	2 282	1 632	1 633
Other	6 672	6 009	5 068	4 786	4 715	4 230	3 860	3 981	3 612	3 389
Western Europe, non-EEC, of which:	21 421	14 954	17 225	20 699	20 820	19 677	19 294	19 297	19 459	19 076
Norway	3 660	2 336	2 946	3 083	2 579	2 532	2 531	1 744	1 987	2 113
Sweden	17 709	12 597	14 279	17 615	18 241	17 137	16 762	17 553	17 464	16 430
Other	52	21	-	1	-	8	1	-	8	533
All Western Europe	29 240	22 832	23 872	27 458	27 663	25 698	25 145	25 560	24 703	24 098
Australia	74 500	75 400	76 900	88 700	88 000	82 600	80 600	98 300	108 100	100 316
Canada	41 452	27 281	25 528	30 737	32 266	31 008	29 679	30 523	30 022	27 038
South Africa	13 714	11 356	7 811	11 870	[illegible]	8 850	8 802	11 503	14 566	17 029
United States	5 635	3 229	3 841	5 073	[illegible]	4 553	5 093	5 285	5 895	3 506
Other (including Western Europe)	32 064	25 131	26 334	29 658	29 783	27 915	26 996	27 024	26 303	25 112
Total, A	167 365	142 397	140 414	166 038	165 389	154 926	151 110	172 635	184 886	173 001
					B. Developing market economies					
Africa										
Liberia	20 694	16 304	15 704	16 870	16 100	13 940	13 510	13 779	12 747	3 887
Mauritania	8 609	7 753	7 402	9 527	9 333	8 929	9 002	10 004	11 138	11 356
Other	1 512	1 444	1 757	1 451	87	48	63	122	122	77
Total	30 815	25 501	24 863	27 848	25 520	22 917	22 575	23 905	24 007	15 320
Asia										
India	23 927	25 359	22 001	25 696	28 840	32 031	28 981	32 079	33 479	34 000 [a]
Philippines [b]	3 800	3 200	3 100	3 600	3 300	3 680	4 202	4 764	4 600	4 300
Total	27 727	28 559	25 101	29 926	32 140	35 711	33 183	36 843	38 079	38 300
Latin America										
Brazil	85 798	80 444	69 008	87 179	89 394	91 603	95 332	112 815	118 472	113 511
Chile	6 830	5 502	4 719	5 232	4 816	4 846	5 329	6 397	7 422	6 546
Peru	5 156	5 596	4 182	4 091	5 242	4 212	4 430	4 668	4 014	3 306
Venezuela	12 422	6 616	6 245	8 456	9 032	10 027	11 698	12 460	14 437	13 620
Total	110 206	98 158	84 154	104 958	108 484	110 688	116 789	136 340	144 345	136 983
Total, B	168 748	152 218	134 118	162 102	166 144	169 316	172 547	197 088	206 431	190 603
					C. Centrally planned economies					
Eastern Europe and USSR, of which:										
USSR	44 132	42 836	42 805	45 922	43 880	46 168	45 433	43 063	39 880	36 300
World [c]	380 245	337 451	317 337	374 062	375 413	370 410	369 090	412 197	431 197	399 904

Source: International Iron and Steel Institute, *Steel Statistical Yearbook 1991*, vol. 4 (Brussels, 1991).

[a] Estimate.

[b] Estimates, 1981-1985.

[c] Market economies (A+B) plus USSR.

Total seaborne iron-ore trade in 1990 was 354 million tonnes, a decline of 12 million tonnes from the previous year, and in 1991 was predicted to decline by 3-4 million tonnes [55]. However, increased steel production in the newly industrializing countries should in the years ahead more than compensate for the drop in the traditional producing countries. Overall, there should be an increase in seaborne trade, such that by 1996 it should reach 373 million tonnes [55].

(d) Materials substitution

Whether the ironmaker chooses to charge lump ore, sinter or pellets into the blast-furnace is a decision to

Table V.68. Iron ore imports, 1981 to 1990
(Thousands of tonnes)

Economic grouping, region and country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
A. Developed market economies										
EEC, of which:	123 783	109 889	100 696	124 887	128 274	120 405	121 146	132 440	140 263	133 098
Belgium and Luxembourg	21 148	18 613	17 519	19 628	18 997	18 056	18 385	20 796	19 787	20 278
France	16 511	14 943	12 553	16 088	16 220	16 191	15 056	18 727	19 955	18 807
Germany, Federal Republic of	44 288	38 470	33 942	43 941	45 142	41 803	39 585	45 169	47 171	43 730
Italy	15 196	16 065	13 798	19 239	18 293	17 601	16 523	16 196	18 201	17 202
Netherlands	6 659	6 160	4 979	7 235	8 509	7 361	7 029	7 559	8 151	8 302
Spain	4 687	4 620	4 202	4 220	5 023	4 287	5 767	5 645	7 121	6 705
United Kingdom	14 643	10 572	13 169	14 160	15 405	14 558	18 028	17 867	19 179	17 622
Other	651	446	534	376	685	548	773	482	698	452
Western Europe, non-EEC, of which:	7 085	7 347	7 071	9 267	9 694	9 087	8 302	10 712	12 047	11 363
Austria	3 423	3 241	2 391	3 890	3 684	3 204	3 311	4 164	4 188	3 908
Finland	1 496	1 494	1 300	1 857	1 756	1 987	2 261	2 336	3 016	3 158
Turkey	728	1 064	1 546	1 849	1 747	2 428	1 532	2 369	2 243	1 952
Yugoslavia	1 360	1 477	1 568	1 566	2 180	1 347	1 081	1 486	2 305	1 998
Other	88	71	266	105	327	121	117	357	295	347
All Western Europe	130 868	117 236	107 767	134 154	137 968	129 492	129 448	143 153	152 310	144 461
Canada	5 792	3 357	4 013	4 947	5 800	5 367	5 213	4 791	5 348	4 113
Japan	123 361	121 810	109 152	125 371	124 511	115 234	112 036	123 376	127 709	125 290
United States	28 782	14 734	13 459	17 463	16 024	17 011	16 849	20 183	19 596	18 054
Other (excluding Western Europe)	47	91	52	52	24	59	42	469	1 405	1 099
Total, A	288 850	257 228	234 443	281 987	284 327	267 163	263 588	291 972	306 368	293 017
B. Developing market economies										
Philippines a/	3 800	3 300	3 200	3 600	3 300	3 700	4 000	4 400	4 200	4 600
Republic of Korea	11 201	11 793	11 497	11 962	12 620	12 394	15 987	18 710	21 635	22 707
Taiwan Province	2 413	4 049	4 957	5 199	4 896	5 358	6 140	8 536	8 370	7 762
Other	4 215	4 163	4 461	6 255	3 005	10 608	10 050	10 332	12 518	12 162 b/
Total, B	21 629	23 305	24 115	27 016	29 821	32 060	36 177	41 978	46 723	47 231
C. Centrally planned economies										
Eastern Europe and USSR, of which:	56 858	52 414	52 820	56 749	52 369	54 087	52 293	50 423	46 015	38 700
Bulgaria	2 280	2 360	2 313	2 286	2 215	2 248	2 308	2 122	1 920	1 964
Czechoslovakia	15 682	15 290	15 305	15 024	11 268	11 264	10 366	10 058	9 765	8 700 c/
German Democratic Republic c/	4 245	3 116	2 971	3 179	4 324	4 100	4 300	4 200	4 000	2 800
Hungary	3 765	3 757	3 967	4 170	2 382	3 414	3 403	2 885	3 263	2 882
Poland	15 870	13 493	13 787	17 127	16 973	16 644	17 116	16 668	13 441	11 013
Romania d/	15 016	14 398	14 477	14 963	15 207	16 417	14 800	14 500	13 626	11 341
USSR	-	-	-	-	-	-	-	-	-	-
China	3 336	3 452	4 385	5 970	10 114	12 005	12 098	10 756	12 414	14 191
Total, C	60 264	56 351	57 317	62 919	62 783	66 592	64 991	61 879	59 129	53 591
World, A, B and C	370 743	336 884	315 875	371 922	376 931	365 815	364 756	395 829	412 220	393 839

Source: International Iron and Steel Institute, *Steel Statistical Yearbook 1991*, vol. 4 (Brussels, 1991).

a/ Estimates, 1981-1990.

b/ Estimates.

c/ Estimates, 1986-1990.

d/ Estimates, 1987-1988.

be made on the basis of both quality and price. Smooth furnace operation is essential for quality iron production, and this depends on having a supply of good-quality iron ore. The price question becomes important when, for example, the cost of lump ore becomes less than that of producing sinter at the ironmaker's own plant. Although lump ore is becoming scarcer overall, there are times of low demand when even lump is available at competitive prices. Pellets are more expensive than sinter, and are often an improved product with added flux for higher productivity. They are usually pelletized at the mine site to give added value to the mine operator and provide an easily handled commodity. However, pellets provide a less permeable medium for the stack of the furnace and must be used with either sinter or lump in the recipe. In Japan, a new hybrid pellet has been developed which is predicted to have an important bearing on future charge material for the furnace. The hybrid pellet consists of pellets sintered together into larger agglomerations that individually have high permeability; this provides the quality advantages of pellet with the permeability and reducibility advantages of sinter.

3. *Coking coal inputs*

Table V.69 shows that world coke production has grown only slightly since 1981, and has not kept up with coking coal demands. In particular, the scarcity of coking coal combined with the capital expense and environmental problems of coking operations are major factors in determining the future of ironmaking technology. The capital expense of blast-furnaces themselves, and their relative inflexibility in terms of economy of scale should not be glossed over either. It is fairly certain that if these furnaces did not rely so heavily on coke both as a reducing agent and as a fuel, then ironmaking would not be posing the long-term problem that it now poses. One possible corrective method has been the introduction of coal injection technologies into the blast-furnace. Non-coking coal can be injected in either pulverized or granulated form through the tuyères of the furnace and can replace coke consumption by up to 36 per cent. To increase the coal injection level above these values requires the injection of oxygen-enriched air to provide the correct combustion conditions. The oxygen blast-furnace with high coal injection levels could

Table V.69. Coke production, 1981-1990
(Thousands of tonnes)

Economic grouping, region, country and area	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
					A. Developed market economies					
EEC, of which:	65 257	61 186	53 812	54 387	58 392	55 973	52 355	50 852	50 358	49 754
Denmark	..	67	23	..	..	..	..	..	..	..
Belgium	6 004	5 217	5 106	5 926	5 964	5 131	5 226	5 548	5 343	5 304
France	10 723	9 934	8 457	8 999	8 691	8 254	7 464	7 428	7 323	7 198
Germany, Federal Republic of	28 300	26 655	22 984	21 467	23 232	23 094	20 218	18 825	18 772	18 600 a/
Greece	58	12	15	5	-	-	-	-	-	-
Italy	8 071	7 466	6 492	6 943	7 411	7 209	6 945	6 331	6 170	5 870
Netherlands	2 242	2 428	2 126	2 726	2 973	2 665	2 736	2 920	2 898	2 736
Portugal	198	214	249	237	273	281	267	235	205	181
Spain	4 068	4 126	3 524	3 283	3 440	3 083	2 883	3 004	3 200	3 211
United Kingdom	5 593	5 067	4 836	4 801	6 408	6 256	6 616	6 561	6 447	6 454
Western Europe, non-EEC, of which:	7 685	8 335	8 803	9 422	9 413	9 732	9 019	9 777	9 761	8 750
Austria	1 652	1 662	1 725	1 854	1 751	1 745	1 726	1 745	1 771	1 706
Finland	..	..	..	..	..	..	..	423	433	433
Norway	346	341	314	321	312	312	283	161	..	..
Sweden	1 094	1 183	1 164	1 231	1 203	1 176	1 091	940	984	1 035
Turkey	1 900	2 370	2 160	2 500	2 602	3 003	2 960	3 300	3 300	3 300 a/
Yugoslavia	2 693	2 779	3 440	3 516	3 545	3 496	2 959	3 208	3 273	2 276
All Western Europe	72 942	69 521	62 615	63 809	67 805	65 705	61 374	60 629	60 119	58 504
Canada	4 659	3 999	4 120	4 901	4 684	4 553	4 635	4 663	4 414	3 708
United States	39 916	23 204	23 413	27 725	25 992	23 170	25 434	29 124	30 270	27 216
Japan	50 690	49 781	46 674	51 275	51 742	48 140	46 429	50 635	51 600	5 300 a/
Australia	5 421	4 745	3 678	3 563	3 603	3 776	3 600	4 146	4 545	4 421
New Zealand	4	2	7	8	5	5	1	1	1	1 a/
South Africa	4 666	3 653	3 356	3 505	2 600	3 626	4 016	4 000	4 000	4 000 a/
Total, A	178 298	154 905	143 863	154 786	156 431	148 975	145 489	153 198	154 949	150 850
					B. Developing market economies					
Africa										
Algeria a/	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000 a/
Egypt	970	996	937	952	1 004	900	900	990	900	900 a/
Zambia a/	50	55	35	35	30	30	32	34	40	40 a/
Zimbabwe	209	257	220	180	220	125	120	125	200	200 a/
Total	2 229	2 308	2 192	2 167	2 254	2 055	2 052	2 059	2 140	2 140

Table V.69 (continued)

Economic grouping, region, country and area	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Asia										
India	11 773	11 721	11 610	10 969	11 637	9 619	8 536	10 883	11 700 a/	11 800 a/
Iran (Islamic Republic of)	300	300	300	350	400	350	400	400	500	832
Pakistan	200	346	370	370	451	610	630	650	850	900 a/
Republic of Korea	4 401	4 539	4 682	5 199	5 207	5 280	6 256	6 940	7 323	8 307
Taiwan Province	1 700	1 800	1 900	2 000	2 000	2 100	2 100	3 152	3 271	3 182
Total	18 374	18 706	18 862	18 888	19 695	17 959	17 922	22 025	23 644	25 021
Latin America										
Argentina	467	425	418	336	663	808	859	844	1 080	1 100 a/
Brazil	3 741	3 930	4 642	6 204	6 649	7 344	7 454	7 980	7 893	7 546
Chile	310	240	252	290	301	304	316	306	277	328
Colombia	336	308	326	364	344	377	388	398	256	300 a/
Mexico	2 943	3 548	3 077	2 905	2 904	2 380	2 340	1 785	2 080	2 110
Peru	33	34	31	35	37	35	35	30	30	30 a/
Uruguay	6	1	3	1	1	1	1	1	1	1 a/
Total	7 836	7 486	8 749	10 135	10 899	11 249	11 393	11 344	11 617	11 415
Total, B	28 439	28 500	29 803	31 190	32 848	31 263	31 367	35 428	37 401	38 576
C. Centrally planned economies										
Eastern Europe and USSR, of which:	117 162	117 362	118 609	119 107	119 391	119 488	121 288	121 299	115 166	111 749
Albania a/	16	17	18	19	20	21	22	23	20	20 a/
Bulgaria	1 348	1 274	1 270	1 186	1 087	1 156	1 314	1 261	1 350	1 400 a/
Czechoslovakia	10 323	10 566	10 340	10 302	10 237	10 091	10 586	10 586	10 147	9 625
German Democratic Republic	1 238	1 226	1 193	1 179	1 257	1 307	1 256	1 251	1 224	1 250 a/
Hungary	958	947	877	703	607	665	969	996	953	950 a/
Poland	17 346	16 810	16 643	16 869	16 440	16 398	17 441	17 482	16 548	14 004
Romania	2 933	3 513	4 268	4 849	4 743	4 850	4 700	4 700	4 500	4 500 a/
USSR b/	83 000	83 000	84 000	84 000	85 000	85 000	85 000	85 000	80 424	80 000 a/
China	38 948	40 190	42 135	45 567	47 947	52 668	57 906	61 076	66 240	73 270
Democractic People's Republic of Korea a/	3 000	3 300	3 400	3 400	3 500	3 500	3 500	3 500	3 500	3 500 a/
Total, C	159 110	160 852	164 144	168 074	170 838	175 656	182 694	185 875	184 906	188 519
World, A, B and C	365 847	344 257	337 810	354 050	360 117	355 894	359 550	374 501	377 256	377 945

Source: International Iron and Steel Institute, *Steel Statistical Yearbook 1991*, vol. 4 (Brussels, 1991).

a/ Estimate.

b/ Estimates, 1976-1988.

easily lower coke consumption by one half. This would have a major effect on coking coal demand and on coke-oven capacity requirements. This technology is widely practised in Europe, Japan and the United States. The levels of coal injection achieved vary, with the United Kingdom leading the way with the use of granulated coal at 180 kilograms per tonne of hot metal on a regular basis in certain blast-furnaces. The use of granulated rather than pulverized coal results in less expensive coal preparation and safer handling and storage.

(a) Coke-oven life constraints

Increased use of coal injection allows existing coke ovens to cope more easily with coke demand, and reduces the need for new capital investment in oven batteries. Techniques are being implemented to improve campaign life with the application of refractory repair techniques and better working practices, nevertheless lives of only 30-35 years are the best anticipated. The efficiency of a coke oven declines with age, and productivity may fall below the critical break-even point well before this time. In 1989 it was estimated that 39 per cent of coke ovens in the developed market economies were less than 16 years old and accounted for 47 per cent of the coke-making capacity of those economies [55]. At the same time, 27 per cent of their coke ovens were over 25 years old, but accounted for only 17 per cent of their coke-making capacity. Over 33 per cent of coke-making capacity of those economies [54]. At the same time, end of its useful life. The fact that in the last three years only one significant new coke-making battery with a capacity of just under 500,000 tonnes has been completed and commissioned in the developed market economies does not have a major impact on these percentages. The only change is that existing batteries have aged by a further three years, pushing the age profile ever older. Estimates of the cost of coke-oven battery replacement are in the region of $200 million per million tonnes of coke annually.

Few investors in new capacity can be found, given a static forecast for steel demand and the fact that new ironmaking technologies, which will not be coke-dependent, are approaching industrial trial stages in many different locations in the world. Indeed, the Corex process has been in operation in South Africa on an industrial scale for three years [54]. Work in Europe, Australia, Japan and the United States, all along slightly different lines but towards the common goal of cokeless ironmaking (smelting reduction), is proceeding rapidly, and smaller-scale production units of 500 tonnes per day are approaching reality. These technologies all aim at producing liquid hot metal, as with the blast-furnace, and should not be compared with direct reduction processes which produce a solid high-iron-content product.

(b) Environmental problems

It is not only heavy capital investment that causes the coke oven to be an unpopular item of plant for the steelmaker. The coking process is one which has long been associated with environmental problems due to the nature of the emissions inherent in the coking process. The fumes are largely sulphurous (the cause of acid rain), while the aqueous effluent contains pollutants such as phenols, thiocyanates and ammonia. Good maintenance and management of the batteries reduces these emissions, but finding the design for a plant with large, supposedly gas-tight, doors to ensure that no leaks occur is more difficult. When the coke is pushed from an oven, capturing the resultant fumes is an additional problem to avoid escape to the atmosphere. Increasingly stringent environmental legislation further adds to the expenses of the steelmakers.

(c) Trade

Commercially exploitable reserves of coking coal are found in few countries of the world; as shown in table V.70, countries in possession of those reserves are currently the major exporters. World coking-coal trade is also reported to have been static over 1989-1990. The major exporting countries of the developed market economies are Canada, United States and Australia, with exports of the former USSR being mainly to the former centrally planned economies of Eastern Europe. Japan is completely dependent on coking coal imports, as it is for iron ore.

4. Significance of the natural resource base

It is interesting to examine the correlation between a country's mineral resource base for steelmaking and its success as a steelmaking nation. Contrary to expectation, the parallels are hard to find. As has been stated, Japan, as the world's biggest steelmaker, is totally reliant on both imported ore and coking coal. The United States has both minerals and yet has experienced 10 years of almost constant rationalization in the face of declining demand for steel. Its steel industry was late in the adoption of continuous casting and oxygen steelmaking (both benchmark technologies for a modern steel industry), and is now increasingly involved in joint venture projects with Japanese steelmakers. Canada and Australia both have good-quality ore and coking coal, but their domestic industries are of insufficient size to guarantee a continuing demand for steel and steel products through periods of recession. The year 1991 was disastrous for the steel industry in both these countries, and 1992 holds no promise for improved conditions.

Brazil, as a major iron ore source and a developing economy, might have been viewed as an endowed country. Instead of using coke to fuel their blast-furnaces, large quantities of charcoal are used. This has had a devastating effect on forest resources; however, ironmakers claim that they use the trees to better effect than do cattle ranchers, who simply burn the forest *in situ* to provide temporary grazing for beef cattle. New legislation now means that ironmakers are obliged to reforest at the same rate as they use trees for charcoal, so as to be self-sufficient in blast-furnace fuel. Starting in 1991 the largely government-owned Brazilian steel industry was being sold to private investors, a pattern which is being repeated in Argentina and which has been completed in Mexico.

It is unfair to compare market economies with centrally planned ones, since their objectives have been so disparate, but the differences certainly cannot be ignored. The former USSR has both major raw materials in abundance, but its steel industry cannot be compared with that of developed market economies, since it is technologically outdated and highly inefficient. Changes to a market economy can only improve both these factors in the medium term. In China, the availability of raw materials also is not the answer to an efficient steel industry and plentiful cheap steel. Indeed, the only country that has had the benefit of raw materials and has established a relatively prosperous steel industry is Germany. It must thus be concluded that the possession of mineral resources is no guarantee for a successful steel industry.

5. Scrap inputs

Scrap should be regarded not as a waste material, but as a raw material or commodity. Accordingly, it has been receiving increasing public attention. For example, the recyling of steel and aluminium cans is now commonplace in developed countries. In addition, automobile manufacturers are beginning to build recyclability into their products as a result of legislation in some countries, which is making the manufacturers themselves responsible for the ultimate disposal of their products. If consumers were really aware of the fact that some 40 per cent of the steel that they use is already a totally recycled product, then this would be a step forward. To steelmakers, scrap means a valuable raw material.

(a) Utilization

Scrap steel is used both by integrated steelmakers and by electric-arc-furnace operators. In the latter case it is normally the sole supply of so-called "iron units", although there is limited competition from direct reduced iron (DRI). In developed market economies, electric-arc steel accounts for around

Table V.70. World coking-coal trade, 1989 and 1990
(Millions of tonnes)

	Importers																	
	OECD		North America		Japan		Africa and Western Asia		Asia[a/]		Latin America		Centrally planned economies		Balancing item		Total world imports	
Exporters	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990
OECD, of which:	41.2	43.2	5.9	4.5	58.2	56.9	1 0	2.4	23.4	23.0	8.0	8.8	5.0	4.3	5.6	2.6	148.3	145.7
Australia	8.4	9.8	..	..	30.0	29.6	0.4	0.9	13.7	14.1	1.3	1.6	1.9	1.6	-0.1	-0.7	55.6	56.9
Canada	2.1	2.7	..	..	17.7	17.5	..	0.3	4.5	5.5	1.6	1.3	..	..	2.8	-0.4	28.7	26.9
United States	26.6	27.3	5.9	4.5	10.1	9.6	0.7	1.1	5.1	3.3	5.1	5.9	2.9	2.6	2.7	3.3	59.1	57.6
Other	4.1	3.3	..	..	0.3	0.2	..	..	0.1	0.1	..	..	0.1	0.1	0.4	0.7	5.0	4.4
Non-OECD																		
China	..	..	..	..	1.2	1.3	..	..	..	..	..	..	2.3	2.7	..	..	3.5	4.0
Colombia	0.1	..	..	..	0.2	..	..	..	..	..	..	..	..	..	..	..	0.3	..
Poland	2.8	3.8	..	..	..	..	0.3	..	0.4	0.4	2.1	2.2	1.4	1.0	..	..	7.0	7.4
South Africa	..	0.2	..	..	3.5	3.4	..	..	0.6	0.9	..	..	..	..	..	..	4.1	4.5
USSR	1.5	1.8	..	..	5.5	5.5	0.2	..	..	..	..	..	11.4	12.1	..	..	18.6	19.4
Other	0.9	0.8	..	..	0.1	0.3	..	..	..	..	..	..	0.7	0.9	..	..	1.7	2.0
Total	46.5	49.8	5.9	4.5	68.6	67.4	1.5	2.4	24.4	24.3	10.1	11.0	20.8	21.0	5.5	2.8	183.5	183.0

Sources: Statistical database of the International Energy Agency of OECD and other international sources.
Note: Data in the columns OECD to Japan are import statistics. The rows for OECD countries, except for the columns just referred to, are export statistics. All other data are based on national and international sources and estimates.
[a/] Excluding centrally planned economies and Japan.

40 per cent of steel output.* Integrated plants also use scrap to supplement hot metal on a strict cost basis. If scrap is cheaper than hot metal, these plants will maximize scrap use up to about 30 per cent in a normal top- and bottom-blown basic-oxygen-steel vessel. Before the advent of continuous casting, recirculating scrap was much more readily available in the plant, and could amount to around 15 per cent of steel output. With open hearth furnaces this volume of scrap was not a problem for the steelshop, but basic-oxygen-steel furnaces do have an upper limit for scrap consumption.

The electric furnace operator also has a choice, but in this case the option of either scrap or DRI as a melting stock is not only an economic one but also involves quality considerations. In some regions of the world scrap is not readily available and DRI becomes an economic possibility. But DRI also offers product quality advantages, which means that in a very few specific instances, minimills located in scrap surplus areas do need to use DRI, if they wish to meet certain quality standards, particularly for flat products. The scrap suppliers have become much more conscious of the quality question in recent years, and much more discerning suppliers by adding value to their product through improved processing and sorting technologies.

*Based on information drawn from database of the British Scrap Federation (BSF), Brampton, Huntingdon, United Kingdom.

(b) Trade

Scrap is the heaviest-traded primary metal of steelmaking. Table V.71 shows that world scrap trade has a strong regional pattern. In the case of the EEC, exports and imports have been roughly balanced. However, the EEC is gradually becoming a net exporter with the main destinations being France, Germany, Netherlands and the United Kingdom. Next in importance is Western Europe, where the non-EEC countries are significant importers. This is particularly true of Turkey, with its heavy preponderance of minimills. There also is trade by Eastern Europe, which is not very substantial, since most of the countries are more or less in balance. The exceptions were the former German Democratic Republic, which

Table V.71. Estimated consumption, exports and imports of scrap worldwide, 1989
(Thousands of tonnes)

Region and country	Consumption	Imports	Exports	Resources
Eastern Europe and USSR, of which:	118 902	915	2 922	120 909
USSR	95 000	44	2 728	97 684
Western Europe				
EEC	69 340	16 672	16 621	69 289
Other	12 552	5 122	577	8 007
Total	81 892	21 794	17 198	77 296
North America				
United States	66 320	1 011	11 150	76 459
Canada	7 790	1 460	890	7 220
Total	74 110	2 471	12 039	83 679
Oceania, of which:	2 000	-	1 154	3 154
Australia	1 706	-	1 154	1 860
Africa	4 000	200	-	3 800
Western Asia	1 800	600	-	1 200
Asia				
Japan	45 836	1 157	587	45 266
Republic of Korea	10 323	4 089	19	6 253
China	21 000	470	-	20 530
India	5 000	2 047	5	2 958
Other	7 841	4 237	289	3 893
Total	90 000	12 000	900	78 900
Latin America	15 500	1 000	-	14 500
Total a/	388 500	39 000	34 200	383 500

Sources: Replies to questionnaires; International Iron and Steel Institute; Latin American Iron and Steel Institute; and country estimates.
a/ Rounded figure.

was an importer, and the former USSR, which was a major exporter. And finally in North America, large volumes are traded between Canada and the United States.

With regard to international maritime trade, scrap exports of the order of 11-15 million tonnes per year originate from the United States (8 million to 10 million tonnes per year), the former USSR (3 million to 4 million tonnes per year), and Australia (0.5 million to 1 million tonnes per year).* Imports of the same order are mainly received by Asia, with an apparent intake of 12 million to 13 million tonnes per year; Western Europe has a rising intake of 3 million to 5 million tonnes per year (especially Turkey, with over 3 million tonnes). In summary, the scrap trade has been relatively stable over the years with a magnitude of the order of 15 million tonnes per year (a range of 12 million to 18 million), and with the United States as the principal country of origin. Concerning recent changes in trade flows, initially the flow was towards Europe, where it increasingly became concentrated in southern Europe, first Italy and then Spain and finally Turkey. However, now it is largely towards South and South-East Asia. Regarding the future, it is hard to make any predictions for scrap trade by the Eastern European countries, and especially hard to do so for exports by the former USSR, which in any case declined substantially in 1990.*

*Based on information drawn from the BSF database.

*Based on information drawn from the BSF database.

6. *Direct reduced iron*

For a raw material that comprises such a small percentage of the total supply of iron inputs to the steel industry, DRI has a disproportionately large influence. In 1990 world pig-iron production (the output from blast-furnaces) stood at 530 million tonnes; scrap consumption was 328 million tonnes; and DRI production was a mere 19 million tonnes, just 2.2 per cent of the total suppy of iron units for steelmaking. The large discrepancy between installed capacity and DRI production shows that DRI has not proved to be quite as widely applicable as was first envisaged, when the technology was first brought to commercial fruition in the early 1970s. Many production units have been closed down or are working at low capacity utilization. However, table V.72 suggests that in certain locations, direct reduction technology has been widely adopted.

Table V.72. Direct-reduced-iron capacity, 1970-1991
(Millions of tonnes per year)

Country	1970	1975	1980	1985	1986	1987	1988	1989	1990	1991
Argentina	..	..	0.75	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Brazil	..	0.31	0.66	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Canada	..	0.79	1.63	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Egypt	..	..	..	..	0.72	0.72	0.72	0.72	0.72	0.72
Germany, Federal Republic of	0.15	0.55	0.55	1.28	1.28	0.40	0.40	0.40	0.40 [a]	0.40 [a]
India	..	..	0.03	0.21	0.30	0.30	0.30	0.60	1.48	1.70
Indonesia	..	..	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Iran (Islamic Republic of)	..	..	0.33	0.73	0.73	0.73	0.73	0.73	1.13	1.53
Iraq	..	..	0.54	0.54	0.54	0.54	1.47	1.47	1.47	1.47
Italy	..	0.01	0.05	..	..	..	..	..	..	..
Japan	..	..	0.15	..	..	..	..	..	..	..
Libyan Arab Jamahiriya	..	..	..	..	..	..	..	0.55	1.10	1.10
Malaysia	..	..	..	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Mexico	0.92	1.39	2.00	2.03	2.03	2.03	3.03	3.03	4.03	4.03
Myanmar	..	..	..	0.04	0.04	0.04	0.04	0.04	0.04	0.04
New Zealand	0.12	0.12	0.17	0.17	0.17	0.17	0.17	0.17	0.17	..
Nigeria	..	..	..	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Peru	..	..	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Qatar	..	..	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Saudi Arabia	..	..	..	0.80	0.80	0.80	0.80	0.80	0.80	0.80
South Africa	..	0.15	0.15	1.28	1.28	1.28	1.28	1.36	1.36	1.06
Sweden	..	..	..	..	..	..	..	..	..	..
Trinidad and Tobago	..	..	0.42	0.84	0.84	0.84	0.84	0.84	0.84	0.84
United Kingdom	..	..	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
United States	0.30	1.03	1.09	0.70	0.40	0.40	0.40	0.40	0.40	0.40
USSR	..	..	..	0.83	1.25	1.67	1.67	1.67	1.67	1.67
Venezuela	..	..	4.50	4.50	4.50	4.50	4.50	4.50	5.93	5.93
Total	1.49	4.35	14.64	21.48	22.71	22.25	24.18	25.11	29.37	29.52

Source: Midrex Corporation, *Newsletter No. 1* (Charlotte, North Carolina, January 1992).
[a] Excluding the former German Democratic Republic.

DRI is charged into electric-arc furnaces, and therefore is viewed as an alternative to scrap. In locations where scrap is in limited supply and the raw materials for DRI are abundant, it can make good economic sense to produce steel via the DRI and electric-arc-furnace route. The raw materials for DRI are iron ore and either coal or natural gas, different technologies being applied depending on the nature of the reductant available. For gas-based DRI the iron ore must be either in lump form, or more commonly it is pelletized ore fines. In the coal-based systems, fines can be used directly.

Natural-gas-based systems today account for 92 per cent of DRI production. The gas is reformed using either steam or carbon dioxide to produce hydrogen and carbon monoxide which act as reductants for the solid state pellets. The product remains solid, and is frequently briquetted, making hot-briquetted iron an easier commodity to handle. Unbriquetted DRI has a tendency to spontaneously reoxidize. Natural gas is considered by many to be too precious a natural resource to be used for ironmaking, while non-coking coals are readily available in many locations at lower cost. The early success of gas-based systems has depended on the initial low price of natural gas supplies, the use of simpler technology in engineering terms for gas-based systems, and an improved operating history for gas-based systems.

As can be seen from table V.72, Venezuela remains the preferred location for DRI production, since ore and natural gas are found in abundance in the same region. The Guayana region also has good seaport access for merchant DRI export. Mexico is the country of origin of one of the leading gas-based direct reduction technologies, but its DRI production is all consumed at tied steelworks. The other main supplier of merchant DRI is Indonesia, where new capacity is planned. Malaysia is also installing new gas-based DRI capacity on a large scale, as is India, where coal-based DRI production has met with some success. The next five years will see a 10 per cent increase in DRI production worldwide, while steel production will rise by only 2-3 per cent.

DRI competition with scrap concerns price and quality. Much of the redundant capacity currently lying idle is doing so because scrap can be purchased at a lower price in those locations than DRI can be produced. However, there is a quality penalty. For minimills producing simple bar and rod products and light angles for constructional purposes, this is not usually a problem. However, for the more sophisticated products such as engineering quality steels, the scrap must be more rigorously selected and, therefore, is more expensive. Minimills are beginning to move into the flat products sector using thin-slab casting technology and scrap containing accumulated quantities of copper, tin, antimony, arsenic and other deleterious elements (which are unfortunately not removed in the electric-arc-furnace process). As the minimills move up market, thay will find an increasing need for DRI to act as a dilutant for scrap to enhance quality.

7. *Short and long-term outlook*

This survey should serve to illustrate that global figures alone cannot explain what is happening in the steel industry worldwide. The diversity of technologies and the fact that steel is only one of several raw materials for a manufacturer adds considerable complications to the interpretation of available information. In addition, industry growth rates have varied considerably among different countries and different regions of the world. The downturn experienced by many countries in 1990-1991 should continue but not for too long. Capacity utilization was high following a decade of rationalization and diversification for some of the larger companies. The achievements of the Republic of Korea have been very impressive. China continues to show strong growth, with no slow-down in sight, although consumption per capita is still a fraction of that experienced in developed countries. Latin America will remain debt-ridden and is a victim of current high interest rates; but steel consumption will still probably grow, as has been the case in Brazil. The United States and Western Europe are now in a strong position to meet demand and can produce high-quality steel at competitive prices. There will be further rationalizations and many observers see increasing internationalization, as the countries of Eastern Europe shift to stronger market economies and their modernization requires the increased use of steel products.

According to the International Iron and Steel Institute, the year 1992 should show signs of improvement due to gradual recovery in the United States and Canada [54]. United States consumption should rise about 4 per cent above 1991 levels, while Canada should see a significant recovery of about 10 per cent. Although most forecasters seem to agree that the United States economy is now entering a recovery phase, only a gradual recovery is forecast in the demand for steel. Apparent consumption in Germany should show further modest growth in 1992, although this forecast was made prior to the dispute between the engineering union and management, which came to a head in May 1992. Little or no improvement is likely in the former USSR. The total apparent consumption of the EEC should grow by just 1 per cent to reach 119 million tonnes in 1992. Slower growth in Japan during 1992, with some liquidation of inventories, would bring a fall of 6 million tonnes (6.6 per cent) in the apparent Japanese consumption. Of the other industrialized countries only Canada should show any significant recovery. The total apparent consumption of the industrialized countries in 1992 should be 352 million tonnes, representing a 1 million tonne increase, or 0.3 per cent up from 1990.

Among the developing regions, there was some optimism about the demand prospects in Latin America (up 11.1 per cent at 33 million tonnes), but in the Republic of Korea, growth of only 3.3 per cent, to 91 million tonnes was forecast. In Western Asia, reconstruction could be expected to give some improvement to steel consumption, about 4.2 per cent above the 1991 level.

Given the minimal rise in the total apparent consumption of the industrialized economies, the overall improvement of demand in the developed market economies should be marginal. Projected world crude steel consumption for 1992 is expected to reach 743 million tonnes, 1.1 per cent above the 1991 level. Looking towards the future, world consumption is expected to reach a level of 790 million tonnes by the year 2000, according to the International Iron and Steel Institute [54]. Despite a drop of more than 50 million tonnes in Eastern Europe and the former USSR, world consumption benefiting from better yields and efficiency of steel use should equal the world peak achieved in 1989. This projection depends largely on growth of steel demand in developing countries averaging more than 3 per cent a year. Much of this growth should occur in the recovering Latin American economies, where crude steel consumption should rise from 27 million tonnes in 1990 to 45 million tonnes by the year 2000. In developing Asia, demand should increase from 30 million tonnes to a trend level of 114 million tonnes. By the year 2000 developing regions should be consuming around 187 million tonnes of steel, 53 million tonnes more than in 1990.

Steel consumption in China should also continue to rise, reaching 85 million tonnes in the year 2000 compared with 71 million tonnes in 1990. By contrast, in Eastern Europe and the former USSR, the consumption of steel products should fall towards levels typical of more efficient developed market economies. Yields of steel products from crude steel (cast raw steel prior to transformation to other steel products) should also improve dramatically. Crude steel demand has been stable in most developed market economies due to technological developments that have made possible significant reductions in the amount of crude steel utilized. Similar developments in Eastern Europe and the former USSR should bring crude steel consumption in that region to about 135 million tonnes by the end of the century, 52 million tonnes below the 1990 figure.

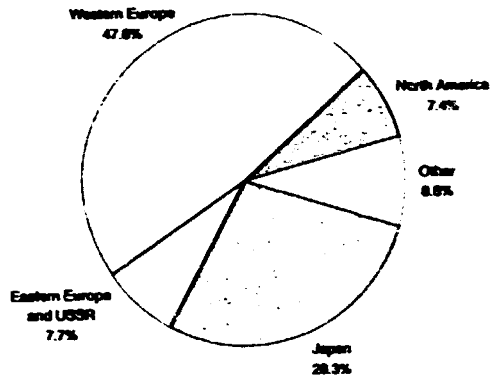
I. Machine tools (ISIC 3823)*

1. *Current conditions*

The output of machine tools in 1991 declined by almost 10 per cent in the 33 countries that account for most of world production; this was mainly the result of expanding recession as well as the industrial decline in the former USSR, and subsequently the economies of Eastern Europe. Machine-tool production and consumption for major regions are shown in table V.73 and figures V.26 and V.27. About 90 per cent of production and 80 per cent of consumption were in the industrialized countries. Among all countries only Japan showed an increase, about 6 per cent in production. When measured in yen values, however, shipments of machine tools declined by 1.2 per cent. While Japan had a 24.1 per cent share of world production in 1990, this had grown to 28.3 per cent by 1991. Growth continued in the developing countries of Africa and Asia; the largest area was Asia, where regional output accounted for about 6 per cent of the world total. Western Europe, despite its decline in output, continued to dominate with a 48.7 per cent share of world production, while North America shrunk from its once dominant position to 7.4 per cent [56].

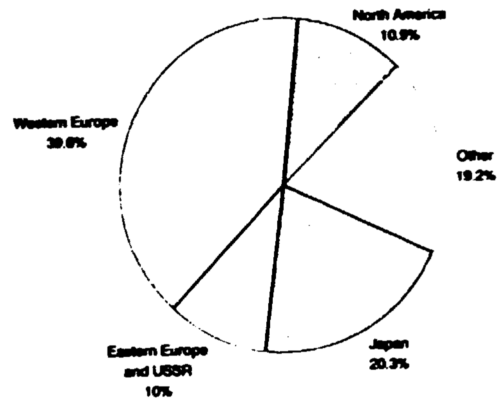
*UNIDO acknowledges the contribution of Anderson Ashburn, Editor Emeritus, *American Machinist*.

Figure V.26. World machine-tool production, 1991



Source: *American Machinist*, vol. 136, No. 2 (February 1992), pp. 59-65, with adjustments for countries not reported there, on the basis of trade data of OECD countries.

Figure V.27. World machine-tool consumption, 1991



Source: *American Machinist*, vol. 136, No. 2 (February 1992), pp. 59-65, with adjustments for countries not reported there, on the basis of trade data of OECD countries.

(a) *Production*

Two countries have dominated machine-tool production: Japan had a 28.26 per cent market share in 1991, while united Germany followed with 22.19 per cent. The latter combined total of $9 billion was only $350 million higher than the output of the Federal Republic of Germany alone in the previous year. Most of the output from the German Democratic Republic had been sold to the former USSR, but sales ended when tools were priced in the convertible deutsche mark of the Federal Republic of Germany.

Table V.74 shows that Italy is the major producing country with 8.44 per cent of world production, though its output is less than 40 per cent of that of Germany. The United States, the former USSR and Switzerland come next. France, Spain and the United Kingdom are the only other industrialized countries

Table V.73. World machine-tool production and consumption, 1990 and 1991

Economic grouping and region	Production 1990 (million dollars)	Production 1991 (million dollars)	World share 1990 (percentage)	World share 1991 (percentage)	Percentage change 1990-1991	Consumption 1990 (million dollars)	Consumption 1991 (million dollars)	World share 1990 (percentage)	World share 1991 (percentage)	Percentage change 1990-1991
A. Western Europe	22 183.8	19 643.9	48.7	47.8	-11.4	17 858.4	16 236.1	39.3	39.6	-9.1
Eastern Europe and USSR	4 875.6	3 167.2	10.7	7.7	-35.0	6 633.3	4 097.2	14.6	10.0	-38.2
Japan	10 945.3	11 617.7	24.1	28.3	6.1	7 617.5	8 344.0	16.8	20.3	9.5
North America	3 835.1	3 040.9	8.4	7.4	-20.7	5 537.4	4 478.7	12.2	10.9	-19.1
Other[a]	174.1	154.3	0.4	0.4	-11.4	422.0	315.9	0.9	0.8	-25.0
Total, A	42 013.9	37 624.0	92.3	91.5	-10.4	38 068.6	33 471.9	83.8	81.6	-12.1
B. Asia										
Centrally planned economies (including China)	821.7	837.6	1.8	2.0	1.9	1 200.0	1 250.0	2.6	3.0	4.2
Market economies	2 113.2	2 160.8	4.6	5.3	2.3	3 512.6	3 549.4	7.7	8.7	1.0
Latin America	497.8	404.7	1.1	1.0	-18.7	1 492.4	1 454.8	3.3	3.5	-2.5
Western Asia	50.0	60.0	0.1	0.1	20.0	901.0	983.0	2.0	2.4	9.1
Africa	25.0	27.0	0.1	0.1	8.0	277.0	315.0	0.6	0.8	13.7
Total, B	3 507.7	3 490.1	7.7	8.5	-1.1	7 383.0	7 552.2	16.2	18.4	2.3
TOTAL, A and B	45 521.6	41 114.1	100.0	100.0	-9.7	45 451.6	41 024.1	100.0	100.0	-9.7

Source: *American Machinist*, vol. 136, No. 2 (February 1992), pp. 59-65, with adjustments for countries not reported there on the basis of trade data of OECD countries.

a/ Australia, Israel, New Zealand and South Africa.

producing more than 1 per cent of the world's machine tools. Two developing countries, China and the Republic of Korea, and one area, Taiwan Province, each produce about 2 per cent of world output. Along with Singapore, they are the only economies that experienced output increases in 1991. Japan still recorded a loss in production despite the gain in the value of the yen, and so did Germany.

Several other countries not included on the list also produce machine tools. Some of these have long been producers on a small scale, while others have more recently developed to this stage. These include Greece, Ireland, New Zealand and Norway. Among producing countries in the South are Indonesia, Malaysia and Thailand. There is also some production among the countries in North Africa. Estimates for the amount of this production, based on import statistics for industrial countries, are included in the regional data in table V.73 and the totals from that table are used to determine the world share of the individual countries listed in tables V.74 and V.75. In addition, in virtually all of these countries there are some machine tools made by companies for internal use which are not always captured in the data.

(b) Consumption

Although machine tools are required because they are the basis of all other manufacturing, a country can be an extensive producer or trader of machine tools and still do relatively little of the manufacturing that uses them; however, most of the major industrial countries are both major producers and consumers of machine tools. Consumption, which is production plus imports minus exports, is shown for individual countries and areas in table V.75. The 10 largest-producing economies are also the 10 largest consuming economies, though the order is slightly different, and Taiwan Province among the producers is replaced by the Republic of Korea among the consumers.

Japan has steadily increased both its production and consumption of machine tools, and in 1991 had a slight increase measured in yen that, when converted to dollars, accounted for 20 per cent of world consumption. This was a third more than Germany and twice that of the United States. The worldwide slow-down, however, caused reductions in consumption in almost all of the industrial countries. Besides Japan, other exceptions were Austria and Hungary. As a result of increased foreign investment, consumption in Hungary nearly doubled despite a decline of 77 per cent in production. Several major Asian countries also showed slight gains, and Argentina reported consumption that was 83 per cent higher than in 1990.

(c) International trade

There is extensive international trade in machine tools, with the major exporting countries also being the major importers, as shown in tables V.76 and V.77. Germany, for example, the largest exporter with 26.47 per cent of total world exports, also commanded 12.92 per cent of the imports in 1991. An exception to this pattern is Japan; though it was the second largest exporter at 20.73 per cent of the total, it imported only 3.51 per cent of the total. This difference can be explained by the fact that exports accounted for only 34 per cent of Japanese production, whereas imports represented only 8 per cent of domestic consumption.

Table V.74. Largest machine-tool-producing countries and areas, 1990 and 1991

Rank in 1991	Country and area	Production 1990 (million dollars)	Production 1991 (million dollars)	World share 1990 (percentage)	World share 1991 (percentage)	Percentage change 1990-1991
	A. Developed economies					
1	Japan	10 945.3	11 617.7	24.04	28.26	6.1
2	Germany[a]	8 734.3	9 123.8	19.19	22.19	4.5
3	Italy	3 705.9	3 468.4	8.14	8.44	-6.4
4	United States	3 471.8	2 740.0	7.63	6.66	-21.1
5	USSR	4 000.0	2 500.0	8.79	6.08	-37.5
6	Switzerland	2 930.5	2 441.3	6.44	5.94	-16.7
7	United Kingdom	1 679.4	1 370.3	3.69	3.33	-18.4
8	France	1 311.5	1 081.6	2.88	2.63	-17.5
9	Spain	1 014.8	798.6	2.23	1.94	-21.3
10	Yugoslavia	630.0	375.0	1.38	0.91	-40.5
11	Romania	481.7	350.0	1.06	0.85	-27.3
12	Canada	363.3	300.9	0.80	0.73	-17.2
13	Austria	283.7	277.5	0.62	0.67	-2.2
14	Belgium	284.7	259.0	0.63	0.63	-9.0
15	Sweden	270.6	231.4	0.59	0.56	-14.5
16	Czechoslovakia	191.9	141.8	0.42	0.34	-26.1
17	Poland[b]	124.3	124.3	0.27	0.30	-
18	Netherlands	135.8	113.9	0.30	0.28	-16.1
19	Denmark	85.0	74.1	0.19	0.18	-12.8
20	Finland	50.7	45.1	0.11	0.11	-11.0
21	Portugal	32.6	29.0	0.07	0.07	-11.0
22	Australia	15.6	14.0	0.03	0.03	-10.3
23	South Africa	13.5	7.3	0.03	0.02	-45.9
24	Hungary	27.0	6.0	0.01	0.01	-77.0
	Total, A[c]	42 013.9	37 624.0	92.29	91.75	-10.4
	B. Developing economies					
1	Taiwan Province	943.7	981.5	2.07	2.39	4.0
2	China	821.7	837.6	1.81	2.04	1.9
3	Republic of Korea	785.1	790.8	1.72	1.92	0.7
4	Brazil	431.5	350.0	0.95	0.85	-18.9
5	India	242.8	230.0	0.53	0.56	-5.2
6	Singapore	104.5	113.0	0.23	0.27	8.1
7	Argentina	44.8	39.7	0.10	0.10	-11.4
8	Hong Kong	17.1	15.5	0.04	0.04	-9.4
9	Mexico	21.5	15.0	0.05	0.04	-30.2
	Total, B[c]	3 507.7	3 490.1	7.71	8.25	-1.1
	TOTAL, A and B	45 521.6	41 114.1	100.00	100.00	-9.7

Source: American Machinist, vol. 136, No. 2 (February 1992), pp. 59-63.

a/ Including the former German Democratic Republic.

b/ 1991 data not available for Poland.

c/ Including estimates for other countries listed in table V.73.

Switzerland also exports much of its production, some 88 per cent even though Swiss machines are generally the most expensive. They stand as the third largest exporter, with a world market share of 11.37 per cent. Switzerland imports more machine tools than Japan; more than two thirds of the machines consumed in Switzerland are imported.

After Switzerland, the most aggressive exporter is Taiwan Province, which exports 67 per cent of its production, its machine tool imports are also high at nearly 50 per cent of consumption. The United Kingdom exports 54 per cent of production, while imports account for 54 per cent of consumption. Italy exports 48 per cent of its output and imports about 34 per cent of the machines it uses. Two other countries are major exporters and at the same time major importers. France exports 41 per cent of its production and imports more than 67 per cent of its consumption; the United States exports 39 per cent of its production and imports 56 per cent of its consumption. Much of this export-import pattern can be explained by the fact that imports are re-exported to other countries. The most notable example of this is Hong Kong, where exports and imports are almost

Table V.75. Largest machine-tool-consuming countries and areas, 1990 and 1991

Rank in 1991	Country and area	Consumption 1990 (million dollars)	Consumption 1991 (million dollars)	World share 1990 (percentage)	World share 1991 (percentage)	Percentage change 1990-1991
	A. Developed economies					
1	Japan	7 617.5	8 344.0	16.76	20.33	9.5
2	Germany[a]	6 449.5	6 547.7	14.19	15.96	1.5
3	United States	4 714.4	3 820.0	10.37	9.31	-19.0
4	USSR	5 700.0	3 400.0	12.54	8.29	-40.4
5	Italy	3 019.8	2 742.5	6.64	6.69	-9.2
6	France	2 419.0	1 968.2	5.32	4.80	-18.6
7	United Kingdom	1 738.8	1 379.2	3.83	3.36	-20.7
8	Switzerland	1 184.9	976.5	2.61	2.38	-17.6
9	Spain	1 087.2	824.1	2.39	2.01	-24.2
10	Canada	823.0	658.7	1.81	1.61	-20.0
11	Austria	265.3	318.4	0.58	0.78	20.0
12	Belgium	341.9	314.8	0.75	0.77	-7.9
13	Romania	432.6	310.0	0.95	0.76	-28.3
14	Netherlands	318.7	299.2	0.70	0.73	-6.1
15	Sweden	329.6	233.0	0.73	0.57	-29.3
16	Yugoslavia	283.4	232.3	0.62	0.57	-18.0
17	Portugal	139.1	123.5	0.31	0.27	-11.2
18	Poland[b]	122.3	122.3	0.27	0.30	-
19	Czechoslovakia	162.7	120.2	0.36	0.29	-26.1
20	Denmark	136.2	118.7	0.30	0.29	-12.8
21	Finland	195.1	108.0	0.43	0.26	-44.6
22	Australia	90.4	82.0	0.20	0.20	-9.3
23	South Africa	131.6	55.9	0.29	0.14	-57.5
24	Hungary	18.6	36.7	0.04	0.09	97.3
	Total, A[c]	38 068.6	33 471.9	83.76	81.59	-12.1
	B. Developing economies					
1	Republic of Korea	1 549.3	1 581.4	3.41	3.85	2.1
2	China	1 115.4	1 186.6	2.45	2.89	6.4
3	Taiwan Province	597.6	615.8	1.31	1.50	3.0
4	Brazil	481.5	356.0	1.06	0.87	-26.1
5	India	328.3	305.3	0.72	0.74	-7.0
6	Singapore	281.7	296.4	0.62	0.72	5.2
7	Mexico	268.7	255.0	0.59	0.62	-5.1
8	Argentina	45.2	82.8	0.10	0.20	83.2
9	Hong Kong	32.3	12.2	0.07	0.03	-62.2
	Total, B[c]	7 383.0	7 552.2	16.24	18.41	2.3
	TOTAL, A and B	45 451.6	41 024.1	100.00	100.00	-9.7

Source: American Machinist, vol. 136, No. 2 (February 1992), pp. 59-65.

a/ Including the former German Democratic Republic.

b/ 1991 data are not available for Poland.

c/ Including estimates for other countries listed in table V.73.

equal, yet are more than 10 times greater than local production. Other countries where re-exporting can be found include Austria, Belgium, Denmark, Netherlands, Singapore and Sweden.

An indication of the development of machine tool production and consumption in countries other than major producers can be gleaned from table V.78. Available data are for trade in metalworking machinery and apparatus (a broader definition than that used for the data in tables V.73 through V.77), and represent only about one half of the total trade in these products. The data shown also are limited to the major 18 OECD countries; but because they include re-exports of imported machines from the 18, it does not necessarily reflect capacity.

(d) Major companies in the global industry

A few large, diversified companies manufacture machine tools; among the largest are Hitachi Ltd., Mazda Motor and Mitsubishi (all of Japan). However, most machine tools are produced by smaller companies, only a half dozen of these companies having sales greater than $500 million a year. Among the

Table V.76. Machine-tool exports of major trading countries and areas, 1990 and 1991

Rank in 1991	Country and area	Exports 1990 (million dollars)	Exports 1991 (million dollars)	Percentage share 1990	Percentage share 1991	Percentage change 1990-1991
	A. Developed economies					
1	Germany[a/]	5 016.4	5 032.9	23.63	26.47	0.3
2	Japan	3 980.1	3 941.8	18.74	20.73	-9.6
3	Switzerland	2 556.9	2 162.3	13.93	11.37	-15.4
4	Italy	1 740.3	1 653.6	8.20	8.70	-5.0
5	United States	1 062.5	1 080.0	5.09	5.68	1.6
6	United Kingdom	873.4	742.6	4.11	3.91	-15.0
7	Belgium	543.7	448.8	2.56	2.36	-17.5
8	France	520.3	443.3	2.45	2.33	-14.8
9	Spain	452.0	386.3	2.13	2.03	-14.5
10	Austria	391.2	365.6	1.72	1.92	-6.5
11	Sweden	289.0	247.9	1.36	1.30	-14.2
	B. Developing economies					
1	Taiwan Province	640.3	657.1	3.02	3.46	2.6
2	China	250.3	215.0	1.18	1.13	-14.1
2	Hong Kong	136.6	167.7	0.64	0.88	22.8
3	Republic of Korea	86.9	89.4	0.41	0.47	2.9
4	Brazil	37.8	54.0	0.18	0.28	45.9
5	India	28.8	25.0	0.14	0.13	-13.2
	Total, A and B	21 233.1	19 011.6	100.00	100.00	-10.5

Source: American Machinist, vol. 136, No. 2 (February 1992), pp. 59-65.
a/ Including the former German Democratic Republic.

Table V.77. Machine-tool imports of major trading countries and areas, 1990 and 1991

Rank in 1991	Country and area	Imports 1990 (million dollars)	Imports 1991 (million dollars)	Percentage share 1990	Percentage share 1991	Percentage change 1990-1991
	A. Developed economies					
1	Germany[a/]	2 131.6	2 456.7	10.04	12.92	15.3
2	United States	2 305.1	2 160.0	10.86	11.36	-6.3
3	France	1 627.9	1 329.9	7.67	7.00	-18.3
4	USSR	2 000.0	1 000.0	9.42	5.26	-50.0
5	Italy	1 054.2	927.6	4.96	4.88	-12.0
6	Switzerland	811.3	697.5	3.82	3.67	-14.0
7	United Kingdom	932.9	751.5	4.39	3.95	-19.4
8	Japan	652.3	668.1	3.07	3.51	2.4
9	Canada	651.3	537.7	3.07	2.83	-17.4
10	Belgium	601.0	504.6	2.83	2.65	-16.0
	B. Developing economies					
1	Republic of Korea	851.1	880.0	4.01	4.63	3.4
2	China	544.0	564.0	2.56	2.97	3.7
3	Singapore	322.1	362.3	1.52	1.91	12.5
4	Taiwan Province	294.2	291.4	1.39	1.53	-0.9
5	Mexico	258.0	250.0	1.22	1.31	-3.1
6	Hong Kong	151.8	164.4	0.71	0.86	8.3
7	India	114.3	100.3	0.54	0.53	-12.2
	Total, A and B	21 233.1	19 011.6	100.00	100.00	-10.5

Source: American Machinist, vol. 136, No. 2 (February 1992), pp. 59-65.
a/ Including the former German Democratic Republic.

Table V.78. Total machine-tool trade of individual countries and areas with 18 OECD countries, 1985 and 1990
(Millions of dollars)

Economic grouping, region, country and area	Imports		Exports		Percentage share in 1990		Percentage change 1985-1990	
	1985	1990	1985	1990	Imports	Exports	Imports	Exports
A. Developed economies								
North America								
Canada[a/]	357.1	663.4	168.0	312.6	3.48	1.97	85.8	86.1
United States[a/]	1 066.3	1 699.3	798.5	1 118.4	8.91	7.03	159.4	40.1
Western Europe, OECD								
Austria[a/]	162.8	516.2	174.3	418.6	2.71	2.63	217.[illegible]	140.2
Belgium and Luxembourg[a/]	216.9	626.5	139.2	346.3	3.28	2.18	188.8	148.8
Denmark[a/]	98.7	194.2	46.0	118.4	1.02	0.75	96.7	157.4
Finland[a/]	70.9	184.2	24.9	81.6	0.97	0.16	159.8	227.7
France	452.7	1 752.4	261.7	738.3	9.19	4.65	287.1	182.1
Germany, Federal Republic of[a/]	637.0	2 284.5	1 533.4	3 604.8	11.98	22.68	258.6	135.1
Greece[a/]	19.7	48.9	0.5	4.8	0.26	0.03	148.2	860.0
Iceland[a/]	3.6	4.1	-	0.2	0.02	-	13.8	-
Ireland	40.6	95.6	17.6	41.7	0.50	0.26	135.5	136.9
Italy	276.0	1 057.9	562.5	1 523.4	5.55	9.59	283.3	170.8
Netherlands[a/]	226.8	610.1	117.6	340.0	3.20	2.14	169.0	189.1
Norway	74.1	85.9	13.8	31.3	0.45	0.20	15.9	126.8
Portugal[a/]	24.2	107.6	6.2	21.9	0.56	0.14	344.6	253.2
Spain[a/]	78.4	512.9	102.6	301.4	2.69	1.90	554.2	193.8
Sweden[a/]	201.0	498.9	195.6	411.8	2.62	2.59	148.2	263.6
Switzerland[a/]	209.5	643.8	641.2	1 487.8	3.38	9.36	207.3	132.0
United Kingdom[a/]	388.5	1 040.8	365.1	835.6	5.46	5.26	167.9	128.9
Yugoslavia[a/]	91.6	143.8	14.4	65.4	0.75	0.41	57.0	354.2
Eastern Europe and USSR								
Bulgaria	87.6	48.7	4.0	13.8	0.26	0.09	-44.4	245.0
Czechoslovakia	98.2	187.1	50.0	80.3	0.98	0.51	90.5	60.6
German Democratic Republic	21.0	46.3	33.0	29.5	0.24	0.19	120.5	-10.6
Hungary	45.3	90.8	14.5	37.4	0.48	0.24	100.4	157.9
Poland	60.9	182.1	18.0	44.5	0.95	0.28	199.0	147.2
Romania	7.7	12.2	4.1	10.1	0.06	0.06	58.4	146.3
USSR	437.8	1 040.9	38.8	46.7	5.46	0.29	137.8	20.4
Japan	283.2	701.0	1 802.2	3 023.7	3.68	19.03	147.5	67.8
Other								
Australia	115.7	151.6	3.[illegible]	17.7	0.79	0.11	31.0	353.8
Israel	68.5	64.0	16.0	34.1	0.34	0.21	-6.6	113.1
New Zealand	17.9	15.3	1.1	3.5	0.08	0.02	-14.5	218.2
South Africa	66.3	167.2	4.4	7.8	0.88	0.05	152.2	77.3
B. Developing economies								
Latin America								
Argentina	27.1	57.4	1.8	1.0	0.30	-	111.8	-
Bahamas	0.3	0.1	-	-	-	-	-66.7	-
Brazil	72.9	213.0	34.7	51.9	1.12	0.33	192.2	49.6
Chile	11.4	46.4	-	-	0.24	-	307.0	-
Colombia	16.2	42.3	-	0.3	0.22	-	161.1	-
Ecuador	5.0	9.4	-	-	0.05	-	88.0	-
Guatemala	1.7	3.5	-	-	0.02	-	105.9	-
Netherlands Antilles	0.5	3.6	0.1	0.1	0.02	-	620.0	-
Mexico	211.0	317.7	6.7	8.9	1.67	0.06	50.6	32.8
Peru	6.0	9.1	-	-	0.05	-	51.7	-
Trinidad and Tobago	4.3	8.1	-	-	0.04	-	88.4	-
Venezuela	69.4	140.1	-	1.5	0.73	-	101.9	-

Table V.78. (continued)

Economic grouping, region, country and area	Imports		Exports		Percentage share in 1990		Percentage change 1985-1990	
	1985	1990	1985	1990	Imports	Exports	Imports	Exports
Africa								
Algeria	49.6	75.6	-	0.1	0.40	-	52.4	-
Cameroon	0.8	2.2	-	-	0.01	-	175.0	-
Côte d'Ivoire	0.5	1.9	-	-	0.01	-	280.0	-
Gabon	0.4	0.3	-	0.1	-	-	-25.0	-
Ghana	2.1	7.3	0.1	-	0.04	-	247.6	-
Liberia	1.0	0.4	-	-	-	-	-60.0	-
Libyan Arab Jamahiriya	28.5	11.3	-	0.6	0.06	-	-60.4	-
Morocco	6.8	13.2	-	0.2	0.07	-	94.1	-
Nigeria	27.1	11.7	0.3	-	0.06	-	-56.8	-
Tunisia	7.4	10.9	-	0.2	0.06	-	47.3	-
Zaire	2.6	7.3	-	-	0.04	-	180.8	-
Western Asia								
Iran (Islamic Republic of)	102.4	225.7	0.1	0.1	1.18	-	120.4	-
Iraq	16.4	90.7	0.1	0.3	0.47	-	453.0	-
Kuwait	5.8	4.0	-	-	0.02	-	-31.0	-
Oman	4.8	2.1	0.1	-	0.01	-	-56.3	-
Qatar	1.1	2.0	-	0.1	0.01	-	81.8	-
Saudi Arabia	43.0	60.5	0.2	0.4	0.32	-	40.7	-
Syrian Arab Republic	5.7	8.2	-	-	0.04	-	43.9	-
Turkey[a/]	75.4	211.8	0.6	44.9	1.11	0.23	180.9	7 383.3
United Arab Emirates	9.2	16.8	0.4	0.3	0.09	-	82.6	-
Asia, developing market								
Brunei Darussalam	0.3	0.1	-	-	-	-	-66.7	-
Hong Kong	30.7	54.3	4.0	6.1	0.28	0.04	76.9	-
India	116.1	268.8	4.8	12.1	1.41	0.08	131.5	152.1
Indonesia	45.4	73.1	-	0.2	0.38	-	61.0	-
Malaysia	14.9	67.4	0.1	2.3	0.35	0.01	352.3	-
New Guinea	0.5	0.5	-	-	-	-	-	-
Pakistan	29.3	36.2	0.1	-	0.19	-	23.5	-
Philippines	34.9	67.6	0.2	1.5	0.35	-	93.7	-
Republic of Korea	98.3	480.6	20.3	59.3	2.52	0.37	388.9	192.1
Singapore	57.0	147.5	25.9	40.8	0.77	0.26	158.8	57.5
Taiwan Province	51.3	203.3	205.3	354.2	1.07	2.23	296.3	72.5
Thailand	25.0	81.4	-	11.6	0.43	0.07	225.6	-
Asia, centrally planned								
China	234.8	353.2	7.7	74.3	1.85	0.47	50.4	864.9
TOTAL	7 836.0	19 071.7	7 495.7	15 892.5	100.00	100.00	143.4	112.0

Source: OECD, *Foreign Trade by Commodities*, Series C (Paris, 1990).

a/ Countries whose import and export data are combined in tabulation.

companies reported in table V.79, 14 of them are based in Japan, five in Germany, four in the United States, and one each in Switzerland and Italy.

There is a lack of comparable data for plants in the former centrally planned economies. Among the largest firms, Amada is primarily an engineering and marketing company, doing little manufacturing. Fanuc is primarily a producer of numerical control systems, although it also produces machine tools, robots, and plastics machinery. In 1991, Cross & Trecker was acquired by Giddings & Lewis (United States). The combined sales of these two firms in 1990 were $663 million, which would have placed them in sixth place on the list and made them the largest producer in the United States (if only machine tools are counted). More than half of the turnover listed for Litton Industries is in handling equipment [57]. Among Japanese firms (Yamazaki Mazak, Okuma and Mori Seiki) which started as Japanese lathe manufacturers, all also manufacture machining centres and other types of machine tools.

2. *Manufacturing capacity of developing countries and areas*

(a) Taiwan Province

The principal manufacturing capacity among developing countries and areas is accounted for by Taiwan Province which has an industry with a large number of small, aggressive companies, most of them

Table V.79. World's 25 largest machine-tool companies, 1990

Rank	Company and country	Turnover[a] (million dollars)	Percentage change	Profit[b] (million dollars)	Percentage change	Margin[c]	Number of employees
1	Amada Co., Ltd. (Japan)	1 207.2	4.7	133.7	44.7	10.0	1 594
2	Yamazaki Mazak Corp. (Japan)	1 150.4	-2.8	..	..	..	3 524
3	Fanuc Ltd. (Japan)	1 100.7	2.0	242.3	24.4	22.0	2 046
4	Okuma Machinery Works (Japan)	739.0	11.1	32.9	15.8	4.2	1 884
5	Litton Industries, Inc. (United States)	721.8	-1.1	178.8	2.7	3.5	59 600
6	Mori Seiki Co., Ltd. (Japan)	661.3	4.0	81.2	4.0	12.0	1 803
7	Komatsu Ltd. (Japan)	470.7	-0.7	195.1	1.9	3.1	15 097
8	Schuler Group (Germany)	464.2	42.4	..	..	..	4 000
9	Toyoda Machine Works (Japan)	464.1	-0.5	19.5	-25.3	1.5	4 620
10	Gildemeister Group (Germany)	443.2	29.0	10.2	-20.9	2.3	3 742
11	Maho Group (Germany)	442.1	56.1	8.7	29.8	2.0	2 780
12	Fuji Machine Mfg. (Japan)	435.7	11.1	48.4	20.4	11.1	931
13	Cross & Trecker Corp. (United States)	430.9	-5.6	-7.7	-	-1.8	3 200
14	Cincinnati Milacron, Inc. (United States)	429.0	8.9	-24.3	-	-2.9	7 416
15	Ingersoll Milling Mach.Co.(United States)	400.0	9.1	..	..	..	4 806
16	Trumpf Group (Germany)	399.7	17.3	20.7	19.6	5.2	2 874
17	Deckel Group (Germany)	393.6	36.3	-3.3	d/	-0.8	2 213
18	George Fischer (Switzerland)	380.1	4.2	56.9	16.8	3.1	15 299
19	Toshiba Machine (Japan)	374.2	4.1	35.6	26.7	3.5	3 383
20	Hitachi Seiki (Japan)	364.8	5.3	22.8	-52.9	5.6	1 247
21	Amadasonoike (Japan)	364.7	-6.7	23.9	42.3	6.6	573
22	Makino Milling Machine (Japan)	336.6	5.8	31.9	71.5	8.0	1 085
23	Amada Wasino (Japan)	321.8	13.1	15.1	37.3	4.7	528
24	Citizen Watch (Japan)	298.4	-11.9	80.9	11.9	3.3	3 192
25	Comau, SpA (Italy)	294.5	41.7	0.4	-97.7	0.1	3 178

Source: *American Machinist*, Blue Bulletin (August 1991).

a/ Turnover figures represent the portion of total sales accounted for by machine tools (including numerical controls and handling equipment).

b/ Net profit figures represent after-tax profit for the total turnover of the company.

c/ Calculated on total turnover.

located in the area around Taichung. The industry is heavily dependent on exports, dominated by some 50 companies. The influx of non-numerically controlled (non-NC) lathes from Taiwan Province into the United States has virtually eliminated the production of that product in the latter country. This has led to the inclusion of Taiwan Province in the negotiated limits on shipments of both NC and non-NC lathes in an agreement that expired in 1991, and for which extension is being sought. The agreement has caused a decline in exports to the United States, largely offset by increases to Europe. The Government of Taiwan Province also has funded a programme to help the industry develop precision products. Machines with numerical controls, generally Japanese, now make up a substantial part of capacity in the industry, and about a fourth of the exports.

(b) China

China began privatizing industry in the early 1980s, leading to steady growth in the machine-tool industry. An important result was that imports, which peaked by 1986, have declined each year since then. Exports continued to increase until 1990, but declined in 1991. Production reached a peak of $1.15 billion in 1989 [58]; it has declined as a consequence of the contractionary macroeconomic policies. The capacity should be at least equal to the level reached in 1989, but this value must be considered in terms of the difficulty of determining the value of products in a centrally planned economy where prices need not reflect production costs.

(c) Republic of Korea

Although the capacity of the industry in the Republic of Korea is less than that in either China or Taiwan Province, exports are much lower, since there is a much greater flow into the domestic manufacturing economy. To supply these other industries, imports are also one half again higher than those of China and three times those of Taiwan Province. There were 673 machine tool plants in 1988 with 20,764 workers, but the majority of these plants were quite new and had lower employment levels. About 100 companies of longer standing account for more than half of the production. The largest were built in a new industrial area developed by the Government in Changon, near Pusan. After 1988, increasing labour disputes slowed the growth of the domestic industry and, combined with a strengthened currency, resulted in growing demand being handled primarily by imports [59].

(d) India

There is ample machine tool capacity to meet present needs in India, where one large government-owned company and nearly 300 private companies form the backbone of the industry. The Government has stimulated industry growth: restricting imports through protectionist trade policies for many years. Though there is not an outright ban today, tariffs on imports range from 35 to 135 per cent. This has led to an unusual number of foreign arrangements, either licensing or joint ventures. In 1991, 33 Indian machine tool builders had a total of 41 such agreements with companies in Austria, Czechoslovakia, France, Germany, Hungary, Italy, Japan, Sweden, Switzerland, United Kingdom and United States. Well over half of exports were going to the USSR as recently as 1990 [60], but this situation may now deteriorate.

(e) Singapore

As an early free market bastion in the area, Singapore has attracted a number of machine tool plants from Japan and the United States, and production has grown steadily for several years. However, capacity is still small compared to its trade volume. Imports have increased 10 times since 1988 and exports by a factor of six. More than half of its exports represent re-exports of imported goods, Singapore being a central trading point for South-East Asia.

(f) Brazil

Brazil has long had the largest machine-tool capacity in Latin America. The major manufacturer and exporter is Romi, a manufacturer of lathes. Rapid industrialization after 1970 caused a large increase in imports; however, after 1976 restrictions on machine tool imports became so severe that it forced development of the domestic industry. A number of German firms began machine tool manufacturing in Brazil during this period. There are more than 50 tool companies in Brazil now, including Italian firms in addition to the German ones. At present there is conside.able excess capacity, as economic reform measures continue to restrict investment.

(g) Mexico

The growth of industry in Mexico has been supplied almost entirely by imported machine tools, with little capacity existing in its own small industry. United States companies have been rapidly increasing their manufacturing operations in Mexico, and if the negotiations to include Mexico in a free trade area with Canada and the United States are successful, this rate of growth will increase. However, the internal capacity to produce the machine tools for this expansion does not appear to exist.

3. Capacity utilization and expansion plans

(a) Japan

The largest machine tool consumer in the world is Japan. Since Japan permits relatively few imports, the Japanese builders have had this market to themselves. Only excessive protectionism has fuelled the tremendous expansion of the Japanese industry. None the less, in 1991 new orders slackened and shipments fell by 1.2 per cent (though this translated to an increase when converted to dollars). If this marks a leveling-off of demand in Japan, it will cause an even greater pressure to export. Trade frictions have been increasing between Japan and the developed countries of Europe and North America, and these practices are likely to increase as long as current policies continue. Factories in Japan have the most modern and productive equipment in the world, but their wages are now higher than in many other countries. They also make a practice of keeping prices competitive by setting a target price for a product and then assigning costs and profits to that product in a way that will permit that price to be achieved [61]. Although tool imports grew slightly in 1991, when measured in dollars, they declined in yen by more than consumption, so that imports represented only 8 per cent of consumption in 1991, down from 8.5 per cent the previous year.

(b) Germany

Because so much of the production of the former German Democratic Republic had gone to the USSR, and that of the former Federal Republic of Germany to Eastern Europe, production in the united Germany declined by some $700 million or 7 per cent in 1991. This was the first decline in many years. In the wake of reports of the German contribution to the arms and chemical-warfare build-up in the Islamic Republic of Iran and the Libyan Arab Jamahiriya, the Government introduced stiff new export restrictions on militarily sensitive industrial goods. Many machine-tool builders argued that the Government had over-reacted and handicapped machine tool exports for other purposes.

The efforts to restructure and rebuild industry in the newly independent States of the former USSR produced a slight increase of 1.5 per cent in consumption. The situation worsened in 1992, and many of the machine-tool builders are operating at a loss.

(c) United States

Production fell by 21 per cent, consumption by 19 per cent, and imports by 6 per cent during the 1991 recession. However, since imports declined less than consumption, they continued to increase their share of the United States market, rising to 57 per cent of consumption. Although recession in Canada caused a 29 per cent decline in exports to that country, which is the principal market of the United States industry, exports as a whole increased slightly more at 37 per cent of production. Exports to Germany increased by 31 per cent and to Japan by 25 per cent.

The voluntary restraint agreements that limited imports of certain equipment (lathes, machining centres, and numerically controlled turret punch presses) from Japan and Taiwan Province expired at the end of 1991. There was considerable debate in the industry over whether it had been helped or hurt by the restrictions. Some pointed to companies that had prospered by building low-cost machining centres, while others pointed to firms that had been hurt because their use of imported parts had been restricted. In the end, the Government sought a two-year extension of the agreements. Restructuring into a smaller industry continued as several more plant closings were announced and liquidation of several others continued.

(d) Poland

Poland, which has moved rapidly toward privatization, has announced that the 32 companies that make up its machine-tool industry are for sale, and is employing a consulting firm in the United Kingdom to search for buyers. The industry, one of the best established in Eastern Europe, was primarily dependent upon trade with other centrally planned economies.

4. *Restructuring and deployment*

There is certainly idle plant capacity in almost all of the countries that produce machine tools. Whether the skilled workers needed to utilize this capacity would be available if required is another matter. In the United States the downsizing resulting from reconstruction continues; few of the workers who have been laid off would be available if there were to be a major increase in demand. Concerning many of the job skills involved in machine operation, new workers could be found or trained, but for the assembly operations, which are more critical for machine tools than for most assembled products, labour problems could be severe. In Germany and other countries where there is still a strong tradition of training skilled workers as apprentices, the problems of finding skilled workers is not so great. The greatest restructuring is needed in Eastern Europe and the industrial States of the former USSR. As this takes place, it will certainly increase the capability of their machine tools to meet current international standards, even if it reduces the total machine-building capacity of most countries.

5. *Environmental considerations*

The principal environmental problems that arise in producing machine tools stem from dust generation in foundries producing castings and from the machining of cast iron. Also created are noise and air pollution from forging, noise from stamping, air pollution and waste disposal from cleaning, stripping, and surface treatment processes, and air pollution and waste disposal required when spray-painting. Closely related are the hazards of working around machinery. Smaller firms, and many larger ones, avoid many of these problems by not producing their own castings, by discontinuing their use altogether, or by shipping parts to other firms for chemical treatment.

The cost of meeting the strict environmental requirements on foundries in the United States and some other industrialized countries has resulted in the closing of many foundries and has produced difficulties in acquiring quality castings. These factors, combined with the cleaner operation associated with machining steel, largely induced most machine tool builders to shift to the use of welded steel assemblies for bases and frames and to substitute steel for cast iron in many smaller parts.

When cast iron is machined, air pollution can be avoided by encapsulating the machine and precipitating the dust produced. Surviving foundries in the countries with strict environmental laws have taken steps to control air pollution and have found that one result is often higher-quality castings. There are productivity gains from using castings aside from the ease of machining them, however, and some companies have begun to equip their machines to meet the latest environmental regulations.

The environmental problems associated with forging have encouraged a change to other methods whenever possible and reduced the use of forging. Noise can be reduced by encapsulating the machines, but the size of forging hammers and presses makes this difficult and expensive, while the isolation tends to reduce productivity unless the operation can be automated. In stamping and other pressworking operations the machine may be designed to contain the noise, as some press builders have demonstrated.

Treatments required for cleaning and painting processes can be more complex and may vary with each of the pollutants. Painting is done in enclosed areas, increasingly by robots, using water to capture the overspray. The water must be purified before it can be disposed of. Dealing with solvents used in cleaning and stripping can be even more difficult.

Recent clean-air laws in the United States have placed strict limits on pollutants such as hydrocarbons and other volatile organic compounds, limits that will affect all plants involved with cleaning or painting. In many cases these will lead to a search for alternative materials over and above the addition of equipment for cleaning the air. Emission standards governing 189 toxic substances will also be developed, and processes that involve any of these substances will have to be adjusted to comply with the established limits. The time required to develop the standards and then to secure compliance is expected to extend over a decade.

The process of dealing with environmental problems is less advanced in Western Europe and Japan and has scarcely been started elsewhere.

6. *Technological trends*

A group of non-traditional machining processes have developed, some as many as 50 years ago; today they are often referred to as physico-chemical processes, and they include electrical discharge machining (EDM), electrochemical machining, ultrasonic machining, and laser machining. None developed as rapidly as had been originally forecast, though each found niche applications. In recent years further technical developments have made EDM an important and widely used process. Experiments with machines using electron beams to process materials have been the subject of development for many years, but have been eclipsed by lasers which have become a rapidly growing technological sector. Other machine tools have developed because of the ability to apply numerical controls to machine tools, machining centres and turning machines.

(a) Electrical discharge machining

What is non-traditional about EDM is both the type of chip produced and the method of producing it.

The heat of an electrical spark vaporizes tiny bits of material and blasts them from the surface being machined. The sparks are generated one at a time in a rapid series between an electrode (which serves as the tool) and the workpiece, which are separated by an insulating fluid (called a dielectric). The workpiece must be electrically conductive, but its hardness is of little consequence, which makes the process of particular value in machining materials used to make cutting tools.

There are two distinctly different types of EDM process: the ram type and the travelling wire. The origins of the process are clouded in controversy involving simultaneous research in the United States and the USSR during the Second World War. The process was originally developed in the United States as a salvage operation to remove broken taps from workpieces. A vibrating electrode that made and broke the spark in a dielectric fluid hollowed out and collapsed the broken tap. The machines were called tap disintegrators. The electrode can also be positioned at a relatively constant distance, and the spark can be initiated and broken with a resistance-capacitance relaxer circuit rather than by vibrating the electrode, the basis for the ram-type machines [62]. The travelling-wire (now often called wirecut or simply wire) form of EDM was developed in Switzerland and is now the dominant form, though the applications of the two types are different.

In the basic ram-type machine, the workpiece is submerged in a tank of dielectric fluid, usually a low-viscosity oil, which forces a pumping system in continuous motion. The electrode on the ram is lowered into the fluid and approaches the workpiece. An electrical potential is established by the power supply, generally 80 to 100 volts between the electrode and the workpiece. As the servo-mechanism feeds the electrode closer to the workpiece until the voltage gradient exceeds the electrical resistance of the fluid, a spark occurs. The spark has a temperature of 14,000° to 20,000° F, which melts and vaporizes a tiny bit of both workpiece and electrode. The power supply then cuts off the current; the material solidifies into a "chip", and is washed away by the flowing dielectric. This pattern is repeated with each cycle of pulsating voltage [63].

As the process has developed, a series of different methods have been used to generate the spark. The initial relaxer circuit used in the USSR and elsewhere was followed by methods that could deliver longer and higher pulses. The rotary impulse generator could do this, but could not produce fine finishes. Vacuum tubes came next as an attempt to reinforce the energy of the relaxer circuit. Ultimately, transistor circuits were used to switch the pulse on and off. Controlled by feedback circuits and adaptive control networks, the circuits are the basis of modern power supplies.

The voltage required to create a spark depends on the distance at the closest point, the insulating qualities of the dielectric, and the debris in the gap. The ram must advance until a spark is created and retract if it makes direct contact with the workpiece. Adjustments to the power supply determine the intensity and duration of the spark, the size of each crater, the speed of metal removal and the surface finish. However, the EDM process is slow. A typical rate of metal removal is 1 cubic inch (16.4 cubic centimetres) per hour for a current of 20 amperes with a steel workpiece and a graphite electrode [64]. Because higher metal-removal rates produce rougher surface finishes, an EDM operation will often include initial cuts at higher rates of removal, tapering off to lower and lower rates for the finishing operation.

Another problem is electrode wear. In theory the electrode would wear away at the same rate as the workpiece, but in practice electrode wear depends on the polarity, thermal conductivity and melting-point of the electrode, as well as the duration and intensity of the electric pulse. In practice it is possible to restrict electrode wear to as little as 1 per cent of material removed from the workpiece. The hardness of the electrode does not influence the wear rate, as ideally it never contacts the workpiece; when it does, it is immediately retracted. A variety of electrode materials are used, but brass or copper is generally favoured in Europe and graphite in the United States. Graphite machines easily produce shaped electrodes used in die-sinking, but require special equipment to collect and control the dust produced. Because of their lower melting-point, copper electrodes wear more rapidly than other metals, but they produce fine finishes and are often chosen for this reason.

Wirecut machines work in the same way, except that the electrode is a moving wire that cuts in the fashion of a band-saw, and instead of being immersed in the dielectric, the fluid flows along the wire. Electrode wear is not a factor in wirecut machines because the wire is generally used only once. The wire is usually made of copper, typically 0.008 inches (0.203 millimetres) in diameter, and can be coated with aluminium or zinc, the coating materials vaporize as they absorb heat and reduce the temperature rise in the core wire, permitting faster cutting rates. When sharper inside corners need to be cut, tungsten or molybdenum wire are sometimes used in diameters as small as 0.002 inches (0.051 millimetres).

It was initially thought that substantial advances would occur in the cutting rates for EDM, but that has not happened. There has been some improvement, but the rates remain very slow in comparison with other methods of metal-cutting. There have been a great many technical improvements, most of them small, combined with a recognition that cutting speed is not the only factor in cost. Today, many shops operate their EDM machines 24 hours a day, seven days a week, much of the time with no operator in attendance. If a ram-type machine can produce, in two of three days, a finished steel mould of complex shape that is the mirror image of an easily machined graphite electrode, it can be the lowest-cost and even the fastest way to produce it.

A major advance has been electrode orbiting, first as an accessory and later built into either the machine ram or table. Essentially this causes the electrode to move in an orbital path in relation to the workpiece (or vice versa). The electrode, normally undersized by the amount of the gap clearance, is now undersized by an additional amount to allow for the orbiting. This permits more even electrode wear because more cutting is done with the sides of the electrode and less with the bottom and corners. The result is the more accurate control of finished dimensions by adjustments to the orbital path, making possible the cutting of inside tapers, contoured sides and undercuts. In addition, the orbiting movement of the electrode helps to stir the dielectric fluid, improves the flushing of the cutting area, and speeds the operation. Orbiting also makes it possible to cut shapes different from that of the electrode.

A next important improvement has been the addition of computer NC systems to the ram-type EDM machines. More complex motions became possible, even the generation of complex shapes with rod-shaped electrodes operating rather like end mills in the cavity. This also has made possible longer periods of untended operation. Some machines are equipped with automatic electrode changers, much like the tool-changing features of a machining centre. In fact, with computer NC machines no orbiting mechanism is necessary because the orbiting motions can be programmed into the table movements.

Wirecut machines are always equipped with NC systems because the shape is generated by changing the position of wire and workpiece. Wirecut machines can only be used to make external cuts on a workpiece or internal cuts that go all the way through the workpiece, and they now predominate in these applications. For internal work, a hole must first be cut through the workpiece with a rod electrode, either on a ram-type machine or with an accessory on the wirecut machine. The starting hole can be very small, typically 0.06 to 0.12 inches (1.52 to 3.05 millimetres) in diameter. Wire breakage is a big problem with wirecut EDM, hence a major breakthrough came with the development of automatic rethreading machines. Such machines can start a new cut automatically or restart one in which the wire has broken. For restarting, the machine must return to the starting hole, because it cannot push the wire through the kerf of the cut, which will be only slightly wider than the wire. None the less, after restarting it can track rapidly through the programme to the point where it was cutting when the wire broke.

Wirecut machines have greatly increased their speed since first introduced. While an initial cutting rate of 1 square inch (6.45 square centimetres) per hour was possible, today the top rate may be as much as 30 square inches per hour. By using deionized water instead of oil as the dielectric fluid, cuts can be even faster and fireproof as well (an extra advantage if the operation is untended). However, the surface finish is better with oil. Some machines are capable of automatically switching between oil and water to suit the job at hand. Higher speeds are the result of many small improvements, including improved spark parameters, finer servo-mechanisms, more efficient flushing, and changes in wire and guiding systems [65].

Ram-type EDM machines range in size from small machines for use on carbide cutting tools to models large enough to produce dies for an automobile roof. There are many special machines to handle unusual configurations of the workpiece, notably for many parts used in jet engines.

One shadow over the EDM process has been the question of whether the intense spark temperatures damage the surface, creating a recast layer that may affect the physical properties of the part being manufactured. As more was learned about the process, it was found that this could be controlled by proper adjustment of the EDM operation, and today many of the production applications involve machining the superalloys used in jet engines.

The same questions have been raised over the use of EDM to shape cutting tools made of carbide or polycrystalline diamond. If surface damage has occurred, it may not be visible. Successful operation requires careful control of the power supply and quality techniques to minimize damage [66]. The EDM process is also capable of drilling very small holes. Some processors report routinely producing holes as small as 0.005 inches (0.127 millimetres) in diameter. The holes in fuel injector nozzles are produced by EDM despite the slowness of the operation and the large quantity required; eventually lasers are likely to replace EDM for mass production operations.

Ram-type EDM machines are produced in a number of developed countries, but more complex wirecut machines are primarily produced in Japan and Switzerland, followed by Germany, Italy, Spain and Sweden. One developing economy that has substantial production of EDM machines is Taiwan Province. Although most of its production is in ram-type machines without numerical control, it also produces ram-type and wirecut machines. Japan, which has the largest number of companies producing EDM machines, seems to be the largest producer. Table V.80 shows that most exports from Japan were in the form of wirecut machines in 1990, with further information on the latter provided in table V.81.

Among developing countries the greatest utilization of this new technology is in Asia, with little application in either Latin America or Africa. There were notable increases in imports of wirecut machines by the Republic of Korea, Singapore, Thailand, and Malaysia. Table V.82 provides a more realistic indication of the worldwide distribution of electrical discharge machines by combining the exports from Japan, Federal Republic of Germany, United States and Taiwan Province for all types of EDM machines.

(b) Lasers

The laser is unique in the variety of manufacturing jobs to which it can be applied; it can cut, drill holes, weld, heat-treat, alloy, clad, coat, strip, mark and deflash. As a result, the use of lasers in metalworking plants is increasing. While no one laser can perform all of these operations, and the efforts to develop machine tools that use lasers to perform turning or milling operations have produced impressive demonstrations, they have not yet found large-scale acceptance.

The idea of creating an "optical maser" was first suggested in 1958. The maser began as a device for amplifying microwaves by the stimulated emission of radiation. The maser using light waves rather than microwaves, or laser, as the new device was called, soon eclipsed its parent. In effect, the laser consists of an intense beam of coherent light. All light is produced by atoms absorbing energy from an external source and emitting this energy in the form of photons of light. In the laser, the atoms are excited to produce that intense beam. Amplification is accomplished

Table V.80. Exports from Japan of electrical discharge machines, 1990
(Thousands of dollars)

Economic grouping, region, country and area of destination	Number of units	Type of machine and value of shipments: Wirecut	Ram-type numerical control	Ram-type non-numerical control	Total value	Percentage share
A. Developed economies						
North America						
Canada	8	328	358	10	696	0.32
United States	736	46 664	11 002	1 290	58 956	27.49
Western Europe						
Austria	1	-	173	-	173	0.08
Belgium	6	288	-	-	288	0.13
Denmark	2	77	-	-	77	0.04
Finland	3	256	-	-	256	0.12
France	65	4 000	-	73	4 073	1.90
Germany, Federal Republic of	908	52 573	13 443	2 104	68 120	31.76
Ireland	1	-	278	-	278	0.13
Italy	56	3 855	143	86	4 084	1.90
Netherlands	3	255	-	-	255	0.12
Norway	2	-	303	-	303	0.14
Spain	52	2 951	-	-	2 951	1.38
Sweden	28	1 604	-	-	1 604	0.75
Switzerland	13	277	-	26	303	0.14
United Kingdom	107	6 523	410	140	7 073	3.30
Eastern Europe and USSR						
Hungary	1	41	-	-	41	0.02
USSR	4	332	130	45	507	0.24
Other						
Australia	18	903	697	5	1 605	0.75
Israel	2	211	-	-	211	0.10
New Zealand	1	66	-	-	66	0.03
South Africa	5	317	-	-	317	0.15
Total, A	2 022	121 521	26 937	3 779	152 237	70.99
B. Developing economies						
Latin America						
Brazil	7	721	-	-	721	0.34
Colombia	2	152	-	-	152	0.07
Africa						
Nigeria	2	33	39	-	72	0.03
Western Asia						
Iran (Islamic Republic of)	9	1 325	-	145	1 470	0.69
Asia, developing market						
Hong Kong	91	3 912	1 590	145	5 647	2.63
India	8	591	708	-	1 299	0.61
Indonesia	2	172	-	-	172	0.08
Malaysia	25	1 336	735	103	2 174	1.01
Pakistan	4	-	-	42	42	0.02
Philippines	14	248	289	66	603	0.28
Republic of Korea	310	22 421	1 254	779	24 454	11.40
Singapore	148	8 031	372	121	8 524	3.97
Sri Lanka	2	-	-	2	2	-
Taiwan Province	100	7 899	764	-	8 663	4.04
Thailand	98	4 954	2 098	127	7 179	3.35
Asia, centrally planned						
China	12	581	430	40	1 051	0.49
Total, B	834	52 376	8 279	1 570	62 225	29.01
TOTAL, A and B	2 856	173 897	35 216	5 349	214 462	100.00

Source: Database of the Association for Manufacturing Technology, McLean, Virginia.

Table V.81. Exports from Japan of wirecut electrical discharge machines, 1988 and 1990

Economic grouping, region, country and area of destination	Number of units 1988	Number of units 1990	Value (thousand dollars) 1988	Value (thousand dollars) 1990	Percentage share 1988	Percentage share 1990	Percentage change 1988-1990
A. Developed economies							
North America							
Canada	13	5	1 078	328	0.59	0.19	-69.6
United States	706	563	59 282	46 664	32.19	26.83	-21.3
Western Europe							
Austria	3	-	217	-	0.12	-	-
Belgium	6	5	394	288	0.21	0.17	-26.9
Denmark	2	2	114	77	0.06	0.04	-53.2
Finland	1	3	51	256	0.03	0.15	602.4
France	30	61	2 374	4 000	1.29	2.30	68.5
Germany, Federal Republic of	562	649	48 922	52 573	26.56	30.23	7.5
Hungary	-	1	-	41	-	0.02	-
Italy	56	48	3 891	3 855	2.11	2.22	-0.9
Netherlands	4	3	158	255	0.09	0.15	61.4
Portugal	3	-	280	-	0.15	-	-
Spain	21	52	1 409	2 951	0.77	1.70	109.4
Sweden	17	28	954	1 604	0.52	0.92	68.1
Switzerland	3	7	125	277	0.07	0.16	121.6
United Kingdom	117	98	8 761	6 523	4.76	3.75	-25.5
Eastern Europe and USSR							
USSR	14	2	1 945	332	1.06	0.19	-82.9
Other							
Australia	28	13	1 900	903	1.03	0.52	-52.5
Israel	-	2	-	211	-	0.12	-
New Zealand	-	1	-	66	-	0.04	-
South Africa	8	5	455	317	0.25	0.18	-30.3
Total, A	1 594	1 548	132 310	121 521	71.84	69.88	-8.2
B. Developing economies							
Latin America							
Brazil	3	7	271	721	0.15	0.41	166.1
Colombia	-	2	-	152	-	0.09	-
Mexico	1	-	106	-	0.06	-	-
Africa							
Nigeria	-	1	-	33	-	0.02	-
Western Asia							
Iran (Islamic Republic of)	-	7	-	1 325	-	0.77	-
Asia, developing market							
Hong Kong	83	62	7 494	3 912	4.07	2.25	-47.8
India	4	5	300	591	0.16	0.34	97.0
Indonesia	4	2	513	172	0.28	0.10	-66.5
Malaysia	2	12	178	1 336	0.10	0.77	650.6
Philippines	2	3	190	248	0.10	0.14	30.5
Republic of Korea	140	184	15 642	22 421	8.49	12.89	43.3
Singapore	51	96	5 261	8 031	2.86	4.62	52.6
Taiwan Province	218	93	19 012	7 899	10.32	4.54	-58.4
Thailand	16	60	1 871	4 954	1.02	2.85	164.8
Asia, centrally planned							
China	6	4	1 017	581	0.55	0.33	-42.9
Total, B	530	538	51 855	52 376	28.16	30.12	1.0
TOTAL, A and B	2 124	2 086	184 165	173 897	100.00	100.00	-5.5

Source: Database of the Association for Manufacturing Technology, McLean, Virginia.

Table V.82. Exports of electrical discharge machines from Japan, Germany, Federal Republic of, Taiwan Province and United States, 1990
(Thousands of dollars)

Economic grouping, region, country and area of destination	Japan	Germany, Federal Republic of	Taiwan Province	United States	Total	Percentage share
		A. Developed economies				
North America						
Canada	696	894	301	3 047	4 938	1.21
United States	58 956	9 602	2 835	-	71 393	17.43
Western Europe						
Austria	173	14 342	503	-	15 017	3.67
Belgium	308	2 635	83	-	3 027	0.74
Denmark	77	4 002	22	-	4 101	1.00
Finland	256	587	46	-	889	0.22
France	4 073	24 288	777	-	29 138	7.12
Germany, Federal Republic of	68 121	-	1 922	1 837	71 880	17.55
Gibraltar	-	2	-	-	2	-
Greece	-	165	231	-	396	0.10
Ireland	278	201	-	-	479	0.12
Italy	4 084	28 456	2 269	35	34 845	8.51
Malta	-	333	-	-	333	0.08
Netherlands	255	6 437	223	33	6 948	1.70
Norway	303	211	11	-	525	0.13
Portugal	-	888	722	-	1 610	0.39
San Marino	-	-	7	-	7	-
Spain	2 951	3 462	396	-	6 809	1.66
Sweden	1 604	2 406	97	-	4 108	1.00
Switzerland	304	11 674	6	-	11 984	2.93
United Kingdom	7 074	4 189	2 029	193	13 485	3.29
Yugoslavia	-	1 757	-	-	1 757	0.43
Eastern Europe and USSR						
Bulgaria	-	2 258	-	-	2 258	0.55
Czechoslovakia	-	9 337	-	-	9 337	2.28
Hungary	41	4 652	204	-	4 897	1.20
Poland	-	2 034	-	-	2 034	0.50
Romania	-	64	-	-	64	0.02
USSR	506	8 581	-	-	9 087	2.22
Japan	-	4 077	1 897	1 548	7 523	1.84
Other						
Australia	1 604	160	481	-	2 245	0.55
Israel	211	66	145	-	422	0.10
New Zealand	66	-	36	-	102	0.02
South Africa	317	305	-	176	798	0.19
Total, A	152 258	148 065	15 244	6 869	322 436	78.81
		B. Developing economies				
Latin America						
Argentina	-	13	169	-	182	0.04
Brazil	721	253	35	-	1 009	0.25
Chile	1 052	51	116	-	1 219	0.30
Colombia	-	2	199	-	201	0.05
Costa Rica	-	-	51	-	51	0.01
Ecuador	-	-	41	-	41	0.01
Guatemala	-	-	13	-	13	-
Mexico	-	454	358	768	1 580	0.39
Uruguay	-	-	32	-	32	0.01
Venezuela	-	4	29	-	33	0.01
Africa						
Algeria	-	25	-	-	25	0.01
Egypt	-	658	27	-	685	0.17
Ghana	-	27	-	-	27	0.01
Morocco	-	1	-	-	1	-

Economic grouping, region, country and area of destination	Japan	Germany, Federal Republic of	Taiwan Province	United States	Total	Percentage share
Nigeria	72	-	-	-	72	0.02
Tunisia	-	15	-	-	15	-
Zambia	-	1	-	-	1	-
Zimbabwe	-	-	19	-	19	-
Western Asia						
Iran (Islamic Republic of)	1 470	342	-	-	1 812	0.44
Iraq	-	16	-	-	16	-
Kuwait	-	-	15	-	15	-
Lebanon	-	-	21	-	21	0.01
Saudi Arabia	-	265	63	-	327	0.08
Syrian Arab Republic		-	78		78	-0.02
Turkey	-	659	-	-	659	0.16
United Arab Emirates		1	17		18	-
Asia, developing market						
Bangladesh	-	6	-	-	6	-
Hong Kong	5 502	2	5 664	-	11 169	2.73
India	1 306	83	-	-	1 389	0.34
Indonesia	172	7	1 442	-	1 622	0.40
Malaysia	2 174	132	1 569	-	3 875	0.95
Pakistan	42	571	84	-	697	0.17
Philippines	603	-	132	-	735	0.18
Republic of Korea	24 455	315	218	156	25 144	6.14
Singapore	11 876	720	2 085	130	14 811	3.62
Sri Lanka	2	2	12	-	16	-
Taiwan Province	8 808	633	-	-	9 441	2.31
Thailand	7 178	245	992	-	8 415	2.05
Asia, centrally planned						
China	152	1 079	-	-	1 231	0.30
Democratic People's Republic of Korea	-	4	-	-	4	-
Total, B	65 585	6 586	13 481	1 054	86 706	21.19
TOTAL, A and B	217 843	154 519	29 725	7 923	409 142	100.00

Source: Database of the Association for Manufacturing Technology, McLean, Virginia.

within the lasing medium as the radiation makes many passes between mirrors through the medium. The external energy is applied either at a constant level to produce a constant-wave laser beam, or in a series of bursts to produce a pulsed laser beam.

Thus a laser is a device for converting electrical energy into a coherent beam of electromagnetic energy, which may or may not be visible as light. A great many lasing media have been developed including gas, liquid, and solid, but only four types have been applied in metalworking and two of these account for 90 per cent of the applications. The most widely used is the gas laser, called CO_2. This laser uses a mixture of carbon dioxide (to activate photon generation), nitrogen (to reinforce it), and helium as the principal constituent (to cool it). It operates on a wavelength of 10.6 micrometres, and generates beams of the highest power well into the kilowatt range. The other three are solid state lasers: the ruby laser, neodymium-doped yttrium-aluminium-garnet laser (usually called YAG), and the neodymium-doped glass laser (usually called glass). The YAG laser operates at a wavelength of 1.06 micrometres and is capable of power output up to 400 watts pulsed, or 600 watts constant wave. The YAG laser beam can be focused to a much smaller spot (about one tenth the diameter of the CO_2).

The beam generated by the laser is fed through an optical delivery system that delivers it to the workpiece to provide the intensity needed for the operation required. The radius of the focused beam depends directly on the laser wavelength and the lens focal length and inversely on the radius of the unfocused beam. Because the focused beam radius remains nearly constant for some length, the spacing between the lens and the workpiece is not critical, as long as it remains within this length. Because the laser is a controlled heat source that operates when it is absorbed by a material, it is not effective on either transparent or highly reflective materials. Cutting speed varies considerably depending on the characteristics of the material and the thickness being cut.

The most widely used type of laser machine tool is applied to cutting sheets or plates of material on a NC table. Such machines were originally produced by adding the laser to a turret punch press, but later these machines were specially designed to use a laser. Cutting begins by "drilling" a hole through the material, then moving along a programmed path of the shape to be cut. A stream of gas, usually oxygen, is directed at the cutting point to assist burning and speed the operation. This gas also removes the molten metal and cools the workpiece. If a stack of plates is being cut, it also prevents the plates from welding together. This method is used as an alternative to punching, blanking, nibbling, and oxyacetylene or plasma-arc cutting.

Metals such as steel, titanium, nickel, and some refractory metals and many plastics can be cut readily. Speeds of up to 600 inches (15.24 metres) per minute have been achieved in thin materials, but the speed drops off rapidly as thickness increases. The principal advantages of the laser lie not so much in the speed of cutting as the fact that complex shapes with sharp corners can be started and stopped anywhere on the workpiece. Because of the very thin cut (typically 0.04 inches (1.02 millimetres), sometimes as little as 0.004 inches (0.10 millimetres)), there also is very little waste material. This results in a smaller heat-affected zone in the material and less distortion than with other methods. Other advantages are that the cut edges are square and often require no finishing; cutting tools are eliminated; the cutting is free of noise and vibration; and cutting for many materials is free of fumes that must be controlled [67].

Most manufacturers of punch presses now also produce laser-cutting machines that are offered as an alternative, and at least one manufacturer also offers a machine that combines both punching and laser-cutting. Because the laser started as a laboratory instrument (the first applications were in precision measurement with the laser interferometer), there was some question as to how lasers would stand up under the more rigorous environment of an operating machine tool. However, this has not been as much of a problem as feared. The fact that lasers are specifically designed for shop applications, some of them by machine tool builders, has produced sturdier lasers.

For small holes in thin material the laser is a cost-effective competitor to drilling or EDM. Hole sizes range from about 0.0001 to 0.06 inches (0.005 to 1.5 millimetres), but are rarely used in materials that are very thick. For such work the lower-powered YAG, ruby, and glass lasers are generally used. Precision holes are only possible in thin stock. In thicker stock, the hole is tapered, increasing in diameter from the point of beam entry to the exit. A recast layer also forms on the inner wall of the hole and can be a problem in some applications. However, the laser is used to produce air-cooling holes in blades for jet aircraft engines, and in this application the taper is considered an advantage.

Most of the original laser-cutting machines were built on frames designed as turret punch presses, but a few years ago machines specifically designed to use lasers began to appear. There are a number of five-axis machines on the market; many of these have been developed into fully automatic machines that can be incorporated into flexible manufacturing systems.

Lasers have also been evaluated for their use in turning operations, primarily either to soften the workpiece just ahead of the cutting tool, or to demolish chips in automatic operation, but there has been little or no commercial application.

A national research programme in lasers that began in Japan in 1977 has produced a laser system for flexible system development and led to the development of 5-, 10- and 20-kilowatt CO_2 lasers as well as a 300-watt YAG laser. In the installation at Tsukuba, the beam produced by a 10-kilowatt CO_2 laser is piped to two separate work stations. One is off the production line and has two 10-kilowatt processing heads for cutting and welding steel plate in thicknesses of up to 0.8 inches (20.32 millimetres). The other station is on line and has two 5-kilowatt processing heads for surface-hardening steel gears and welding the gears to shafts. The 300-watt YAG laser transmits the beam through optical fibres to two processing heads, one for chip-breaking in turning operations and one for deburring machined gear teeth [68].

In a research installation at a Westinghouse plant in the United States, the beam from a 25-kilowatt CO_2 laser can be selectively piped to six different stations in the research area. Each station is equipped with modified machine tools or positioners for work-handling [64].

An ambitious effort at applying lasers to a different machining operation is the Maho Lasercav, a German machine designed like a milling machine, using a laser to cut complex cavities to a depth of 0.32 inches (8.13 millimetres). The 5-axis, computer NC machine with a 750-Watt CO_2 has a gas nozzle to expel the debris from the cavity. The machine has been under development and testing for several years, and has attracted attention as a possible method for die-sinking. By early 1992, six of the machines had been sold to plants in Europe and one to the Republic of Korea [69].

The latest application of lasers is in "desktop manufacturing", in which prototype parts of complex shape are developed from liquid or powder plastic by selectively curing the plastic by laser as the part is formed, layer by layer, using data from the computer file, after the part has been designed with a computer-assisted design program. Each pass of the laser selectively hardens the top layer in accordance with a slice through the part design. Another layer of plastic is applied and the laser makes the pass in accordance with the next slice. The rapid-prototyping technique is attracting attention because it can greatly shorten the time to produce a sample part of a proposed design for testing.

Lasers are being applied in a few European countries and in three countries in Asia. Table V.83 shows exports from Germany, Federal Republic of, Japan, and the United States, by country of destination. The unusual quantity exported to Belgium probably includes many re-exports.

(c) Machining centres

Machining centres continue to have the most impact on machine tools throughout the world. Although as the technology has matured, technological development is largely in terms of incremental upgrades and changes in design to reduce cost. Because the machining centre can be a replacement for so many other types of machines, and so many manufacturers have

Table V.83. Exports of lasers and photon beams for working materials from Japan, the United States and Germany, Federal Republic of, 1990
(Thousands of dollars)

Economic grouping, region, country and area of destination	Japan	United States	Germany, Federal Republic of	Total	Percentage share
	A. Developed economies				
North America					
Canada	150	2 991	-	3 141	2.20
United States	28 283	-	-	28 283	19.84
Western Europe					
Austria	93	-	-	93	0.07
Belgium	28 023	615	-	18 638	13.08
Denmark	-	226	-	226	0.16
Finland	-	20	-	20	0.01
France	10	2 190	-	2 200	1.54
Germany, Federal Republic of	461	4 286	-	4 747	3.33
Italy	4 303	2 235	-	6 538	4.59
Monaco	-	29	908	937	0.66
Netherlands	-	1 027	-	1 027	0.72
Spain	23	221	-	244	0.17
Sweden	1 206	218	-	1 424	1.00
Switzerland	-	482	-	482	0.34
United Kingdom	1 756	2 529	-	4 825	3.01
Yugoslavia	-	58	-	58	0.04
Eastern Europe and USSR					
Czechoslovakia	41	-	-	41	0.03
Poland	-	61	-	61	0.04
USSR	-	17	-	17	0.01
Japan	18 525	118	18 643	13.08	
Other					
Australia	339	123	-	462	0.32
Israel	-	387	-	387	0.27
South Africa	-	237	-	237	0.17
Total, A	54 688	36 477	1 026	92 191	64.68
	B. Developing economies				
Latin America					
Argentina	430	126	-	556	0.39
Bolivia	-	22	-	22	0.02
Brazil	6	743	-	749	0.53
Colombia	-	106	-	106	0.07
Dominican Republic	-	17	-	17	0.01
Mexico	-	392	-	392	0.28
Panama	-	96	-	96	0.07
St. Kitts and Nevis	-	948	-	948	0.67
Trinidad and Tobago	-	116	-	116	0.08
Venezuela	-	116	-	116	0.08
Africa					
Egypt	-	72	-	72	0.05
Western Asia					
Iran (Islamic Republic of)	344	-	-	344	0.24
Saudi Arabia	175	-	-	175	0.12
Turkey	-	20	-	20	0.01
United Arab Emirates	-	184	-	184	0.13
Asia, developing market					
Bangladesh	-	13	-	13	0.01
Hong Kong	-	210	13 404	13 614	9.95
India	-	126	-	126	0.09
Indonesia	293	-	124	417	0.29
Malaysia	3 584	654	4 028	8 266	5 80

Table V.83. (continued)

Economic grouping, region, country and area of destination	Japan	United States	Germany, Federal Republic of	Total	Percentage share
Republic of Korea	6 541	302	-	6 843	4.80
Singapore	1 304	148	175	1 627	1.14
Taiwan Province	8 028	4 363	-	12 391	8.69
Thailand	-	15	1 401	1 415	0.99
Asia, centrally planned					
China	865	799	-	1 664	1.17
Total, B	21 570	9 643	19 132	50 345	35.32
TOTAL, A and B	76 258	46 120	20 158	142 536	100.00

Source: Database of the Association for Manufacturing Technology, McLean, Virginia.

gone into the business of producing them, the competition is particularly keen. The recent trends have been toward machines that are simpler in design and lower in costs. Japan is the largest single producer of machining centres. However, substantial quantities are also produced in a number of other countries. Table V.84 provides an indication of the degree to which machining centres are being adopted by combining the exports from Japan with those from Germany, Federal Republic of, Taiwan Province and the United States.

(d) *Numerically controlled lathes*

Like the machining centre, traditional NC lathes continue to offer significant technical refinements and to be one of the most import elements in developing a world-class manufacturing operation. NC lathes generally have turrets holding a number of tools that can be rapidly indexed to bring different tools to the workpiece. Many machines now have the spindle as an axis, meaning that the spindle can be stopped in the precise position programmed and indexed to other positions as required. Some of the tool positions in the turret provide for rotating tools. Thus, after a part has been turned, the spindle can be stopped and a pattern of holes drilled and tapped or milling operations performed.

One recent addition is the development of machines with two spindles and the capability of transferring a workpiece between spindles. Thus a part can be turned on one end in the first spindle, then held on the finished end in the other spindle, while the operations are performed on the end that was gripped in the first spindle. Such lathes have tool turrets for each spindle, and will have a spindle axis and rotating tools, permitting complete machining of a workpiece in one cycle.

Exports of NC horizontal lathes from Germany, Federal Republic of, Japan, Taiwan Province and United States are given in table V.85 by country of destination and provide an indication of the extent of application in developing countries and areas.

7. *Short- and long-term outlook*

The short-term outlook is poor for the machine-tool industry. Although there are signs that the orders for machine tools in the United States may begin to recover in 1992, they are still declining in the rest of the world. In general, orders for machine tools tend to decline in advance of a recession and to lag behind in the recovery.

In the longer term, there are large requirements for modernizing the production facilities in Eastern Europe and the former USSR in the next few years, and this may produce a surge in demand. On the other hand, the substitution of electronics for mechanical parts in manufactured products tends to reduce the demand for machine tools. In addition the development of NC machine tools has so increased their productivity that fewer machines are required than formerly for a given level of output.

Table V.84. Exports of machining centres from Japan, Germany, Federal Republic of, Taiwan Province and United States, 1990
(Thousand dollars)

Economic grouping, region, country and area of destination	Japan	Germany, Federal Republic of	Taiwan Province	United States	Total	Percentage share
			A. Developed economies			
North America						
Canada	15 831	4 839	1 040	17 144	38 854	2.90
United States	255 512	35 323	13 897	-	304 732	22.72

Economic grouping, region, country and area	Japan	Germany, Federal Republic of	Taiwan Province	United States	Total	Percentage share
Western Europe						
Austria	4 156	28 788	554	-	33 498	2.50
Belgium	106 948	19 812	1 938	9 792	138 490	10.33
Denmark	6 004	5 293	1 870	421	13 588	1.01
Finland	8 120	8 670	1 379	-	18 169	1.35
France	30 622	46 023	7 910	482	85 037	6.34
Germany, Federal Republic of	106 589	-	6 865	2 588	116 042	8.65
Ireland	-	83	-	150	233	0.02
Italy	26 853	24 665	12 310	988	64 816	4.83
Netherlands	12 782	13 664	2 472	-	28 918	2.16
Norway	4 284	2 061	655	-	7 000	0.52
Portugal	546	97	98	-	741	0.06
Spain	12 098	11 729	2 169	-	25 996	1.94
Sweden	19 593	13 826	2 181	514	36 113	2.69
Switzerland	19 814	45 955	2 050	-	67 820	5.06
United Kingdom	42 246	35 340	12 694	3 951	94 231	7.03
Yugoslavia	1 432	6 122	-	-	7 554	0.56
Eastern Europe and USSR						
Bulgaria	-	2 577	-	-	2 577	0.19
Czechoslovakia	-	1 155	-	-	1 155	0.09
Hungary	-	654	104	-	758	0.06
Poland	-	5 401	-	-	5 401	0.40
USSR	779	14 160	-	-	14 939	1.11
Japan	-	809	1 533	1 612	3 954	0.29
Other						
Australia	8 097	821	960	-	9 879	0.74
Israel	4 722	-	1 771	125	6 618	0.49
New Zealand	1 328	-	12	-	1 340	0.10
South Africa	952	6 704	-	-	7 656	0.57
Total, A	689 308	334 569	74 464	37 767	1 136 108	84.87
		B. Developing economies				
Latin America						
Argentina	549	1 114	72	407	2 142	0.16
Brazil	805	6 691	56	297	7 850	0.59
Chile	-	-	42	156	198	0.01
Colombia	-	202	146	169	516	0.04
Costa Rica	-	-	-	185	185	0.01
Ecuador	-	-	117	-	117	0.01
Honduras	-	-	-	310	310	0.02
Jamaica	-	-	-	60	60	a/
Mexico	8 476	1 460	392	4 191	14 519	1.08
Venezuela	-	-	67	367	434	0.03
Africa						
Egypt	-	1 309	-	-	1 309	0.10
Tunisia	-	53	-	-	53	a/
Zimbabwe	280	-	-	-	280	0.02
Western Asia						
Iran (Islamic Republic of)	814	7 595	-	-	7 595	0.57
Iraq	175	4 414	-	-	4 589	0.34
Syrian Arab Republic	-	495	37	-	531	0.04
Turkey	3 420	1 018	517	-	4 955	0.37
Asia, market economies						
Hong Kong	5 752	-	4 168	-	9 920	0.74
India	621	1 843	394	223	3 081	0.23
Indonesia	15 428	-	282	-	15 710	1.17
Malaysia	6 470	-	529	202	7 201	0.54
Philippines	1 152	-	-	138	1 290	0.10
Republic of Korea	19 867	4 553	1 467	5 161	31 049	2.32
Singapore	12 075	1 723	1 111	46	14 955	1.12

Table V.84. (continued)

Economic grouping, region, country and area	Japan	Germany, Federal Republic of	Taiwan Province	United States	Total	Percentage share
Taiwan Province	26 859	1 758	-	476	29 093	2.17
Thailand	16 394	1 500	1 436	164	19 494	1.45
Asia, centrally planned						
China	2 956	15 836	-	6 297	25 089	1.87
Total, B	122 093	50 750	10 836	18 849	202 527	15.13
TOTAL, A and B	811 401	385 319	87 709	56 616 [a]	1 341 045 [a]	100.00

Source: Database of the Association for Manufacturing Technology, McLean, Virginia.
[a] Including some machines not assigned to a country.

Table V.85. Exports of numerical control horizontal lathes from Japan, Germany, Federal Republic of, Taiwan Province and United States, 1990
(Thousands of dollars)

Economic grouping, region, country and area of destination	Japan	Germany, Federal Republic of	Taiwan Province	United States	Total	Percentage share
		A. Developed economies				
North America						
Canada	10 444	4 560	1 364	13 349	29 717	1.99
Greenland	106	-	-	-	106	0.01
United States	234 280	33 674	7 355	-	275 309	18.41
Western Europe						
Austria	3 842	25 495	165	-	29 503	1.97
Belgium	94 128	19 733	628	7 301	121 790	8.14
Denmark	9 610	11 732	1 228	-	22 570	1.51
Finland	10 992	8 261	1 252	-	20 505	1.37
France	18 895	89 352	6 850	1 752	116 849	7.81
Germany, Federal Republic of	133 908	-	8 317	802	143 027	9.56
Greece	-	532	-	-	532	0.04
Ireland	-	732	-	-	732	0.05
Italy	27 863	41 645	7 814	710	78 032	5.22
Malta	-	482	-	-	482	0.03
Netherlands	12 336	15 852	6 482	160	34 830	2.33
Norway	2 506	545	163	-	3 214	0.21
Portugal	311	864	404	553	1 268	0.08
Spain	6 897	24 704	2 214	-	33 816	2.26
Sweden	25 045	31 237	2 558	-	58 840	3.93
Switzerland	53 383	46 192	586	-	100 162	6.70
United Kingdom	45 707	35 492	6 068	9 069	96 336	6.44
Yugoslavia	99	6 196	-	105	6 400	0.43
Eastern Europe and USSR						
Bulgaria	-	350	-	-	350	0.02
Czechoslovakia	5 626	5 765	-	139	5 765	0.39
Hungary	-	1 377	-	139	1 516	0.10
Poland	-	12 412	-	-	12 412	0.83
USSR	1 900	66 030	-	-	67 930	4.54
Japan	-	8 664	632	2 299	11 595	0.78
Other						
Australia	14 888	1 596	96	2 230	18 810	1.26
Israel	2 225	296	158	265	2 945	0.20
New Zealand	835	-	-	-	835	0.06
South Africa	1 181	4 616	-	-	5 797	0.39
Total, A	711 623	497 698	54 334	38 320	1 301 975	87.29

Economic grouping, region, country and area of destination	Japan	Germany, Federal Republic of	Taiwan Province	United States	Total	Percentage share
			B. Developing economies			
Latin America						
Argentina	727	8 178	40	422	9 367	0.63
Brazil	2 032	4 760	-	801	7 593	0.51
Colombia	-	-	438	-	438	0.03
Ecuador	-	-	40	106	146	0.01
Mexico	4 977	2 414	1 435	1 626	10 452	0.70
Panama	-	51	-	-	51	a/
Paraguay	-	22	-	-	22	-
Suriname	-	-	72	-	72	a/
Venezuela	1 978	-	-	173	2 151	0.14
Africa						
Algeria	-	2 135	-	-	2 135	0.14
Egypt	1 266	1 473	-	-	2 739	0.18
Guinea	-	28	-	-	28	a/
Kenya	-	4	-	-	4	a/
Tunisia	-	49	217	217	266	0.02
United Republic of Tanzania	-	2 344	-	-	2 344	0.16
Zimbabwe	711	-	54	-	765	0.05
Western Asia						
Iran (Islamic Republic of)	129	17 643	-	-	17 772	1.19
Saudi Arabia	435	-	-	-	435	0.03
Syrian Arab Republic	-	1 240	36	-	1 275	0.09
Turkey	2 735	4 508	836	-	8 079	0.54
United Arab Emirates	-	3	-	-	3	a/
Asia, developing market						
Hong Kong	5 144	1 049	1 068	-	7 261	0.49
India	3 150	3 208	-	498	6 856	0.46
Indonesia	7 562	11	127	-	7 700	0.51
Malaysia	6 398	-	1 227		7 625	0.51
Pakistan	188	935	-	-	1 123	0.08
Philippines	1 477	-	-		1 477	0.10
Republic of Korea	16 943	3 687	817	497	121 944	8.15
Singapore	19 742	127	409	94	20 372	1.36
Taiwan Province	15 508	2 330	-	258	18 096	1.21
Thailand	22 455	1 145	983	56	24 639	1.65
Asia, centrally planned						
China	1 812	3 619	-	831	6 262	0.42
Total, B	115 369	60 962	7 582	5 579	189 492	12.71
TOTAL, A and B	826 922	558 660	61 917 a/	43 899	1 491 467 a/	100.00

Source: Database of the Association for Manufacturing Technology, McLean, Virginia.
a/ Including some machines not assigned to a country.

J. Food-processing machinery (ISIC 3824)*

1. *Current situation*

(a) *Regional variations*

The world's manufacturers of food-processing machinery currently face a variety of business conditions across different geographic markets and different product sectors. This is to be expected in such a heterogeneous industry which produces thousands of different products for varied clients in both food- and drink-processing industries around the world. It is rare, however, for economic conditions to differ as widely as at present, and the downturn in certain important markets has come as a shock to many equipment suppliers.

The United States market has been experiencing a recession for the past two years, while Australasia has also been very depressed. Conditions have been difficult in the United Kingdom, while suppliers to

*UNIDO acknowledges the contribution of Andrew Baxter of the *Financial Times*.

Eastern Europe and the former Soviet Union are struggling because of current political and economic instability in that region. In Latin America, machinery producers are finding it difficult to expand sales, while African sales are losing ground to Eastern Europe. Germany continues to grow at a very satisfactory pace, and other markets in continental Europe are performing well. Elsewhere, there is continued growth in Japan and South-East Asia, with the latter benefiting from the coincidence of population growth and economic expansion. China is recovering from the aftermath of the recent domestic political unrest, while the market in Western Asia is picking up after interruptions caused by the 1991 war in the Persian Gulf. Recovery has been symbolized by the order placed with APV Pasilac in 1991 for the rebuilding of the Kuwaiti-Danish Dairy, the most modern in Western Asia.

The recession in the United States has contrasted with good market conditions in the mid- to late-1980s, and indicates that the close links of equipment suppliers with a basic industry such as food-processing cannot insulate them completely from the malaise that has beset other suppliers of capital equipment since 1990. In the case of the United States market, food processors have been wary of purchasing new capital equipment because of a lack of confidence in the economy generally, and also because of their need to reduce debt, resulting from some of the highly leveraged take-overs experienced by the food industry in the 1980s. However, while conditions in such markets have been harsh in comparison with what food equipment suppliers had been used to, they are by no means as depressed as in other engineering branches. The long-term trends that stimulated, in the mid-1980s, a real increase in equipment sales in the food industry in developed countries remain generally favourable to equipment suppliers.

Among the major factors that have influenced the industry over the recent period are five in particular, spelt out below:

(a) Food manufacturers in Europe and North America are moving to rationalize production in order to increase efficiency. The concentration on bigger facilities requires larger, faster-running and more heavily automated equipment;

(b) Food manufacture is becoming increasingly international as consumers become more cosmopolitan. In the EEC, single market reforms being introduced at the end of 1992 are encouraging pan-European production by transnational corporations such as Unilever and Nestle;

(c) Food producers now want equipment that can be adapted quickly to changing market requirements. This is particularly necessary for products such as snack foods and ice-cream, but is a mixed blessing for machinery suppliers used to selling specialist machines;

(d) Recent scares over listeria and salmonella contamination of some processed and packaged foods have belatedly forced food manufacturers to re-equip their plants with modern, redesigned plant leading to higher development costs for processors and equipment suppliers. This is a further argument for more advanced process control systems;

(e) Rising living standards in countries of the Pacific area in particular have filtered through to the equipment supply industry, as consumers switch to more value-added processed foods.

These trends, in various permutations, underpin business conditions in specific product sectors, and are helping to offset weaknesses caused by external factors. One of the main sources of growth in the industry is beverages, because of growing demand in the Pacific area, particularly for soft and carbonated drinks. Demand for juice production equipment is also rising by between 2 per cent and 10 per cent a year, reflecting the internationalization and rationalization of production, especially in Europe, and a demand for less manipulated, additive-free juices with better quality.

The ice-cream equipment branch in Europe has also been buoyant in recent years, as large producers such as Unilever move to pan-European production, and consumers demand more processed products. In this branch East Asia has also been buoyant, but conditions in the United States market, which remains primarily geared to bulk, lower value-added products, are stagnant. In fats and oil production machinery, the strong growth in East Asia has been offset in the past two years by the total collapse of markets in Eastern Europe and the former USSR.

In the closely related food-packaging equipment and materials branch, a similar pattern emerges, and the industry is benefited indirectly by the success of its customers, who are waiting for economic recovery. Again, the industry is being underpinned by long-term trends in food packaging, and in particular aseptic packaging, another reflection of the extent to which health and hygiene issues are having an impact on equipment and material suppliers. The profitability of the food equipment industry is hard to gauge, because so many of the suppliers are privately owned and do not disclose financial results. In general, however, margins on equipment sales are tight, and have been squeezed further by business conditions in some key markets.

(b) Production

The food manufacturing equipment branch has always been dominated by European and North American producers and is likely to remain so for a variety of reasons. According to one recent estimate, between 80-90 per cent of total world production of food-processing and packaging equipment is located in the region comprising member countries of the Economic Commission for Europe (all European countries, Canada, the United States and, since July 1991, Israel) [70]. Table V.86 gives an estimate of global market range in the region of $17.7 billion to $20.5 billion for 1989. However, it is important to note that this market definition includes packaging equipment; some official statistics keep packaging and processing equipment separate [71]. Packaging accounts for around one sixth or one seventh of the total market.

As can be seen from table V.86, Western Europe represents the biggest market, but its machinery producers also supply other markets. Another report on the Western European food equipment industry

Table V.86. Estimated annual world market for food-processing and -packaging machinery and equipment, 1989

Economic grouping, region and country	Estimated market size (billion dollars)	Percentage share
Western Europe	6.0 - 6.5	33.9 - 31.7
North America	3.6 - 3.8	20.3 - 18.5
USSR	2.5 - 3.0	14.1 - 14.6
Japan	2.1 - 2.2	11.9 - 10.7
Eastern Europe	1.5 - 2.0	8.5 - 9.8
Rest of the world	2.0 - 3.0	11.3 - 14.6
TOTAL	17.7 - 20.5	100.0 - 100.0

Source: Institute of Food Studies and Agroindustrial Development, Horsholm, Denmark.

estimated 1989 production at $13.6 billion. While there may be some statistical discrepancy between the two reports, the major equipment suppliers believe that Europe accounts for around three quarters of world production [72]. Within Western Europe, Frost and Sullivan estimate that Germany accounted for 40.5 per cent of production in 1989, more than three times as much as the 15.3 per cent share registered by Italy. As shown in table V.87, the share of production of united Germany is estimated to rise to 59.3 per cent of Western European production by 1996; this production depends on the future technological leadership, degree of market influence and position of Germany at the centre of the European Community. Northern European countries are particularly dominant in dairy- and meat-processing, while Italy has a strong position in packaging machinery.

In contrast, table V.88 shows that the value of shipments in the United States decreased by 0.7 per cent in real terms between 1987 and 1991. This partly reflects the recession which started in 1990, and the fact that United States industry is likely to grow in the long term. United States production of equipment is highly diversified and is spurred to a great extent by the rapid introduction of new products into the domestic food system. Not surprisingly, North America largely manufactures equipment for cereal-based foods and meat-processing equipment.

In the former USSR a large number of different kinds of machines and equipment are produced. While

Table V.87. Production of food-processing equipment in Western Europe, 1989 and 1996
(Percentage)

Country	1989	1996 [a]
Germany [b]	40.5	59.3
Italy	15.3	11.7
United Kingdom	10.2	6.9
France	8.0	5.3
Sweden	7.7	4.9
Rest of Europe	18.3	11.9
TOTAL	100.0	100.0

Source: Institute of Food Studies and Agroindustrial Development, Horsholm, Denmark.

[a] Forecast.

[b] 1989 figure for the former Federal Republic of Germany, 1996 figure for united Germany.

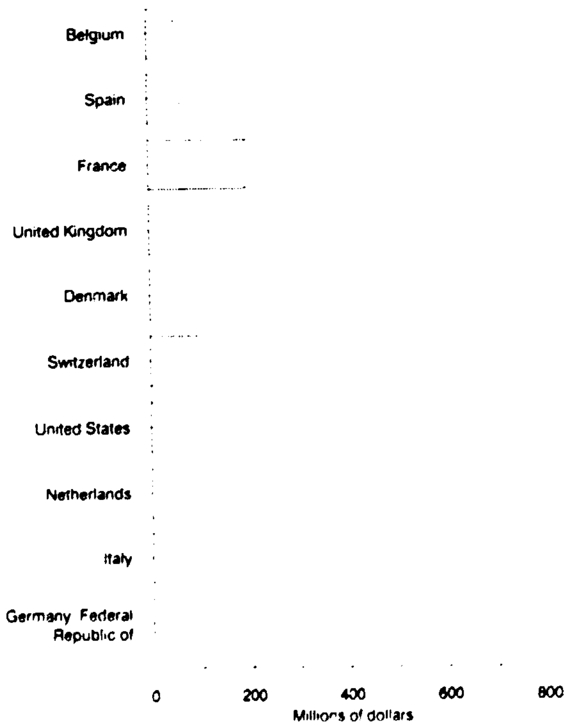
this means that flexibility is often difficult to obtain, table V.89 shows that the production of equipment has risen in value in the former USSR. As for employment within the food equipment industries of the main producing countries, the share of employment in food-processing machinery and packaging industries has been estimated at some 3 per cent of total employment in the food industries of the region. That would amount to about 300,000 people out of some 9 to 10 million [70].

(c) *Trade*

Just as Europe is the dominant producer of food-manufacturing equipment, so is it the leading exporter. Much of the world's food-processing and packaging machinery and equipment are produced in the countries where they are installed [70]. For example, very limited imports or exports are registered in Japan. Important net exporters include Denmark, Germany, Italy, Netherlands and Switzerland, while most developing countries are important net importers, even if their national markets are limited.

The Economic Commission for Europe (ECE) estimates total annual world trade at about $8 billion to $9 billion and some of the major trading countries are shown in table V.90. While the major part of this trade is between ECE member countries, developing countries are gaining importance and should be seen as a long-term growth area [70]. Figure V.28 illustrates the extent of market shares in the industry for the 10 major exporting countries in 1989. Germany is

Figure V.28. Ten largest exporters of food-processing machinery, 1989



Source: Economic Commission for Europe database of the Industry and Technology Division

Table V.88. Trends and forecasts for food-processing machinery in the United States, 1987-1992
(Millions of dollars)

Item	1987	1990[a]	1991[b]	1992[c]	Percentage change 1987-1991	1990-1991	1991-1992
Industry data							
Value of shipments[d]	1 971 (1 971)	2 165 (1 908)	2 340 (1 957)	- (2 036)	18.7 (-0.7)	7.1 (2.6)	- (4.0)
Total employment (thousands)	19.2	18.7	16.8	-	-12.5	-10.2	-
Production workers (thousands)	11.8	10.9	9.6	-	-18.6	-11.9	-
Average hourly earnings	11.32	-	-	-	-	-	-
Capital expenditure	47.4	-	-	-	-	-	-
Product data							
Value of shipments[e]	1 735 (1 735)	1 834 (1 689)	2 071 (1 732)	- (1 801)	19.4 (-0.2)	7.1 (2.5)	- (4.0)
Trade data							
Value of imports	-	504	561	573	-	11.3	2.1
Value of exports	-	588	617	641	-	4.8	3.9

Source: United States Department of Commerce, *Industrial Outlook 1992* (Washington, D.C., September 1991).

Note: Figures in parentheses represent values in 1987 United States dollars.

[a] Estimates, except for imports and exports.

[b] Estimates.

[c] Forecasts.

[d] Value of all products and services sold by establishments in the food-products machinery industry.

[e] Value of products classified as food products machinery manufactured by all industries.

Table V.89. Production of food-processing machinery in selected countries of Eastern Europe and the USSR, 1980-1988
(Millions of units of national currency)

Country	1980	1985	1987	1988	Percentage change 1980-1988	Percentage change 1987-1988	Percentage share 1988
Bulgaria	47.5	79.7	76.7	74.0	55.8	-3.5	1.4
Czechoslovakia	953	1 479	1 432	1 396	46.5	-2.5	26.7
German Democratic Republic	669	757	774	857	28.1	10.7	16.4
Hungary	1 201	1 807	1 766	1 576	31.2	-10.8	30.1
Poland[a]	11 856	12 368	11 781	..	..	..	..
USSR[b]	805	1 060	1 124	1 330	65.2	18.3	25.4
TOTAL	15 532	17 551	16 954	5 233	-66.3	-69.1	100.0

Source: *Statistical Yearbook of CMEA Member Countries 1989* (Moscow, CMEA, 1989).

[a] Data for 1980 and 1985 in 1982 zlotys and as from 1986 in 1984 zlotys.

[b] Including spare parts. Data for 1980 in 1975 roubles and as from 1985 in 1982 roubles.

comfortably ahead with exports of $800.8 million, followed by Italy at $575.5 million, the Netherlands at $433.8 million, and the United States at $430.4 million.

With regard to Western European trade flows, table V.91 estimates 1989 production at 655,038 tonnes and consumption at 503,570 tonnes [72]. Imports are relatively low at 34,242 tonnes, and are for direct sale to end-users, or used as a component within an integrated system. Given an export level of 213,500 tonnes, as table V.91 shows, less than 35 per cent of production by volume is exported from Western Europe. As for the source of Western European imports of food-processing equipment, table V.92 illustrates the self-sufficiency of the European market, with 75.5 per cent of imports coming from within the EEC and only 6.1 per cent imported from the United States.

In relative terms, however, the United States compares well with Europe in terms of international trade activity, with exports to some 150 countries account-

Table V.90. Exports of food-processing machinery of selected countries, 1980-1989
(Thousands of dollars at current prices, f.o.b.)

Region and country	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
EEC										
Belgium	31 247	51 665	39 010	30 214	40 593	34 196	33 133	41 211	73 738	53 867
Denmark	87 770	86 651	86 272	82 435	79 605	96 051	135 666	135 150	192 818	253 308
France	182 705	161 437	122 601	116 087	96 533	104 721	119 942	180 055	181 103	196 005
Germany	434 736	384 914	374 030	351 532	337 570	364 541	529 550	685 653	788 377	800 832
Italy	200 408	228 934	234 036	231 745	223 350	288 724	352 440	411 209	474 043	575 478
Netherlands	166 300	154 045	154 672	158 461	174 354	202 492	247 309	318 020	411 479	433 793
Spain	34 427	31 036	34 593	20 209	24 687	24 297	35 276	46 373	58 272	64 904
United Kingdom	223 514	201 191	164 434	130 264	131 008	151 013	158 659	149 367	238 567	227 748
EFTA										
Sweden	34 596	30 569	23 330	25 992	30 424	32 486	40 356	38 061	47 212	42 497
Switzerland	123 236	137 808	136 320	114 984	105 890	112 430	180 340	192 290	258 688	259 681
North America										
Canada	24 974	28 652	25 872	42 882	28 455	39 438	36 024	32 825	34 844	35 056
United States	332 154	390 437	361 835	302 272	298 405	270 560	268 278	331 114	384 557	430 384
CMEA										
Czechoslovakia	..	..	120 671	178 969	294 423	184 416	218 549	243 109	..	..
Poland	150 384	137 670	74 196	79 637	98 479	95 124	85 371	59 700	..	..
Other[a]										
Australia	13 811	19 373	9 788	11 471	9 249	11 560	12 980	22 232	27 123	34 644
Japan	39 963	70 523	51 793	93 309	73 558	102 07	109 747	96 410	118 237	158 655

Source: Economic Commission for Europe, database of the Industry and Technology Division.
a/ Non-members of the ECE.

Table V.91. Western European exports and imports of food- processing equipment as a percentage of consumption and production, 1989

Region or country of origin or destination	Percentage of imports: In total consumption of 503 570 tonnes	Percentage of imports: In total consumption valued at 11 005 million dollars	Percentage of exports: In total consumption of 655 038 tonnes	Percentage of exports: In total consumption valued at 13 647 million dollars
Japan	0.4	0.6	0.8	1.0
United States	1.4	1.7	4.2	4.1
Eastern Europe and USSR	0.2	0.1	2.6	2.7
Rest of the world	4.8	4.4	25.0	22.1

Source: *The European Market for Industrial Food Processing Equipment* (London, Frost and Sullivan, 1990).

Table V.92. Sources of Western European imports of food-processing equipment, 1985
(Percentage)

Region and country	Imports: Tonnes	Imports: Value
EEC	79.5	75.5
United States	4.3	6.1
Japan	1.3	2.1
Eastern Europe and USSR	0.6	0.3
Other	14.3	16.0
TOTAL	100.0	100.0

Source: *The European Market for Industrial Food Processing Equipment* (London, Frost and Sullivan, 1990).

ing for about 30 per cent of product shipments in 1991. Exports from the United States in 1991 rose by 5 per cent to an estimated $617 million (see table V.88), with Canada retaining its traditional position as the leading importer of United States machinery. The relative weakness of the dollar over the past two to three years has helped exporters, and might have presented tougher competition for European producers were it not for the fact that the two largest manufacturers in the United States are APV and Alfa-Laval. These two companies have the opportunity to sell from within the United States.

Mexican imports from the United States rose about 40 per cent in 1991, reflecting the country's strong growth in agribusiness, while other top-ranked export markets for United States machinery were Japan, United Kingdom, Netherlands, France, Republic of Korea, Germany and Australia [71]. At the same time, United States imports of food products machinery rose by 11 per cent in 1991 to an estimated $561 million, the leading suppliers being Germany, Italy, Netherlands, Japan and Switzerland. Higher imports of food-manufacturing equipment indicate increased internationalization of the United States food system. In product terms, both exports and imports were headed by bakery ovens or baking equipment, pasta machinery and meat- and poultry-processing machinery.

As shown in table V.93, the two countries with the best engineering reputation and infrastructure in Eastern Europe, Czechoslovakia and the former German Democratic Republic, are the only ones to have consistently managed a significant trade surplus in food-manufacturing equipment, although Poland posted a small surplus in 1988. However, the unification of Germany and the privatization of industry in the former German Democratic Republic have changed the picture radically. What is left of the equipment sector of the former German Democratic Republic is grouped around the Nagema Kombinat, destined to become, at best, a source of low-cost manufacturing to suppliers in the former Federal Republic of Germany rather than an exporter in its own right.

The former USSR has run a heavy deficit in food-processing machinery since 1980, with insignificant exports to countries such as Cuba, Mongolia and Viet Nam outweighed by imports. As with the countries of Eastern Europe, the foreign trade of the USSR mainly took place within the former CMEA, and the same countries previously supplied more than 80 per cent of the import needs of the former USSR. The collapse of CMEA and of the USSR itself has created uncertainty, but with imports apparently covering about a half of total demand, suppliers in developed market economies are keen to fill the vacuum left by suppliers in the formerly centrally planned economies such as Nagema. Apart from CMEA countries, the most important suppliers to the former USSR were Germany, Federal Republic of, Italy and Finland.

Table V.93. Exports and imports of food-processing machinery in selected countries of Eastern Europe and the USSR, 1980-1988
(Millions of roubles)

Country	1980	1985	1986	1987	1988
Bulgaria					
Exports	27.5	58.6	46.1	52.1	67.1
Imports	28.6	57.9	70.3	80.5	90.7
Czechoslovakia					
Exports	30.9	18.6	18.4	18.9	21.7
Imports	32.4	72.5	69.0	75.7	90.3
German Democratic Republic					
Exports	18.9	25.2	23.6	25.5	27.0
Imports	69.7	59.4	77.3	79.2	11.4
Hungary					
Exports	73.8	14.4	10.5	11.5	13.5
Imports	19.1	23.5	26.3	28.7	34.8
Poland					
Exports	11.4	15.7	10.9	12.4	14.0
Imports	89.8	83.5	10.5	12.5	13.5
USSR					
Exports	12.0	73.6	86.9	10.9	84.4
Imports	45.5	83.0	70.0	68.7	77.8

Source: *Statistical Yearbook of CMEA Member Countries 1989* (Moscow, 1989).

2. *The manufacturing capacity of developing countries*

(a) *Recent trends*

In many developing countries, the industry consists of a subclass of small companies producing simple, stand-alone machines for use by a food industry that is often similarly fragmented. Such machines, produced on a small-scale workshop basis, are often designed for the specific food needs of the country or locality concerned, and are not part of the international market for food-processing equipment which serves mass producers of food. At this latter level, the contribution of NICs and developing countries to total world production is small, and technology is generally at a low level. The market for food-processing and packaging equipment outside North America, Western Europe, Japan and Eastern Europe and the former USSR accounts for $2 billion to $3 billion out of a world total of $17.7 billion to $20.5 billion. As shown in table V.86, however, the developing countries' share of their own market is significantly less, because of the impact of imports from Europe, North America and Japan.

When considering the manufacturing capacity of developing countries for food-processing equipment, a distinction needs to be drawn between the manufacturing subsidiaries of companies based in developed market economies, on the one hand, and indigenous, locally owned equipment suppliers on the other. Only the very largest suppliers based in developed market economies, such as APV, Alfa-Laval and Buhler, have manufacturing subsidiaries in NICs or developing countries, with Brazil and India a favoured location. The equipment produced in such subsidiaries may not be state-of-the-art technologically, but it is designed to comply with more sophisticated production lines made in Europe and to play an integral part in the companies' global manufacturing strategy.

Alfa-Laval has two manufacturing plants in India and a well-established distribution network as well. The plants produce a range of equipment including tanks and the simpler types of separators, which have applications within and beyond the food industry. Increasingly the role for such plants could be to produce types of separators and heat exchangers that have been superseded elsewhere by more modern designs. Their application would be in the simpler, smaller equipment with which Alfa-Laval has had considerable success in developing countries and which brings a competitive advantage. From the early 1980s, it lost dominance of the Brazilian food-separator market after its rival Westfalia decided to produce its entire range of separators there. Fortunately for Alfa-Laval, customs duties are being reduced, and in 1991 it set itself a goal to win back a 50 per cent share of the market in three years.

Buhler, the Swiss machinery group, notes that the main purpose of local manufacturing plants is to overcome trade restraints such as customs barriers, lack of foreign currency, or the requirement of fulfilling local manufacturing quotas. The facilities require a large amount of know-how transfer and a considerable investment in training to ensure the necessary quality standards.

As for the indigenous suppliers, within a generally low to medium technological capability, there are variations in skills levels and in the ability of countries to be self-sufficient in food manufacturing equipment. Indonesia, for example, produces only about 20 per cent of the $250 million of food-manufacturing equipment it needs every year, and a similar figure applies for most other developing countries. Among Asian NICs, Singapore has been expanding its food machinery industry, and has had some success exporting mainly to neighbouring countries in South-East Asia, while retaining some equipment for internal purposes. In global terms, however, exports from Singapore are quite insignificant, running at less than $20 million a year. It is noteworthy, however, that countries which make even such modest efforts to build up a food equipment industry soon enter the international market to achieve greater returns for investment in a relatively specialized area of manufacturing. Exports from Argentina were running at about $5 million a year in the late 1980s, and went mainly to neighbouring Latin American countries. They compare with imports of around three times that amount, with the United States accounting for a third of the total. In the longer term, China is expected to become a significant producer of food manufacturing equipment, but in the immediate future it can only satisfy simpler equipment needs internally.

(b) *Prospects for growth*

Given potential increases in population growth it might be thought that the indigenous food-manufacturing equipment industries could be expanded in line with the food-processing industry itself. However, the food-processing industry in developing countries accounts for only about 15 per cent of the world market, and while growth rates for food processing are high in some countries, it will be at least another decade before the industry accounts for 25 per cent of the world market. While this is an attractive prospect for equipment suppliers based in developed market economies, it is not leading to any surge of interest among indigenous suppliers. In any case, population growth in itself will not necessarily benefit the equipment suppliers, unless it is accompanied by higher per capita incomes. In subsistence economies the majority of the current population survive on unprocessed foods and will continue to do so for some time.

The food equipment industry is unlikely to grow significantly in most developing countries, with some exceptions such as China, because new technologies and the indirect impact of food quality and environmental pressures have raised the costs of entry to the food-processing equipment industry. The advantage that the South might have in terms of lower labour costs is now less relevant for an industry that is becoming ever more capital-intensive, while the long-term investment in manufacturing capability and the design and production expertise of individual employees cannot be replicated quickly.

Furthermore, there are more important and more sensible priorities for industrial growth in developing countries. Because of the specialized nature of food-manufacturing equipment, it is difficult to achieve the kind of volume production that most developing countries look for from their industrial development, and thus the potential benefits from high-volume, labour-intensive production are not available. However, equipment suppliers based in developed market economies say that subcontractors could aid equipment suppliers in developing countries, if they can raise management expertise. This would raise local content levels in larger food-processing plants built in developing countries above their current low levels.

(c) *Equipment import potential*

The demand for food-processing equipment is linked to the growth prospects for food processing in developing countries. There are several factors which influence the potential imports of this equipment. First of all, there are immense regional variations, and companies based in developed market economies have clearly targeted countries in Latin America and particularly in the Pacific area where prospects for growth in gross national product are considerably higher than in Africa. Once a country becomes more prosperous and demand for more sophisticated, processed food arises, so the demand for machinery grows. There are constraints, however, on growth caused by factors well beyond the control of suppliers. In India, there may be a population of some 60 million to 70 million people prosperous enough to be considered targets for a sophisticated food-processing industry, but reaching this target market is a challenging prospect in a country of such a size.

Secondly, equipment suppliers based in developed market economies have to be careful about intellectual property rights in countries such as China. There have been a number of cases of duplication of simpler equipment from developed market economies in China and the former USSR, although there is no evidence of "passing-off" (or counterfeiting) as has occurred in other engineering industries. Over the long term there might even be some benefits for suppliers based in developed market economies from this unofficial technology transfer, if it helps to build the developing countries' manufacturing base for less sophisticated equipment.

Thirdly, the food equipment supplier has to gear the supply of equipment to the level of technology and infrastructural support present in the market it intends to serve. This may imply supplying dated technology until these markets reach the level of sophistication required to benefit from the latest techniques available. This holds true in Eastern Europe and the former USSR, as well as the NICs and developing countries of Latin America and the Pacific area. The installation of a large full-scale aseptic dairy could fail, if a local dairy industry is at the level of small farm production and distribution of raw milk. Some problems that could arise include the lack of an effective collection method for raw milk, the rejection of the end-product by the consumer due to the different taste of the processed milk, or the unavailability of support materials such as the films required to make the aseptic packages.

In some urban areas, there is still demand for large plants. In 1991 the Beijing Huaguan Dairy, worth 156 million yuan renminbi, was commissioned in the Haidian district of the Chinese capital, four years after construction began, with capacity to process 150 tonnes of raw milk daily into end-products ranging from milk drinks to cheese and ice-cream. VMF Stork, the process plant manufacturer with headquarters in the Netherlands, was the general contractor, and much of the equipment, including the process control system, came from the German company Tuchenhagen. For rural areas, however, equipment suppliers based in developed market economies have come under pressure from aid agencies to provide equipment that would be more suitable for regions with poor infrastructure, where there was a need to stem population drift from rural to urban communities and to provide necessary amounts of animal protein. The response of Alfa-Laval was to begin the production of mini-dairies, small, simple dairies built around an easily serviceable 900-litres-per-hour pasteurizer with heater, cooler and tank. The only infrastructure required is power, which can be provided by generator water, and a waste outlet.

The intention is for mini-dairies staffed by the owner and one or two helpers to produce good-quality milk and other dairy products for supply to the neighbourhood, with long-life products perhaps being sent to the next village. To date, Alfa-Laval has sold about 100 mini-dairies, mainly to developing countries, and has recently been finding a market for them in Eastern Europe and the former USSR. Profit margins on equipment costing $150,000 to $250,000 are low, but the current stagnation in infrastructural development in parts of the developing world suggests to Alfa-Laval that prospects are bright for further sales. In any case, there is an element of trade politics involved in such sales, which could open the door to the sale of so-called village dairies (the next step with a capacity of 20,000 litres per day) or much larger urban plants.

More recently Alfa-Laval has extended the concept into mini-juice plants and mini-ice-cream plants, aided in the latter case by its acquisition of the Italian supplier Mark in 1989. The company is now working on a development project to deliver entire ice-cream plants in containers which, singly or in groups, can be used as the buildings to house the process equipment. It reports fantastically unfilled demand for ice-cream plants in developing countries. Alfa-Laval has also looked at mini-fats-and-oils plants, but has opted to focus on the NICs such as Indonesia and Malaysia, where there is growing demand for large, highly automated plants.

Finally, large equipment manufacturers based in developed market economies are also following the ambitious expansion plans of their food and drink customers in countries with good economic and population growth prospects. APV has recently won significant contracts from Coca-Cola in South-East Asia, including the Philippines and Taiwan Province, and is Coca-Cola's largest supplier of soft-drinks-related plants in China. Producers of dry-food equipment often stress their advantages in supplying countries that lack an effective cold chain for providing aseptically packed and refrigerated goods to end-users. Hence APV is looking for significant developments in markets for products such as biscuits. It has also had major success in China with its rusk plants, addressing an acute shortage of correctly formulated foods in China, a shortage that is mirrored in other developing countries. Satake, the Japanese producer of rice-milling machinery, has also had major success in markets of developing countries, having supplied 55 per cent of the existing modern rice mills in Latin America, 82 per cent of those in Asia and 61 per cent of those in Africa.

3. *Capacity utilization and expansion plans*

(a) *Nature of capacity*

Estimating the number of producers of food-manufacturing equipment is a very difficult task, but an extrapolation of statistics from the better-documented regions of the world would produce a figure of between 5,000 and 10,000, if manufacturers of simple food-processing machinery in developing countries are included. A brief review of the history of the industry will explain why this should be the case, and why it could even prove to underestimate the number of producers of food machinery.

Over the past century, and especially in Europe, the industry has developed from families who excelled in the preparation by hand of a particular type of food and wanted to find a mechanized replica. Given the enormous diversity of foods worldwide, hundreds of different types of basic machines were devised and are still being produced, particularly in developing countries. Among smaller companies, therefore, the emphasis on specialization remains strong, even if the processes used in current machinery have developed a long way from simply being scaled-up and automated versions of kitchen appliances. Even some of the largest players in the industry, such as Westfalia Separator of Germany, have developed a broad range of applications from a long tradition in a limited number of basic technologies.

In Europe, there are 12 basic types of equipment: mills, dough mixers, blenders, ovens and grills, driers, bottling equipment, packaging equipment, meat-processing equipment, chillers, salad preparation equipment, dairy equipment and batch mixers; the final category also includes other miscellaneous equipment. Table V.94 indicates the size of the market in Europe for these categories in 1990 and forecasts for 1996 [72]. Whatever debate there may be about such a growth forecast, it can be seen that packaging equipment accounts for about one sixth of all production tonnage, meat-processing equipment for about one seventh, and ovens and grills for one ninth.

In Japan, and thus for much of East Asia, the following broad classifications are similar but the emphasis is very different: beverages; cereal products (snacks); confectionery products; dairy products; fruit and vegetables; grain milling; meat, fish and poultry; pasta products; and other formulated foods [73]. The high cost of meat has ensured that manufacturers of meat-processing equipment are far less common in Japan than in the United States or Europe, while the preference for raw fish (sushi) precludes significant development of equipment for prepared fish dishes that are common in developed market economies.

Table V.94. Market and production forecasts in Western Europe, 1990-1996

End-user industry	1990[a]	1996[b]	Percentage change 1990-1996
A. Western European market for food-processing equipment by end-use: tonnes			
Milling	64 755	140 145	2.16
Bakery products	132 060	296 385	2.24
Dairy products	72 680	131 260	1.80
Non-dairy drinks	26 895	50 245	1.86
Meat and poultry	81 185	171 830	2.12
Fish	60 690	121 810	2.01
Fruit and vegetables	63 980	113 685	1.77
Confectionery and other	50 370	102 010	2.02
Total. A	552 615	1 127 370	2.04
B. Western European production of food-processing equipment by type: millions of dollars			
Mills	873.58	1 980.46	2.26
Dough mixers	528.03	1 441.08	2.73
Blenders	873.65	2 109.46	2.41
Ovens and grills	1 418.47	3 836.11	2.70
Driers	1 124.09	2 751.56	2.45
Bottling equipment	1 663.33	3 627.95	2.18
Packaging equipment	2 162.42	5 398.79	2.50
Meat procurement equipment	2 176.42	5 129.55	2.35
Chillers	1 211.13	2 640.61	2.18
Salad preparation equipment	349.73	762.16	2.18
Dairy equipment	1 136.44	2 539.81	2.23
Batch mixers and other	1 283.23	3 333.65	2.59
Total. B	14 800.52	35 551.19	2.40

Source: *The European Market for Industrial Food Processing Equipment* (London, Frost and Sullivan, 1990).

[a] Estimate.

[b] Forecasts.

Within these broad categories, there are a wide variety of machines to perform different functions, and once again this has led to specialization within the equipment industry. The detailed United States classifications for food-processing equipment provide a good illustration. Within the overall category of meat-, poultry- and egg-processing equipment can be found the following: tenderizers; compactors; disintegrators; moulding machines and presses; poultry equipment; rendering equipment; frozen-meat flakers, slicers and cubers; bone saws, choppers and machines; and power cleavers, sausage-stuffing machines and slaughtering equipment.

(b) *Major companies in the global industry*

With regard to the number of companies in the industry, there are a total of 3,833 manufacturers supplying 2,674 categories of machinery and equipment. Of these, more than 1,000 supply processing and packaging equipment worth more than $3.5 billion a year, or just $3.5 million per manufacturer. There are very few large manufacturers, and it is estimated that about a dozen big companies supply the United States market with 20 per cent of all its food-processing equipment needs. The biggest United States companies in the equipment-manufacturing industry are Cherry-Burrell, part of United Dominion Industries, and parts of the machinery and equipment division of FMC.

Figures for Western Europe are not readily available, but follow a similar pattern. Total production is estimated to have been about $10 billion to $15 billion for 1990 [70]. None of the companies active in the European market can be considered to have what would normally be considered a large market share, but there are a small number of dominant players, notably Alfa-Laval of Sweden (now merged with Tetra Pak), APV of the United Kingdom, Buhler of Switzerland, and Werner and Pfleiderer of Germany. These firms together account for around 19 per cent of total market share in Western Europe, but the major manufacturers believe their share is closer to 30 per cent.

In some markets, the estimated market share masks the real concentration of power. In France, for example, there were some 310 food-processing and packaging equipment suppliers in the mid-1980s, but the 15 largest companies had more than 60 per cent of the market [73]. In some product markets, the large number of producers can be misleading: Buhler, the Swiss company, claims that more than one third of all pasta produced worldwide is made on its machinery. In the beverage sector, Alfa-Laval estimates that it, APV and Tuchenhagen have about 30 per cent of the world market between them, with 5 per cent for regional companies and 15 per cent for niche companies. That leaves half the market for local companies. A similar pattern exists in the dairy branch, while the ice-cream equipment branch is much more concentrated.

As for the industry's corporate structure elsewhere, in the former USSR, the Ministry for Machine Building for Light and Food Industries was responsible for the production of food-processing and packaging equipment until 1988, before the role was transferred to the Ministry of Defence. By 1985, 50 factories under the old ministry were producing equipment said to be worth $1.8 billion, but this includes fodder production, catering and retailing equipment, as well as food-processing and packaging. The food-processing and packaging equipment alone may have been worth $894 million in 1985 [74]. The Ministry of Defence since then has switched 250 defence industry factories to food machinery production.

In Japan, the composition of the food manufacturing industry is similar, and more than 95 per cent of equipment manufacturers are small- and medium-sized companies. Major producers have emerged only in branches where demand is greatest. The most obvious example of this is Satake, which vies with Buhler for leadership of the world grain-milling business, and which has 80 per cent of the Japanese domestic market for large-scale rice mills; it also has extensive activities overseas.

(c) Capacity adjustments and productivity

The food equipment industry in Europe and North America has in some respects faced the same manufacturing challenges as other parts of engineering, but with one important difference. Much of the impetus for improved efficiency, reduced product-development lead times and faster response to orders has in other branches been prompted by the necessity to match the standards set by Japanese seafood equipment, where with the exception of Satake in the specialized area of rice-milling equipment, there are hardly any companies with extensive export markets or ambitions to develop them.

Over recent years, however, the pressure on food equipment producers to improve their manufacturing techniques and productivity has been intense, because of the combination of technological, environmental and market developments in the food production industry. At the same time, the need to increase spending on research and development has obliged the large western equipment producers in developed market economies to rationalize manufacturing, to reduce overcapacity, and to concentrate production of specific products in single factories that serve a large regional or global market. In absolute terms there is still manufacturing overcapacity in the equipment industry, despite the rationalization that took place in the mid-1980s. In Europe, one of the first large companies to take action was Alfa-Laval, which reduced employment in its food business from 3,800 in 1986 to 3,000 in 1987, largely because of its need to rationalize dairy equipment manufacture. Since then, Alfa-Laval's food business workforce rose to 4,700, partly reflecting acquisitions and the consolidation into the group of its Indian manufacturing businesses.

Buhler, meanwhile, states that the portion of its existing manufacturing capacity in industrialized countries that is normally used for export cannot be fully utilized because developing countries can no longer finance their imports through hard currency. In contrast, its existing capacity in developing countries is satisfactorily utilized.

There is further evidence for overcapacity. Since German unification, the sharp rise in demand in the former German Democratic Republic for food-manufacturing equipment made in developed market economies has been, and is continuing to be, satisfied without the need for new manufacturing capacity in Germany or elsewhere. Current overcapacity has been exacerbated, however, by conditions in several of the important geographic markets and product areas mentioned above.

Within this general picture there are two qualifications that should be made. First, not all the manufacturing capacity is suitably located to allow equipment producers to respond to new business trends and market developments. The need to stay close to the uniquely critical needs of the food industry in the former USSR is an important reason why Tetra Pak has been actively developing manufacturing joint ventures there.

Secondly, the large equipment suppliers in Europe and North America have recognized the need to replace old manufacturing capacity with modern plants that encompass the main trends in modern manufacturing: computer-aided design and manufacturing (CAD and CAM), just-in-time stock control, total quality management, and flexible production via cell manufacturing. The latter is particularly important in an industry where product specialization and customization will never allow the mass production techniques seen elsewhere in engineering. APV estimates that as much as a quarter of its food equipment is non-standard.

The $58 million investment by a United Kingdom company in new manufacturing facilities at Peterborough (United Kingdom) is the clearest recent example of the commitment of the industry to modernize by replacing an older factory in the same town. But European suppliers have not been alone in upgrading their manufacturing. United States companies have matched and in some cases exceeded the European commitment to CAD, even if in some branches such as the dairy industry the production technology of their clients is less advanced and kept in service longer.

On both sides of the Atlantic, the use of automation by equipment suppliers has raised productivity.

Table V.95 on labour productivity in the United States food-machinery industry shows that the value of shipments per man-hour of production rose, in 1982 dollars, from $51 in 1972 to $61.4 in 1986. Table V.88, meanwhile, showed that total employment in the United States food-products machinery industry fell from 19,200 in 1987 to an estimated 16,800 in 1991, while over the same period the number of production workers fell from 11,800 to 9,600. Some of this reduction, however, may be due more to depressed business conditions than to increased efficiency and automation.

The current industry overcapacity has not been a serious concern to the major equipment suppliers; modern manufacturing techniques are a higher priority. In fact, most firms will be able to react quickly to the more positive business climate expected in the next few years. Major expansion of manufacturing capacity over the next five years is not on the industry agenda. Beyond that, there could be a need for more capacity if the industry capitalizes on its long-term growth prospects, but that in turn raises the questions of where and in what form new manufacturing should be undertaken.

4. *Restructuring and redeployment*

(a) *Changes in industry structure*

Worldwide, there is considerable variety in the structure and ownership of companies. In Europe, many of the medium-sized food manufacturing equipment concerns are deeply embedded in the general mechanical engineering and contracting industry, as companies have diversified out of, or into, the food market to maximize their opportunities from similar technologies. At the top of the scale, the world's largest manufacturer and the company with the broadest range of products is APV. This London-based company is publicly quoted, but most small firms in Europe are privately held. In Germany, Europe's biggest centre of production, there are dozens of small, privately held manufacturers.

Over the past five years, the structure of the industry has been slowly changing, although the extent of fragmentation is such that the net effect has not been dramatic. There are a number of reasons for the food equipment industry to begin to concentrate. First, the gradual emergence of global players in the food-processing industry itself, brought about by a wave of mergers in the early 1980s in the United States and United Kingdom, and more recently in Europe, has encouraged the equipment manufacturers to follow suit and thus to preserve, or at least partially to restore, the balance of power. Transnational food corporations are increasingly adopting equivalent buying policies, and will do so, if they can, with equipment as much as raw materials. They are also building larger plants, to serve several national markets more efficiently, and thus prefer to deal with large, broad-based equipment suppliers, which can take the risk of having turnkey responsibility for a plant.

Secondly, the costs of developing new technologies are rising quickly, smaller companies may find this increasingly hard to bear and thus need to spread these costs over a wider variety of applications. Finally, a factor that comes into play especially in Germany, and is not unique to the food equipment industry, is the inheritance problem. Many owners of private companies founded after the Second World War are reaching retirement age, and may have no descendants to whom they can transfer ownership.

Some or all of these trends were at work in a buying spree spearheaded by the two biggest companies in the industry, APV and Alfa-Laval in the mid- to late-1980s. The major acquisitions by APV were Baker Perkins (the United Kingdom bakery and confectionery machinery manufacturer), Pasilac (the Danish dairy equipment manufacturer), and Rosista (a German brewery equipment concern). In 1989 it took

Table V.95. Labour productivity in the United States food-products machinery industry, 1972-1986

Year	Value of product shipments (millions of 1982 dollars)	Man-hours of production (millions)	Value of shipments in 1982 dollars per man-hour of production
1972	2 077	40.7	51.0
1973	2 550	47.6	53.6
1974	2 698	54.9	49.1
1975	2 574	47.1	54.6
1976	2 371	44.1	53.8
1977	2 497	45.4	55.0
1978	2 848	49.4	57.7
1979	2 711	51.0	53.3
1980	2 564	47.5	54.0
1981	2 303	44.5	51.6
1982	2 160	40.1	53.9
1983	2 074	36.7	56.5
1984	1 962	33.6	58.4
1985	1 842	31.3	59.0
1986	1 798	29.3	61.4

Source: *Census of Manufacturers and Annual Surveys of Manufacturers* (Washington, D.C., Bureau of the Census, 1988).

a majority shareholding in Ortmann & Herbst (a German high-speed bottle- and can-filling machine supplier), and in a much smaller deal bought Wight Engineering (the United States manufacturer of ice-cream extrusion systems for the frozen confectionery branch).

Alfa-Laval, meanwhile, has made several acquisitions in its food business over recent years, particularly in the convenience food branch. Purchased were Koppens of the Netherlands, Formax of Illinois, and Kramer + Grebe (the large German producer of packaging machinery and one of the world's leading meat treatment and sausage-making equipment suppliers). Other notable food business acquisitions included the Italian ice-cream-machine manufacturer Mark, but Alfa-Laval has also made acquisitions in its industrial equipment business which are of direct relevance to food equipment, including the Swedish automation company SattControl, and flow equipment producers such as Tri-Clover in the United States and Reginox, its Brazilian licensee. After all this activity, Alfa-Laval was then purchased early last year by Tetra Pak (the Swedish manufacturer of soft-drink packaging equipment and materials) to create a formidable worldwide combination.

Among other less noticed take-overs, the Italian Sasib group is expanding rapidly in food manufacturing equipment as part of a general strategy based on expertise in precision engineering. It began by making acquisitions in the fragmented Italian equipment industry, but in 1990 also made purchases in the United States and in Denmark.

(b) *Joint ventures and low-cost sourcing*

Take-overs are not the only method of forming an alliance; joint ventures between western companies and manufacturers of developed market economies in developing countries and Eastern Europe and the former USSR are also of particular relevance. As shown in table V.96, APV has manufacturing joint ventures in Bulgaria and Hungary, although in general there has been only a very limited cooperation between firms based in developed market economies and firms of former centrally planned economies. An increase in joint ventures in this area is expected [74]. In fact, equipment suppliers based in developed market economies take the markets of Eastern Europe and the former USSR seriously. Tetra Pak Alfa-Laval has formed a new company that will coordinate the activities of the group in the States of the former USSR to ensure that those activities remain close to the customers' requirements. Tetra Pak already has three manufacturing joint ventures in the former USSR, including Tetra Pak Lutch, established near Moscow in 1990, which produces packaging machinery with a partner in the Russian Federation that previously manufactured missiles. A fourth joint venture, Tetra Pak Luban, will produce packaging for liquid and other foods starting in the third quarter of 1992, and requiring investment of $45 million from the Swedish group.

As regards links between equipment suppliers based in developed market economies and companies in developing countries, joint ventures have been less

Table V.96. Selected joint ventures in the food-processing and -packaging equipment industry

Joint venture company and country	Foreign partner	Domestic partner	Type of activity
APV-Bioinvest (Bulgaria)	APV International, APV Paracel (United Kingdom)	Bioinvest	Engineering and consultancy in biotechnology, refrigeration, air-conditioning and food-processing (since 1985)
APV-Ungaro (Hungary)	APV International, APV Paracel (United Kingdom)	Tatabanya B.V., GEPSZEV, Komplex Trading	Manufacture of food-processing machinery and equipment (since 1985)
HBH-Skala Bavarian-Hungarian Brewery (Hungary)	Hopfen- und Malzgetränkevertrieb (Germany)	Skala-Coop	Technology for small breweries (since 1985)
Finnpack-Hungaria (Hungary)	Halonen	Milk Industrial Trust	Manufacture of packaging machinery and equipment (since 1986)
SOVITALPRODMASH (former USSR)	FATA European Group (Italy)	VOLZHSKPRODMASH	Industrial refrigeration and freezing equipment (before 1987)
SOMAPAC (Hungary)	M.A.I.E.R. (Italy)	SOPIANA Pecs, KOMPLEX Trading, National Bank of Hungary	Manufacture of packaging machinery and equipment (since 1987)
Tetra Pak Lutch (Russian Federation)	Tetra Pak (Sweden)	Former USSR Ministry of Atomic Energy and Industry	Packaging machine assembly, technical service and training (since 1990)

Source: *Food Processing Machinery* (United Nations publication, Sales No.E.91.II.E.30) and information supplied by Tetra Pak.

popular for the suppliers based in developed market economies than fully owned manufacturing facilities or the sourcing of parts from independent suppliers. Big suppliers based in developed market economies have limited low-cost sourcing arrangements in developing countries, whether for components used in machinery manufactured in developed countries, or for large pieces of relatively unsophisticated equipment which are uneconomic to ship long distances. For example, APV manufactures tanks for its food equipment at its plant in Malaysia, a practice that would be unprofitable in the United States. The obstacle to the development of such a practice is the need for suppliers based in developed market economies to maintain their reputations, especially in large, complex plants where they are the turnkey supplier. Low labour costs can also be offset by low productivity.

Although all equipment suppliers based in developed market economies subcontract parts of their manufacturing to a greater or lesser extent, the majority of subcontractors are located in the OECD area, and often in the same country as the main supplier. Equipment producers suggest that Eastern Europe, and in particular Czechoslovakia, Hungary and Poland could in time become a source of component production, but not necessarily at low cost. High standards of specification require automated, capital-intensive production where labour costs are less important. With regard to NICs, United States machinery producers in particular have successfully used Mexico as a source of low-cost manufacturing.

(c) *Future structure of the industry*

Conventional wisdom has it that the inexorable rise in product development costs and the increasing globalization of the client base will lead to a thinning-out of numbers in the food-processing equipment industry. This will probably prove to be the case, but the process is likely to be a steady one; many of the smaller companies in the industry have retained their independence since the last century and will not relinquish it lightly. Even so, it seems likely that they will increasingly find themselves cast as subcontractors, providing specialist services to the broader-based equipment suppliers on large contracts.

There are certainly powerful stimuli to further concentration of the industry in Europe and the United States. The internationalism and purchasing power of the major food manufacturers means that the independent manufacturers of food-processing equipment will need an increasingly close relationship with the various factions of the Western European food industry [72]. Furthermore, the majority of companies currently active within the industry will become suppliers of standardized equipment to the large integrated companies. In addition, the intra-EEC market-place will see severe cross-national rationalization of companies manufacturing food-processing equipment, especially of the smaller and more specialist manufacturers.

A further stimulus to concentration could be the desire by the large equipment producers to fill gaps in the range of the services they can offer. Looking at the four stages of preparation, processing, packaging and handling, the main strength of a company like APV is in processing equipment; further acquisitions would thus give it the chance to extend its influence upstream and downstream, and are normally considered a quicker and cheaper solution than starting a new R and D effort afresh. Indeed, the ability of suppliers to provide a turnkey service could become increasingly important if the food industry decides to wind down its own in-house plant design capabilities so that it can concentrate on food manufacture and marketing. There will always be innovative new food-technology companies that reach a vulnerable point in their development, giving the larger equipment suppliers a good opportunity for purchases.

5. *Environmental considerations*

(a) *Consumer awareness*

As a branch of mechanical and electrical engineering, the food-manufacturing equipment industry is no worse a producer of pollutants than any other engineering industry. In the interests of manufacturing efficiency, it makes the same efforts to produce equipment in an energy-efficient way as its counterparts, and there are no specific additional environmental problems connected with the manufacture of food-processing equipment.

There are, however, immense indirect pressures on the industry because increasing demands by clients in the food industry to produce hygienic, safe foods without losing nutritional values [75]. The pressures are particularly strong in developed market economies, such as the United States and the United Kingdom, where health scares over Listeria in such products as cheese and yoghurt, the contamination of prepackaged salads, and the inadvertent contamination of supposedly sealed foods with foreign objects such as glass, have a pervasive effect through the food supply chain to the equipment manufacturer. The trend towards healthy eating is also relevant to the food equipment manufacturers, and there are situations where the desire of consumers in developed market economies for foods with fewer additives makes the manufacturing process more difficult, and thus affects the equipment used and its associated control systems. For example, the demand for reduced additives in bread makes the production process more critical.

At the legislative level, food safety is becoming an important issue for manufacturers as more policies conform to consumer interests. There already are indirect effects on the equipment industry, but the pressure is set to become more direct in the next few years. Within the EEC, work is under way on Community-wide safety and hygiene specifications which are expected to be produced by 1993. According to an ECE report on food-processing machinery, separate specifications are planned which include the following groups of machinery: baking machines, baking ovens and pasta machines; machinery for processing cereals and animal feed; slaughterhouse and butchers' machines and equipment; seafood processing machines; machines for fruit- and vegetable-processing; machinery for alcoholic and non-alcoholic drinks; machinery and equipment for dairies; whipped-cream and ice-cream machines; equipment for processing edible oils and fats; confectionery and chocolate machines; coffee- and tea-processing machines; equipment for sugar industries; and coolers and freezers [70].

These specific regulations are likely to influence food-processing and packaging standards in other parts of the ECE region. The ECE report also suggests that, as regards food safety, the model of regular inspections used in the United States could be of inspiration to other countries. In general, according to equipment suppliers, the United States has been ahead of the United Kingdom on food safety awareness, with continental Europe a little further behind, perhaps because of a lack of media interest.

(b) Hygiene and food machinery design

Some of the design changes made by the industry in recent years are fairly prosaic examples of environmental and cost pressures combined. There has, for example been a strong trend away from painted metal panels on food equipment towards stainless steel, which is cleaner, and cheaper to maintain. Other changes in the use of materials are more serious; the replacement of asbestos by alternative materials attests to the current preference for materials that are not only efficient but also environmentally safe. Among other specific changes encouraged by wider environmental fears, the growing concern about the harmful effects of chloro-fluorocarbons (CFCs) on the ozone layer is forcing design changes in refrigerators and freezers, and turning the industry back to older ammonia-and-brine refrigeration systems. In baking equipment, there is concern, too, about ethanol emissions from bread plants as a cause of ground-level ozone, and the equipment suppliers are already having to include scrubbers in markets such as Germany to cope with the problem.

A major problem for food equipment suppliers in an era of large continuous-flow food production is hygiene, and in this regard the current controversy over food safety merely emphasizes an influence on product design that has been, or at least ought to have been, present ever since economic forces prompted the switch from batch production. In the United Kingdom, the Richmond report on the microbiological safety of food found that poor hygienic design of equipment can, and has, led to food poisoning incidents [75]. Some observers accuse the equipment manufacturers of being ignorant for too long about the hygienic aspects of equipment design, concentrating on the ability of a design to perform a particular function. The food industry itself is often castigated for buying equipment without realizing the importance of hygienic design.

While such claims are debatable, and inevitably vary in veracity depending on the market, there is little doubt that the original impetus for sophisticated cleaning systems was economic. As equipment became bigger and more complex and was run for longer periods (to yield a quicker return on investment), it was no longer possible to clean manually. The past decade has thus seen a major growth in so-called clean-in-place (CIP), fully automated cleansing systems that do not require the dismantling of the equipment. The dairy industry, a critical branch in hygiene terms, led the way in CIP from the mid-1950s, with APV and Alfa-Laval instrumental in much of the pioneering work. However, equipment suppliers are now more aware than before of the need to support CIP with product design, so that food particles cannot linger and bacteria cannot accumulate.

As for dry products, there are major health implications in the handling or blending of dry, finely divided food such as flour and non-fat dry milk, and powder-handling equipment must be smooth in construction and cleanable preferably with automatic washing systems [76]. In addition, dryers including cyclones and sifters are now available in stainless steel of welded construction to permit CIP.

(c) Packaging and preservation techniques

A number of techniques and processes have emerged over recent years which can be linked to a greater or lesser extent with environmental and health pressures on end-users, often coupled with other trends such as the growth of the convenience food market and the need of the food industry for consistent quality. The search of the food industry for a more natural product, tastier but with fewer calories, less fat, cholesterol, salt and fewer preservatives has necessitated product reformulation, naturally impacting on product processing as well. This quest has put a larger onus on the sanitary integrity of the process itself and the equipment it encompasses.

Sterilization of food via heating during production is one long-established area where advances are being made. The ultrahigh temperature process for homogeneous liquids is being constantly refined, but new heat treatment processes are being developed for foods combining liquid and particles, which solve hygiene problems identified in current food production processes. Alfa-Laval has, for example, developed a process called Twintherm to address the problems caused by heating large particles through to their centres without overcooking. The technique separates the liquid and particle elements of the food, heating the liquids in a continuous process, and the particles in batches, and then combining the two.

Another new method is ohmic heating, pioneered by APV, which occurs when an electric current is passed through an electrically conducting food product. There are high hopes for this process commercially, which is seen as having particular advantages for foods with very large particles, as it sterilizes with minimal flavour change and insignificant particle damage. The prospects for such methods of heat treatment look rather better than for food irradiation, which is perhaps the most controversial issue in food safety. Irradiation uses radioactive elements or a stream of electrons to kill the micro-organisms present in food, and undoubtedly works. Unfortunately, it has suffered from claims that food past its prime has been exported as uneatable from one country, irradiated in another country and exported back to the original country as edible food.

Food packaging has also been adapted to recent environmental trends and food fashions. In the United States and Europe, there are moves away from excessive packaging, but considerable advances have also been made in aseptic packaging and new techniques such as *sous-vide* cooked items. One recent study has underlined the growing European market for new food preservation techniques, an illustration of technology meeting the demands of consumers [77]. Table V.97 features market forecasts for the next decade in five major European markets; aseptic processing is forecast to grow at an impressive pace between 1990 and 2000. Emerging technologies with high growth rates such as modified atmosphere, *sous-vide* and oxygen absorbers are forecast to grow by substituting for vacuum packs and by creating new market segments.

Within the food equipment industry, the impact of environmental awareness is felt particularly keenly at Tetra Pak. Advances in aseptic packaging for liquid foods are linked inextricably with the products pioneered by Ruben Rausing, founder of the group, and the TetraBrik carton in particular is being continually refined for new applications by producers of drinks and other liquids such as tomato paste. Such packaging is of particular significance to developing countries which lack a sophisticated cold chain infrastructure; it also facilitates milk consumption in warmer developed countries such as Italy and Spain. The concept of using as little material as possible to package as much product as possible, aseptically or otherwise, means that the environmental policy of Tetra Pak is akin to its declared mission. The need to consider the environmental aspect of packaging material production and eventual waste disposal puts companies such as Tetra Pak under a spotlight that shines on food equipment suppliers more indirectly. Overall, though, the food-manufacturing-equipment industry has been forced to become much more sensitive over the past decade to environmental pressures. These may be peaking in developed market economies; but given that most equipment is produced in those economies, environmental awareness is thus exported to the markets of developing countries as those markets expand.

6. *Technological trends*

(a) *Responses to lifestyles*

Leaving aside the environmental, hygiene and nutrition issues covered earlier, there are two clear technological trends which have emerged in the supply of food-manufacturing equipment. They are trends which are being driven by the changing demands of western food suppliers in developed market economies, and to which the dominant equipment industry in those economies is responding. The first of these trends has been prompted by lifestyle changes in developed market economies, such as reduced family cohesion, leading to fewer family meals, and the growing market for convenience foods and food service. In general terms, this means more complex, higher-value-added food, and has ramifications for the equipment suppliers. The constant need to satisfy the food industry's perceptions of changing fashions is bringing hitherto discrete sections of the equipment industry together, linking processes in an unprecedented way. Mixed products such as granola (using dried fruit in breakfast cereal) in the United States are an attempt by the food industry to stimulate sales in a mature product sector to which the equipment industry has to respond, and the larger suppliers are better able to achieve this. Furthermore, the food industry wants the flexibility to respond quickly to new trends, whether through new equipment or through modifications to existing plant. But it retains a very conservative attitude to totally new processes, largely through fear of alienating customers because of health or food quality problems unforeseen at the time of the introduction of the technology.

The second major trend is the need to make existing technologies work more efficiently. The food industry, at least in developed countries, has been building bigger manufacturing plants, and wants larger, faster and less labour-intensive production processes. This has led to a general trend away from batch production to continuous processes, a shift that in many industries in developed market economies has already taken place. However, it has brought with it a growing

Table V.97. European market for the main food preservation technologies, selected countries[a/], 1990-2000

Technology[b/]	Thousands of tonnes of finished products 1990	1995	2000	Average annual growth 1990-1995 (percentage)	Average annual growth 1995-2000 (percentage)
Vacuum pack	1 178	1 272	1 325	1.5	0.8
Skin pack	73	164	249	17.6	8.7
Modified atmosphere	569	952	1 347	10.8	7.2
Aseptic (millions of litres)	11 556	13 663	15 678	3.4	2.8
Sous-vide cooked	19	58	112	25.0	14.1
Oxygen absorber and ethanol generator[c/]	-	105	225	-	16.5

Source: GIRA, *New Food Preservation Techniques* (Grilly, France, March 1991).

a France, Germany, Italy, Spain and the United Kingdom.

b Chilled and aseptically packed products, excluding drinks or dried goods.

c Only bakery and take-away branches.

requirement for process control systems and computers to ensure that the equipment can produce food of consistent quality, and also further reduce staffing in food factories. Consequently, management information systems are thus seen as an important area of development in product planning, particularly as applied in bread plants over the past three decades. A great deal of manual intervention in large bread plants in developed market economies was removed in the 1960s, while in the 1970s the plants became more or less mechanized. Now, bread producers want to reduce the need for supervisors through increased usage of sophisticated process control. The trend affects large and small equipment producers alike; the small German equipment manufacturer MIWE Michael Wenz is reported to have begun a programme of research into the viability of an integrated baking system known as computer-aided bakery.

Clearly there is some tension between demands of customers for flexibility to respond to fashions, and increasing automation and computerization. Performing this task requires considerable process engineering expertise, but this is why R and D spending is on the rise.

(b) *Some new products*

There are a number of recent product developments that exemplify one or more of the factors outlined above. Continuous extrusion cooking technology can be traced back to the 1930s as a general concept, but it has taken the past 15 years for it to become generally acceptable to the food manufacturers, helped by developments in single-screw and in twin-screw technology. In breakfast cereal production it is replacing traditional pressure-type steam cookers, offering advantages in costs, labour, space, processing time and energy, but also supporting the search for new products, for example, by allowing centre-filling at the point of extrusion. The food producer also can configure an extruder to obtain a uniquely shaped product that competitors would find very hard to emulate. Traditional batch production would be unable to offer such an advantage.

Another process developed by APV in the United Kingdom is starchless moulding; confectionery products which have customarily been formed by being deposited into starch are instead shaped with the help of reusable moulds. The process promises to replace a labour-intensive process involving so-called moguls or moulding starch, but it also reduces space and manufacturing time dramatically [78].

Developments are also taking place in continuous heat exchangers, a vital component of the continuous food-manufacturing process. Although batch heat exchangers are still widely used and have become increasingly sophisticated through the use of programmable logic controllers, continuous exchangers offer much better thermal efficiency [79]. A new generation of continuous exchangers uses corrugated tubes to replace the smooth-walled tubes traditionally used, and create an improvement in thermal efficiency of up to 30 per cent.

As food producers build larger factories and buy larger equipment, they also need greater machine speeds. Alfa-Laval's Hoyer ice-cream equipment company has developed an extrusion machine for producing a wide range of new ice-creams, a machine that has raised speeds from 9,000 to 18,000 ice-creams an hour over the past three years, and is now working on a machine that can produce at a rate of 27,000 hourly. Hoyer also has a belt extrusion line that can produce at 80,000 an hour, a rate unheard of a decade ago. The company points out, however, that customers in a fashion-led industry are looking for flexibility if a new product launch proves unsuccessful. This creates the need for modular equipment design and emphasizes the importance of programmable controls.

(c) *Computerization in manufacturing*

As has happened in almost all areas of the world's engineering industries, computers have revolutionized the production of food-manufacturing equipment. The most important development has been CAD-CAM, because of its effect on product development times and its integral role in a philosophy known variously as concurrent, simultaneous or parallel engineering, in other words, interdisciplinary teamwork that is designed to avoid the delays caused by the more traditional step-by-step approach to manufacturing. In the food equipment industry, the role of the client in this process is particularly important, and the pressures from the market-place onto the food producers require the suppliers to develop faster solutions. At Tetra Pak, the Swedish packaging materials and machinery concern that pioneered aseptic packaging of liquid foods, machinery design moved from the drawing-board to a CAD-CAM system over a five-year period beginning in 1984, and has boosted efficiency substantially by allowing more engineers to work on the same design simultaneously. CAM manufacturing is facilitated by links to component manufacturers.

APV, Alfa-Laval and the larger equipment suppliers with all-round process-plant contracting expertise are able to design plants on screen and manufacture the equipment well ahead of completion of the intended building. It is believed that very few of the European and United States equipment suppliers now work without the help of CAD-CAM, which in technical terms is easier for the smaller companies to install and thus pays for itself more quickly. It is important to note, however, that the increasing complexity of food equipment would have led to major increases in product development times without CAD-CAM. In this regard, computers are offsetting this trend rather than actually reducing lead times. Also, while it is true that the competitive advantages of CAD-CAM risk being cancelled out in an industry where their use is universal, the trend raises a further entry barrier for any developing country that may wish to build up its presence as an equipment supplier.

Sophisticated electronic controls such as programmable logic controllers are increasingly seen as having a crucial role in helping the food industry achieve goals ranging from quality and reliability of the end-product to flexibility of production and supervision. But there are also many types of sensors used for in-line process monitoring and based on ultrasonics or vision systems. Often these are being developed jointly by the equipment suppliers and universities and other research establishments.

According to one study, European food processors are moving increasingly towards on-line analysis equipment and away from the laboratories, while analyzers which can monitor more than one food constituent are rapidly stealing sales from those which cannot [76]. As shown in table V.98, the biggest growth in the European market is forecast for spectroscopy systems. Near infrared reflectance and nuclear magnetic resonance will be popular mainly because of the expected rise in on-line analysis. With the most obvious benefit being in speed of response, the use of near infrared reflectance has already spread from the grain and animal feed industries into meat products, beverages, confectionery and dairy products.

Table V.98. European market for food-processing analysers, 1989 and 1994

Item	Market value 1989 (million dollars)	Market value 1994 (million dollars)	Compound annual growth rate
Automated wet chemistry	22.4	21.7	-0.7
Electrical methods	2.8	3.8	6.1
Physical methods	21.3	26.2	4.2
Spectroscopy systems	24.8	40.0	10.0
Chromatographic systems	4.6	6.8	7.9
TOTAL	75.9	98.5	5.4

Source: *The European Market for Food Processing Equipment* (London, Frost and Sullivan, 1990).

There is another level of automation in which food-manufacturing equipment is becoming involved. A recent ice-cream plant contract fulfilled in Italy involved orders being fed by computer from ice-cream vendors into the process control system, which adjusts output accordingly and thus dovetails production precisely to consumption patterns. APV and Alfa-Laval, the two biggest companies in the food equipment industry, have devoted considerable resources to process control and management information systems. The APV batch-manager system, for example, is designed specifically for the food processing industry and the beverage industry, and is a computer-based system designed to optimize the use of labour, minimize down-time, and capitalize on just-in-time techniques.

The SattControl subsidiary of Alfa-Laval also has strong links with clients in the confectionery, milling, bakery, dairy, ice-cream and oil-processing branches. The unit benefits from synergies with food equipment produced by its owner, but also from its automation work in other industries. There is a considerable advantage for Alfa-Laval in such an approach. SattControl not only brings long-established expertise in the specific challenges of food automation, notably the control of CIP along with the food production process itself, but can also transfer technologies from other industries where automation is more developed.

A subsidiary reason for the growing importance of process control and computerized food manufacture is the expanding usage of robots in the food industry. These need to be controlled by computers and integrated with the production chain. Once again, vision systems and sensors are prompting the increasing use of robots, along with automatic guided vehicles.

(d) Research and development

There are no exact figures for most countries on R and D in the food manufacturing equipment industry. However, it is well known that in several countries, links between the industry and public and private research institutes are important. It is difficult to separate pure research conducted by the equipment industry from work done on a shared basis with a particular client; but it would appear that the total is rather higher then the norm of around 3 per cent for manufacturing industry in developed countries, though lower than the 12 per cent commonly found in the pharmaceutical industry.

A number of the trends identified above suggest that R and D spending by the equipment industry may be rising, and this is confirmed by the large suppliers. The end-users may be conservative as regards new technologies, and current technologies are developing in an evolutionary manner, yet the growing emphasis on computers and controls is taking the industry into more expensive areas of research. The relentless demands of the food industry are also increasing product development spending in a number of ways; clients will often come to the equipment suppliers with a rival product which they require to replicate as quickly as possible. Similarly, a client could come up with a new idea in a laboratory process that proves extremely difficult to reproduce in scaled-up form for mass production.

The large equipment suppliers are in a much stronger position to cope with these trends. One of the biggest United States equipment suppliers, FMC, recently opened a new laboratory in California devoted to food equipment, studying production processes and developing new packaging concepts. Significantly, the FMC food laboratory is adjacent to its corporate technology centre, which makes advances in electronics vision systems, engineering technologies, artificial intelligence and materials engineering. In another indication of the importance of software expertise, the Swiss grain machinery producer Buhler in 1990 acquired a small United Kingdom software development company, Control, Design & Development.

In the United Kingdom, the $35 million investment over the past two years by APV Baker at Peterborough includes a facility where the food industry can develop and test its ideas on APV machinery to ensure they are practical, strengthening the links between customer and supplier in a way that would not be available to the smaller equipment manufacturer. Conversely, some of the best ideas for new products emerge from small, technology-based companies and are sold to the larger groups that have a better chance of surmounting the mistrust of image-conscious food manufacturers.

(e) Technology transfer

Over the next 10 years, technological developments in the industry are more likely to be evolutionary than revolutionary, continuing a long-established pattern.

Even so, it is clear from the above that, leaving aside the other obstacles to further development of a food equipment industry in the South, technology trends are raising the entry costs for any company wishing to rival producers based in developed market economies. The success of the larger companies in those economies rests on enormous technological expertise built up over many years, and the ability to transfer ideas from one branch of the industry to another helps spread the costs of technology development. Crucially though, the pressures for change that have come through the supply chain, whether environmentally or commercially motivated, are not present in developing countries to an extent even remotely comparable to what exists in developed market economies. Thus there is little technological stimulus for the development of sophisticated process control technologies outside the countries where the expertise is currently concentrated. In particular, it should be noted that the current emphasis on computerized control techniques involves even equipment suppliers in developed market economies in the building of links with innovative computer and sensor manufacturers and research houses, whose centres of excellence match the dominant country producers of food-manufacturing equipment quite closely.

7. *Short- and long-term industry outlook*

In the short term, there are a number of challenges for equipment suppliers in those markets currently experiencing weak business conditions. In the United States and the United Kingdom, suppliers are hoping for a recovery in investment levels from the subdued levels of the past two years, but this will depend on an improvement in the general business climate. However, given that present conditions in the United Kingdom are due more to a deferral of sizeable equipment orders than cancellation or abandonment of spending plans, APV believes an upturn in confidence could release pent-up demand. In both markets, when conditions do improve, the larger equipment manufacturers will be relatively better placed than smaller rivals to handle the needs of the large food processors.

In Eastern Europe and the former USSR, there is at present no sign of an end to the political and economic uncertainty which has caused considerable difficulties for the financing of orders. In contrast, the markets identified earlier as showing healthy growth are likely to continue strong. It is interesting to note, for example, that the priorities in food-processing equipment terms are much the same in the former German Democratic Republic as in its former CMEA neighbours, the difference being that money has rapidly been made available in the former German Democratic Republic for rebuilding its infrastructure and manufacturing base.

Long-term prospects offer the food equipment industry considerable grounds for optimism. Positive trends identified above are likely to stimulate machinery suppliers in the 1990s. These trends include: increased competition between the larger food corporations in most developed countries, leading to the construction of large and efficient food-processing plants; the convergence of hitherto discrete food technologies such as ice-cream and confectionery, cereals and fruit, as the food industry searches for new products; the growing importance of quality control; and the increase in consumption of high-value-added snack foods and convenience food. Similarly, the increasing demand for fresh and prepared foods, aseptically packaged for long shelf-lives, and healthy foods such as low-fat, no-additive products will represent both a challenge and an opportunity for machinery suppliers. One possible scenario reflecting these prospects suggests that the "normal" food-processing plant of the next decades will be a highly automated plant where production takes place in continuous processing lines with the high degree of flexibility needed to satisfy the demanding markets in the region [70]. Experience achieved in other engineering branches with the implementation of computer-based integrated systems and new managerial approaches should be advantageously utilized in the food-processing industry as well.

One of the opportunities for equipment suppliers lies in the wide differences in the attitude of the food industry to the adoption of automation and continuous production techniques. One source indicates that some segments that lend themselves to continuous flow production, such as dairy production, beverages and baked goods, have been highly automated for many years [73]. However, other segments which are batch oriented tend to rely on automation technologies that have been proven effective in other industries. The further use of process control and process development tools would maximize automation results, particularly in Europe, the United States and Japan. Some of its other findings also suggest opportunities for equipment suppliers, especially the large companies with in-house automation expertise; intelligent sensor application is not widespread, plant-wide digital communication networks are not prevalent, and new and faster analysis techniques are sparsely implemented. For example, table V.99, which describes the introduction of new food-processing machinery in the former USSR, illustrates the slow pace of introduction of new types of equipment and removal of obsolete types, particularly when viewed as a percentage of types of equipment in use. With regard to the Western European market, figure V.29 shows the differing extent of automation in the six most important country markets.

In the long term, one major source confirms that the food machinery industry is international and successful manufacturers will adopt global marketing strategies similar to those of the food processors they serve [71]. United States machinery builders have the advantage of being linked directly to the world's largest and most innovative food processors, now well into their second decade of growth. Demands for more healthful, sanitary and conveniently prepared food products with longer shelf-life are being met through the collaboration of various segments of the food industry, including machinery suppliers. In all but subsistence economies, food tastes are becoming international.

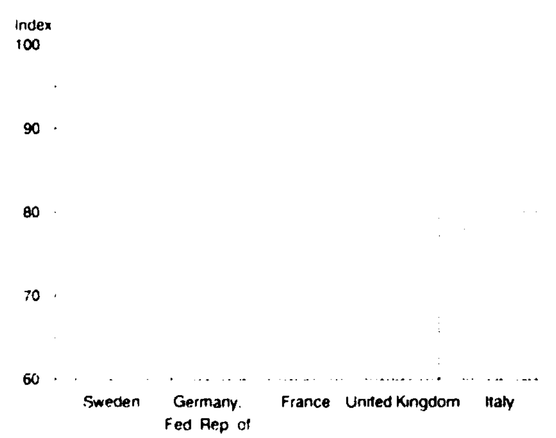
On the subject of production in Western Europe, another source predicts a 240 per cent rise in its value from $14.8 billion in 1990 to $35.5 billion in 1996 (see

Table V.99. Introduction of new food-processing machinery in the USSR, 1971-1987

Indicator	1971-1975	1976-1980	1981-1985	1985	1986	1987
Number of new models and types of machinery and equipment, apparatus, instruments and means of automation produced	624	527	626	139	100	112
Percentage of total number in industry	4.1	3.8	4.7	5.3	4.1	5.4
Number of new types of machinery and equipment acquired for the first time	281	178	277	84	52	60
Percentage of total number in industry	2.1	1.3	1.8	2.4	1.5	1.7
Number of obsolete types of machinery and equipment taken out of production	102	157	206	66	93	64
Percentage of total number in industry	1.8	2.4	2.4	3.5	4.0	2.4

Source: *Food Processing Machinery* (United Nations publication, Sales No.E.91.II.E.30).

Figure V.29. Extent of automation in European food industries[a]



Source: *Multiclient Program on Advanced Automation for the Food Processing Industry* (Columbus, Ohio, Battelle Institute, 1988)

[a]Based on arbitrary index equal to 100 for Sweden

also table V.95)[76]. The installation of large computer-integrated food-processing systems will become more and more evident as the industry moves people away from the direct food-processing chain. Other changes which should benefit equipment producers include: environment-related concerns such as the ozone layer and greenhouse gases; anticipated acceptance by consumers of food irradiation (this could be a long time coming); and the increasing tendency for consumers to become grazers of food products rather than large meal eaters. In Western Europe, a further positive influence, at least for large equipment suppliers, is the European Single Market. Alfa-Laval says that towards the year 2000 there will be increasing pressure on suppliers to utilize the advantages of that market.

Regarding market trends in Eastern Europe, the same source suggests the following: the opening of Eastern Europe will produce a much more free market for the goods of equipment producers in developed market economies; Eastern Europe will serve as a local source of low-value-added food-processing equipment; and a united Germany will have a positive effect on the rest of Europe. The likely relative importance of these trends on the equipment industry differs internally, but there is clearly considerable long-term confidence about Eastern Europe, despite current difficulties, simply because of the growing needs for food equipment as the former centrally planned economies expand through closer links with developed market economies. Further east, China as a market has considerable potential, even if projected population growth is not in itself a positive factor unless accompanied by economic growth; more opportunities are thus likely to spring up in the big coastal cities and regions than in the Chinese hinterland. The continued economic growth of South-East Asia will also have a positive bearing on food needs and thus on equipment orders.

Elsewhere, there is cautious optimism over prospects in Latin America, where the current more stable political and economic environment could generate increased interest in food equipment produced by developed market economies. Brazil, as a major producer of coffee, chocolate powder and orange juice, has potential for long-term growth, if it is able to capture a greater share of the value-added side of these food industries. Prospects for growth in Africa seem rather more remote, while Australasia looks likely to become relatively less important as a market for food equipment.

The long-term prospects for different equipment industries reflect a number of positive trends. The beverage (soft and carbonated drinks) business is expected to remain strong and is perhaps the ideal branch to benefit from high economic growth in the warmer countries of South-East Asia. The dairy equipment producers have a large, if not too financially rewarding market in developing countries, along with good prospects for larger dairies in Western Asia. Alfa-Laval sees Saudi Arabia investing in large, sophisticated dairy plants, following the trend set by the European dairy industry. The fats-and-oils equipment business is rather harder to predict; indeed Alfa-Laval suggests two contrasting positive and negative scenarios, on the basis of the differing effects of a big rise in palm oil supply.

In the dry-goods branch, the considerable growth in the market for snack foods in developed countries could extend into developing countries, especially Asia, over the next few years, while the bakery equipment branch could continue to see changes as the United States and the United Kingdom begin to move away from taste-free white bread to more healthy types. There is also a trend towards more flexible bakery production which could be of benefit to Japanese equipment producers.

In the long term, all these trends could have a marked effect on the profitability of the food equipment industry. As mentioned at the start, profit margins are tight and a fall in turnover can be damaging. The process of rationalization in the industry implies a smaller number of equipment producers sharing a more profitable market, so long as the industry is able to withstand the downward pressure on prices that could be caused by a customer base that is itself rationalizing and concentrating. In developing countries, the evidence suggests that the balance of power in the industry is likely to remain very much as it is now, until at least the end of the century.

K. Mineral-processing equipment (part of ISIC 3824 and 3831)*

1. *Current conditions*

Mineral-processing equipment improves the quality and purity of ore for smelting by crushing, drying, flotation and separation of unwanted constituents. Major mineral-processing equipment includes the following: crushers, which reduce ore size (gyratory, impact, roll and jaw crushers); grinding mills, which are used to pulverize the ore into a fine powder; screens, which are normally used for washing and dewatering the ores and can also be used for sizing; classifiers, which are used for size separation of ores and consist of centrifuges to classify material of different density by means of centrifugal action; and flotation machines, jigs, concentrating tables or spirals, which are used to separate the more finely crushed mineral materials.

In terms of structure, the mineral-processing industry as defined here comprises the following stages: comminution, which includes crushing and grinding; beneficiation (sometimes referred to as concentration), which consists in screening, classification, flotation, and electrostatic, gravity and magnetic separation; and media separation, also termed dewatering, which consists of pressure or vacuum filtration. The broad term "milling" is sometimes used to refer to the mineral-processing stages from crushing, grinding, classification and concentration to dewatering.

The mineral-processing industry has historically lagged behind world business cycles, due to persistent worldwide surpluses of metal and mineral supplies. The fact that the industry is directly linked to the demand for mineral products, has helped to raise the demand for mineral-processing equipment and for replacement and repair parts at times when the demand for processed minerals was increasing. Today, the mineral-processing-equipment industry has yet to recover from the steep decline in activity that took place during the worldwide recession in 1982-1983. The mineral-processing-equipment industry has also been found to respond negatively to falling oil prices. For example, the decline in oil prices has induced a decrease in demand both for coal-processing machinery and for mineral-processing equipment in general. Equipment manufacturers everywhere are plagued by slow growth in export markets. Another factor that has limited growth is the capital-intensiveness of the industry, which leads to long pay-off periods for existing technologies and extra-high risks in introducing new ones.

Competitiveness in this industry has historically been assessed by the price gaps that exists among producers. These differentials stem from varying domestic production costs, as well as from the currency exchange rates of producing countries against the dollar. A competitive factor, which partially offsets the price disadvantage for some producers, is advanced technology. The development of high-technology machinery is strengthening the competitiveness of the mineral-processing industry of developed countries compared with that of developing countries.

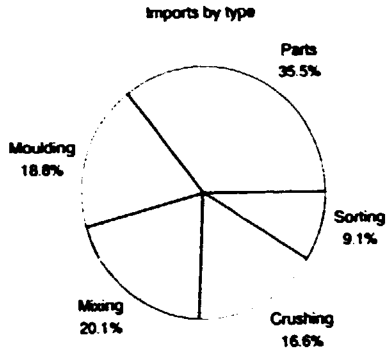
Equipment output in the past has been determined primarily by the derived demand for minerals in the production of a wide range of consumer products and capital goods. Other important factors in the supply of mineral-processing equipment include: government policies affecting the overall mineral-processing branch; high material and capital costs; growing participation by developing countries; and policies adopted to reduce overcapacity in the North. Changes in each of these components will affect the pattern of growth in the world market over time.

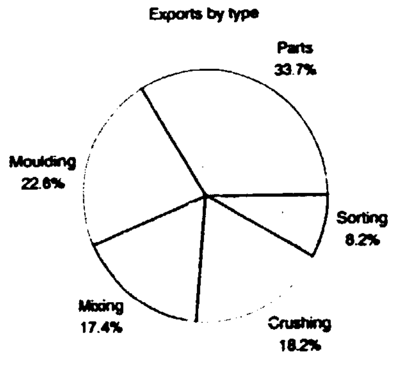
2. *International trade*

The growing demand for specialized machinery in expanding developing economies and the need for major mineral producers to constantly renovate their processing equipment have, in recent years, resulted in considerable trade. Figure V.30 shows the composition of trade in mineral-processing equipment by region in 1990. Today, the international trade in parts

*UNIDO acknowledges the contribution of B. Bocoum, Department of Resource Economics, West Virginia University

Figure V.30. World composition of trade in mineral-processing equipment, 1990





Source: UNCTAD trade data bank

for mineral-processing machines is between 33 and 36 per cent of total trade. Spare parts represented the largest proportion of all equipment traded worldwide in 1990. Table V.100 shows that both developed and developing countries have significantly increased their exports of mineral-processing equipment since 1983. World exports of such equipment reached some $3.714 billion in 1990. This figure is 97.5 per cent higher than that recorded in 1983. Concerning specific countries, Finland had the largest increase at 377.2 per cent during the period considered. Significant increases were also recorded in the Netherlands with 281.2 per cent, and Canada with 215.4 per cent. Most impressive were the increases recorded in the South at 122.7 per cent, with Latin America recording an astonishing 1000 per cent increase in exports of mineral-processing equipment. The increases that occurred in the developed market economies of Oceania were also significant.

Germany maintained its position as the world's leading exporter of mineral-processing equipment, followed by the United States, Italy, and the United Kingdom. China had the largest increase from 1989 to 1990, at 100.1 per cent. Other significant increases over these two years were recorded in the Netherlands at 54.5 per cent, in Austria at 50.6 per cent, and in Denmark at 49.6 per cent.

Changes in market shares of exports of mineral-processing equipment are also reflected for all types in table V.100. Both North America and Western Europe gained market shares between 1983 and 1990. The share of the South decreased marginally from 0.05 per cent in 1983 to 0.04 per cent in 1990. Table V.101 gives the composition of regional exports for five major types of mineral-processing equipment traded worldwide. While parts and replacement units composed the greatest shares of North American and Western European exports, machinery for moulding and shaping mineral pastes and solids was the major export for Japan. Exports from other developed countries consisted mainly of sorting, screening, separating and washing equipment. Parts were, by far, the most significant items traded by the North.

The composition of exports in the South was also dominated by the parts category, followed by machinery for shaping and moulding mineral pastes and solids. Exports by Latin America were highly concentrated in the parts category, followed closely by exports of sorting, screening, separating and washing equipment. African exports of mineral-processing equipment consisted almost entirely of spares and replacement units. Developing countries of Asia had the largest market share of mixing and kneading machinery in 1990, while in the centrally planned economies of Asia, the crushing and grinding category dominated.

Table V.102 provides further details on the market shares of individual countries and regions in global exports for each category of mineral-processing equipment. While Germany was the leading exporter of crushing, mixing, and moulding equipment and parts in 1990, it was second in world exports of screening and separating equipment. The United Kingdom was the leading exporter of screening and sorting equipment and the third most important exporter of crushing and grinding equipment in that year. The ranking of the United States changed from third to sixth in almost all types of mineral-processing equipment, though it was the second most important exporter of parts.

Japan remained among the top 10 leading exporters in all categories of equipment. In terms of geographic distribution, developed market economies dominated the export market almost entirely, with over 95 per cent in all equipment types. The shares of the export market accounted for by centrally planned economies of Asia in 1990 were 0.3 per cent, 1.5 per cent, 0.3 per cent, 0.3 per cent and 0.7 per cent for screening, crushing, mixing, moulding equipment and parts, respectively. The corresponding shares of the developing economies of the South were 2.1 per cent, 2.6 per cent, 4.5 per cent, 2.0 per cent and 1.8 per cent, respectively. In terms of 1990 shipments, world exports of parts for mineral-processing machines were the largest of the five types at $1,205 million, followed by moulding machinery at $802 million, crushing and grinding machinery at $647 million, mixing machinery at $619 million, and screening equipment at $290 million.

World imports of mineral-processing equipment also grew significantly between 1983 and 1990. As

Table V.100. World exports of mineral-processing equipment, 1983 and 1990

Rank in 1990	Economic grouping, region and country	Exports in 1990 (thousand dollars)	Percentage change		Percentage share	
			1983-1990	1989-1990	1983	1990
1	Germany	1 010 010	104.87	28.38	26.21	27.19
2	United States	430 539	100.80	25.03	11.40	11.59
3	Italy	400 908	131.92	23.74	9.19	10.79
4	United Kingdom	311 452	77.94	21.61	9.31	8.39
5	France	285 918	45.93	26.64	10.42	7.70
6	Denmark	211 038	122.55	49.62	5.04	5.68
7	Japan	178 468	18.32	16.08	8.02	4.81
8	Belgium and Luxembourg	109 608	158.69	34.17	2.25	2.95
9	Switzerland	109 453	148.57	46.60	2.34	2.95
10	Sweden	104 006	143.14	30.20	2.27	2.80
11	Netherlands	95 491	281.17	54.52	1.33	2.57
12	Finland	82 686	377.15	13.61	0.92	2.23
13	Austria	66 371	130.58	50.59	1.53	1.79
14	Canada	60 467	215.39	36.77	1.02	1.63
15	Spain	54 632	89.26	-1.55	1.53	1.44
A.	Western Europe, of which	2 880 000	109.76	28.51	72.99	77.54
	EEC	2 505 000	101.85	27.68	65.98	67.45
	North America	491 000	109.83	28.53	12.44	13.11
	Japan	178 500	18.54	16.23	8.03	4.82
	Eastern Europe [a]	19 000	..	..	-26.92	-0.51
	Other	44 000	131.58	-13.73	1.01	1.18
	Total, A	3 612 500	102.42	26.60	94.36	96.74
B.	Asia					
	Developing market economies	55 000	37.50	3.77	2.13	1.48
	Centrally planned economies	23 000	-62.90	91.67	3.30	0.62
	Latin America	22 000	1000.00	-18.52	0.11	0.59
	Africa	1 500	50.00	-70.00	0.05	0.04
	Total, B	101 500	122.73	-12.50	0.05	0.04
	Total, A and B	3 714 000 [b]	97.45	25.39	100.00	100.00

Source: UNCTAD, trade data bank.

[a] Former Yugoslavia only. Data not available for Eastern Europe and former USSR.

[b] Exports may exceed imports due to possibility of error in data collection.

Table V.101. Regional composition of trade in mineral-processing equipment[a], 1990
(Percentage share of imports/percentage share of exports in regional total shares)

Economic grouping, and region grouping	Sorting screening equipment	Crushing grinding equipment	Mixing kneading equipment	Moulding equipment	Parts
A. North America	12.8/9.1	12.3/14.1	11.4/13.3	14.3/11.7	49.3/51.9
Western Europe, of which	8.7/7.9	15.6/17.3	19.6/17.7	18.5/24.4	37.7/32.7
EEC	9.9/7.8	17.1/16.2	23.7/18.8	23.5/24.4	25.7/32.9
Japan	7.7/5.9	7.7/37.9	16.9/14.8	40.0/27.8	2.7/13.6
Other	15.1/32.4	28.8/26.5	6.1/23.5	18.2/5.9	31.8/11.8
Total, A	9.6/8.2	15.1/18.1	17.7/17.1	18.3/22.8	39.3/33.9
B. Africa	3.6/-	29.1/-	20.0/-	34.6/-	12.7/100
Latin America	8.6/32.3	35.4/12.9	17.2/9.7	13.4/9.7	25.4/35.5
Asia	8.7/8.9	18.2/24.4	19.2/42.2	21.8/11.1	32.0/13.3
Total, B	8.3/6.7	23.9/19.1	18.3/31.5	20.7/18.0	28.9/24.7
C. Centrally planned economies[b]	10.8/4.4	10.8/43.5	18.1/8.7	36.1/8.7	24.1/34.8
Total, A, B and C	9.1/8.22	16.6/18.2	20.1/17.4	18.8/22.6	35.5/33.7

Source: UNCTAD trade data bank

[a] Import and export data given for each type of equipment as a percentage of total imports and exports of mineral- processing equipment for that region. Total of row = 100.0/100.0 per cent for imports and exports, respectively.

[b] Including Asia, Eastern Europe and the former USSR.

Table V.102. World exports of mineral-processing equipment by type, 1990

Sorting, screening, separating or washing equipment

Rank in 1990	Economic grouping, region and country	Exports (thousand dollars)	Percentage share
1	United Kingdom	87 245	30.08
2	Germany	46 235	15.94
3	United States	34 905	12.04
4	Belgium and Luxembourg	14 864	5.13
5	France	14 261	4.92
6	Italy	12 676	4.37
7	Australia	10 263	3.54
8	Japan	9 750	3.36
9	Sweden	9 671	3.33
10	Switzerland	7 719	2.66
11	Netherlands	7 037	2.43
12	Finland	6 735	2.32
13	Spain	6 158	2.12
14	Denmark	4 774	1.65
15	Canada	4 510	1.56
	A. North America	38 000	13.10
	Western Europe, of which	224 000	77.24
	EEC	193 000	66.55
	Eastern Europe[a/]	1 000	0.34
	Japan	10 000	3.36
	Other[b/]	11 000	3.79
	Total, A	284 000	97.59
	B. Africa[c/]	-	-
	Latin America	1 000	0.34
	Asia		
	Developing market economies	4 000	1.38
	Centrally planned economies	1 000	0.34
	Total, B	6 000	2.07
	Total, A and B	290 000	100.00

Crushing and grinding equipment

Rank in 1990	Economic grouping, region and country	Exports (thousand dollars)	Percentage share
1	Germany	149 380	23.09
2	Denmark	66 918	10.34
3	United Kingdom	65 606	10.14
4	Japan	63 767	9.86
5	France	56 833	8.78
6	United States	54 583	8.44
7	Italy	35 600	5.50
8	Sweden	33 147	5.12
9	Finland	27 132	4.19
10	Austria	15 188	2.35
11	Netherlands	10 371	1.60
12	China	9 610	1.49
13	Switzerland	7 381	1.14
14	Belgium and Luxembourg	7 306	1.13
15	Spain	7 171	1.11
	North America	59 000	9.12
	Western Europe, of which	488 000	75.43
	EEC	400 000	61.82
	Eastern Europe[a/]	2 000	0.31
	Japan	64 000	9.89
	Other[b/]	9 000	1.39
	Total, A	622 000	96.13
	Africa[c/]	-	-
	Latin America	4 000	0.62
	Asia		
	Developing market economies	11 000	1.70
	Centrally palnned economies	10 000	1.54
	Total, B	25 000	3.86
	Total, A and B	647 000	100.00

Mixing or kneading machinery

Rank in 1990	Economic grouping, region and country	Exports (thousand dollars)	Percentage share
1	Germany	243 947	39.47
2	Italy	87 674	14.19
3	France	53 108	8.59
4	United States	51 380	8.31
5	Netherlands	30 911	5.00
6	United Kingdom	28 657	4.64
7	Japan	24 641	3.99
8	Switzerland	13 244	2.14
9	Singapore	9 346	1.51
10	Republic of Korea	8 127	1.32
11	Denmark	7 950	1.29
12	Finland	7 943	1.29
13	Australia	7 642	1.24
14	Austria	6 281	1.02
15	Yugoslavia	5 585	0.90
	North America	56 000	9.06
	Western Europe, of which	500 000	80.91
	EEC	465 000	75.24
	Eastern Europe[a/]	6 000	0.97
	Japan	25 000	4.05
	Other[b/]	8 000	1.29
	Total, A	595 000	96.13
	Africa[c/]	-	-
	Latin America	3 000	0.49
	Asia		
	Developing market economies	19 000	3.07
	Centrally planned economies	2 000	0.32
	Total, B	24 000	3.87
	Total, A and B	619 000	100.00

Table V.102. (continued)

Agglomerating, shaping or moulding machinery

Rank in 1990	Economic grouping, region and country	Exports (thousand dollars)	Percentage share
1	Germany	236 258	30.93
2	Italy	152 773	20.05
3	France	65 517	8.65
4	Denmark	31 570	4.19
5	Japan	27 466	3.54
6	United States	24 925	3.28
7	United Kingdom	23 804	3.27
8	Switzerland	22 634	3.01
9	Finland	21 836	2.88
10	Netherlands	16 894	2.23
11	Austria	15 025	1.97
12	Spain	15 003	1.97
13	Belgium and Luxembourg	12 980	1.70
14	Yugoslavia	7 655	1.05
15	Sweden	7 000	0.92
	A. North America	29 000	3.80
	Western Europe, of which	687 000	90.04
	EEC	604 000	79.16
	Japan	27 000	3.54
	Eastern Europe[a/]	8 000	1.05
	Other[b/]	2 000	0.26
	Total, A	753 000	98.69
	B. Africa[c/]	-	-
	Latin America	3 000	0.39
	Asia		
	Developing market economies	5 000	0.66
	Centrally planned economies	2 000	0.26
	Total, B	10 000	1.31
	Total, A and B	763 000	100.00

Parts for mineral processing machines

Rank in 1990	Economic grouping, region and country	Exports (thousand dollars)	Percentage share
1	Germany	337 866	28.05
2	United States	244 296	20.25
3	Italy	102 185	8.46
4	France	96 198	7.97
5	United Kingdom	86 140	7.14
6	Denmark	80 090	6.64
7	Belgium and Luxembourg	69 325	5.73
8	Sweden	48 883	4.07
9	Canada	44 010	3.65
10	Switzerland	43 476	3.57
11	Japan	32 844	2.74
12	Netherlands	30 581	2.57
13	Spain	23 487	1.91
14	Austria	22 841	1.90
15	Finland	19 617	1.66
	North America	218 000	18.09
	Western Europe, of which	921 000	76.43
	EEC	813 000	67.47
	Japan	33 000	2.74
	Eastern Europe[a/]	3 000	0.25
	Other[b/]	4 000	0.33
	Total, A	1 179 000	97.84
	Africa	1 000	0.08
	Latin America	11 000	0.91
	Asia		
	Developing market economies	6 000	0.50
	Centrally planned economies	8 000	0.66
	Total, B	26 000	2.16
	Total, A and B	1 205 000	100.00

Source: UNCTAD trade data bank.

a/ Former Yugoslavia only, excluding other Eastern Europe and former USSR due to unavailability of data.

b/ Australia, New Zealand, Israel, Ryukyu Islands and South Africa.

c/ Less than 1 million 1990 dollars.

shown in table V.103, total imports of mineral-processing equipment increased by 141.82 per cent. Among all countries, the most remarkable increases occurred in Thailand, with 1549.4 per cent. Among developed countries, the strongest import increases occurred in Spain at 895.7 per cent, Sweden at 478.6 per cent, the Netherlands at 324.1 per cent, and Switzerland at 299.6 per cent. Other significant import increases occurred in Canada, France, Germany, Italy, United Kingdom and United States. Import changes were not significant for the centrally planned economies of Asia.

From 1989 to 1990, Thailand also had the largest increase in mineral-processing equipment imports at 144.3 per cent, followed by Chile at 92.3 per cent. Major declines were recorded in China at −25.4 per cent, the United States at −18.2 per cent, Canada at −3.9 per cent, and the United Kingdom at −2.6 per cent. A lesser decline occurred in Italy at −0.9 per cent. The United States is still the world's leading importer of mineral-processing equipment, with 8.4 per cent of all such imports, followed by France, which increased its share from 6.9 per cent in 1983 to 8.1 per cent in 1990. With regard to economic groupings, the North continued to account for the largest share of imports, with 74.8 per cent of the total in 1990, followed at a distance by the South at 25.3 per cent. Total world imports of mineral-processing equipment were estimated at $3 billion in 1990. In the South, imports of mineral-processing equipment showed a marginal decrease from the 1983 level at −7.3 per cent, while imports were increasing at a high rate in the developed market economies of the North at 225.7 per cent during the same period. The most significant increase from 1989 import levels, 17.2 per cent, occurred in the North.

As shown in table V.104, the United States had the largest market share, 12.6 per cent of the imports of screening and washing equipment, followed closely by Germany with 10.3 per cent. As regards geographic

Table V.103. World imports of mineral-processing equipment, 1983 and 1990

Rank in 1990	Economic grouping, region and country	Imports in 1990 (thousand dollars)	Percentage change 1983-1990	Percentage change 1989-1990	Percentage share 1983	Percentage share 1990
1	United States	252 398	184.52	-18.19	7.15	8.34
2	France	245 322	184.88	22.70	6.94	8.11
3	Germany	232 094	263.69	46.69	5.14	7.67
4	United Kingdom	176 166	143.84	-2.59	5.82	5.82
5	Canada	161 925	140.79	-3.93	5.42	4.86
6	Belgium and Luxembourg	147 308	82.52	44.94	6.50	4.66
7	Spain	140 833	895.71	35.91	1.14	4.27
8	Thailand	129 194	1 549.36	144.34	0.63	3.97
9	Netherlands	120 396	324.09	50.67	2.29	3.24
10	Sweden	97 517	478.56	66.12	1.36	3.04
11	Republic of Korea	92 498	271.55	21.39	2.01	2.88
12	Italy	86 971	179.14	-0.90	2.51	2.81
13	Switzerland	85 351	299.62	28.53	1.72	2.78
14	China	83 527	..	-25.44	..	2.75
15	Portugal	83 156	301.34	56.35	1.68	2.74
A.	North America	414 000	165.38	-11.35	12.57	13.70
	Western Europe, of which	1 674 000	248.02	21.53	38.76	55.38
	EEC	1 327 000	254.81	26.62	30.14	43.90
	Japan	65 000	195.45	35.42	1.77	2.15
	Eastern Europe [a]	22 000	..	-4.35	..	0.73
	Other	86 000	138.81	26.47	2.90	2.84
	Total, A [b]	2 218 000	225.70	17.17	54.88	74.79
B.	Africa	55 000	-75.00	-5.17	17.73	1.82
	Latin America	211 000	154.22	-5.80	6.69	6.98
	Asia					
	Developing market economies	412 000	-5.94	38.72	35.29	13.63
	Centrally planned economies	84 000	..	-25.00	..	2.78
	Total, B	700 000	-7.28	16.28	60.84	25.21
	Total, A and B	3 001 000	141.82	52.96	100.00	100.00

Source: UNCTAD trade data bank.

[a] Former Yugoslavia only.

[b] Excluding Eastern Europe and former USSR, except for former Yugoslavia, due to unavailability of data.

Table V.104. World imports of mineral-processing equipment by type, 1990

Sorting, screening, separating or washing equipment

Rank in 1990	Economic grouping, region and country	Imports (thousand dollars)	Percentage share
1	United States	35 449	12.57
2	Germany	29 062	10.28
3	Canada	17 720	6.38
4	France	17 704	6.37
5	Belgium and Luxembourg	12 936	4.59
6	Netherlands	12 628	4.48
7	Portugal	10 081	3.57
8	Republic of Korea	10 078	3.57
9	United Kingdom	9 917	3.52
10	Singapore	9 227	3.27
11	China	9 203	3.26
12	Chile	8 703	3.09
13	Sweden	8 611	3.05
14	Italy	8 306	2.95
15	Switzerland	8 182	2.90
A.	North America	53 000	18.79
	Western Europe, of which	145 000	51.42
	EEC	112 000	39.72
	Japan	5 000	1.77
	Eastern Europe[a]	1 000	0.35
	Other	13 000	4.614
	Total, A[b]	217 000	76.95
B.	Africa	2 000	0.71
	Latin America	18 000	6.38
	Asia		
	Developing market economies	36 000	12.77
	Centrally planned economies	9 000	3.19
	Total, B	65 000	23.05
	Total, A and B	282 000	100.00

Crushing and grinding equipment

Rank in 1990	Economic grouping, region and country	Imports (thousand dollars)	Percentage share
1	Germany	42 164	8.22
2	Chile	41 085	8.00
3	Republic of Korea	37 075	7.23
4	United States	27 833	5.43
5	Sweden	26 212	5.11
6	Mexico	23 662	4.61
7	Belgium and Luxembourg	22 831	4.44
8	Canada	22 687	4.42
9	France	22 654	4.42
10	Spain	22 049	4.30
11	Portugal	20 846	4.06
12	United Kingdom	18 650	3.64
13	Australia	18 063	3.52
14	Netherlands	17 356	3.38
15	Italy	16 471	3.21
	North America	51 000	9.94
	Western Europe, of which	259 000	50.49
	EEC	193 000	37.62
	Japan	5 000	0.97
	Eastern Europe[a]	2 000	0.39
	Other	22 000	4.29
	Total, A[b]	339 000	66.08
	Africa	16 000	3.12
	Latin America	74 000	14.42
	Asia		
	Developing market economies	75 000	14.62
	Centrally planned economies	9 000	1.75
	Total, B	174 000	33.92
	Total, A and B	513 000	100.00

Mixing or kneading machinery

Rank in 1990	Economic grouping, region and country	Imports (thousand dollars)	Percentage share
1	France	72 747	13.55
2	Spain	41 018	7.64
3	Belgium and Luxembourg	32 518	6.06
4	Germany	26 693	4.97
5	United States	26 088	4.86
6	United Kingdom	25 476	4.74
7	Netherlands	21 974	4.09
8	Thailand	21 450	3.99
9	Canada	20 838	3.88
10	Portugal	19 724	3.67
11	Austria	17 516	3.26
12	Indonesia	17 390	3.24
13	China	15 327	2.85
14	Switzerland	14 831	2.76
15	Singapore	14 646	2.73
	North America	47 000	8.75
	Western Europe, of which	326 000	60.71
	EEC	267 000	49.72
	Japan	11 000	2.05
	Eastern Europe[a]	2 000	0.37
	Other	10 000	1.86
	Total, A[b]	396 000	73.74
	Africa	11 000	2.05
	Latin America	36 000	6.70
	Asia		
	Developing market economies	79 000	14.71
	Centrally planned economies	15 000	2.79
	Total, B	141 000	26.26
	Total, A and B	537 000	100.00

Agglomerating, shaping or moulding equipment

Rank in 1990	Economic grouping region and country	Imports (thousand dollars)	Percentage share
1	Spain	47 637	8.21
2	United Kingdom	46 547	8.03
3	United States	38 929	6.71
4	France	37 234	6.42
5	Germany	30 870	5.32
6	China	30 451	5.25
7	Belgium and Luxembourg	27 322	4.71
8	Republic of Korea	27 205	4.69
9	Thailand	25 628	4.42
10	Japan	22 685	3.91
11	Canada	20 309	3.50
12	Netherlands	19 089	3.29
13	Italy	18 925	3.26
14	Portugal	18 127	3.13
15	Mexico	13 218	2.28
A.	North America	59 000	10.17
	Western Europe, of which	308 000	53.10
	EEC	265 000	45.69
	Eastern Europe[a/]	8 000	1.38
	Japan	23 000	4.48
	Other	15 000	2.59
	Total, A[b/]	413 000	71.20
B.	Africa	19 000	3.28
	Latin America	28 000	4.83
	Asia		
	Developing market economies	90 000	15.52
	Centrally planned economies	30 000	5.17
	Total, B	167 000	28.80
	Total, A and B	580 000	100.00

Parts for mineral-processing machines

Rank in 1990	Economic grouping region and country	Imports (thousand dollars)	Percentage share
1	United States	124 090	11.35
2	Germany	103 305	9.45
3	France	94 982	8.69
4	Canada	80 370	7.35
5	United Kingdom	75 576	6.91
6	Thailand	68 369	6.26
7	Belgium and Luxembourg	51 601	4.72
8	Netherlands	49 348	4.51
9	Sweden	39 174	3.58
10	Switzerland	36 524	3.34
11	Italy	34 414	3.15
12	Austria	30 220	2.76
13	Spain	24 596	2.25
14	Mexico	22 724	2.08
15	Indonesia	21 369	1.96
	North America	204 000	18.66
	Western Europe, of which	628 000	57.46
	EEC	289 000	26.44
	Eastern Europe[a/]	10 000	0.91
	Japan	18 000	1.65
	Other	21 000	1.92
	Total, A[b/]	881 000	80.60
	Africa	7 000	0.64
	Latin America	53 000	4.85
	Asia		
	Developing market economies	132 000	12.08
	Centrally planned economies	20 000	1.83
	Total, B	212 000	19.40
	Total, A and B	1 093 000	100.00

Source: UNCTAD trade data bank.

a/ Yugoslavia only.

b/ Excluding Eastern Europe and former USSR, except for Yugoslavia, due to unavailability of data.

areas in the distribution of screening and washing equipment, Western Europe was the leading importer in 1990 with 51.4 per cent of the total, with the EEC accounting for 40 per cent of these imports. North America followed with 18.8 per cent. The North led in imports of screening and washing equipment at 77 per cent, compared with 23 per cent for developing countries. Western Europe also led in imports of crushing and grinding equipment at 51 per cent. The EEC alone accounted for over 37 per cent of all such imports, followed by North America at 10 per cent, making the total share of the North 66 per cent in 1990. Developing countries, however, had a strong share of the market for crushing and grinding equipment at 34 per cent, compared with 23 per cent of the market for screening and washing equipment. Centrally planned economies of Asia had only a 1.8 per cent market share of imports of this equipment category. Imports of mixing and kneading machinery were largest for Western Europe at 60.7 per cent in 1990. The share of the South in such imports was recorded at 26.3 per cent of the world total during the same year. Developing countries of Asia accounted for the greater share of the total imports by the South of mixing and kneading machinery, with 14.7 per cent of the world total in 1990.

Western Europe also dominated imports of moulding machinery with 53.1 per cent of total world imports in this category, making the share of the North a significant 71.2 per cent of the world total. The market share held by developing Asian countries was also significant at 15.5 per cent. Imports of parts for mineral-processing machines were led by Western Europe at 57.5 per cent, followed by North America at 18.7 per cent, with a combined share for the North of about 81 per cent. Among the developing economies of the South, those of Asia had over 12 per cent of total world imports of parts, for an aggregate of 19.4 per cent recorded by the South in 1990. World imports of screening equipment totalled $282 million in 1990, those of crushing and grinding equipment, $513 million; mixing or kneading equipment, $537 million; moulding machinery, $580 million; and parts, $1.093 million. Table V.101 showed that parts of mineral-processing machines led imports at 35.5 per cent of total world imports of mineral-processing equipment, followed by mixing and kneading machinery at 20.1 per cent. Also, parts constituted the greatest share of imports of all major economic groups, except for crushing and grinding equipment, which dominated Latin American imports, and moulding machinery, which constituted the greatest share of African imports of all types of mineral-processing equipment.

The position of the United States among the top three exporters and importers of mineral-processing equipment can be explained by the fact that in recent years, the high value of the dollar raised the price of United-States-built machinery to potential foreign purchasers, and made imports of mineral-processing machinery from other manufacturing countries relatively less expensive. Latin America is currently the fastest-growing region in terms of exports of mineral-processing equipment. NICs such as Brazil and Mexico are currently expanding production for export.

World imports of mineral-processing equipment as a proportion of world consumption have increased significantly in the last decade. This change reflects the beginning of a transitional period in world production and trade towards the greater processing of mineral resources by producers in developing countries. The market share of the United States is increasingly being threatened by strong competition from European exporters such as Germany and the United Kingdom. In China, imports of mineral-processing machinery have also strongly increased in recent years in the form of coal- and phosphate-processing equipment.

3. *Major countries in the global industry*

World production of mineral-processing equipment is reported in table V.105 in terms of the number of units, not dollar equivalents. Although information on all countries was not available, table V.105 shows the leading producers in 1988 to have been Brazil, Japan, the United States, and Germany, Federal Republic of. Japan was the second-largest producer of mineral-processing equipment in 1988 with a share of 13.1 per cent of world production. The United States produced about 5.9 per cent of total world production of mineral-processing equipment in 1988.

Concerning the geographic distribution of production in 1988, the EEC produced over 27 per cent of the total quantity of equipment manufactured worldwide. The share of developing Africa in total world produc-

Table V.105. World production of mineral-processing equipment, 1988

Rank in 1988	Economic grouping, region and country	Production in 1988 (number of units)	Percentage share 1988	Percentage change 1987-1988
1	Brazil	82 842	27.16	-
2	Japan	39 913	13.08	37.94
3	United States	17 953	5.89	28.37
4	Germany, Federal Republic of	14 504	4.75	-10.45
5	Poland	13 850	4.54	-0.04
6	Republic of Korea	11 711	3.84	0.53
7	Bulgaria	8 548	2.80	1.77
8	Mexico	6 312	2.07	11.32
9	Hungary	4 130	1.35	-26.24
10	Czechoslovakia	3 182	1.04	-3.16
11	Yugoslavia	3 172	1.04	7.03
12	France	3 029	0.99	-11.09
13	Austria	2 029	0.67	20.92
A.	North America	24 265	7.95	22.89
	Western Europe, of which	92 413	30.30	-5.26
	EEC	83 970	27.53	-3.32
	Japan	39 913	13.08	37.94
	Eastern Europe[a]	39 029	11.75	-3.78
	Total, A	195 620	64.13	7.09
B.	Africa	458	0.15	-1.72
	Latin America	89 154	27.66	-0.02
	Asia[b]	29 342	8.06	4.29
	Total, B	109 422	35.87	0.67
	Total, A and B	305 042	100.00	3.29

Source: *Industrial Statistics Yearbook 1988*, vol. II (United Nations publication, Sales No. E/F.90.XVII.13).

[a] Excluding former USSR.

[b] Including China.

tion of mineral-processing equipment was a low 0.2 per cent in 1988. World production of mineral processing equipment rose by about 3 per cent during the period 1987-1988.

The production of milling equipment alone is given in table V.106 for reporting countries worldwide. Although data were not available from all producers, the information provided in this table permits an assessment of the production of milling equipment in 1988. Production of milling equipment was dominated in 1988 by the EEC and Eastern Europe with market shares of 29 per cent and 22 per cent respectively. Among developing regions, Africa had the lowest production share at 0.25 per cent in 1988. The decreases were recorded by the EEC at −9 per cent, and Latin America about −1 per cent from 1987 to 1988. World production of milling equipment, which amounted to 57,971 units in 1988, rose by 3.5 per cent from 1987 to 1988.

Some conservative estimates of consumption, also in terms of the number of units, are provided in table V.107 for selected countries. According to the data presented here, demand for mineral-processing equipment was the largest in Japan, Republic of Korea and the United States. Because the availability of data for other regions or countries was limited, a further comparative analysis of consumption trends worldwide was not attempted.

Table V.106. World production of milling equipment, 1988

Rank in 1988	Economic grouping, region and country	Production in 1988 (number of units)	Percentage share 1988	Percentage change 1987-1988
1	United States	7 712	13.30	5.01
2	Japan	6 959	12.00	-28.35
3	Republic of Korea	2 802	4.83	71.06
4	Czechoslovakia	2 208	3.80	726.97
5	Bulgaria	1 453	2.51	34.29
6	Poland	1 387	2.39	-3.07
7	Yugoslavia	1 074	1.85	-19.97
8	Austria	828	1.43	50.00
9	France	570	0.98	-70.98
10	Portugal	146	0.25	8.15
11	Denmark	103	0.18	-75.06
12	Finland	100	0.18	..
13	Hungary	22	0.12	-72.15
	A. North America	7 717	13.31	22.94
	Western Europe, of which	18 086	31.20	-7.72
	EEC	17 095	29.49	-9.04
	Eastern Europe[a]	12 561	21.67	2.22
	Japan	6 959	12.00	43.22
	Total, A	45 323	78.18	6.60
	B. Africa	146	0.25	22.69
	Latin America	1 530	2.64	-0.97
	Asia[b]	10 972	18.93	0.11
	Total, B	12 648	21.82	-1.92
	Total, A and B	57 971	100.00	3.53

Source: UNIDO, *Industrial Statistics Yearbook 1988*, "Commodity Production Statistics" vol. II, United Nations, New York, 1990.

a/ Excluding former USSR.

b/ Including China

Table V.107. Consumption of mineral-processing equipment in selected countries, 1987

Country	Consumption[a] (number of units)
Japan	22 802
Republic of Korea	18 549
United States	15 487
Germany	10 973
Sweden	8 421
Denmark	703

Source: UNIDO, *Handbook of Industrial Statistics* 1990 (Aldershot, United Kingdom, Edward Elgar Publishing Limited, 1990).

a/ Apparent consumption estimated on the basis of information obtained for the ratio of output to apparent consumption. The consumption figures were calculated for countries where this ratio and further information on production were available.

Note: Data not available for other countries.

Global production of mineral-processing equipment has stagnated since 1983, with the few notable exceptions reported above, reflecting a lack of improvement in prices and the growing adverse influence of overcapacity in the North. However, the increase in production by the developing countries of Latin America and Asia is mainly a result of current capacity expansions in industries supplying mineral-processing and associated equipment.

4. *Manufacturing capacity of developing countries*

The leading manufacturing industries in the developing countries are based on the production of consumer goods, the manufacture of mineral-processing equipment being relegated to a minor place. Today, developing countries still depend heavily on imports to meet their requirements for mineral-processing equipment.

The development of the mineral-processing equipment industry requires, above all, improvements in mineral-processing manufacturing capacity and the increased domestic demand for processed goods. The small size of the domestic market for mineral-processing equipment in most developing countries makes it difficult to establish production facilities on an economic basis. Furthermore, the high technology or specialized skills required for making the majority of such equipment have acted as a major obstacle to the development of domestic production. The absence of associated industries for supplying parts, components and special services also puts these newcomers at a competitive disadvantage relative to developed countries. In spite of these difficulties and of the continued heavy dependence on imports for the supply of mineral-processing equipment, domestic production of such equipment has been growing in developing countries.

There is, however, a clear distinction among the levels of sophistication found in the mineral-processing equipment industry in developing countries. The most significant improvements have so far taken place in Brazil, China, Mexico, India, Republic of Korea and the former Yugoslavia. These countries have not only produced a wide range of standard equipment, but have also begun to manufacture technologically complex equipment. Rising income levels and increasing availability of local development financing have encouraged the development of their processing equipment industry. Also, some of these countries have encouraged the assembly and local manufacture of machinery as a deliberate policy response to the rising prices of imported machinery or as an attempt to secure the dynamic benefits to be derived from the industry (including direct and indirect employment effects). In other developing countries, the production of mineral processing equipment is still at an embryonic state.

Production in developing countries, while expanding, has consistently been in deficit relative to consumption. In addition, the experience of developing countries so far leads to the conclusion that, in spite of the growing volume of equipment production and manufacturing capacity, these countries have generally not succeeded in developing domestic technological capacity in this industry. There is an apparent asymmetry between the progress made in the manufacture of mineral-processing equipment and the development of domestic technological capacity. Although developing countries have gained some manufacturing experience, they still have to acquire the indigenous capacity to design, adapt and produce mineral-processing equipment efficiently. One serious consequence has been that the domestic equipment-manufacturing industry has not played a dynamic role in the development of the economy as a whole.

Because the demand for mineral-processing equipment is essentially a derived demand stemming from the demand for mineral commodities and technological infrastructure, additional planning is essential for the industry to expand in developing countries. The increasing high-technology-intensiveness of the industry together with its impact on technological progress in other industries, are additional reasons why the manufacture of mineral-processing equipment should receive particular attention in development planning.

While considerable potential exists for the growth of the mineral-processing equipment industry in developing countries, there are several constraints that need to be handled effectively. To begin with, there are very limited R and D facilities in most developing countries, whereas in developed countries the strengthening of competitiveness has recently caused a renewed focus on R and D programmes. The increased R and D efforts in mineral technologies will probably slow down the speed of technology transfer to developing countries. Moreover, the introduction of new technology expected throughout the 1990s will further increase the need for capital. This development will make it more difficult for developing countries to employ new technology.

Developing countries will have to reduce their dependence on imports. While the technological capability to ensure adequate and efficient manufacture of mineral-processing equipment may be growing in many developing countries, considerable progress still needs to be made in most of them in order to alleviate current regional imbalances in production.

5. *Industry restructuring and redeployment*

Profitability declined in the mineral-processing equipment industry during the first half of the 1980s, and a new market structure has begun to emerge in recent years. A list of the major companies supplying mineral-processing equipment worldwide is provided in table V.108. So far the equipment manufacturers have been independent from the mineral companies. There is a growing tendency for transnational corporations such as Outokumpu (Finland) and Trelleborg (Sweden) to lead equipment manufacturers towards greater concentration. A typical example of this trend is the quick growth of the mineral-processing divisions of Trelleborg. In 1987, Trelleborg acquired the United-States-based Allis Chalmers, which was a leading producer of grinding and crushing equipment, and renamed the group Boliden Allis. During the last two years Boliden Allis has merged with several minor manufacturers of crushing or sorting equipment such as the British Goodwin Barsby Ltd and Braham Miller Ltd. of the United Kingdom and Mineral Processing Systems Inc. of the United States. In 1989, Boliden Allis was known to be the world's leading producer of crushers, all of this growth having been achieved in two years.

Examples of industry concentration in the South include the recent acquisition by Caemi of Brazil, of 100 per cent of the voting capital of Caulim da Amazonia SA (Cadam). Also, a joint venture for a kaolin-processing equipment project to start in mid-1992 has been formed by the Rio Capim Quimica Companhia Vale do Rio Doce (CVRD) and Caemi Mineracao e Metalurgia SA group.

In the United States, concentration has increased among equipment companies. Of these, the top 20 companies controlled 78 per cent of the total production of mineral processing-equipment in the United States in 1958. The corresponding value in 1982 was 83 per cent of total production. In 1991, large producers with assets of $10 million or more controlled about 18 per cent of the market. The leading 20 producers of mineral-processing equipment in the United States ranked by sales size are listed in table V.109. Joy Technologies Inc., a Pennsylvania-based company, led in sales in 1991 with $520 million; it is followed by the Harnischfeger Corporation, a company based in Wisconsin with sales approximating $300 million. The most remarkable increases in sales among top producers were obtained by Bucyrus-Erie Co., a company also based in Wisconsin, with a 110.1 per cent increase from its 1990 levels for a total sales value of $250 million. Other significant changes were recorded by the Robbins company in Washington with a 133.3 increase from its 1990 level. Less recent structural changes occurred in the mineral-processing equipment industry in the United States with the 1988 merger of Gruendler Crusher and Pulverizer and Simplicity Engineering [80].

Table V.108. Largest companies supplying mineral-processing equipment worldwide, 1991

Company and country	Major type of processing equipment
AKW Apparate (Germany)	Cyclones
Baxter Crushers Ltd. (United Kingdom)	Gyratory and jaw crushers
Boliden Allis (Sweden)	Gyratory crushers
Boliden Contech (Sweden)	Grinding mills
Bondar Clegg (Canada)	Process control
Boxmag Rapid Ltd. (United Kingdom)	Magnetic tables, dry separators
Broadbent, Thomas & Sons Ltd.	Centrifugal classifiers
Cepcor Ltd. (United Kingdom)	Mouldings
Charleston Engineering (United Kingdom)	Cyclones
Denver Process Equipment (United Kingdom)	Classifiers, dryers, filters, flotation machines, jaw crushers, separators, jigs, process control
Door-Oliver Inc. (United States)	Centrifugal classifiers, cyclones, screens, filters
Fives-Call Babcock (France)	Magnetic separators, screens
Flood Supply Co. (United States)	Cyclones
Gollonda Engineering & Mining Services (Australia)	Hydraulic classifiers
Hewitt Robins Int. Ltd (United Kingdom)	Screens
IHC Holland Group (Netherlands)	Screens, separators, jigs
Ingersoll-Rand Co. (United States)	Filters
Knelson International Sales Inc. (Canada)	Centrifugal separators
Krebs Engineers (United States)	Cyclones
Krupp Industrietechnik (Germany)	Crushers, separators, process control, screens
Kue-Ken (Japan)	Gyratory and jaw crushers
Larox Oy (Finland)	Centrifugal classifiers, cyclones, filters, hydraulic classifiers
Liquid-Solid Separations Ltd (United Kingdom)	Cyclones, centrifugal classifiers
Lokomo (Finland)	Dryers, filters, grinding mills, crushers, screens
Master Magnets Ltd. (United Kingdom)	Magnetic separators
Mineral Deposits (Australia)	Separators, cones and spirals
Morgardshammar AB (Sweden)	Screens
Mozley (Richard) Ltd. (United Kingdom)	Cyclones, centrifugal separators
Nomis Computer Systems Corporation (Canada)	Process control
Nordberg Group (Finland)	Grinding mills, crushers
O & K Orenstein & Koppel (Germany)	Grinding mills, crushers, separators
Roberts & Schaefer Co. (United States)	Cyclones
Roxon Rammer (Finland)	Grinding mills, crushers, separators
Sala International (Sweden)	Grinding mills, crushers, separators, filters, flotation machines, cyclones
Scandinavian Grinding Mills Systems Inc. (Canada)	Grinding mills
Schmelzbasalwerk Kalenborn (Germany)	Mouldings
Skako A/S (Denmark)	Screens
Skega AB (Sweden)	Mouldings
Tideo Croft Ltd. (United Kingdom)	Mouldings
Trelleborg AB (Sweden)	Mouldings
Wilkinson Process Rubber Co. (Malaysia)	Mouldings

Source: S.T. Hall and C. Eng, "Mineral and coal processing" *Annual Mining Review* (London, Mining Journal, June 1990).

6. *Capacity expansion plans*

Although cyclical world business conditions have led to a stagnation in investments in mineral-processing equipment, expansion plans are still being carried out to implement new equipment designs. A lack of information on recent capacity expansions worldwide for equipment manufacturing plants has restricted this analysis to recent purchases of equipment by mineral-processing plants.

In Brazil, new processing equipment is to be installed at the Rio Capim kaolin-processing plant in mid-1992 by the Cadam/CVRD group. Equipment to be installed includes facilities for beneficiation, magnetic separation, centrifuging, filtering and drying. The equipment is expected to be purchased both in Brazil and abroad [81]. A $1.3-million pilot plant for the processing of graphite was installed in 1991 by Rossing Uranium Ltd. (part of the RTZ Group) in North Central Namibia. Constructed by Van Eck and Lurie (VEL),

Table 109. Leading producers of mineral-processing equipment in the United States[a], 1991

Rank in 1991	Company	Sales: 1991 (million dollars)	Sales: Percentage change 1990-1991
1	Joy Technologies Inc.	520	-0.2
2	Harnischfeger Corp.	300	9.9
3	Bucyrus-Erie Company	250	110.1
4	Longyear Company	220	-2.2
5	ETI Explosives Technologies International Inc.	194	..
6	Marathon LeTourneau Co.	130	-
7	Terex Corporation Unit Rig	123	..
8	Cooper Industries Inc. Gardner-Denver Mining	100	-
9	Jenmar Corporations	95	-
10	Atlas Copco North America Inc. Wagner Mining	91	49.2
11	EIMCO Coal Machinery Inc.	72	-64.0
12	Marmon Group Inc. Long-Airdox Co.	70	-
13	EIMCO Mining Machinery International Eimco Coal Machinery	70	133.3
14	Robbins Company	70	-
15	Dresser Industries Inc. Jeffrey Division	66	-
16	Galveston/Houston Company	62	14.8
17	Baker Hughes Inc. Wemco	62	..
18	Nordberg Inc.	61	-
19	Ingersoll-Rand Company	55	-
20	Bird Machine Company Inc.	50	-

Source: Morton Research Associates, *The US Mining Equipment Industry* (Merrick, New York, 1991).

[a] Comprises some mining equipment as well.

the pilot plant consists of complex screening, crushing, milling and filtration units and flotation circuits enabling it to achieve a high-purity graphite. A decision to start up full-scale production is anticipated by the end of 1992. There are ongoing plans in Zaire to purchase several million pounds of copper filtration technology from Delkor in 1993. This order represents the company's largest single order for that year [82].

In South Africa, Hernic Pty. Ltd. reports expansion in capacity of chrome from its Mooi Nooi processing plant in the western Transvaal. The expansion in capacity was made possible by the addition of further spiral water-washing equipment in 1991. In the United Kingdom, Carbo Coal Shipping and Trading Ltd. will use a new flotation process developed by Mineral Processing and Management Ltd. (MPM), a New-Jersey-based company specializing in process design for minerals, to operate a pulverized-fuel-ash treatment plant in South Wales. The project is expected to be completed in 1993 and to cost about 4 million pounds sterling. The Czechoslovak company, Techno-export, is currently contemplating purchases of Neyric technology from France in order to expand its Palmyra fertilizer-processing plant, but delays are expected because of an unanticipated lack of funds. Minpro International A/S together with its Mozley (Richard) representative in Norway and Sweden has recently secured an order by the Norwegian company Hustadmarmor A/S for flotation equipment and a range of cyclones. Poland has recently invested in environmentally safe technology by purchasing two "Larox-of-Finland" automatic chamber filters for its Inowroclaw soda factory.

7. *Technological trends*

The downward business cycle encountered by international mineral firms during the first half of the 1980s exerted considerable influence on industries producing mineral-processing equipment. Up to then, technological development of the mineral-processing industry had been slow. Most of the unit operations of mineral processing as currently known were established between the end of the last century and the Second World War. More recently, a variety of factors have been identified as the main driving forces behind technological innovation in the mineral-processing equipment industry. How best to comply with increasing costs, in particular energy and environmental costs, and still to produce machinery that is globally competitive has been the major concern of most producers in developed countries over the last decade. Concerning the industry as a whole, major technological innovations have centered on ways to improve the recovery of the valuable components of the ore, given that processing stages are increasingly being fed with ores of gradually lower metal content and growing mineralogical complexity. Quality improvement of existing products and the production of new products have also induced technological innovations in the mineral-processing equipment industry, though to a lesser extent. This is strongly related to the concern of manufacturers to increase revenues, with attention being paid to raise throughput and to control recovery and purity; these qualities improve the metallurgical processes following milling. In order to make these improvements, the latest developments in mineral-processing equipment technology have concentrated on the following: increased scale of production; mechanization and automation; improved utilization of energy and materials; and process simplification.

Traditional mineral-processing methods have been adjusted according to the physical properties of the ore, such as crystal structure and dislocations, particle size and gravity, and magnetic and adsorption properties. A group of unit operations characterized as chemical ore processing are based on the chemical properties of an ore. These methods include solvent extraction-ion exchange technology and improved versions of classical flotation; both are known to increase ore recovery and purity as well as to reduce operation costs significantly. Chemical ore-processing methods are expected to continue to play an increasingly important role in the future.

The general tendency worldwide is towards mechanization and automation. The most important aspects of automation have been developments in process control which have improved productivity considerably over the last decade. Furthermore, mineral-processing modelling, developed during the 1980s, is now being applied at a number of operating plants. The field of artificial intelligence and expert systems has contributed immensely to process control [83]. In particular, dynamic optimization has been shown to be a cost-effective method of increasing production or improving product quality [84]. The application of an expert system for the selection of crushing circuits offers advantages over traditional selection procedures. The gradual replacement of classical control loops with computerized model-based control systems has been rapid and important. The new control models are intended to make the use of more sophisticated new equipment more feasible. The on-stream analysing of elements by means of X-ray analysis, electrochemical sensors to measure and control the flotation processes, and the addition of new sensors to measure particle size are examples of the recent development of new control systems. Another promising area involves image analysis techniques, which are finding wider applications in the mineral-processing industry. Texture distribution can be ascertained by image analysis.

It has been possible to decrease energy consumption in some of the most energy-intensive unit operations of mineral processing by introducing new technologies and by rationalizing existing ones. Filtration is a major energy-consuming step for the minerals industry, and as such there have been several developments in traditional filtration technology. In particular, continuous belt and rotary drum filters have undergone refinements to speed up water removal and automated control; these have resulted in substantial energy savings for the filtration process [81]. Other significant energy cost-reduction improvements have been made in the area of comminution. Most recent developments have aimed at improving cone-crusher productivity and ease of operation. The effect of varying the head throw and head speed on the productivity of the crusher are significant. As the throw increases, the capacity increases and the energy consumption per tonne decreases. Also, in the field of gravity separation, modern dynamic dense-medium circuits offer many opportunities for simplifying processes, for cost- and energy-saving, and for extending the reserves of ores that can be mined economically. To some extent these successes have been offset by the continuing trend towards lower ore grades with mineralogically more complex structures.

Among other new comminution technologies, recent innovative crushing techniques have made the division between crushing and grinding less distinct. The TIDCO Barmac autogenous crushing mill offers the production of a remarkably uniform cubical particle shape throughout a wide range of sizes. The newly improved crusher thus has potential as a substitute for a conventional crusher-rod mill circuit [85]. Further improvements in grinding technology centre on the improvement of the throughput of the grinding plants in order to produce the same amount of finished mineral product. This has led to the increase in mill sizes and the design of a new, more compact drive system for tube mills termed Combiflex. This device has the advantage of lowering investment costs compared to the most elegant and sophisticated drive concept for tube mills, the ring motor. In a parallel development, there have also been incremental increases in equipment size, capacity, limits of particle size distribution and maximum feed-rock size. These have been mainly motivated by an increasing concern about overgrinding in comminution, which causes process disturbances and losses of energy and mineral material. Also, fully autogenous grinding and semi-autogenous grinding have received wide acclaim during the last decade, because of their ability to enhance subsequent metallurgical performance. These presumably eliminate the use of balls or rods in the grinding process and hence reduce operating costs and overgrinding significantly. However, improvements to these systems are needed as they are not suitable for all ore types and are relatively difficult to control or optimize. Current research in comminution is directed into some potentially revolutionary methods, such as application of high-voltage pulses.

Thermally assisted liberation has been suggested as a possible method for improving recovery of minerals from appropriate ores, and the use of microwaves has been recently suggested to improve the grindability of ores [86]. This is expected to generate improvements in the grindability of ores that could exceed 20 per cent of that of existing technology. However, the high cost of microwave energy still remains a significant negative factor for this technology. Current research in this area also concentrates on the application of some chemical compounds as additives in order to modify the grinding rate of solid mineral substances.

With regard to screening and classification, it has been recognized that efficient screening is dependent upon good design, installation and operation [87]. A two-stage cylinder-cyclone system has been developed that permits the classification size of a cyclone to be varied instantly. In addition, a useful method for performing mass balance computations for a network of interconnecting hydrocyclones treating mineral suspensions has been presented; this method allows any configuration of hydrocyclones, recycling loops and particle size distributions to be considered. The problem of overgrinding has been dealt with at this stage by the introduction of classification systems with a higher capacity. More particularly, the design of hydrocyclones has been continuously improved, and new configurations have been given to achieve finer and sharper size distribution.

Technological developments in electrostatic, gravity and magnetic separation processes have been slow. Today, gravity separation techniques are experiencing a revival of interest, because they are cheaper to operate and potentially more environmentally acceptable. A recent review of magnetic separation reports that while magnetic separation has the advantage that it can be environmentally friendly, problems of selectivity must be overcome before it finds wider application in mineral separation. One method of improving selectivity is to alter the magnetic properties of mineral phases [88]. For that reason, new centrifugal separators applying centrifugal forces to enhance gravity separation have recently found only limited industrial application. In addition, continuous efforts are being made at treating finer particles by utilizing centrifugal forces in gravity separation devices. More recently, the multi-gravity separator has led to improvement in processing speed and is currently being considered for various processing operations. One promising area is its potential application to the non-toxic recovery of fine gold. The future of gravity concentration will hence depend on the further development of methods to recover even finer particles, possibly by means of electrochemical or centrifugal forces, combined with improved methods of comminution.

Magnetic and electrostatic separation methods are also used in the processing of some minerals, for example, in the beneficiation of the heavy minerals produced by the beach-sands industry. The new rare-earth high-density magnetic separators offer an attractive alternative to the traditional electromagnetic induced-magnetic-roll separators for the separation of ilmenite from several concentrates of heavy mineral deposits. Performance is shown to be comparable, and it is said that rare-earth separators deserve serious consideration because of their simplicity, high capacity, compactness and lower operating costs, in applications where induced-magnetic-roll separators have been traditionally selected. Another opportunity for lowering processing costs is being opened up by the new superconducting magnetic separators, which possess features unique to the superconducting magnets. However, the uncertainties surrounding the performance of such techniques have delayed their introduction.

In the flotation process, froth washing in mechanical cells offers a number of metallurgical and economic benefits resulting from significant reductions in gangue entrainment. Autogenous flotation (also termed column flotation) is the most significant innovation in the mineral-processing industry in recent years, and has become an important alternative to mechanical flotation. In this process, more easily flotated material than fine ground ore is introduced to attract fine particles and to enhance flotation recovery. The industrial acceptance of flotation columns now seems firmly established, with many new plants being built. This technology has also been applied in cleaning, where it has proven superior to mechanically agitated flotation (although the "froth depth", commonly called the "interface level", still needs to be improved). Other promising innovations in the treatment of fines include: selective flocculation and agglomeration; and oil and dissolved air flotation.

New trends have emerged in filtration technology with the recent development, by the Finish-based Outomec Oy, of the Outomec filtration process using ceramic filter units. This technique applies capillary filtration to the dewatering of mineral slurries containing denser solids [81]. Capillary filtration has an advantage over other filtration techniques by eliminating air flow through the filter media and by completely filling the pore structure of the filter unit with water. This ensures washing of the product and removal of soluble impurities.

Developments within the field of screening tend to be incremental rather than revolutionary. A more durable, long-lasting, and less costly alternative to wire cloth has been introduced by Durex Products, the Dur-X-Lite™ screen surface designed for light- to medium-weight load applications with smaller-aperture screen sizes.

Producers of mineral-processing equipment recognize technical sophistication and product innovation as major advantages. R and D equipment expenditures have remained fairly constant as a percentage of sales, despite the downturn experienced by the industry in recent years. In the past, major purchasers of equipment emphasized repairing and renovating machinery rather than purchasing new equipment. This has generated constant efforts by suppliers to increase the quality and durability of the machines they sell. Research efforts have concentrated on providing technology and equipment that results in higher efficiency, lower costs and increased productivity for users. New directions in R and D support the movement of the industry toward more capital-intensive production processes, including the increased use of CAD processes.

As more uniform and higher-quality mineral products are required, the necessary additional processing will be accomplished using more efficient techniques. The role of magnetic separation in minerals processing, in particular, will undoubtedly grow in the future, as lower-cost and more efficient physical processes replace more expensive chemical processing. Another promising field of development is the removal of waste material prior to grinding, in order to reduce communition costs and enhance subsequent processing efficiency.

8. *Environmental considerations*

Recent growing environmental concerns are having an increasing impact on the mineral-processing and related industries. While creating many problems for the mining industry, the external environmental effects of mineral processing have been reduced. Environmental concerns have offered equipment suppliers opportunities to innovate. The introduction of technology with less impact on the environment has affected the processing stages of the minerals industry. In media separation, most of the processes employed today are aimed at reducing emissions in the atmosphere and ground water. An increased interest in dewatering systems using pressure filtration has been noted. These methods, in addition to reducing energy consumption, also protect the environment. Other steps recently taken to reduce pollution have focused on technological improvements at the milling stage, in particular the recovery of more of the product lost with the mill water containing the finest material residues.

The introduction of technology with less impact on the environment has affected the smelting and refining stages of the mineral-processing industry in particular. Technologies are being developed, such as those employing biochemical methods, which will make it more acceptable to loc .e smelters in developed countries. In the short run, this will possibly affect the trend towards the establishment or use of smelters in developing countries.

9. *Short- and medium-term outlook*

Because the demand for mineral-processing equipment is closely related to fluctuations in business conditions and hence minerals consumption, a continued cyclical pattern of growth is expected in the future. In general, world demand for processed minerals has tended to lag behind the rate of world economic growth. The current unstable economic conditions worldwide, together with increased transmaterialization, do not suggest further demand growth at this time [89].

A number of factors will undoubtedly continue to influence the growth of demand for mineral-processing machinery in the North. In particular, the growing number of tax burdens imposed on the mineral-processing industry will affect overall industry activities. Federal regulations covering air and water pollution, waste clean-up and environmental conservation will continue to have a direct impact on demands for mineral-processing equipment. Expected stricter pollution standards in developed countries will reduce the profitability of processing operations, leading to diminished activity and lower equipment demand. Moreover, safety standards will affect the future design of processing equipment.

The mineral-processing equipment industry will continue to operate with substantial overcapacity in the North, at least in the short term. Many producers will have to reduce costs and rationalize their operations in order to remain competitive. Some have already opted for automation of their processes as a means of reducing long-run costs. Rationalization of production will increase the degree of specialization by some equipment manufacturing plants and lead to the closure of other plants. Some firms will have to leave the industry altogether; others might seek joint ventures or mergers. Price competition is expected to remain strong among those who stay in the industry. Nevertheless, developed countries will at least maintain their share of the world market, on the strength of their reputation for supplying high-quality equipment.

Most demand for mineral processing machinery is likely to come from the developing countries of the South, many of which are contemplating expanding their mineral-processing operations. Debt problems will cause some potential producers to minimize their equipment purchases in the short run. Growth in the world market will be halted, if sufficient financing is not available for equipment purchases by developing countries. Higher levels of agricultural production in those countries, however, will stimulate the demand for fertilizers and machinery such as phosphate-processing equipment. On the basis of current trends, world demand for mineral-processing equipment is thus expected to increase at an average annual rate not exceeding 1 per cent in the short term.

The basic need for metals and minerals and the greater volume of machinery required to process increasingly lower-grade ores in many countries should nevertheless ensure a moderate growth in the global mineral-processing equipment industry. Supply factors should become more likely to contribute to market imbalance than demand factors. One source [80] estimates that there may be brief periods of perceived shortages that may lead to short-term price jumps during the next two to four years. World manufacturing capacity for mineral processing equipment should increase at an average annual rate of 1.5 per cent in the medium term. However, the substitution of plastics, composites, ceramics and other engineering materials for basic minerals and metals is another factor that excludes a higher growth rate for the world mineral-processing equipment industry. This substitution is a major problem faced by both the mineral-processing industry and its equipment suppliers. It challenges the industry and its equipment suppliers to work jointly to develop new mineral products and applications to stimulate demand. Their joint efforts are needed to reduce mineral-processing costs so that processed mineral products can compete on a price basis with synthetic materials. Also, the recycling of mineral products could slow the demand for mineral-processing equipment in some regions.

The abundance of coal and its potential cost advantage over oil and natural gas for electric power generation should ensure a growing market for coal-processing equipment. Assuming the continuation of recent trends, China is likely to be the fastest-growing import market for mineral-processing equipment. Latin America and other Asian countries offer good prospects for increased production in the near future. The European market, on the other hand, is not expected to experience any real growth due to the lingering effects of the general slow-down in economic activity. One source estimates that the United States share of the world market for mineral-processing equipment is projected to average 18 per cent during the 1990s, assuming that the foreign exchange value of the dollar remains relatively low and that United States manufacturers continue to provide technologically competitive equipment [80]. Other major competition among equipment manufacturers will continue to come from Canada, Germany, Japan and the United Kingdom.

L. Footwear (ISIC 324)*

1. *Current situation*

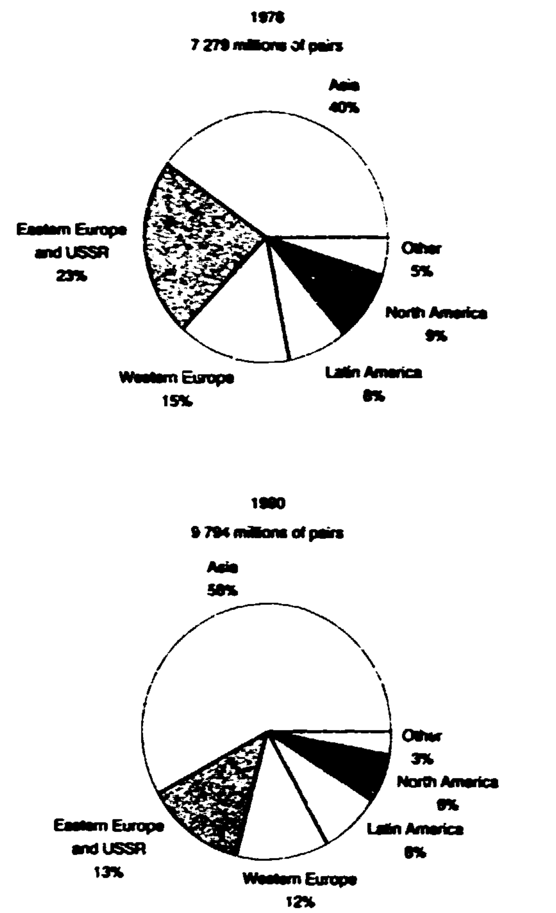
(a) *Regional changes*

The making of footwear is a relatively straightforward operation and, inevitably, attracts considerable interest from low-labour-cost countries wishing to industrialize, particularly in labour-intensive employment. From 1978 to 1990 there was a continuing and significant shift of shoemaking on a global scale from developed to developing countries. For example, in 1978 developed market economies accounted for around 24 per cent of world shoemaking and developing countries 53 per cent. Figure V.31 shows that by 1990, the shares had changed to 18 per cent and 69 per cent, respectively. Within this broad picture, the main benefactor has been Asia, a region which has seen its share of world shoemaking increase from around 40 per cent to 60 per cent, while Eastern Europe and the USSR, Western Europe and North America have seen their combined share reduced from 47 per cent to 31 per cent.

The major increases over the period have occurred in two groups of countries or areas. Brazil, China, Republic of Korea and Taiwan Province have all registered increases of over 100 million pairs, while Italy, Portugal, Thailand and Yugoslavia have all experienced increases of over 50 million pairs each [90]. There have also been several intraregional movements, such as production in Europe shifting from north to south, and, in East Asia, from the Republic of Korea and Taiwan Province to China, Indonesia, Thailand and Viet Nam, with Malaysia and the Philippines also making their presence felt. At the other end of the scale, the United States has seen its shoemaking decrease by over 200 million pairs, and France, Germany and United Kingdom have also

*UNIDO acknowledges the contribution of Iain Howie, International Editor of *World Footwear*.

Figure V.31. World production of footwear by region, 1978 and 1990



Source SATRA Footwear Technology Centre. *World Footwear Markets, 1992*

registered significant decreases. Footwear production in Belgium, Denmark, Ireland and Sweden has virtually ceased. Table V.110 gives China as the leading producer in 1990, with 2,700 million pairs, followed by the former USSR with 820 million pairs. That table also shows clearly the continued dominance of Asia in world shoe production.

In recent years, the shift in shoe manufacturing within Asia has shown a clear trend with production of simpler styles of shoes moving offshore from countries or areas such as Hong Kong, Republic of Korea and Taiwan Province, to China, Indonesia, Thailand and even Viet Nam, as manufacturing gravitates to lower-labour-cost producers. India could be included in this group, but has yet to exploit its potential.

On the consuming and importing side of the shoe market, table V.111 shows Europe, the former USSR and North and Central America as the major consuming regions, while Asia and the Western Asia are minor consuming regions. In terms of per capita consumption of shoes, the highest levels can be found in Western Europe and North America. For example, table V.112 shows per capita consumption to be 6.4 pairs in Switzerland, 5.9 in France, and 5.5 in the United States.

Table V.110. Leading footwear producers, 1990

Country and area	Millions of pairs
China	2 700
USSR	820
Republic of Korea	535
Brazil	503
Italy	425
Taiwan Province	416
Japan	350
Thailand	304
United States	293
India	230
World output	9 794

Source: SATRA Footwear Technology Centre, *World Footwear Markets, 1992* (United Kingdom, 1992).

Table V.111. World consumption of shoes, 1990

Region	Millions of pairs
North and Central America	1 728
Western Europe	1 595
Eastern Europe and USSR	1 327
South America	623
Asia and Western Asia	304
Africa	304

Source: SATRA Footwear Technology Centre, *World Footwear Markets, 1992* (United Kingdom, 1992).

Table V.112. Per capita consumption of shoes, 1990

Country	Pairs per head
Switzerland[a]	6.4
France	5 9
United States	5.5
United Kingdom	5.1
Germany, Federal Republic of	4.3
Canada	4.1
USSR	3.4
Italy	2.4

Source: SATRA Footwear Technology Centre, *World Footwear Markets, 1992* (United Kingdom, 1992).

a/ 1988 data.

(b) Labour costs

German shoe companies now find that it may no longer be possible to manufacture in Germany. It is a fact that new overseas investment by German manufacturers is running considerably higher than investment in Germany. This shows that even a successful country like Germany is far from immune to the effects of wage costs. Productivity levels are higher in developed countries, but the cheap and abundant supply of labour in developing countries more than compensates for that. It is impossible for the European and North American countries to compete on prices with East Asia; companies that manufacture synthetic footwear or lower-cost leather footwear in Europe and America therefore face a difficult future. Eventually, cheap footwear production will go to the countries offering a package that is based on the lowest labour costs, but also able to meet certain other basic criteria, such as reliability and ability to meet delivery dates, political stability and a basic infrastructure.

(c) *Exchange rates*

The large losses which the Italians have sustained in the United States indicate the importance of favourable (or unfavourable) exchange rates. Not only can these sudden changes bring about unfavourable trends, but it is the very uncertainty which is so difficult for future planning. Economies such as that of Taiwan Province were able to progress partly through their currency being linked to the United States dollar. However, changes in the new Taiwan Province dollar (and the won) against the United States dollar brought problems. Movement to the European currency system was designed to stabilize currency movements in Europe and provide for less volatile trading in the EEC.

(d) *Trade liberalization*

The complications involved in trying to introduce free trade in footwear on a global scale are evident. As the GATT negotiations evolve, it seems that some parties have become more and more entrenched. Powerful lobbies or sectoral interests at home mean that government negotiators are limited in how far they can go towards trade liberalization. Commercial trade areas such as the EEC and its possible enlargement over the next years to include EFTA countries and former CMEA countries would mean larger free-trade areas, but it might also mean that barriers will be erected against countries outside the group. It is still a fact that over 70 per cent of world markets are protected in one way or another against footwear imports.

2. *Production and consumption in selected major countries and areas*

A review of the major footwear countries and areas follows, including both producers and consumers, together with a brief appraisal of the main factors affecting movement of production. Sports footwear has become very important, because of the sheer volume produced, its growth in developing countries, and its high profile and advanced ideas for footwear technology and materials; it has thus been included as a separate section.

(a) *Brazil*

The Brazilian footwear industry has the potential to be one of the strongest forces in the footwear world. According to table V.110, it takes fourth place after China, Republic of Korea and the former USSR; with the breakup of the former USSR into a group of independent States, it may soon be the third biggest. What it has not been able to do, or has not chosen to do, is to match its export efforts to its production levels. "Only" 150 million pairs are exported, over 85 per cent of which find their way to the United States. With a production level of more than 550 million pairs, this is a relatively small proportion for a would-be low- to medium-price producer. However, it must be remembered that the domestic market is potentially quite large (150 million people), and there is some pressure to produce for the local market rather than to export. The industry is made up of 4,000 companies that employ some 315,000 people.

There is no doubt that in recent years Brazil has been experiencing some difficulties of both a political and economic nature. The freezing of money supply and wages in 1990 were not popular measures. Domestic demand slumped as a consequence, and output fell to around 500 million pairs, although of late there has been some revival. Exports to the United States have picked up; Brazil is now aiming at supplying the middle ground in United States imports, somewhere between low-cost East-Asian products and higher-priced footwear from Italy and Spain. Exports have also increased to the more competitive Western European markets. The year 1990 proved to be a difficult one for the Brazilians, with shoe exports falling from 170 million to 130 million pairs.

Reports for the first half of 1991 indicate that the volume of exports has still been falling but that their value has increased, corresponding to the move-up to better-quality footwear. However, not everyone agrees that this move-up is for the best. The United States is still in recession, and its buyers could be looking more at lower- and medium-priced product lines. In other words, it may be that the Brazilian shoe manufacturers have picked the wrong time to upgrade their offerings. Men's dress shoe exports, for example, have been particularly badly hit. A further complication is the low exchange rate between the dollar and the cruzado, which means less profit for dollar-based footwear exports. There is still some optimism that the 1990 production level of 520 million pairs will increase by the end of 1991, considering that Brazil did produce 620 million pairs in 1989.

(b) *China*

One of the most significant developments in the world of footwear during the past few years has been the ability of China to advance to the point where it now is the major producer and exporter of footwear in volume terms. However, because firms in China have been accused of copying United States intellectual property, such as software for computers, patents and pharmaceutical formulations, the United States has threatened to retaliate by imposing 100-per-cent duties on Chinese-made footwear, leathergoods and other products. The effect of these measure would be to prevent athletic footwear, in particular, from entering the United States market. A deadline was set for resolving the issue, and the United States is taking a similar policy towards Thailand.

Local companies that source from China have claimed that the imposition of 100-per-cent duties will have the effect of increasing prices for the United States consumer to the point of non-availability. It is claimed that it would take some time for other East Asian countries to fill any shortfall, and even then there would be price increases. The effect of any retaliatory moves on the part of the United States would be very serious for China. While the Republic of Korea and Taiwan Province have been losing ground on the United States market, China is now supplying over 250 million pairs. The claim by importing companies that any ban on low-cost footwear would ultimately be detrimental to domestic consumers is not a new argument. However, the scale of the problem and the argument that companies could not source from other countries in a reasonable time are interesting points. Certainly, China does enjoy a price advantage over many of its East Asian competitors, and it is not difficult to imagine that other sources will soon be snapped up by the largest and most powerful sourcing companies, especially in the sports footwear sector.

The Chinese footwear industry is certainly huge, but the lack of accurate footwear data makes it difficult to estimate its total output. Whereas the former USSR produced virtually exclusively for its domestic market, China has also developed a significant export business, so significant in fact, that it has become the leading volume exporter of footwear. While most sources agree that the annual Chinese footwear output is more than 2,000 million pairs, it is likely that the total is nearer 3,000 million pairs. This is more than the output of the whole of Europe, excluding the former USSR. The greatest part of the production is very basic low-cost footwear of a simple type, especially canvas and athletic footwear. Leather footwear production represents little more than 10 per cent of output, although this amounts to a sizeable volume. Again, it tends not to make high-quality leather footwear.

(c) Eastern Europe

With the breakup of the USSR and the transformation of the centrally planned economies of Eastern Europe, the focus of world development moved in the 1990s from the plight of the South to that of the former CMEA countries. In particular, there is a growing belief that the countries of Eastern Europe and the former USSR could become the great production centre of Europe by manufacturing goods for Western Europe and by replacing the reliance of the latter on the East Asian countries. This premise is based on the present low level of wages, the latent engineering skills in countries such as in Czechoslovakia and the former German Democratic Republic, the relatively high levels of education and the spirit of entrepreneurship in countries such as Hungary and Poland. To this can be added geographical proximity, existing levels of cooperation through joint ventures, and knowledge of languages such as German. As far as the footwear industry is concerned, the collapse of the former USSR market has had the most far-reaching effect by virtually taking away the major export market for the formerly centrally planned economies of Eastern Europe.

(d) Former USSR

Traditionally, the former USSR footwear industry has produced over 1,000 million pairs a year a huge total but still insufficient for needs of the country. Five-year plans were drawn up but were not met, and imports, especially from other CMEA countries, became necessary. Table V.113 shows that some 149 million pairs were imported in 1990. The former USSR footwear industry saw its output level fall to around 800 million pairs in 1990. No estimates are available for 1991, but it may be expected that further slippage has occurred, so that the combined production is probably no more than 75 per cent of the traditional output level, at best. A further negative effect is the abolition of State subsidies for consumer goods. Overnight the price of footwear has rocketed. For example, the subsidized State price for a pair of women's dress shoes was 420 roubles per pair. The private market price is now 1,500 roubles per pair. This means that 750 hours must be worked in order to be able to buy a pair at the market rate. Similarly, for a pair of men's shoes, the old subsidized price was 250 roubles per pair, whereas the new price is 1,000 roubles per pair with 500 hours being required to pay for them. The corresponding figures for children's shoes are 15 roubles, 300 roubles and 150 hours. The average worker earns 350 roubles per month, currently equivalent to approximately 4.37 pounds sterling at the floating exchange rate.

Table V.113. Leading footwear importers, 1990

Country	Millions of pairs
United States	1 097
Hong Kong	682
Germany	317
France	212
United Kingdom	209
Japan	168
USSR	149
Netherlands	93
Canada	79
Italy	74

Source: SATRA Footwear Technology Centre, *World Footwear Markets, 1992* (United Kingdom, 1992).

(e) Germany

There have been some forms of cooperation in footwear production between companies, such as Salamander, of the former Federal Republic of Germany and the former German Democratic Republic. However, joint ventures or other forms of cooperation in footwear have not increased. Companies of the former Germany Democratic Republic have been trying to attract investors, but the move to privatization has not been smooth. Shoe companies have been closed and the workforce has been reduced by 25 per cent. The total German market now covers some 77 million people, albeit with widely differing expectations and possibilities between the two parts of the

(f) Indonesia

As costs have risen in the Republic of Korea and Taiwan Province, so production has shifted to countries such as China, Indonesia and Thailand. This has particularly been the case with sports shoes where fierce price competition exists. Indonesia has become an exporting force somewhat later than China and Thailand, but seems determined to move forward. Indonesia is said to have a production capacity of almost 250 million pairs of sports shoes alone, and this is set to rise to 350 million pairs. Certainly not all capacity is being used at the moment, and the total output of all footwear is said to be around 190 million pairs. However, when it is considered that as recently as 1988 the output was running at less than one half of the current total, then some idea can be gained of the progress that has been made by the Indonesian footwear industry. More than 85 per cent of the output is classified as sports footwear. The majority of footwear produced at the moment is synthetic or textile footwear; only around 25 million pairs are footwear with leather uppers.

The domestic market remains large; there are some 180 million people living in the islands of Indonesia. However, a major part of that potential size will inevitably remain untapped for a few years yet. On a brighter note for the Indonesian shoe manufacturers, the strongest growing age group (under 20 years) have been important consumers of sports shoes with names such as Nike, Reebok, Adidas, Puma, New Balance and Wranglers.

Although the United States is an important market (and Indonesian companies make under licence for Nike, Reebok, New Balance etc.), the bulk of exports (60 per cent) find their way to the EEC. Major markets in particular are the United Kingdom, France, Italy and the Netherlands. Some 30 joint ventures have been set up with companies in Hong Kong, Republic of Korea and Taiwan Province. The export performance of the Indonesian footwear industry has been late developing, but since the middle of the 1980s become established on the Italian market.

Some signs of an improvement in the production and export fields, although relatively modest, were, however, being seen at the beginning of the 1990s. In 1990 production grew by about 4 per cent to 422 million pairs (up 6 per cent by value), while exports gained 6 per cent to 361 million pairs. Imports also fell to 74 million pairs, although the value of imports actually increased by 4.5 per cent. Increasing labour costs (up by 8 per cent in 1990) do not auger well for the future; labour costs now represent 37 per cent of the ex-factory price. In the first half of 1991 there was a production downturn of 4 per cent, while exports remained at a level similar to that of 1990. Imports also increased to 58 million pairs, which represents a growth of 24 per cent. The main thrust from imports came from Indonesia (up 67 per cent), Republic of Korea (up 45 per cent), Thailand (up 41 per cent) and China (up 28 per cent). On the export front the United States continued to be a disappointment (down 32 per cent), while Germany (up 34 per cent) remained the major market. Italy has some 8,000 shoe-manufacturing units employing 115,000 people.

Table V.114. Leading footwear exporters, 1990

Country and area	Millions of pairs
China	800
Hong Kong	652
Taiwan Province	379
Republic of Korea	363
Italy	360
Thailand	159
Brazil	142
Indonesia	110
Spain	108
Malaysia	85

Source: SATRA Footwear Technology Centre, *World Footwear Markets, 1992* (United Kingdom, 1992).

Technical Notes

1. Sources for the following country tables are:

(a) the UNIDO consolidated database of Industrial Statistics.

(b) National Accounts Statistics from UN/UNSO (all entries followed by " na") supplemented by other sources (listed below under item 7).

(c) Population figures by UN Demographic Statistics and UN *Monthly Bulletin of Statistics*. The population figures used in the GDP per capita forecast (1991-1993) are based on the "World Population Prospects as assessed in 1982" (UN DIESA 1985), medium variant.

(d) estimates and forecasts of GDP and MVA (manufacturing value added from National Accounts Statistics and for 28 industrial branches) by UNIDO/PPD IPP/Global Issues and Policy Perspectives Branch

2. All values are in millions of US dollars at current prices, except where otherwise indicated. Official exchange rates have been applied in general to generate dollar values. For selected countries and selected periods a correction factor was calculated to compensate temporary overvaluation of the national currency (Argentina, Brazil, Chile, Dominican Republic, El Salvador, Ghana, Guatemala, Nicaragua, Nigeria, Paraguay, Peru, Sierra Leone, Syrian Arab Republic, Trinidad and Tobago, Uganda, Uruguay). The correction was done by adapting exchange rates to the reported inflation rates.

Exchange rates for Hungary, Poland, and Romania are average market (principal) rates as reported by *International Financial Statistics*.

is calculated relative to 1975. The index number determines the distance from the origin of the star-diagram. For each year the index numbers are connected by a line which reflects the typical "shape" of expansion for the specific country. Since the size of expansion (absolute values of the index numbers) is different in each country, a different scale is used in each diagram. The largest index number of all branches is therefore given below the right end of the horizontal axis. The two numbers in the box on the upper right-hand side are: g: the average annual growth rate for the period 1975 to 1990; and θ: the index of structural change (defined below) for the same period.

7. GDP and MVA growth rates are mainly based on data supplied by UN/UNSO. However, when no UNSO figure was reported, a figure was taken from one of the following sources.

(a) National statistical institute of the specific country.

(b) United Nations regional economic commission for the specific country.

(c) *International Financial Statistics* (International Monetary Fund).

(d) *National Accounts, Detailed Tables (Volume II)* (OECD, Department of Economics and Statistics).

(e) *World Outlook* and *Quarterly Economic Review* (The Economist Intelligence Unit).

(f) *World Bank World Tables*.

(g) *Centrally Planned Economies, Economic Overview* (The Conference Board, Inc.).

The Republic of Korea is especially noted for the production of sports footwear, and it was the return of companies like Reebok and Nike that was particularly important in 1990. However, they deal only with relatively few producers, so that the improvement was confined to a relatively small group. In the end the gains realized in 1990 did not continue in 1991. Over the longer term, producers in the Republic of Korea believe that value rather than quantity will have to be the major export criterion. Reliance on the United States is also too great, and plans to strengthen exports to other markets are beginning. An upgrading of quality will mean a greater concentration on leather footwear, and exports of this type will be closely monitored.

About 25 companies of the Republic of Korea are running joint ventures in other countries, especially Thailand and Indonesia, and even in Latin American countries. Giant companies such as Kukje, H.S. Corporation and Samba will continue to explore foreign possibilities in much the same way as the United States companies.

(i) Taiwan Province

Although footwear exports from Taiwan Province were still showing a downturn in the first half of 1991 (21 per cent down on the corresponding period of 1990), there was a feeling that this rapid decline was beginning to level, with exports falling less in value terms (by 16 per cent). This suggests that efforts made by firms in Taiwan Province to improve the quality of their footwear may be paying off. The United States remains their prime market. Even though exports to the United States declined in 1990 by 38 per cent, the 182 million pairs shipped still represented 48 per cent of the shoe exports of Taiwan Province. The high point of the footwear industry of Taiwan Province was 1986, when some 1,200 factories produced 844 million pairs. By 1990 there were less than 350 factories with output down to 380 million pairs. This process is very likely to continue still further, as more low-end producers are shaken out of the system or transfer the opportunities presented to it by the withdrawal of Taiwan Province and the Republic of Korea from very low-cost footwear sourcing. Thailand has built up its industry to such an extent that it now has a capacity of over 300 million pairs and a workforce of 70,000 people. Exports account for over one half of its output, making it one of the world's major producers. One of the main factors in the rapid expansion of the Thai footwear industry has been the setting-up of joint ventures with companies from Taiwan Province and the Republic of Korea. This arrangement may also include a third party, since production is often for an international sports company such as New Balance, Reebok or Puma. An exception to this rule is Bata, which has had its own factory in Thailand for some time, as it does in so many developing countries. With the arrival of foreign investment and the need to export, the standard of shoemaking in the country has been raised to meet the requirements of sophisticated foreign markets such as the United States and the European countries.

Although the influence of foreigners has been crucial, it is still true to say that many companies are still rather primitive. There are more than 2,000 concerns, and probably only around 80 are of any size. There is also a slight imbalance between the Bangkok area and the rest of the country. Production in 1990 was 304 million pairs, with exports accounting for 159 million pairs. It would perhaps be an exaggeration to speak of an initial "stampede" out of the Republic of Korea and Taiwan Province towards lower-cost areas such as Indonesia and Thailand, but this phenomenon was certainly a help to the Thailand producers.

(k) United States

The United States still represents the greatest market for footwear in the world, consuming more than 1,000 million pairs. Table V.113 also lists the United States as the leading importer of shoes, commanding a high level of quality and more prompt delivery. In return, it is willing to pay relatively high prices and reward innovation; it is thus a very

then reconverted into current dollar figures. These sectoral MVA estimates were constrained to be consistent with the corresponding growth rate of aggregate MVA.

The growth rates of manufacturing value added in 28 industrial branches for the periods 1989 to 1992 were projected only for a sample of 117 countries. Again various sources and UNIDO estimates were used to improve the coverage of data. The forecasts are based on estimates of the contribution of two components: *(a)* the dependence of the sector on the overall economic situation in the country expressed in terms of GDP or MVA, and *(b)* the sector-specific time behaviour expressed in terms of a lag-structure of the value added of the sector.

8 Two figures are reported for manufacturing value added. One is based on the national income accounts definition and the other on the industrial census definition. The main differences are: (i) included in the national income accounts figure but not included in industrial census figure is activity of establishments with less than some specified number of employees, typically five or ten, but the number is not fixed across countries; (ii) in the industrial census each establishment is considered to be either industrial or non-industrial and all activities for the establishment are similarly classified whereas in the national income accounting framework output is classified as industrial based on the nature of the product.

The industrial census data include the receipts for and exclude the costs of non-industrial activities.

For further information refer to *International Recommendations for Industrial Statistics*, Statistical Papers, Series M, No. 48, Rev. 1 (United Nations publication, Sales No. E.83.XVII.8).

9 The figures under the item "profitability" are defined as follows:

Intermediate input = 100 (gross output − value added)/gross output

Wages and salaries = 100 (wages and salaries)/gross output

Operating surplus = 100 (value added − wages and salaries)/gross output

10 The item "profitability" and "productivity" are aggregates across all branches, except that only those branches were included for which all the required data (gross output,

11 For the calulation of the structural indices and the value of θ in the diagram of industrial structural change, index numbers of industrial production weighted by 1980 base year values were used.

The measure for structural change, θ, is defined by:

$$\cos \theta = \frac{\sum_i s_i(t) \cdot s_i(t-1)}{\sqrt{(\sum_i s_i(t)^2) \cdot (\sum_i s_i(t-1)^2)}}$$

where $s_i(t)$ is the share of the i-th branch in total manufacturing value added in the year t.

The value θ can be interpreted as the angle between the two vectors $s_i(t-1)$ and $s_i(t)$ measured in degrees.

The theoretical maximum value of θ is 90 degrees.

12 The item "MVA growth rate/θ" is the growth rate of real value added per degree of structural change between periods t-1 and t.

13 The degree of specialization is defined as follows:

$$h = 100\left(1 + \frac{\sum_i s_i \cdot \ln s_i}{h_{max}}\right)$$

where s_i is defined as above and h_{max} = ln (number of branches), and ln is the natural logarithm.

If shares of all branches are equal, the degree of specialization equals 0. If only one branch exists, the value is 100.

Summary of indicators

n.a value originating from national accounts statistics

c in 1980 constant prices

e estimated by UNIDO/PPD/IPP/GLO

f forecast by UNIDO/PPD/IPP/GLO

value is less than half a unit

n.a. not available

Questions concerning the preparation of data can be directed footwear industry is a move to create a North American free trade zone with Mexico. This could cause problems with Mexican firms having increasing access to the United States market.

The results in 1990 saw imports rise by 4.4 per cent to 1.1 billion pairs, while production fell to 293 million pairs. Companies such as the giant Brown Shoe have been forced to close several of their factories. As far as non-rubber footwear is concerned, the leading sources were China, Taiwan Province, Republic of Korea and Brazil. China, with 267 million pairs is by far the leading supplier of leather footwear to the United States. Indonesia is also starting to expand exports to that country.

(l) Africa

It is perhaps interesting to look at sub-Saharan Africa, which although not a major producer has potential in the long term. However, considerable problems still need to be overcome. This region has some 450 million people (including South Africa), yet produces only around 320 million pairs (about 3 per cent of world output). This is less than one pair per person, and exports are significant. Omitting South Africa and Egypt, the output is less than 200 million pairs. While development problems are huge, eventually the production and consumption potential should also be huge.

3. Sports footwear

Sports footwear is a better barometer than most other types in showing the effects of labour costs on footwear production. While 50 per cent of all footwear is produced in East Asia, the figure for sports footwear is far higher, probably around 75 per cent. It has become extremely difficult to produce sports footwear in Europe. As the styles have started to require increasingly complex upper stitching, for example, the labour costs involved have made it prohibitive to manufacture there. One of the problems facing Adidas, for example, was that they retained too

term potential this will be an added bonus. Companies such as Borovo, Svit, Tisza and Bardejov already have significant investment in the production of sports footwear. North America, although being the home to companies such as Nike, Reebok, L.A. Gear, Bata, Converse, New Balance, Saucony, Brooks and Avia, has relatively little sports footwear production, and instead use sources mainly from East Asia and, to a lesser degree, Latin America.

The growth areas for sports footwear in recent years have been the Republic of Korea and Taiwan Province, followed by Thailand, Indonesia and China. The Republic of Korea developed as the volume producer of sports footwear, with the companies tending to be very large-scale, while in Taiwan Province companies were much smaller. Wage problems have led to a rapid downturn in the fortunes of companies in the Republic of Korea. Major sports companies have consequently shifted some of their sourcing to other, cheaper East Asian countries, although it must be said that they are still keeping the bulk of their sourcing in the Republic of Korea, because it has a better infrastructure and better supply industry and is more reliable. Firms in the Republic of Korea are mindful of the need to change their marketing strategy, and are shifting their low-end production to places like Thailand and often forming joint ventures. They are also developing their own brands, such as Pro-Specs, and this trend can be expected to accelerate.

Although the resources required to take on brands such as Nike, Reebok, and Addidas are likely to be somewhat prohibitive for many East Asian countries, Asics and Mzuno have been able to develop strong brands and there is every indication that they will continue to expand. Since they are Japanese companies, however, they perhaps have more in common with sports companies in developed market economies as producers of sports footwear from a high cost base.

In many respects, sports footwear is in the vanguard of footwear technology, and manufacturers must be aware of new materials and components and decide where to source their footwear. As the market demand has been for increasingly complex designs, both in terms of uppers and solings, so this has affected the

Regional classification of countries and territories:

Country or territory	UNITAD region		Page
AFGHANISTAN	Indian Subcontinent	(IN)	A-113
ALBANIA	Eastern Europe incl. former USSR	(EE)	A-113
ALGERIA	North Africa	(AN)	A- 9
ARGENTINA	Latin America	(LA)	A- 10
AUSTRALIA	Other developed countries	(OD)	A- 11
AUSTRIA	Western Europe (Industrialized)	(WE)	A- 12
BAHAMAS	Latin America and the Caribbean	(LA)	A-113
BAHRAIN	Western Asia (Near East)	(WA)	A-113
BANGLADESH	Indian Subcontinent	(IN)	A- 13
BARBADOS	Latin America	(LA)	A- 14
BELGIUM	Western Europe (Industrialized)	(WE)	A- 15
BELIZE	Latin America and the Caribbean	(LA)	A-113
BENIN	Tropical Africa (Sub-Sahara)	(TA)	A-113
BERMUDA	North America	(NA)	A-114
BHUTAN	Indian Subcontinent	(IN)	A-114
BOLIVIA	Latin America	(LA)	A- 16
BOTSWANA	Tropical Africa (Sub-Sahara)	(TA)	A- 17
BRAZIL	Latin America	(LA)	A- 18
BRUNEI DARUSSALAM	Asia East and South-East. Oceania	(AS)	A-114
BULGARIA	Eastern Europe incl. former USSR	(EE)	A- 19
BURKINA FASO	Tropical Africa (Sub-Sahara)	(TA)	A- 20
BURUNDI	Tropical Africa (Sub-Sahara)	(TA)	A- 21
CAMEROON	Tropical Africa (Sub-Sahara)	(TA)	A- 22
CANADA	North America	(NA)	A- 23
CAPE VERDE	Tropical Africa (Sub-Sahara)	(TA)	A-114
CENTRAL AFRICAN REPUBLIC	Tropical Africa (Sub-Sahara)	(TA)	A- 24
CHAD	Tropical Africa (Sub-Sahara)	(TA)	A-114
CHILE	Latin America	(LA)	A- 25
CHINA	Centrally planned Asia	(OA)	A- 26
COLOMBIA	Latin America	(LA)	A- 27
COMOROS	Tropical Africa (Sub-Sahara)	(TA)	A-114
CONGO	Tropical Africa (Sub-Sahara)	(TA)	A- 28
COSTA RICA	Latin America	(LA)	A- 29
COTE D'IVOIRE	Tropical Africa (Sub-Sahara)	(TA)	A- 30
CUBA	Latin America	(LA)	A- 31
CYPRUS	Western Asia	(WA)	A- 32
CZECHOSLOVAKIA	Eastern Europe incl. former USSR	(EE)	A- 33
DENMARK	Western Europe (Industrialized)	(WE)	A- 34
DJIBOUTI	Tropical Africa (Sub-Sahara)	(TA)	A-115
DOMINICAN REPUBLIC	Latin America	(LA)	A- 35
ECUADOR	Latin America	(LA)	A- 36
EGYPT	North Africa	(AN)	A- 37
EL SALVADOR	Latin America	(LA)	A- 38
EQUATORIAL GUINEA	Tropical Africa (Sub-Sahara)	(TA)	A-115
ETHIOPIA	Tropical Africa (Sub-Sahara)	(TA)	A- 39
FIJI	South East Asia	(AS)	A- 40
FINLAND	Western Europe (Industrialized)	(WE)	A- 41
FRANCE	Western Europe (Industrialized)	(WE)	A- 42

materials used (for example, there has been a switch away from polyurethane solings and a move towards more intricate stitching and meshing of materials), as well as accelerating the movement to low-labour-cost countries.

Partly because of the recession, several sports companies have recently found themselves in financial difficulties, and there has been a feeling that markets (particularly the North American market) has become saturated with basic trainers, offering only limited opportunity for future growth.

4. *Technological trends*

In the case of the footwear industry, even Japan has failed to apply the right kinds of technology to its own footwear industry. Its footwear is too expensive to export, since footwear is subject to rapid change to meet the vagaries of fashion, and thus does not readily adapt to automation. The advent of CAD and CAM was seen as a benefit to developed countries, although developing countries are now using them too. The possibility of quick response was based on the theory that if a firm can supply the market quickly with what it wants, when it wants it, then that firm will have an export advantage. This concept has proved beneficial and should be part of the marketing philosophy of companies. Simplistic but radical thinking is needed if the footwear industries in developed countries are to survive.

However, the effects of the introduction of "quick-response", or "just-in-time", or "modular-rink-system" techniques are being eroded by the recession. Price is the overriding concern because, as stated, developed countries cannot compete in price in the lower to medium price brackets of conventional footwear. Marketing and design of the type displayed by Nike are the platforms for future survival, but until the recession fades, survival remains a major goal.

5. *Short- and medium-term outlook*

In the case of Eastern Europe and the former USSR, it may be true to say that the industry effects have been "internal" rather than "external". In the main, trade in footwear has been between the former USSR and Eastern Europe. The former USSR constituted the largest export market for countries such as Czechoslovakia, Hungary and Poland, but now that consumers in the former USSR have no purchasing power, these countries have excess shoe capacity. This has been coupled with depressed domestic markets, and, as a result, a number of companies have been forced out of business. The move from State-owned to privatized companies has begun, and searches for joint venture partners have intensified. Although Czechoslovakia and Poland did export to Western Europe, the volume was essentially small. In addition to the upheavals in Eastern Europe, the major recent events in the footwear world have been a spreading world recession, the rise of China as a world footwear force coupled with the decline of the Republic of Korea and Taiwan Province, and the predicted fall in the market for trainers.

There is unlikely to be a cataclysmic change in the global distribution of shoemaking. Shoemaking tends to gravitate to the lowest-labour-cost producers, as witnessed by the enormous upsurge of shoemaking in China, where businesses from Hong Kong and Taiwan Province have initiated shoemaking in their own right or under joint venture arrangements. Asia already produces nearly 60 per cent of global footwear, and this could well rise to 80 per cent. There is, however, considerable movement between shoemaking countries and areas within Asia, and it is anticipated that lower-labour-cost countries such as China, India, Indonesia, Malaysia and Thailand will take an increasingly larger share, particularly of simpler styles. Viet Nam is at present an unknown quantity in the shoemaking industry, but has the potential to join the list of producers.

The shoemaking base of the high-labour-cost developed market economies will continue to steadily diminish, with only those companies that enjoy a strong brand or niche position in the market continuing to succeed. High-technology manufacture and quick-response techniques should slow the demise of shoemaking in these economies, but they do not seem to hold the complete solution.

Footwear consumption seems to level out at 5-6 pairs per capita per year, and this is the consumption figure typical of Western Europe countries. It is likely that when the recession ends, this level of consumption will spread further afield, to southern Europe and elsewhere. It will be some time, however, before this figure is typical throughout Europe. The market economies of Asia, such as Japan and the Republic of Korea, have a somewhat lower per capita consumption of around 4 pairs, which is likely to increase slowly with rising living standards and a growing middle class.

Globally, world footwear output may rise to 12,000 million pairs by the year 2000.

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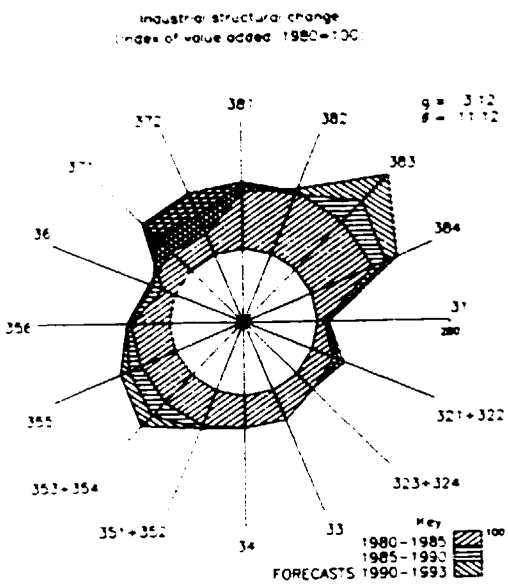
Statistical Annex

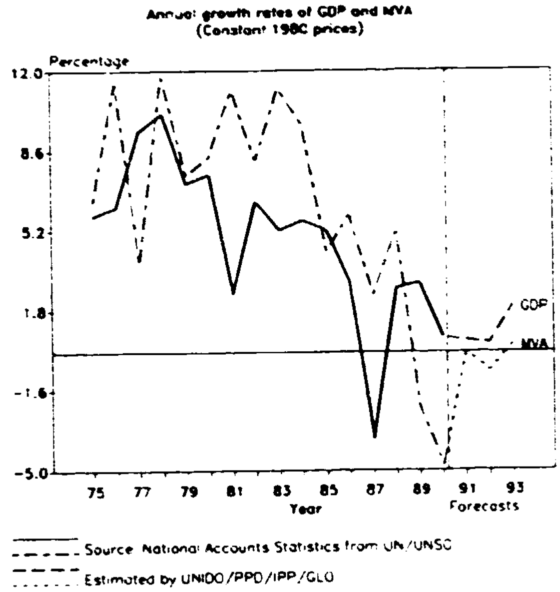
World Industry Development Indicators

Country or territory	UNITAD region		Page
JAPAN	Japan	(JP)	A- 62
JORDAN	Western Asia	(WA)	A- 63
KENYA	Tropical Africa (Sub-Sahara)	(TA)	A- 64
KOREA, DEMOCRATIC PEOPLE'S REP	Centrally planned Asia	(OA)	A-116
KOREA, REPUBLIC OF	South-East Asia	(AS)	A- 65
KUWAIT	Western Asia	(WA)	A- 66
LAO PEOPLE'S DEMOCRATIC REPUBL	Centrally planned Asia	(OA)	A-116
LESOTHO	Tropical Africa (Sub-Sahara)	(TA)	A-116
LIBERIA	Tropical Africa (Sub-Sahara)	(TA)	A-117
LIBYAN ARAB JAMAHIRIYA	North Africa	(AN)	A- 67
LUXEMBOURG	Western Europe (Industrialized)	(WE)	A- 68
MADAGASCAR	Tropical Africa (Sub-Sahara)	(TA)	A- 69
MALAWI	Tropical Africa (Sub-Sahara)	(TA)	A- 70
MALAYSIA	South-East Asia	(AS)	A- 71
MALI	Tropical Africa (Sub-Sahara)	(TA)	A-117
MALTA	Western Europe (South)	(WE)	A- 72
MARTINIQUE	Latin America and the Caribbean	(LA)	A-117
MAURITANIA	Tropical Africa (Sub-Sahara)	(TA)	A-117
MAURITIUS	Tropical Africa (Sub-Sahara)	(TA)	A- 73
MEXICO	Latin America	(LA)	A- 74
MONGOLIA	Centrally planned Asia	(OA)	A-117
MONTSERRAT	Latin America and the Caribbean	(LA)	A-117
MOROCCO	North Africa	(AN)	A- 75
MOZAMBIQUE	Tropical Africa (Sub-Sahara)	(TA)	A-118
MYANMAR	Indian Subcontinent	(IN)	A-118
NAMIBIA	Tropical Africa (Sub-Sahara)	(TA)	A-118
NEPAL	Indian Subcontinent	(IN)	A-118
NETHERLANDS	Western Europe (Industrialized)	(WE)	A- 76
NETHERLANDS ANTILLES AND ARUBA	Latin America and the Caribbean	(LA)	A-118
NEW CALEDONIA	Asia East and South-East, Oceania	(AS)	A-118
NEW ZEALAND	Other developed countries	(OD)	A- 77
NICARAGUA	Latin America	(LA)	A- 78
NIGER	Tropical Africa (Sub-Sahara)	(TA)	A-119
NIGERIA	Tropical Africa (Sub-Sahara)	(TA)	A- 79
NORWAY	Western Europe (Industrialized)	(WE)	A- 80
OMAN	Western Asia (Near East)	(WA)	A-119
PAKISTAN	Indian Subcontinent	(IN)	A- 81
PANAMA	Latin America	(LA)	A- 82
PAPUA NEW GUINEA	Asia East and South-East, Oceania	(AS)	A-119
PARAGUAY	Latin America	(LA)	A- 83
PERU	Latin America	(LA)	A- 84
PHILIPPINES	South-East Asia	(AS)	A- 85
POLAND	Eastern Europe incl. former USSR	(EE)	A- 86
PORTUGAL	Western Europe (South)	(WE)	A- 87
PUERTO RICO	Latin America and the Caribbean	(LA)	A-119
QATAR	Western Asia (Near East)	(WA)	A-119
REUNION	Tropical Africa (Sub-Sahara)	(TA)	A-119
ROMANIA	Eastern Europe incl. former USSR	(EE)	A- 88
RWANDA	Tropical Africa (Sub-Sahara)	(TA)	A-120
SAMOA	Asia East and South-East, Oceania	(AS)	A-120
SAO TOME AND PRINCIPE	Tropical Africa (Sub-Sahara)	(TA)	A-120
SAUDI ARABIA	Western Asia	(WA)	A- 89
SENEGAL	Tropical Africa (Sub-Sahara)	(TA)	A- 90
SEYCHELLES	Tropical Africa (Sub-Sahara)	(TA)	A-120
SIERRA LEONE	Tropical Africa (Sub-Sahara)	(TA)	A-120
SINGAPORE	South-East Asia	(AS)	A- 91
SOMALIA	Tropical Africa (Sub-Sahara)	(TA)	A-120
SOUTH AFRICA	Other developed countries	(OD)	A- 92
SPAIN	Western Europe (Industrialized)	(WE)	A- 93
SRI LANKA	Indian Subcontinent	(IN)	A- 94
SUDAN	North Africa	(AN)	A-121
SURINAME	Latin America and the Caribbean	(LA)	A-121
SWAZILAND	Tropical Africa (Sub-Sahara)	(TA)	A-121
SWEDEN	Western Europe (Industrialized)	(WE)	A- 95
SWITZERLAND	Western Europe (Industrialized)	(WE)	A- 96
SYRIAN ARAB REPUBLIC	Western Asia	(WA)	A- 97
TAIWAN PROVINCE	South-East Asia	(AS)	A- 98
TANZANIA, United Republic of	Tropical Africa (Sub-Sahara)	(TA)	A- 99
THAILAND	South-East Asia	(AS)	A-100
TOGO	Tropical Africa (Sub-Sahara)	(TA)	A-121
TONGA	Asia East and South-East, Oceania	(AS)	A-121
TRINIDAD AND TOBAGO	Latin America	(LA)	A-101
TUNISIA	North Africa	(AN)	A-102
TURKEY	Western Asia	(WA)	A-103
TUVALU	Asia East and South-East, Oceania	(AS)	A-121

Country or territory	UNCTAD region		Page
UGANDA	Tropical Africa (Sub-Sahara)	(TA)	A-122
UNION OF SOV. SOC. REP. FORMER	Eastern Europe incl. former USSR	(EE)	A-104
UNITED ARAB EMIRATES	Western Asia (Near East)	(WA)	A-122
UNITED KINGDOM	Western Europe (Industrialized)	(WE)	A-105
UNITED STATES	North America	(NA)	A-106
URUGUAY	Latin America	(LA)	A-107
VANUATU	Asia East and South-East, Oceania	(AS)	A-122
VENEZUELA	Latin America	(LA)	A-108
VIET NAM	Centrally planned Asia	(OA)	A-122
YEMEN, NORTHERN PART	Western Asia (Near East)	(WA)	A-122
YEMEN, SOUTHERN PART	Western Asia (Near East)	(WA)	A-122
YUGOSLAVIA, FORMER	Western Europe (South)	(WE)	A-109
ZAIRE	Tropical Africa (Sub-Sahara)	(TA)	A-110
ZAMBIA	Tropical Africa (Sub-Sahara)	(TA)	A-111
ZIMBABWE	Tropical Africa (Sub-Sahara)	(TA)	A-112

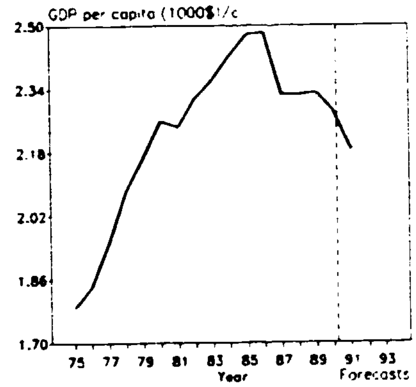
ALGERIA

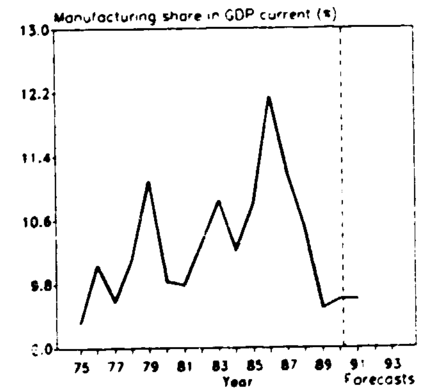


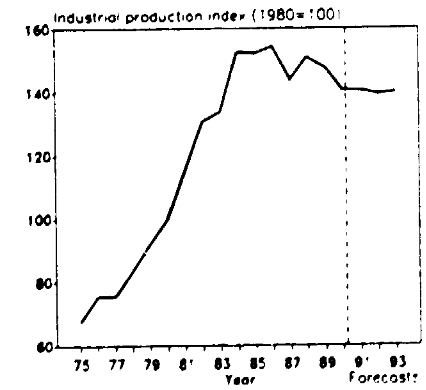


	1980	1985	1990
GDP: (na.c) (millions of 1980-dollars)	42342	53959	56964
Per capita (1980-dollars) (na.c)	2259	2477	2282
Manufacturing share (%) (na) (current prices)	9 8	10 8	9 6
MANUFACTURING:			
Value added (na.c) (millions of 1980-dollars)	3286	5029	5326
Industrial production index	100	152	140
Value added (millions of dollars)	3644	6157	5821 /e
Gross output (millions of dollars)	9122	13978 /e	13400 /e
Employment (thousands)	312	413 /e	469 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	60	56 /e	57 /e
Wages and salaries (%)	22	25 /e	26 /e
Operating surplus (%)	18	19 /e	18 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	29246	33813 /e	28544 /e
Value added / worker	11682	14892 /e	12398 /e
Average wage	6523	8303 /e	7367 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	3 88	3 75	1 44 /e
as a percentage of average θ in 1970-1975	74	72	27 /e
MVA growth rate / θ	2 52	2 00	0 41
Degree of specialization	14 6	13 7	13 4
-VALUE ADDED: (millions of dollars)			
311 Food products	655	852	816 /e
313 Beverages	135	176	173 /e
314 Tobacco products	176	229	206 /e
321 Textiles	291	450	421 /e
322 Wearing apparel	234	362	371 /e
323 Leather and fur products	52	80	73 /e
324 Footwear	90	140	127 /e
331 Wood and wood products	120	205	189 /e
332 Furniture and fixtures	57	97	89 /e
341 Paper and paper products	143	242	223 /e
342 Printing and publishing	16	27	25 /e
351 Industrial chemicals	14	25	21 /e
352 Other chemical products	93	167	160 /e
353 Petroleum refineries	83	150	162 /e
354 Miscellaneous petroleum and coal products	4	7	7 /e
355 Rubber products	17	30	31 /e
356 Plastic products	34	61	58 /e
361 Pottery, china and earthenware	10	14	14 /e
362 Glass and glass products	36	51	52 /e
369 Other non-metal mineral products	355	497	510 /e
371 Iron and steel	323	727	575 /e
372 Non-ferrous metals	19	42	32 /e
381 Metal products	265	598	540 /e
382 Non-electrical machinery	46	105	94 /e
383 Electrical machinery	123	278	308 /e
384 Transport equipment	181	407	411 /e
385 Professional and scientific equipment	30	67	61 /e
390 Other manufacturing industries	42	72	73 /e

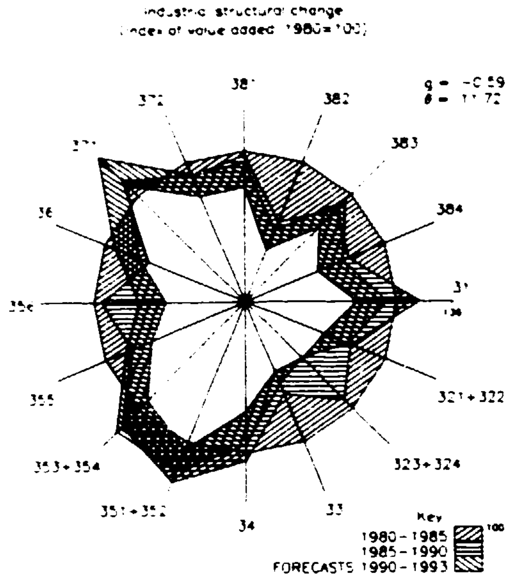
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

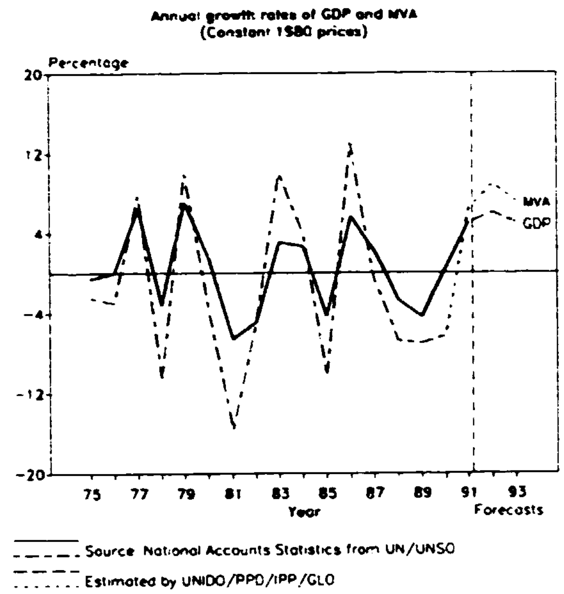






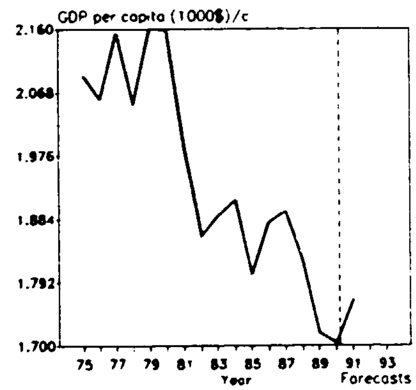
ARGENTINA

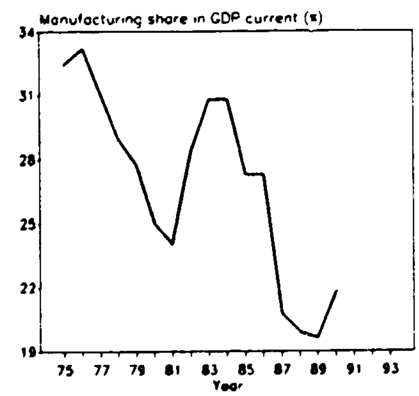


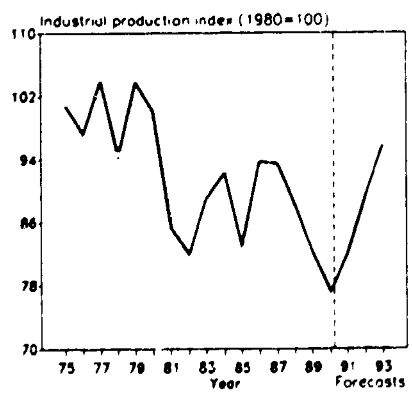


	1980	1985	1990
GDP (na.c millions of 1980-dollars)	60917	54708	55089
Per capita (1980-dollars) (na.c	2157	1804	1703
Manufacturing share (%) (na) (current prices)	25 0	27 3	21 8 /e
MANUFACTURING:			
Value added (na.c (millions of 1980-dollars)	15224	12506	11403
Industrial production index	100	83	77
Value added (millions of dollars)	24511	28891	36987 /e
Gross output (millions of dollars)	55936 /e	48266 /e	87709 /e
Employment (thousands)	1346 /e	1127 /e	948 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	56 /e	40 /e	58 /e
Wages and salaries (%)	10 /e	11 /e	6 /e
Operating surplus (%)	33 /e	49 /e	36 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	41552 /e	42818 /e	92527 /e
Value added / worker	18208 /e	25630 /e	39012 /e
Average wage	4301 /e	4596 /e	5885 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	5 07	4 84	3 76 /e
as a percentage of average θ in 1970-1975	148	141	109 /e
MVA growth rate / θ	-0 57	0 00	-1 35
Degree of specialization	13 0	15 9	15 3
-VALUE ADDED: (millions of dollars)			
311 Food products	3544	4912	5107 /e
313 Beverages	703	942	1344 /e
314 Tobacco products	498	719	783 /e
321 Textiles	1703	1832	2442 /e
322 Wearing apparel	919	558	588 /e
323 Leather and fur products	284	350	367 /e
324 Footwear	245	240	209 /e
331 Wood and wood products	363	283	301 /e
332 Furniture and fixtures	225	185	306 /e
341 Paper and paper products	554	763	1112 /e
342 Printing and publishing	679	800	736 /e
351 Industrial chemicals	914	1367	2231 /e
352 Other chemical products	1206	1916	2356 /e
353 Petroleum refineries	3647	5120	6942 /e
354 Miscellaneous petroleum and coal products	86	121	153 /e
355 Rubber products	331	327	460 /e
356 Plastic products	424	485	459 /e
361 Pottery, china and earthenware	189	130	196 /e
362 Glass and glass products	199	153	285 /e
369 Other non-metal mineral products	659	587	1162 /e
371 Iron and steel	900	1239	2036 /e
372 Non-ferrous metals	235	257	369 /e
381 Metal products	1272	1499	2000 /e
382 Non-electrical machinery	1358	930	1041 /e
383 Electrical machinery	902	936	1297 /e
384 Transport equipment	2289	2054	2443 /e
385 Professional and scientific equipment	86	95	150 /e
390 Other manufacturing industries	96	92	114 /e

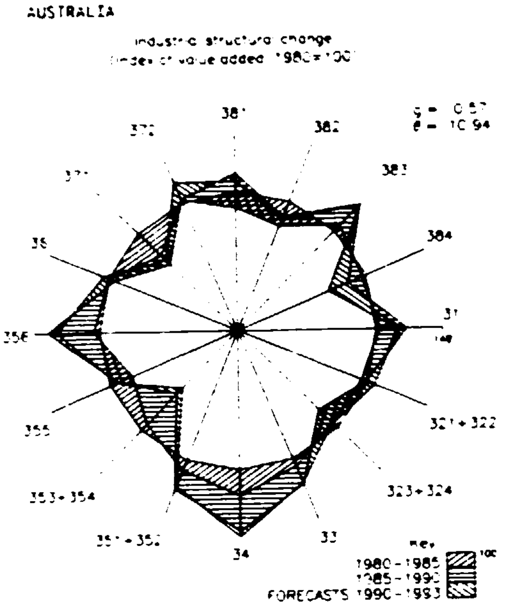
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

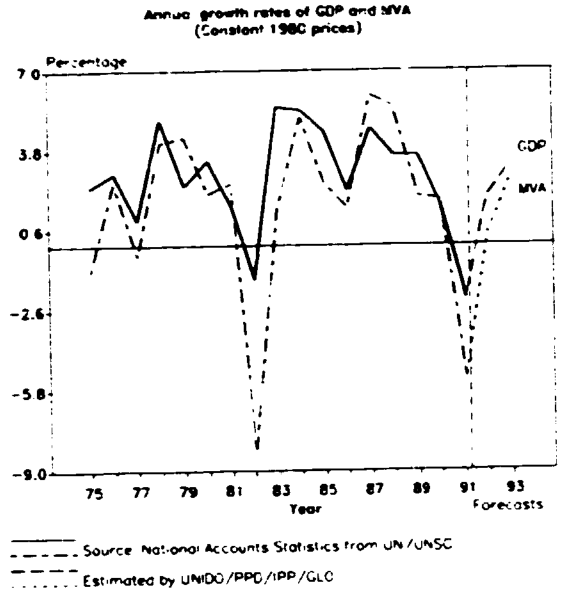






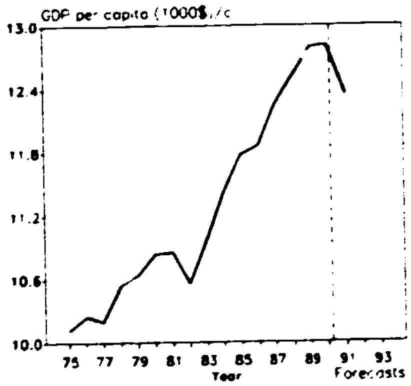
AUSTRALIA

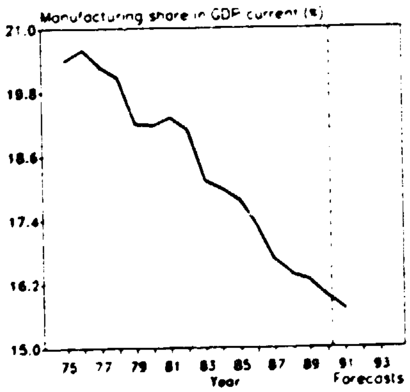


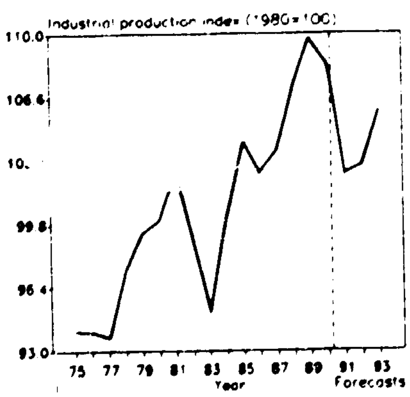


	1980	1985	1990	
GDP (real, millions of 1980-dollars)	159241	185531	216358	
Per capita (1980-dollars, real)	10836	11773	12813	
Manufacturing share (%) (real, current prices)	19.2	17.8	15.9	
MANUFACTURING:				
Value added (real, millions of 1980-dollars)	31218	32096	37843	
Industrial production index	100	104	108	
Value added (millions of dollars)	29173	26900	47297	e
Gross output (millions of dollars)	75474	69329	126691	e
Employment (thousands)	1139	1012	1053	e
-PROFITABILITY (in percent of gross output)				
Intermediate input	51	61	63	e
Wages and salaries	20	19	17	e
Operating surplus	18	20	20	e
-PRODUCTIVITY (dollars)				
Gross output / worker	66263	68477	119996	e
Value added / worker	25613	26569	44926	e
Average wage	13356	12999	20586	e
-STRUCTURAL INDICES				
Structural change θ (5-year average in degrees)	2.78	4.48	2.22	e
as a percentage of average θ in 1970-1975	34	151	75	e
MVA growth rate / θ	0.34	-0.02	0.88	
Degree of specialization	11.1	11.1	11.8	
-VALUE ADDED (millions of dollars)				
311 Food products	3993	3764	7204	e
313 Beverages	785	847	1590	e
314 Tobacco products	248	179	289	e
321 Textiles	1050	955	1761	
322 Wearing apparel	821	722	1005	e
323 Leather and fur products	93	76	137	e
324 Footwear	223	205	248	e
331 Wood and wood products	1052	1028	1767	e
332 Furniture and fixtures	505	507	1008	e
341 Paper and paper products	744	703	1463	e
342 Printing and publishing	1818	2131	4035	e
351 Industrial chemicals	969	982	1740	e
352 Other chemical products	1186	1191	2192	e
353 Petroleum refineries	323	285	304	e
354 Miscellaneous petroleum and coal products	30	25	28	e
355 Rubber products	341	264	[illegible]	e
356 Plastic products	831	808	1706	e
361 Pottery, china and earthenware	46	41	66	e
362 Glass and glass products	246	254	406	e
369 Other non-metal mineral products	1183	1085	1637	e
371 Iron and steel	1920	1391	1947	e
372 Non-ferrous metals	1473	1409	2256	e
381 Metal products	2467	2041	4171	
382 Non-electrical machinery	2091	1575	2749	e
383 Electrical machinery	1351	1329	2539	e
384 Transport equipment	2830	2579	3638	
385 Professional and scientific equipment	290	279	517	e
390 Other manufacturing industries	263	246	416	e

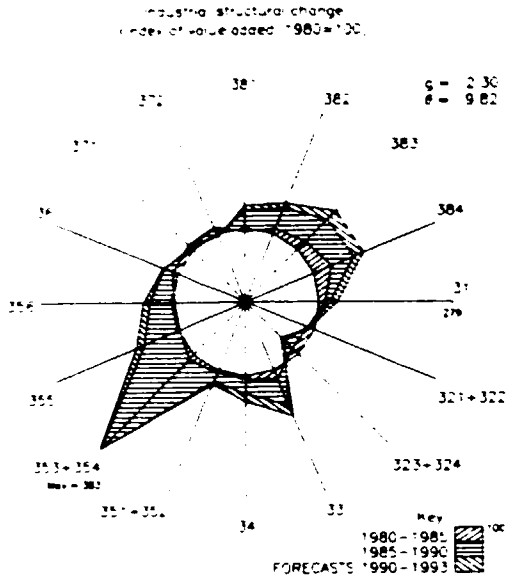
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

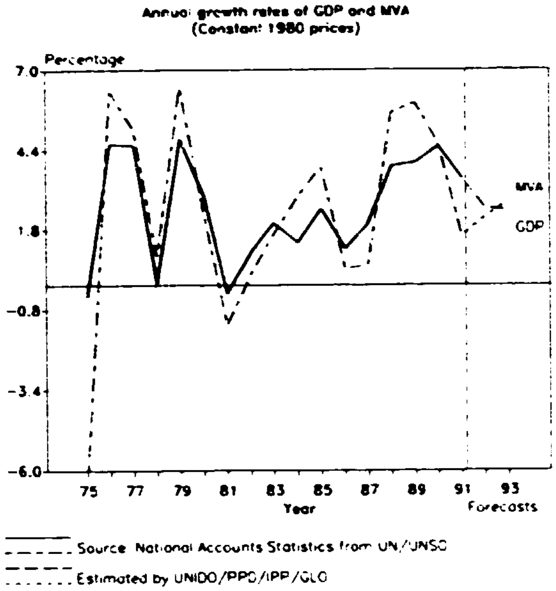






AUSTRIA





	1980	1985	1990
GDP (real, millions of 1980-dollars)	76882	82071	95560
Per capita (1980-dollars) (real)	10183	10859	12600
Manufacturing share (%) (real) (current prices)	27.8	26.9	27.8 /e
MANUFACTURING:			
Value added (real) (millions of 1980-dollars)	23511	25289	29940
Industrial production index	100	111	137
Value added (millions of dollars)	17987	15108	37661
Gross output (millions of dollars)	54666	45959	105540
Employment (thousands)	824	783	771
-PROFITABILITY (in percent of gross output)			
Intermediate input (%)	67	67	64
Wages and salaries (%)	19	18	17 /e
Operating surplus (%)	14	15	19 /e
-PRODUCTIVITY (dollars)			
Gross output / worker	66355	58711	136805
Value added / worker	21834	19300	48818
Average wage	12799	10738	23509 /e
-STRUCTURAL INDICES:			
Structural change θ 5-year average in degrees	4.18	4.99	4.25
as a percentage of average θ in 1970-1975	76	91	77
MVA growth rate / θ	0.49	0.25	0.84
Degree of specialization	10.1	10.2	10.5
-VALUE ADDED (millions of dollars)			
311 Food products	1752	1472	3330 /e
313 Beverages	474	380	857 /e
314 Tobacco products	807	725	1545
321 Textiles	904	657	1460
322 Wearing apparel	512	353	657
323 Leather and fur products	63	45	97
324 Footwear	223	157	257
331 Wood and wood products	192	298	731 /e
332 Furniture and fixtures	365	733	2176 /e
341 Paper and paper products	545	509	1232 /e
342 Printing and publishing	726	626	1580 /e
351 Industrial chemicals	663	584	1376 /e
352 Other chemical products	534	398	951 /e
353 Petroleum refineries	80	72	580
354 Miscellaneous petroleum and coal products	35	27	67 /e
355 Rubber products	258	200	638 /e
356 Plastic products	281	215	603 /e
361 Pottery, china and earthenware	63	42	113 /e
362 Glass and glass products	244	237	570
369 Other non-metal mineral products	894	724	1670
371 Iron and steel	1225	1055	2158
372 Non-ferrous metals	280	241	454
381 Metal products	1542	1170	3171
382 Non-electrical machinery	1765	1502	4007
383 Electrical machinery	1615	1472	4198
384 Transport equipment	943	941	2484
385 Professional and scientific equipment	161	144	368 /e
390 Other manufacturing industries	143	130	333 /e

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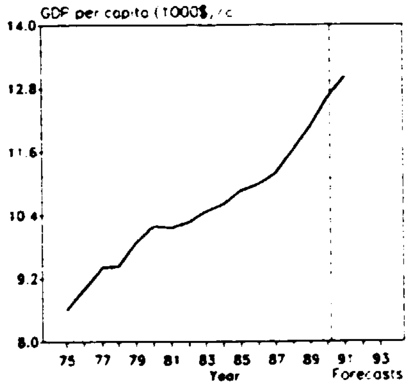

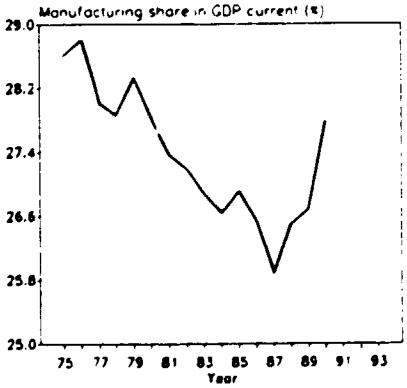

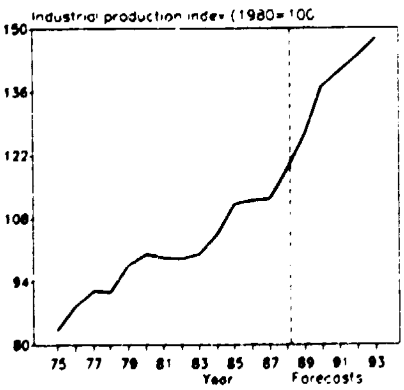

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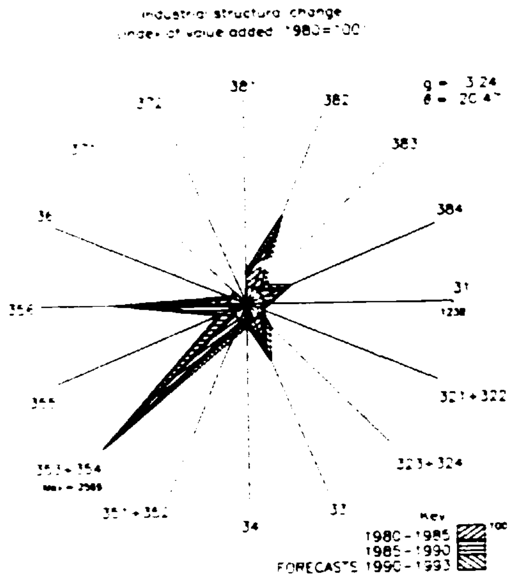

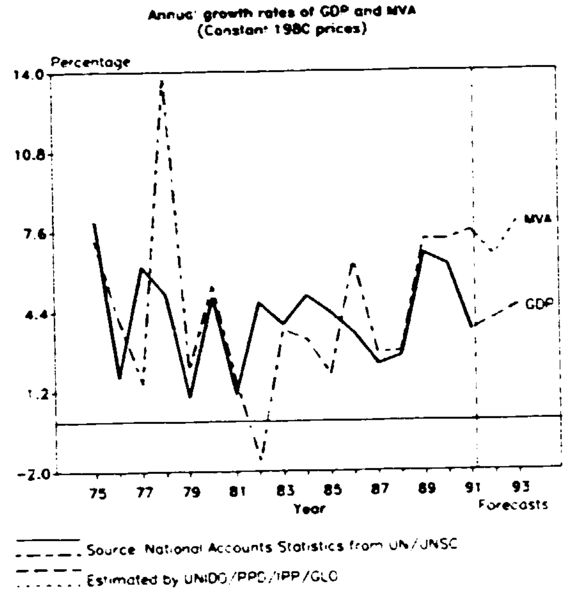

	1980	1985	1990
GDP (m.a.c. millions of 1980-dollars)	15306	19043	23429
Per capita (1980-dollars) (m.a.c.)	179	188	203
Manufacturing share (%) (m.a. current prices)	9.4	7.8	7.1
MANUFACTURING:			
Value added (m.a.c. millions of 1980-dollars)	1479	1512	2082
Industrial production index	100	103	118
Value added (millions of dollars)	834	863	1237 e
Gross output (millions of dollars)	2253	2498	3182 e
Employment (thousands)	412	469	538 e
-PROFITABILITY (in percent of gross output)			
Intermediate input	63	65	61 e
Wages and salaries	12	10 e	12 e
Operating surplus	25	24 e	27 e
-PRODUCTIVITY (dollars)			
Gross output / worker	5466	5331	5912 e
Value added / worker	2023	1842	2297 e
Average wage	634	551 e	701 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	6.86	8.02	5.96 e
as a percentage of average θ in 1970-1975	79	92	69 e
MVA growth rate / θ	3.14	0.21	0.57
Degree of specialization	36.0	25.3	25.4
-VALUE ADDED (millions of dollars)			
311 Food products	78	98	112 e
313 Beverages	7	6	13 e
314 Tobacco products	111	109	169 e
321 Textiles	336	230	333 e
322 Wearing apparel	-	8	11 e
323 Leather and fur products	18	14	25 e
324 Footwear	4	10	15 e
331 Wood and wood products	3	10	11 e
332 Furniture and fixtures	1	2	3 e
341 Paper and paper products	23	19	25 e
342 Printing and publishing	6	8	12 e
351 Industrial chemicals	33	70	108 e
352 Other chemical products	97	85	154 e
353 Petroleum refineries	2	75	78 e
354 Miscellaneous petroleum and coal products	1	2	3 e
355 Rubber products	4	1	6 e
356 Plastic products	-	2	3 e
361 Pottery, china and earthenware	2	4	4 e
362 Glass and glass products	4	4	5 e
369 Other non-metal mineral products	14	7	11 e
371 Iron and steel	39	35	32 e
372 Non-ferrous metals	-	-	- e
381 Metal products	9	13	18 e
382 Non-electrical machinery	4	17 e	22 e
383 Electrical machinery	19	18	26 e
384 Transport equipment	11	10	31 e
385 Professional and scientific equipment	-	-	- e
390 Other manufacturing industries	8	7	6 e

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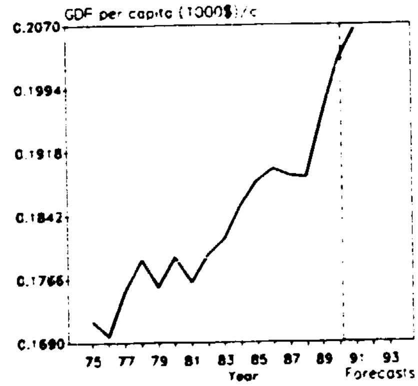
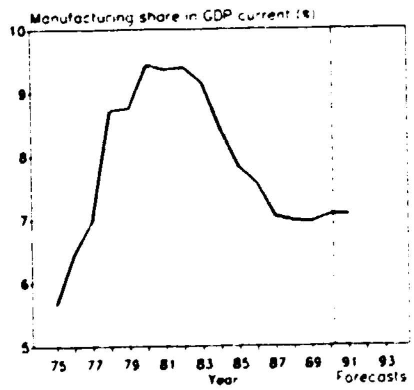
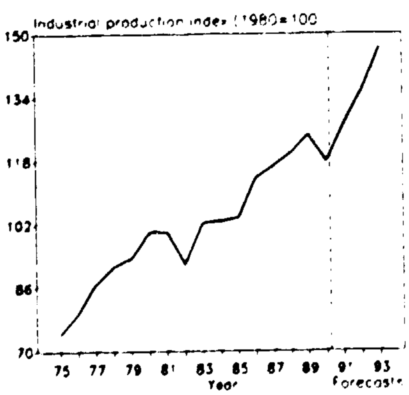
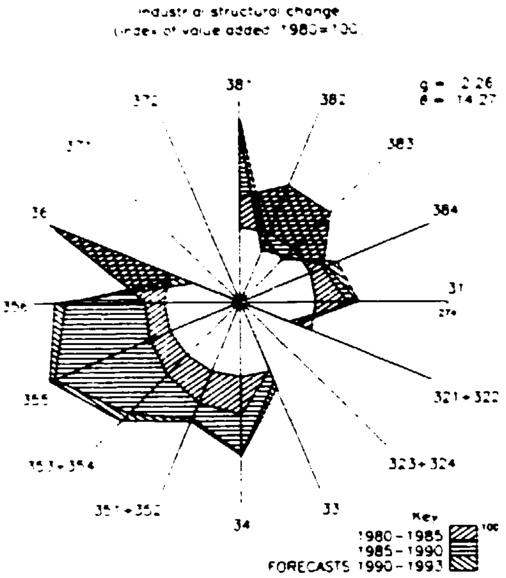
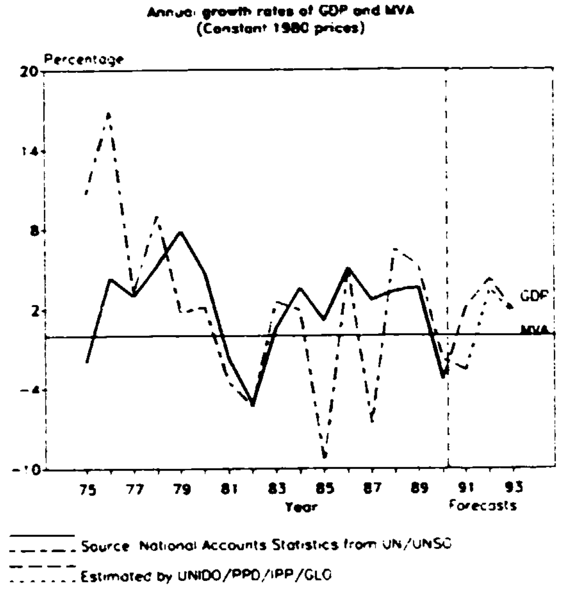






BARBADOS





	1980	1985	1990
GDP: (na.c) (millions of 1980-dollars)	861	844	942
Per capita (1980-dollars) (na.c)	3442	3334	3680
Manufacturing share (%) (na) (current prices)	10 6	9 6	7 0 /e
MANUFACTURING:			
Value added (na.c) (millions of 1980-dollars)	103	89	96
Industrial production index	100	94	102
Value added (millions of dollars)	53	90	122 /e
Gross output (millions of dollars)	241	383	454 /e
Employment (thousands)	8	9	8 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	78	77	73 /e
Wages and salaries (%)	14	18	17 /e
Operating surplus (%)	8	5	9 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	31448	42386	54138 /e
Value added / worker	6886	9919	14527 /e
Average wage	4337	7726	9469 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	16 38	18 06	6 13 /e
as a percentage of average θ in 1970-1975	182	200	68 /e
MVA growth rate / θ	0 09	0 26	0 45
Degree of specialization	15 4	17 0	17 4
-VALUE ADDED: (millions of dollars)			
311 Food products	12	25	31 /e
313 Beverages	6	12	17 /e
314 Tobacco products	1	2	2 /e
321 Textiles	-	-	1 /e
322 Wearing apparel	6	7	8 /e
323 Leather and fur products	-	-	- /e
324 Footwear	-	-	- /e
331 Wood and wood products	-	-	- /e
332 Furniture and fixtures	1	2	2 /e
341 Paper and paper products	-	1	1 /e
342 Printing and publishing	4	8	13 /e
351 Industrial chemicals	-	-	- /e
352 Other chemical products	1	3	4 /e
353 Petroleum refineries	2	3	6 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	1 /e	1 /e	4 /e
356 Plastic products	1 /e	1 /e	3 /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	-	-	1 /e
369 Other non-metal mineral products	3	-3	4 /e
371 Iron and steel	-	-	/e
372 Non-ferrous metals	-	-	- /e
381 Metal products	3	5	10 /e
382 Non-electrical machinery	5	11	6 /e
383 Electrical machinery	3	8	5 /e
384 Transport equipment	1	2	3 /e
385 Professional and scientific equipment	-	-	- /e
390 Other manufacturing industries	3	1	- /e

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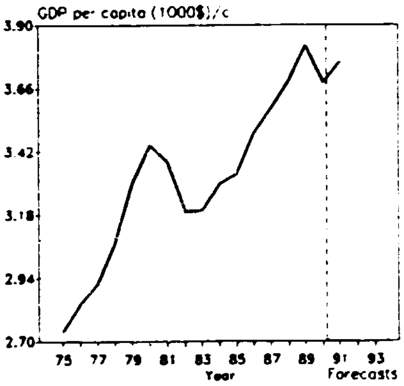
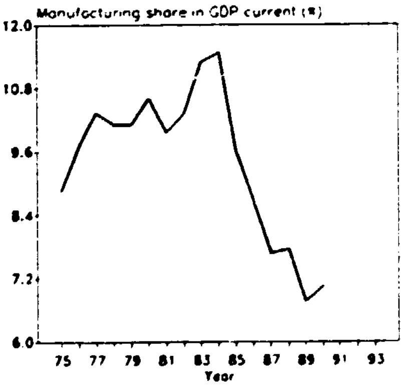
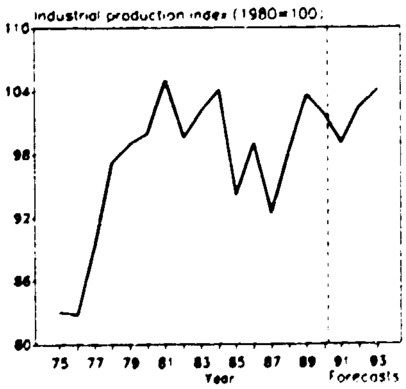
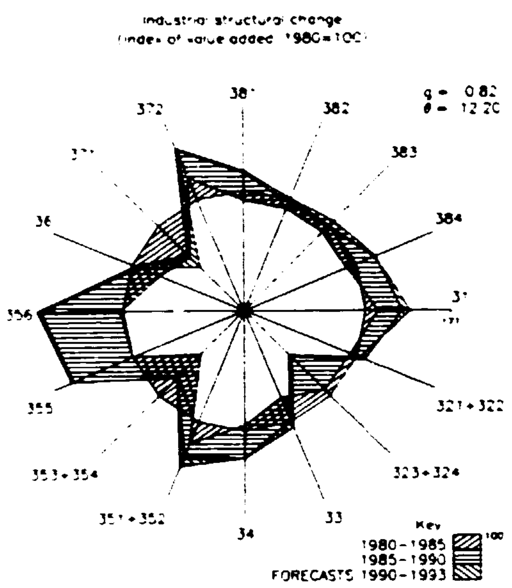




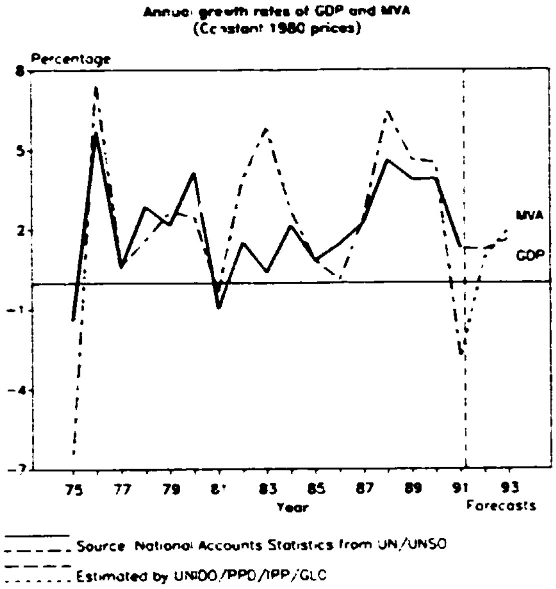


BELGIUM

Industrial structural change
(index of value added: 1980=100)

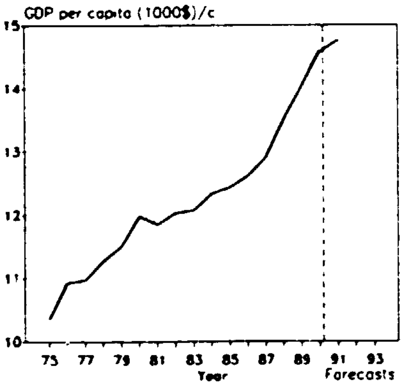


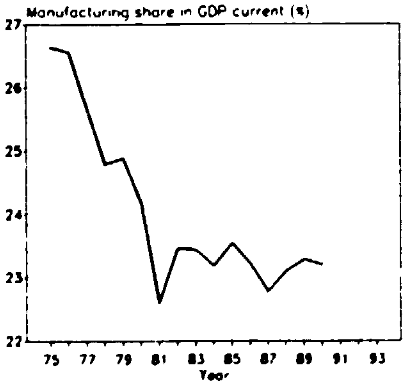
Annual growth rates of GDP and MVA
(Constant 1980 prices)

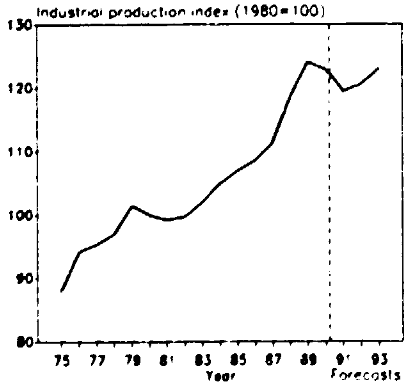


	1980	1985	1990
GDP: (na.c) (millions of 1980-dollars)	118016	122611	143577
Per capita (1980-dollars) (na.c)	11979	12436	14585
Manufacturing share (%) (na) (current prices)	24.2	23.5	23.2 /e
MANUFACTURING:			
Value added (na.c) (millions of 1980-dollars)	28137	31912	38077
Industrial production index	100	107	123
Value added (millions of dollars)	28089	17368	43114
Gross output (millions of dollars)	86206 /e	59978	148916
Employment (thousands)	868	753	750 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	67 /e	71	71
Wages and salaries (%)	16 /e	13 /e	13 /e
Operating surplus (%)	16 /e	16 /e	16 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	99316 /e	79653	198542 /e
Value added / worker	32360	23066	57481 /e
Average wage	16145 /e	10646 /e	25268 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2.55	2.83	2.09 /e
as a percentage of average θ in 1970-1975	57	63	47 /e
MVA growth rate / θ	0.17	-0.33	1.80
Degree of specialization	12.5	14.0	13.8
-VALUE ADDED: (millions of dollars)			
311 Food products	3991	2885	7200
313 Beverages	547	394	834
314 Tobacco products	198	128	225
321 Textiles	1443	920	2111
322 Wearing apparel	670	381	944
323 Leather and fur products	109	72	81 /e
324 Footwear	65	34	47
331 Wood and wood products	226	111	341 /e
332 Furniture and fixtures	1122	576	1564 /e
341 Paper and paper products	612	404	1079
342 Printing and publishing	927	546	1455
351 Industrial chemicals	2401	1905	4559 /e
352 Other chemical products	663	492	1214 /e
353 Petroleum refineries	510	169	549
354 Miscellaneous petroleum and coal products	78	26	72 /e
355 Rubber products	191	125	399 /e
356 Plastic products	814	542	1870 /e
361 Pottery, china and earthenware	117 /e	57 /e	210 /e
362 Glass and glass products	441 /e	216 /e	571
369 Other non-metal mineral products	717 /e	351 /e	881
371 Iron and steel	2267	940	1992
372 Non-ferrous metals	486	379	954
381 Metal products	2079	1244	3266
382 Non-electrical machinery	2455	1468	3325
383 Electrical machinery	2312	1383	3271
384 Transport equipment	1883	1127	2977
385 Professional and scientific equipment	136	117	173 /e
390 Other manufacturing industries	568	378	952 /e

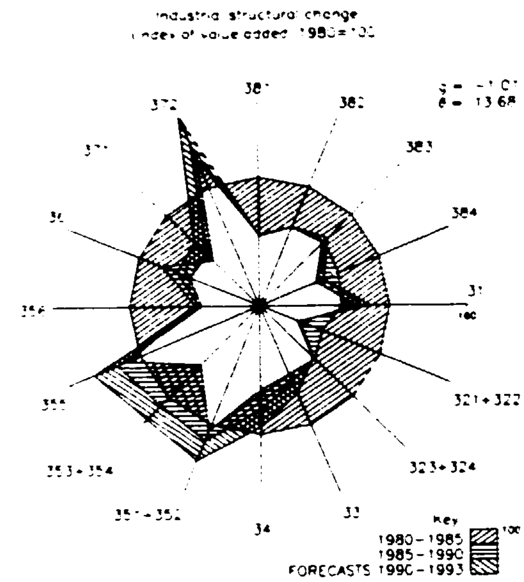
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

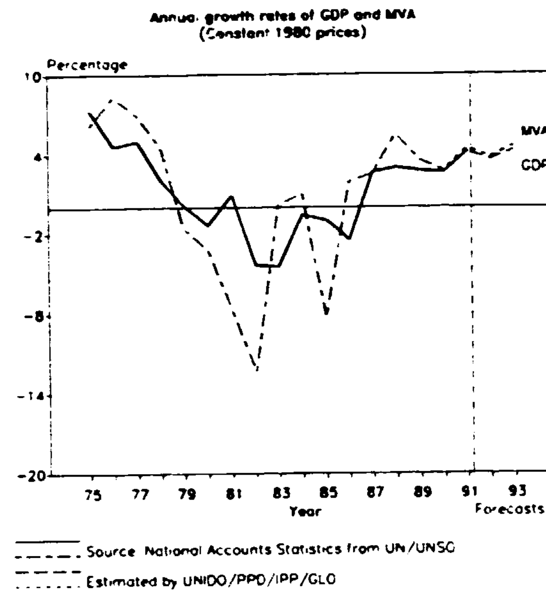






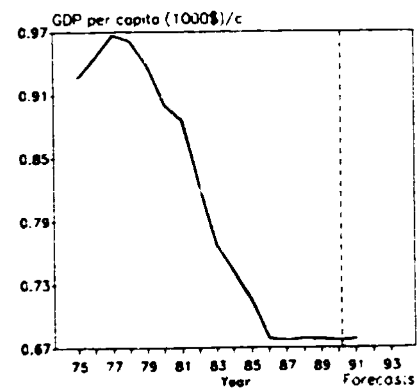
BOLIVIA

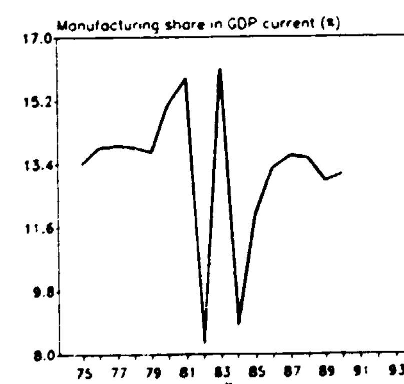


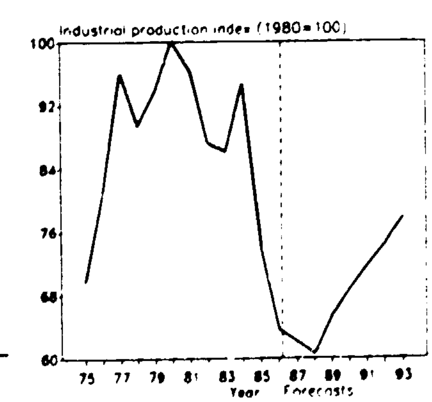


	1980	1985	1990
GDP: (n.a.c., millions of 1980-dollars)	5018	4556	4946
Per capita (1980-dollars) (n.a.c.)	901	715	676
Manufacturing share (%) (n.a., current prices)	15.1	12.0	13.1 /e
MANUFACTURING:			
Value added (n.a.c., millions of 1980-dollars)	734	551	646
Industrial production index	100	74	69
Value added (millions of dollars)	834	818	894 /e
Gross output (millions of dollars)	2465	1956 /e	1958 /e
Employment (thousands)	102	137 /e	169 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	66	58 /e	55 /e
Wages and salaries (%)	10	11 /e	12 /e
Operating surplus (%)	24	31 /e	33 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	24222	14325 /e	11628 /e
Value added / worker	8200	5988 /e	5282 /e
Average wage	2438	1555 /e	1391 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	9.81	6.75 /e	4.64 /e
as a percentage of average θ in 1970-1975	114	78 /e	54 /e
MVA growth rate / θ	0.67	-0.93	0.67
Degree of specialization	25.4	28.0	32.5
-VALUE ADDED: (millions of dollars)			
311 Food products	243	261	269 /e
313 Beverages	52	37 /e	57 /e
314 Tobacco products	21	4	4 /e
321 Textiles	37	35	12 /e
322 Wearing apparel	47	30	27 /e
323 Leather and fur products	5	4	4 /e
324 Footwear	24	20	19 /e
331 Wood and wood products	24	21	21 /e
332 Furniture and fixtures	21	18	18 /e
341 Paper and paper products	1	1	2 /e
342 Printing and publishing	15	15	16 /e
351 Industrial chemicals	3	7	7 /e
352 Other chemical products	31	45	46 /e
353 Petroleum refineries	159	152	241 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	2	3	4 /e
356 Plastic products	12	9	8 /e
361 Pottery, china and earthenware	4	3	3 /e
362 Glass and glass products	11	9	9 /e
369 Other non-metal mineral products	25	35	19 /e
371 Iron and steel	12	9	9 /e
372 Non-ferrous metals	37	68	70 /e
381 Metal products	14	11	10 /e
382 Non-electrical machinery	6	6	5 /e
383 Electrical machinery	3	3	3 /e
384 Transport equipment	5	5	3 /e
385 Professional and scientific equipment	1	1	1 /e
390 Other manufacturing industries	9	5	5 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

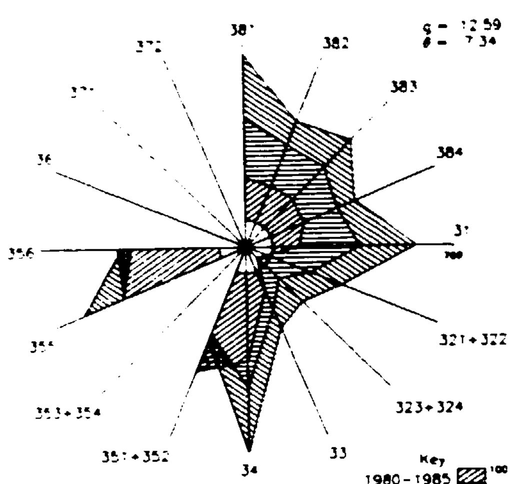




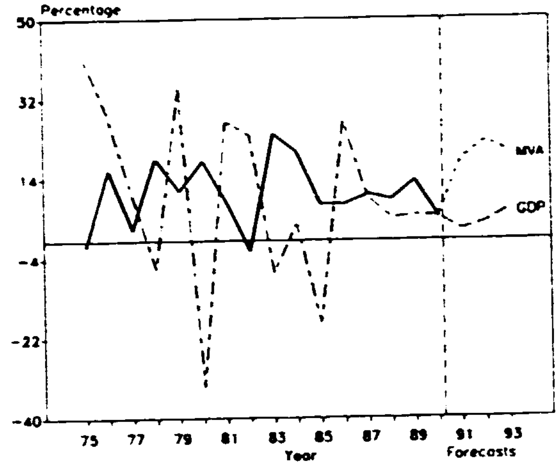


BOTSWANA

Industrial structural change (index of value added: 1980=100)



Annual growth rates of GDP and MVA (Constant 1980 prices)



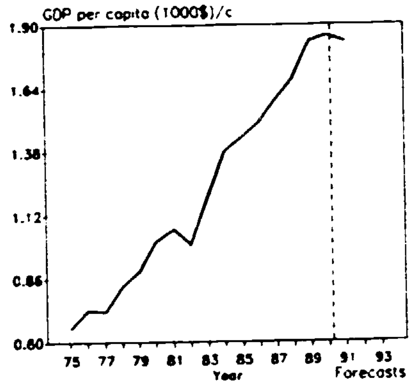
Source: National Accounts Statistics from UN/UNSO

Estimated by UNIDO/PPD/IPP/GLO

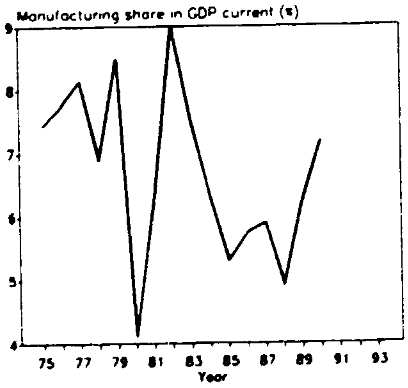
	1980	1985	1990
GDP: na.c millions of 1980-dollars	913	1559	2421
Per capita 1980-dollars na.c	1012	1438	1853
Manufacturing share % na current prices	4 1	5 3	7 2 /e
MANUFACTURING:			
Value added na.c millions of 1980-dollars	43	52	85
Industrial production index	100	174	251
Value added millions of dollars	41	48	148 /e
Gross output millions of dollars	149	166	439 /e
Employment thousands	5	10	19 /e
-PROFITABILITY: in percent of gross output			
Intermediate input %	73	71	66 /e
Wages and salaries %	14 /e	11 /e	10 /e
Operating surplus %	14 /e	18 /e	24 /e
-PRODUCTIVITY: dollars			
Gross output / worker	27097	16552	22562 /e
Value added / worker	7443	4788	7620 /e
Average wage	3663 /e	1880 /e	2216 /e
-STRUCTURAL INDICES:			
Structural change θ 5-year average in degrees	3 47 /e	8 88 /e	3 18 /e
as a percentage of average θ in 1970-1975	296 /e	758 /e	272 /e
MVA growth rate θ	1 44	1 47	4 28
Degree of specialization	35 3	30 0	34 7
-VALUE ADDED: millions of dollars			
311 Food products	13	14	57 /e
313 Beverages	4	10	28 /e
314 Tobacco products	-	-	- /e
321 Textiles	5 /e	3 /e	14 /e
322 Wearing apparel	1 /e	- /e	2 /e
323 Leather and fur products	1 /e	- /e	1 /e
324 Footwear	- /e	- /e	- /e
331 Wood and wood products	- /e	- /e	1 /e
332 Furniture and fixtures	- /e	- /e	1 /e
341 Paper and paper products	1 /e	2 /e	4 /e
342 Printing and publishing	- /e	1 /e	1 /e
351 Industrial chemicals	- /e	1 /e	1 /e
352 Other chemical products	- /e	1 /e	1 /e
353 Petroleum refineries	-	-	- /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	- /e	- /e	1 /e
356 Plastic products	- /e	- /e	- /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	-	-	- /e
369 Other non-metal mineral products	-	-	- /e
371 Iron and steel	-	-	- /e
372 Non-ferrous metals	-	-	- /e
381 Metal products	2 /e	4 /e	11 /e
382 Non-electrical machinery	- /e	- /e	1 /e
383 Electrical machinery	- /e	- /e	1 /e
384 Transport equipment	- /e	1 /e	1 /e
385 Professional and scientific equipment	-	-	- /e
390 Other manufacturing industries	12	10	21 /e

For sources, footnotes and comments see Technical notes at the beginning of this Annex

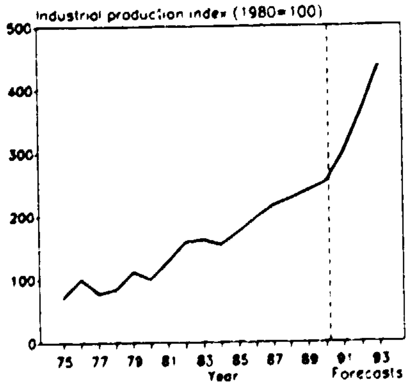
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

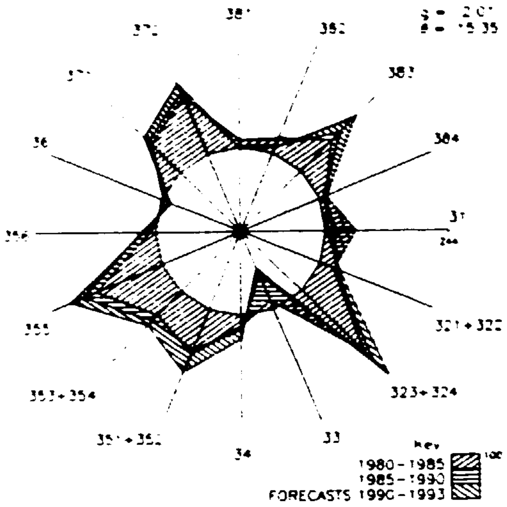


Industrial production index (1980=100)

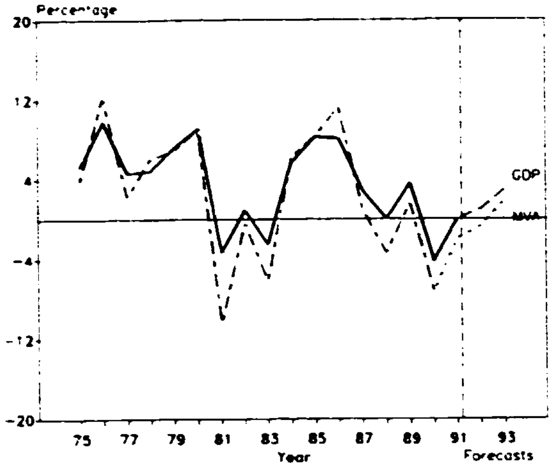


BRAZIL

Industrial structure change
(index of value added 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)



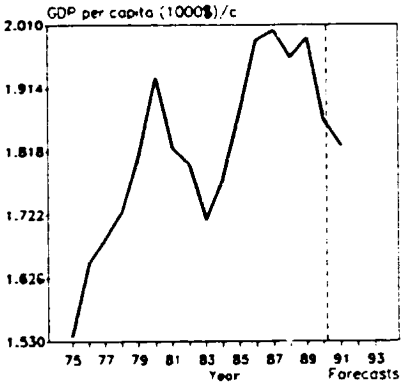
Source National Accounts Statistics from UN/UNSO

Estimated by UNIDO/PPD/IPP/GLO

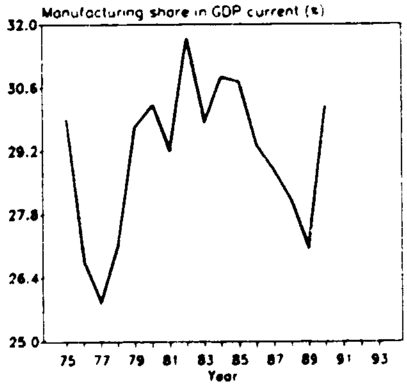
	1980	1985	1990
GDP: n.a.c. (millions of 1980-dollars)	233962	254528	280690
Per capita (1980-dollars) n.a.c.	1929	1878	1865
Manufacturing share (%) (na current prices)	30.2	30.7	30.2 /e
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)	79245	76318	78003
Industrial production index	100	98	103
Value added (millions of dollars)	71690	74568	118743 /e
Gross output (millions of dollars)	176174	169004	382411 /e
Employment (thousands)	4449	4067	3962 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	59	56	69 /e
Wages and salaries (%)	7	9	9 /e
Operating surplus (%)	34	35	22 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	39599	41559	95181 /e
Value added / worker	16114	18337	29973 /e
Average wage	2773	3720	9015 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	4.04	6.03	3.10 /e
as a percentage of average θ in 1970-1975	70	104	53 /e
MVA growth rate / θ	1.63	0.94	-0.21
Degree of specialization	9.0	9.9	9.9
-VALUE ADDED: (millions of dollars)			
311 Food products	7996	9259	12559 /e
313 Beverages	1375	957	1120 /e
314 Tobacco products	495	587	780 /e
321 Textiles	4860	4799	8151 /e
322 Wearing apparel	2307	2035	3450 /e
323 Leather and fur products	309	464	805 /e
324 Footwear	985	1665	2964 /e
331 Wood and wood products	1903	1220	1215 /e
332 Furniture and fixtures	1087	949	1017 /e
341 Paper and paper products	2238	2260	3953 /e
342 Printing and publishing	1901	1496	2498 /e
351 Industrial chemicals	3428	4417	6952 /e
352 Other chemical products	3544	4451	7173 /e
353 Petroleum refineries	3075	4307	7546 /e
354 Miscellaneous petroleum and coal products	1216	572	1015 /e
355 Rubber products	941	1420	2548 /e
356 Plastic products	1994	1728	3133 /e
361 Pottery, china and earthenware	190	168	249 /e
362 Glass and glass products	558	525	806 /e
369 Other non-metal mineral products	3447	2617	3997 /e
371 Iron and steel	4128	4327	8461 /e
372 Non-ferrous metals	1115	1564	2678 /e
381 Metal products	3599	3168	4786 /e
382 Non-electrical machinery	7171	6964	10475 /e
383 Electrical machinery	4536	5598	10122 /e
384 Transport equipment	5625	4954	7936 /e
385 Professional and scientific equipment	453	660	1141 /e
390 Other manufacturing industries	1216	837	1264 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

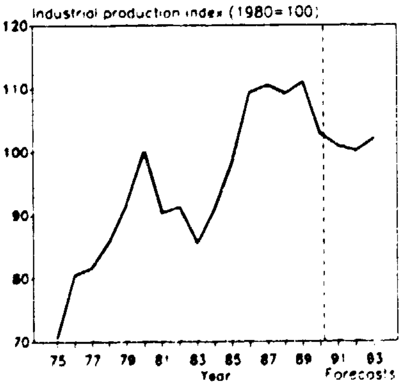
GDP per capita (1000$)/c



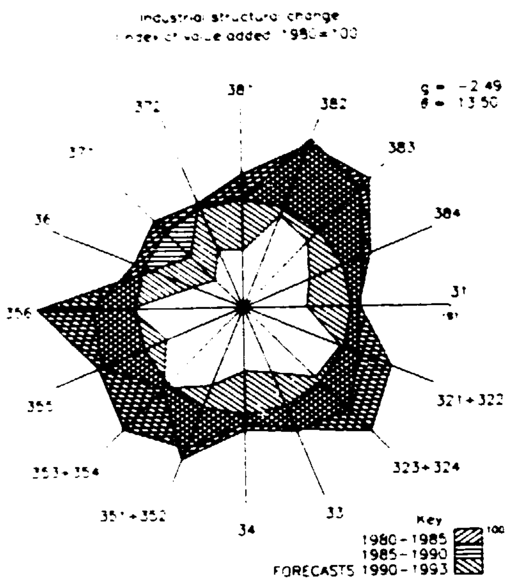
Manufacturing share in GDP current (%)

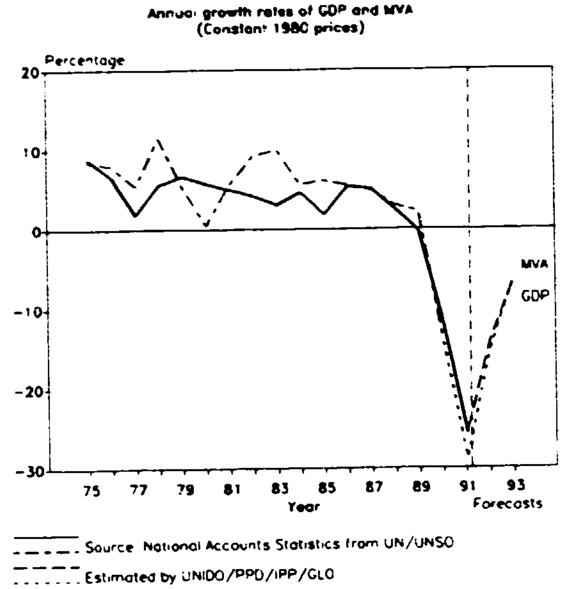


Industrial production index (1980=100)



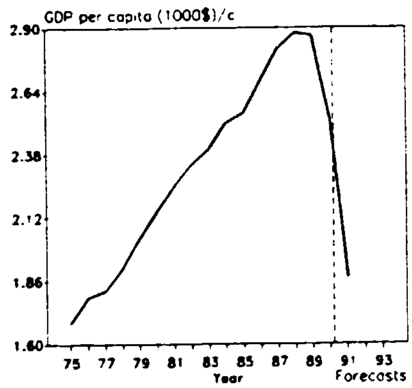
BULGARIA

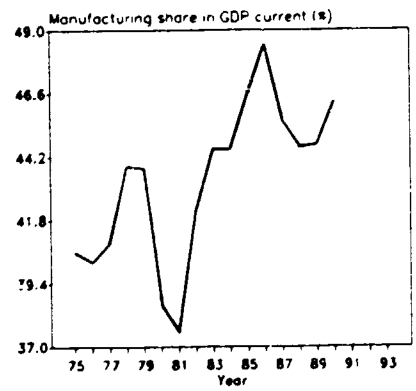


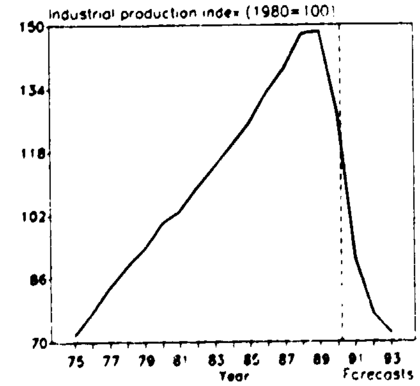


	1980	1985	1990
GDP: na.c millions of 1980-dollars	19031	22837	22756
Per capita 1980-dollars /na.c	2147	2549	2524
Manufacturing share % na current prices	38 5	46 5	46 3 /e
MANUFACTURING:			
Value added na.c millions of 1980-dollars	8069	11469	11478
Industrial production index	100	125	127
Value added millions of 1980-dollars	11771	14768	14993 /e
Gross output millions of dollars	22328 /e	35882 /e	30445 /e
Employment thousands	1260	1316	1258 /e
-PROFITABILITY: in percent of gross output			
Intermediate input %			
Wages and salaries %			
Operating surplus %			
-PRODUCTIVITY: dollars			
Gross output worker	28554 /e	47942	39705 /e
Value added worker c	9675	11756	12387 /e
Average wage	1737 /e	2577 /e	2172 /e
-STRUCTURAL INDICES:			
Structural change θ 5-year average in degrees	2 83	2 84 /e	4 23 /e
as a percentage of average θ in 1970-1975	90	91 /e	135 /e
MVA growth rate θ	2 42	1 64	0 14
Degree of specialization	11 6	11 9	12 6
-VALUE ADDED: millions of 1980-dollars			
311 Food products	1870	1945	2126 /e
313 Beverages	308	357	339
314 Tobacco products	426	472	349
321 Textiles	904	1003	1175
322 Wearing apparel	517	626	915
323 Leather and fur products	84	110	112
324 Footwear	156	218	284
331 Wood and wood products	248	258	240
332 Furniture and fixtures	233	347	352
341 Paper and paper products	119	141	112
342 Printing and publishing	83	91	108
351 Industrial chemicals	404	573	500
352 Other chemical products	291	486	483
353 Petroleum refineries			
354 Miscellaneous petroleum and coal products	126	134	201 /e
355 Rubber products	227	323	332
356 Plastic products	110	154 /e	211 /e
361 Pottery, china and earthenware	45	40	58
362 Glass and glass products	121	140	133
369 Other non-metal mineral products	469	507	390
371 Iron and steel	447	513	304
372 Non-ferrous metals	189	199	195 /e
381 Metal products	484	600	489
382 Non-electrical machinery	1489 /e	2425 /e	2510 /e
383 Electrical machinery	743	1241	1152
384 Transport equipment	567	726	687
385 Professional and scientific equipment	173 /e	285 /e	299 /e
390 Other manufacturing industries	937	853	937

For sources, footnotes and comments see Technical notes at the beginning of this Annex

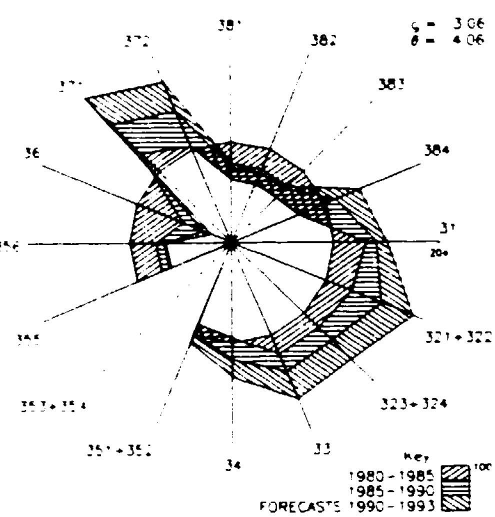




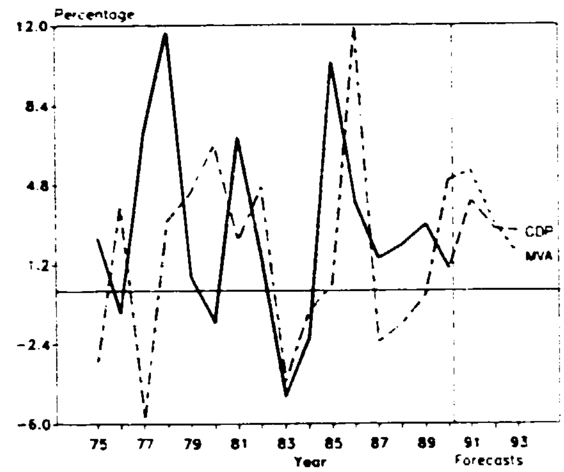


BURKINA FASO

Industrial structural change
Index of value added 1980=100



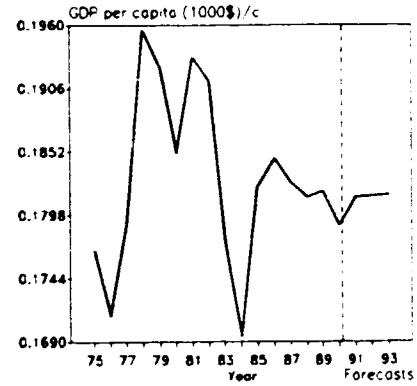
Annual growth rates of GDP and MVA
(Constant 1980 prices)



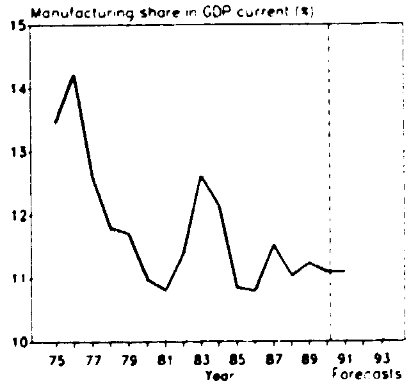
	1980	1985	1990
GDP: (at constant millions of 1980-dollars)	1287	1435	1607
Per capita (1980-dollars)	185	182	179
Manufacturing share (%) (current prices)	11 0	10 8	11 1
MANUFACTURING:			
Value added (millions of 1980-dollars)	150	153	173
Industrial production index	100	110	139
Value added (millions of dollars)	144	121 /e	216 /e
Gross output (millions of dollars)	391	318 /e	624 /e
Employment (thousands)	8	9 /e	9 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	63	62 /e	65 /e
Wages and salaries (%)	8	7 /e	8 /e
Operating surplus (%)	28	31 /e	27 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	47326	36538 /e	67218 /e
Value added / worker	17465	13905 /e	23301 /e
Average wage	4021	2717 /e	5152 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2 80	3 00 /e	1 04 /e
as a percentage of average θ in 1970-1975	240	258 /e	90 /e
MVA growth rate θ	0 49	1 37	2 01
Degree of specialization	36 7	42 9	42 6
-VALUE ADDED: (millions of dollars)			
311 Food products	55	55 /e	98 /e
313 Beverages	29	21 /e	36 /e
314 Tobacco products	1	1 /e	2 /e
321 Textiles	20	18 /e	35 /e
322 Wearing apparel	2	2 /e	4 /e
323 Leather and fur products	2	1 /e	3 /e
324 Footwear	3	3 /e	5 /e
331 Wood and wood products	-	- /e	- /e
332 Furniture and fixtures	2	1 /e	3 /e
341 Paper and paper products	-	- /e	- /e
342 Printing and publishing	1	1 /e	2 /e
351 Industrial chemicals	1	1 /e	2 /e
352 Other chemical products	-	- /e	- /e
353 Petroleum refineries	-	- /e	- /e
354 Miscellaneous petroleum and coal products		- /e	- /e
355 Rubber products	4	2 /e	3 /e
356 Plastic products	2	1 /e	2 /e
361 Pottery, china and earthenware	-	- /e	- /e
362 Glass and glass products	-	- /e	- /e
369 Other non-metal mineral products	-	- /e	- /e
371 Iron and steel	1 /e	1 /e	1 /e
372 Non ferrous metals	- /e	- /e	1 /e
381 Metal products	1	- /e	1 /e
382 Non electrical machinery	1	- /e	1 /e
383 Electrical machinery	1	- /e	1 /e
384 Transport equipment	3	1 /e	3 /e
385 Professional and scientific equipment	-	- /e	- /e
390 Other manufacturing industries	12	9 /e	13 /e

For sources, footnotes and comments see 'Technical notes' at the beginning of this Annex

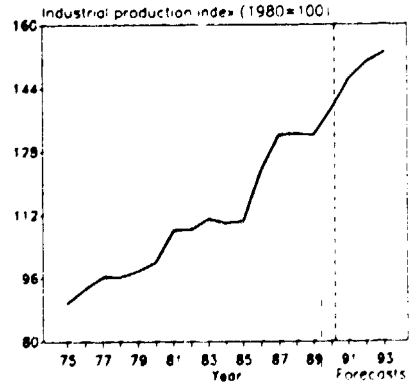
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

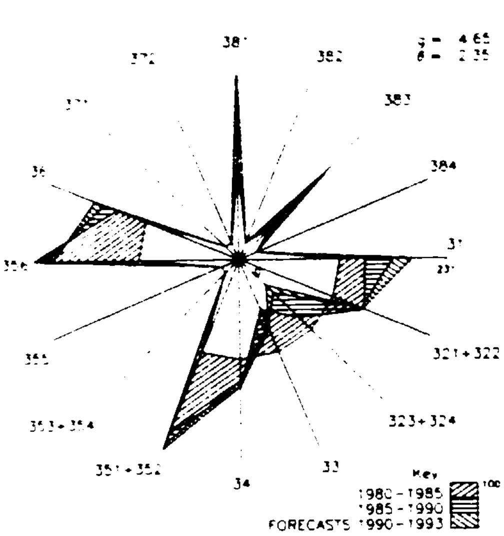


Industrial production index (1980=100)

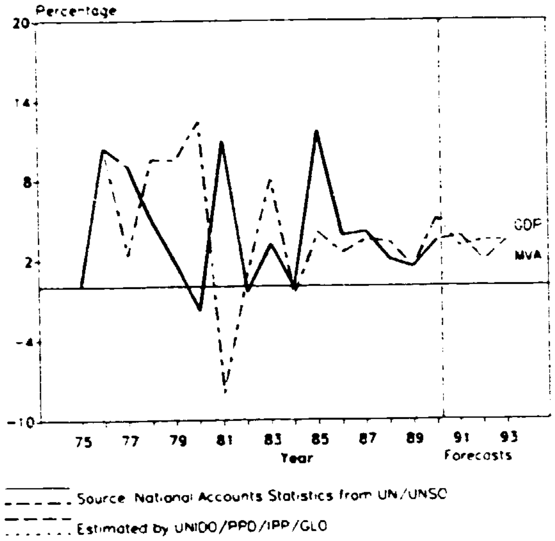


BURUNDI

Industrial structure change
Index of value added 1980=100



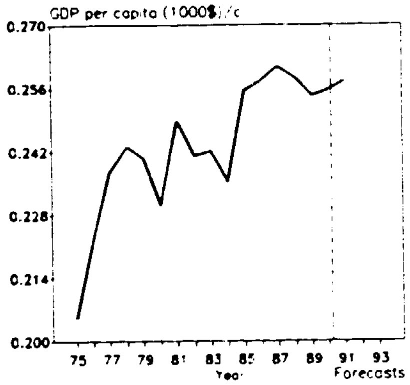
Annual growth rates of GDP and MVA
(Constant 1980 prices)



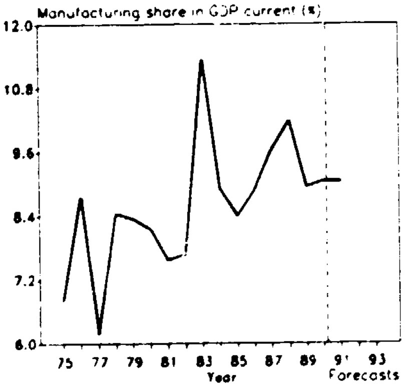
	1980		1985		1990	
GDP (real, millions of 1980-dollars)	951		1208		1397	
Per capita (1980-dollars, real)	230		255		255	
Manufacturing share (%) (real, current prices)	8.1		8.4		9.0	
MANUFACTURING:						
Value added (real, millions of 1980-dollars)	86		89		104	
Industrial production index	100		143		161	
Value added (millions of dollars)	56		78	/e	89	/e
Gross output (millions of dollars)	95		127	e	143	/e
Employment (thousands)	3		4	e	5	e
-PROFITABILITY (in percent of gross output)						
Intermediate input	41		39	e	37	e
Wages and salaries	9	e	10	e	9	e
Operating surplus	51	e	51	e	54	e
-PRODUCTIVITY (dollars)						
Gross output / worker	27640		31466	e	28843	/e
Value added / worker	16370		19307	e	18037	/e
Average wage	2357	e	3160	e	2520	/e
-STRUCTURAL INDICES.						
Structural change θ (5-year average in degrees)	6.65	e	1.94	e	1.08	e
as a percentage of average θ in 1970-1975	105	e	31	e	17	/e
MVA growth rate / θ	1.41		3.50		3.31	
Degree of specialization	37.0		34.4		38.1	
-VALUE ADDED: (millions of dollars)						
311 Food products	26	e	32	e	37	e
313 Beverages	12	e	18	e	23	/e
314 Tobacco products	6	e	9	e	11	e
321 Textiles	2		3	e	3	e
322 Wearing apparel	3		4	e	3	e
323 Leather and fur products	1		1	e	-	e
324 Footwear	-		-	e	-	e
331 Wood and wood products	-	e	-	/e	-	e
332 Furniture and fixtures	-	e	-	e	-	e
341 Paper and paper products	-		-	e	-	e
342 Printing and publishing	1		1	e	1	/e
351 Industrial chemicals	1		3	e	3	e
352 Other chemical products	-		1	e	1	/e
353 Petroleum refineries	-		-	e	-	/e
354 Miscellaneous petroleum and coal products	-		-	e	-	/e
355 Rubber products	-		-	e	-	e
356 Plastic products	-		-	e	-	/e
361 Pottery, china and earthenware	-		-	e	-	e
362 Glass and glass products	-		-	e	-	/e
369 Other non-metal mineral products	1		2	/e	2	e
371 Iron and steel	-		-	/e	-	/e
372 Non-ferrous metals	-		-	/e	-	e
381 Metal products	2		4	/e	4	/e
382 Non-electrical machinery	-		-	e	-	/e
383 Electrical machinery	-		-	e	-	e
384 Transport equipment	-		-	e	-	/e
385 Professional and scientific equipment	-		-	/e	-	e
390 Other manufacturing industries	-		-	e	-	/e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

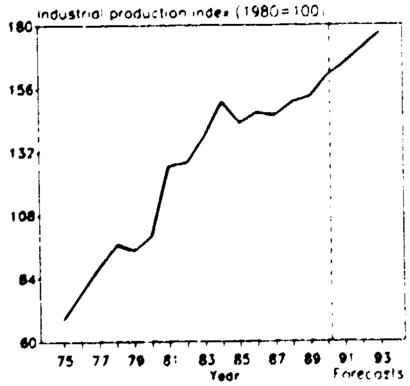
GDP per capita (1000$)/c



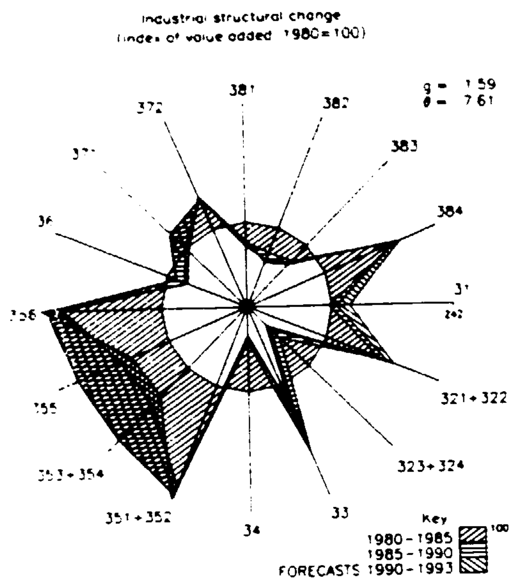
Manufacturing share in GDP current (%)

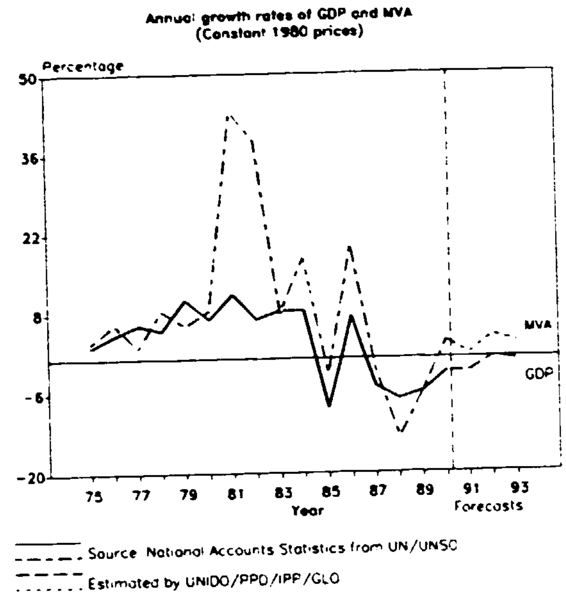


Industrial production index (1980=100)



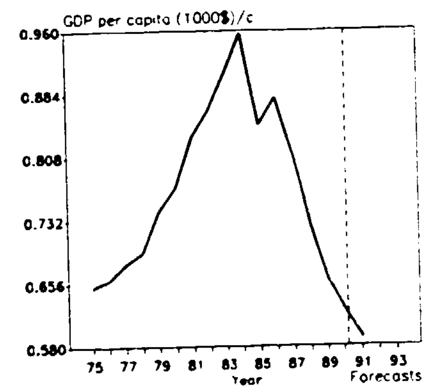
CAMEROON

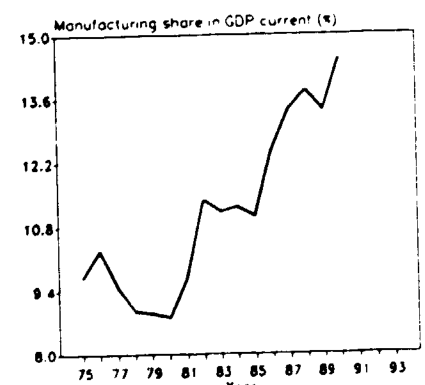


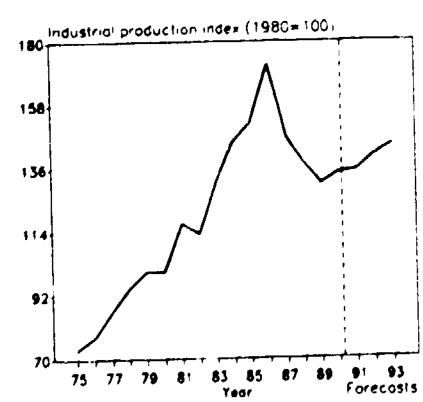


	1980	1985	1990
GDP: na.c millions of 1980-dollars)	6674	8500	7372
Per capita (1980-dollars) /na.c	771	846	624
Manufacturing share (%) /na (current prices)	8 8	11 0	14 5 /e
MANUFACTURING:			
Value added /na.c millions of 1980-dollars)	621	1515	1479
Industrial production index	100	152	134
Value added (millions of dollars)	707 /e	623 /e	1266 e
Gross output (millions of dollars)	1708 /e	1561 /e	2975 /e
Employment (thousands)	51 /e	55 /e	50 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	59 /e	60 /e	57 /e
Wages and salaries (%)	14 /e	12 /e	16 /e
Operating surplus (%)	27 /e	28 /e	26 /e
-PRODUCTIVITY: dollars)			
Gross output / worker	33774 /e	28358 /e	59804 /e
Value added / worker	13979 /e	11309 /e	25441 /e
Average wage	4842 /e	3481 /e	9859 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	8 82 /e	4 21 /e	3 86 /e
as a percentage of average θ in 1970-1975	110 /e	53 /e	48 /e
MVA growth rate / θ	1 38	0 70	0 00
Degree of specialization	23 9	21 3	25 4
-VALUE ADDED: (millions of dollars)			
311 Food products	187 /e	133 /e	376 /e
313 Beverages	183 /e	139 /e	236 /e
314 Tobacco products	24 /e	20 /e	42 /e
321 Textiles	36 /e	48 /e	115 /e
322 Wearing apparel	10 /e	12 /e	14 /e
323 Leather and fur products	7 /e	3 /e	5 /e
324 Footwear	10 /e	4 /e	5 /e
331 Wood and wood products	30 /e	43 /e	69 /e
332 Furniture and fixtures	13 /e	18 /e	29 /e
341 Paper and paper products	17 /e	5 /e	7 /e
342 Printing and publishing	20 /e	7 /e	13 /e
351 Industrial chemicals	12 /e	22 /e	42 /e
352 Other chemical products	15 /e	27 /e	53 /e
353 Petroleum refineries	3 /e	5 /e	7 /e
354 Miscellaneous petroleum and coal products	- /e	- /e	- /e
355 Rubber products	4 /e	6 /e	9 /e
356 Plastic products	24 /e	43 /e	82 /e
361 Pottery, china and earthenware	6 /e	4 /e	7 /e
362 Glass and glass products	4 /e	3 /e	6 /e
369 Other non-metal mineral products	12 /e	8 /e	14 /e
371 Iron and steel	24 /e	23 /e	38 /e
372 Non-ferrous metals	19 /e	20 /e	41 /e
381 Metal products	13 /e	8 /e	15 /e
382 Non-electrical machinery	18 /e	10 /e	17 /e
383 Electrical machinery	4 /e	2 /e	4 /e
384 Transport equipment	3 /e	5 /e	9 /e
385 Professional and scientific equipment	- /e	- /e	- e
390 Other manufacturing industries	11 /e	5 /e	10 /e

For sources, footnotes and comments see 'Technical notes' at the beginning of this Annex

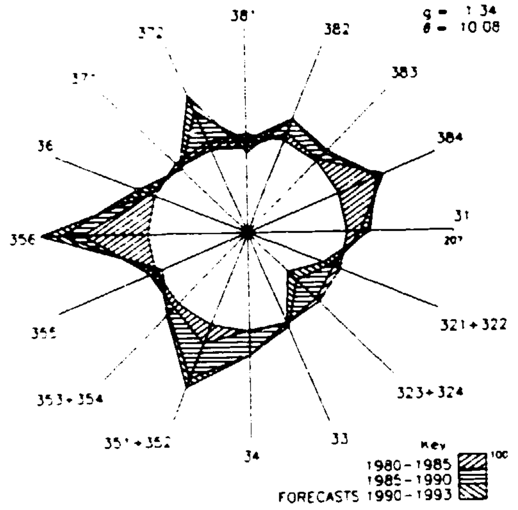




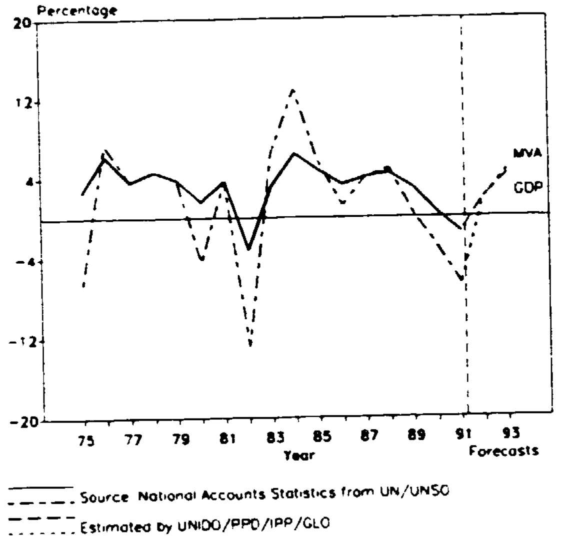


CANADA

Industrial structural change (index of value added 1980=100)



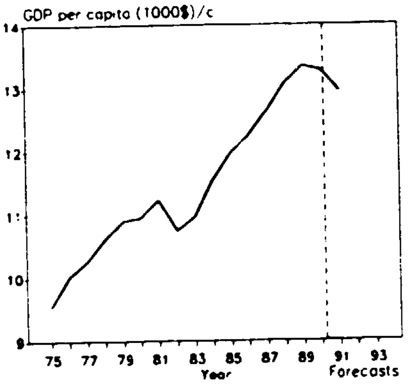
Annual growth rates of GDP and MVA (Constant 1980 prices)



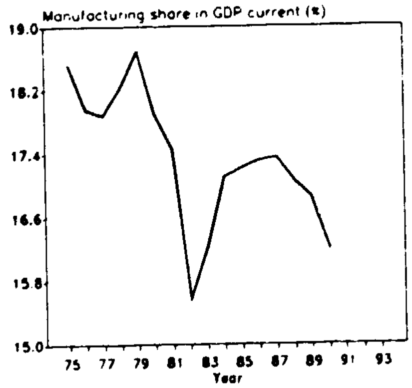
	1980	1985	1990
GDP: na.c (millions of 1980-dollars)	263242	303726	352366
Per capita (1980-dollars) na.c	10949	11968	13277
Manufacturing share (%) na (current prices)	17 9	17 2	16 2 /e
MANUFACTURING:			
Value added na.c (millions of 1980-dollars)	51664	59239	63705
Industrial production index	100	111	119
Value added (millions of dollars)	59803	74209	117971
Gross output (millions of dollars)	167211	211017	308607
Employment (thousands)	1853	1765	1794
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	64	65	62
Wages and salaries (%)	17	16	16 /e
Operating surplus (%)	19	19	22 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	90238	119577	172049
Value added / worker	32274	42052	65769
Average wage	15296	19168	27381 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	3 41	4 85	3 08
as a percentage of average θ in 1970-1975	76	108	69
MVA growth rate / θ	1 06	0 41	0 68
Degree of specialization	10 3	11 0	11 4
-VALUE ADDED: (millions of dollars)			
311 Food products	6142	8001	12470
313 Beverages	1660	2189	3359
314 Tobacco products	479	608	815
321 Textiles	2130	2152	2988
322 Wearing apparel	1694	1933	2602
323 Leather and fur products	154	154	150
324 Footwear	299	344	368
331 Wood and wood products	2968	3236	5005 /e
332 Furniture and fixtures	1044	1332	1837 /e
341 Paper and paper products	5714	5410	11137
342 Printing and publishing	3054	4517	6771
351 Industrial chemicals	2164	2570	6082
352 Other chemical products	2421	3755	5864
353 Petroleum refineries	1531	1867	2808
354 Miscellaneous petroleum and coal products	111	132	295
355 Rubber products	873	1069	1405 /e
356 Plastic products	873	1654	2681 /e
361 Pottery, china and earthenware	43	29	83 /e
362 Glass and glass products	385	578	778
369 Other non-metal mineral products	1497	1713	2903
371 Iron and steel	2652	2906	4027
372 Non-ferrous metals	2190	2284	4782
381 Metal products	4414	4363	6787
382 Non-electrical machinery	3952	4912	8068
383 Electrical machinery	3849	4531	7313
384 Transport equipment	5911	10088	14115
385 Professional and scientific equipment	667	659	889 /e
390 Other manufacturing industries	912	1223	1589

For sources, footnotes and comments see 'Technical notes' at the beginning of this Annex

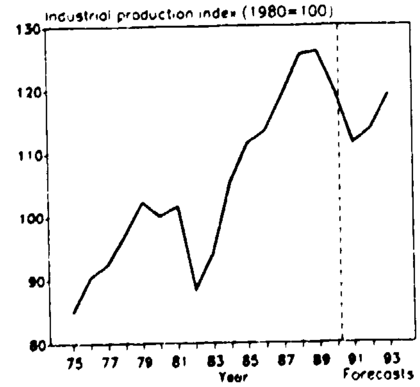
GDP per capita (1000$)/c



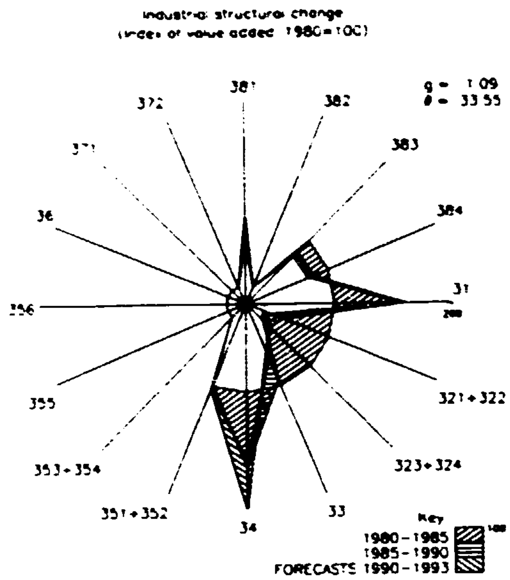
Manufacturing share in GDP current (%)

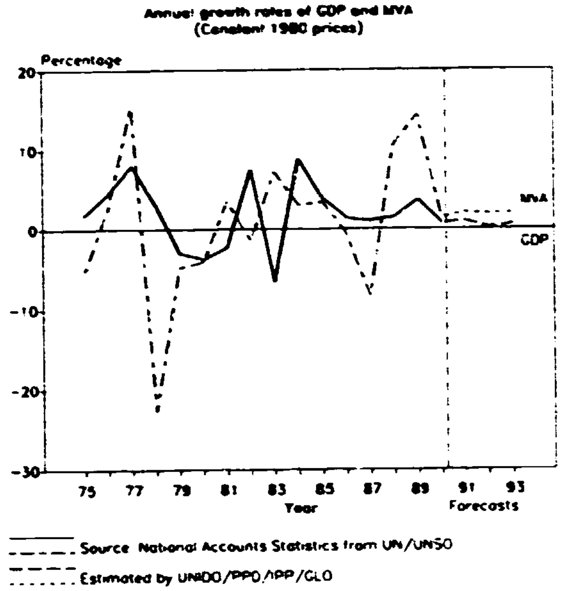


Industrial production index (1980=100)



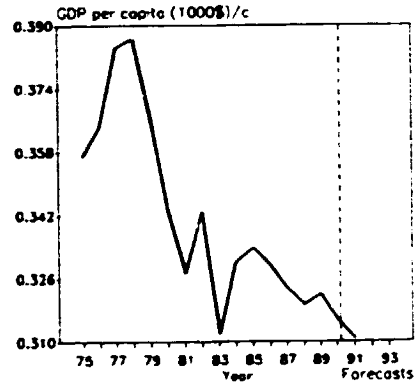
CENTRAL AFRICAN REPUBLIC

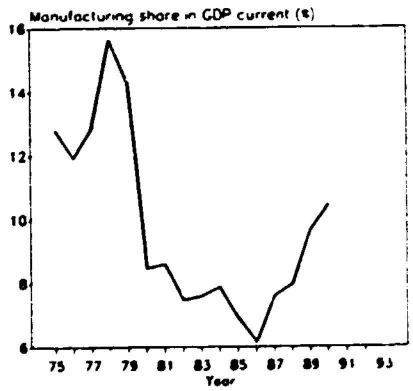


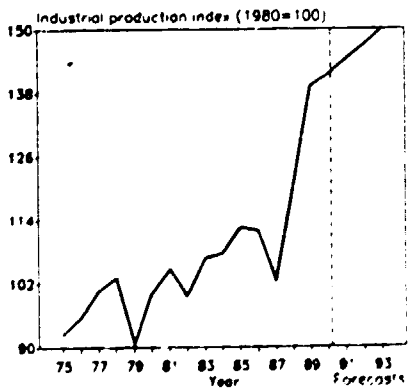


	1980	1985	1990
GDP: na.c (millions of 1980-dollars)	797	883	958
Per capita (1980-dollars) (na.c	343	334	315
Manufacturing share (%) (na current prices)	8 5	6 9	10 4 /e
MANUFACTURING:			
Value added (na.c (millions of 1980-dollars)	71	83	97
Industrial production index	100	112	141
Value added (millions of dollars)	35 /e	33	51 /e
Gross output (millions of dollars)	98 /e	108	151 /e
Employment (thousands)	6 /e	8	5 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	64 /e	70	66 /e
Wages and salaries (%)	16 /e	15 /e	18 /e
Operating surplus (%)	19 /e	15 /e	16 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	16613 /e	13858	28794 /e
Value added / worker	5933 /e	4157	9808 /e
Average wage	2703 /e	2030 /e	5116 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	10 31 /e	16 04 /e	17 49 /e
as a percentage of average θ in 1970-1975	138 /e	215 /e	234 /e
MVA growth rate / θ	-0 58	0 37	0 24
Degree of specialization	21 6	25 4	22 9
-VALUE ADDED: (millions of dollars)			
311 Food products	5	8	14 /e
313 Beverages	3	4	7 /e
314 Tobacco products	4	6	10 /e
321 Textiles	5 /e	- /e	1 /e
322 Wearing apparel	1 /e	- /e	- /e
323 Leather and fur products	- /e	- /e	- /e
324 Footwear	-	-	- /e
331 Wood and wood products	11 /e	8	7 /e
332 Furniture and fixtures	-	1	1 /e
341 Paper and paper products	-	-	- /e
342 Printing and publishing	1	2	3 /e
351 Industrial chemicals	1	1	1 /e
352 Other chemical products	2	1	2 /e
353 Petroleum refineries	-	-	- /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	-	-	- /e
356 Plastic products	-	-	- /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	-	-	- /e
369 Other non-metal mineral products	-	-	- /e
371 Iron and steel	-	-	- /e
372 Non-ferrous metals	-	-	- /e
381 Metal products	1	-	1 /e
382 Non-electrical machinery	-	-	- /e
383 Electrical machinery	-	-	- /e
384 Transport equipment	2	1	2 /e
385 Professional and scientific equipment	-	-	- /e
390 Other manufacturing industries	-	1	2 /e

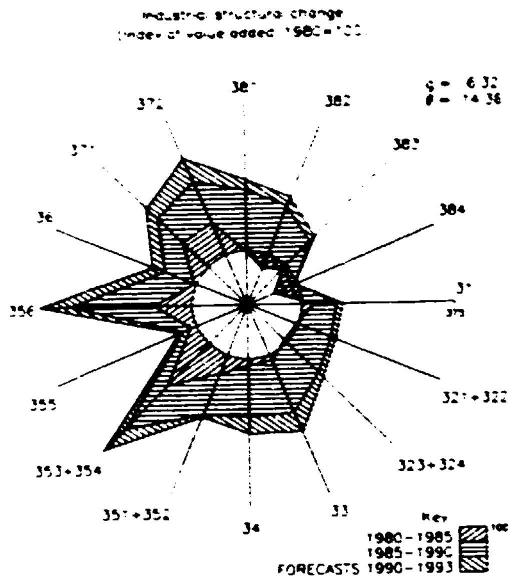
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

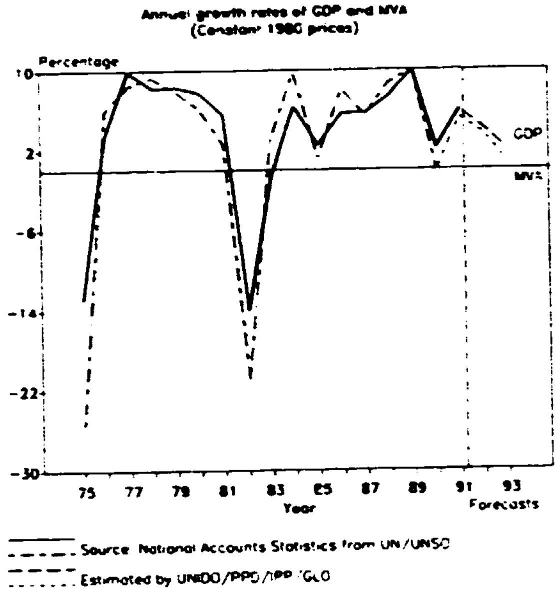






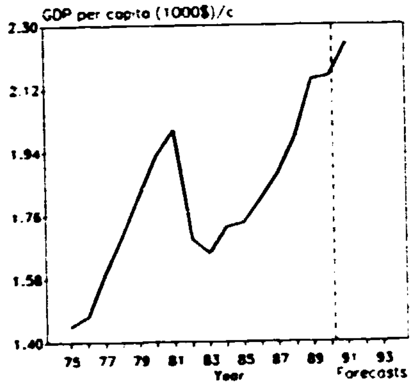
CHILE

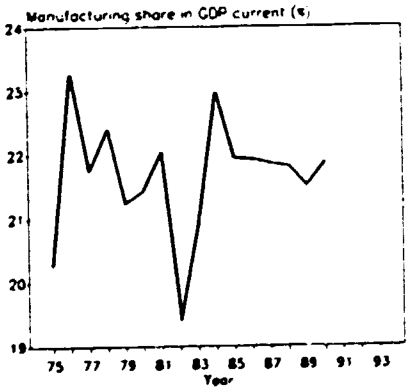


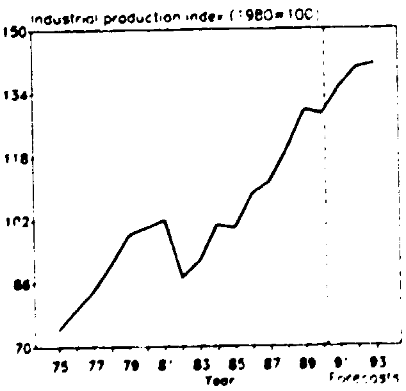


	1980	1985	1990
GDP: (m.a.c. millions of 1980-dollars)	21489	21075	28402
Per capita (1980-dollars m.a.c.)	1928	1739	2155
Manufacturing share (%) (m.a. current prices)	21.4	21.9	21.9 /e
MANUFACTURING:			
Value added (m.a.c. millions of 1980-dollars)	4830	4482	6107
Industrial production index	100	100	128
Value added (millions of dollars)	4991	4717	9439 /e
Gross output (millions of dollars)	10790	10477	22799 /e
Employment (thousands)	206	185	250 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	54	55	59 /e
Wages and salaries (%)	9 e	6	6 /e
Operating surplus (%)	38 /e	39	35 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	52264	56625	91132 /e
Value added / worker	24175	25474	37730 /e
Average wage	4444 e	3498	5642 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	11.13	7.41	4.18 /e
as a percentage of average θ in 1970-1975	63	42	24 /e
MVA growth rate / θ	-0.31	0.73	2.51
Degree of specialization	16.0	20.4	18.0
-VALUE ADDED: (millions of dollars)			
311 Food products	827	805	1367 /e
313 Beverages	289	177	360 /e
314 Tobacco products	214	205	317 /e
321 Textiles	234	162	356 /e
322 Wearing apparel	111	83	180 /e
323 Leather and fur products	22	18	34 /e
324 Footwear	77	51	135 /e
331 Wood and wood products	153	143	322 /e
332 Furniture and fixtures	37	14	65 /e
341 Paper and paper products	281	278	681 /e
342 Printing and publishing	182	104	221 /e
351 Industrial chemicals	55	94	209 /e
352 Other chemical products	324	289	571 /e
353 Petroleum refineries	184	277	548 /e
354 Miscellaneous petroleum and coal products	27	47	81 /e
355 Rubber products	60	49	71 /e
356 Plastic products	50	63	152 /e
361 Pottery, china and earthenware	14	9	21 /e
362 Glass and glass products	38	27	57 /e
369 Other non-metal mineral products	146	115	225 /e
371 Iron and steel	188	226	404 /e
372 Non-ferrous metals	965	1175	2246 /e
381 Metal products	181	130	361 /e
382 Non-electrical machinery	96	50	178 /e
383 Electrical machinery	90	61	138 /e
384 Transport equipment	127	50	115 /e
385 Professional and scientific equipment	5	4	10 /e
390 Other manufacturing industries	13	7	15 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

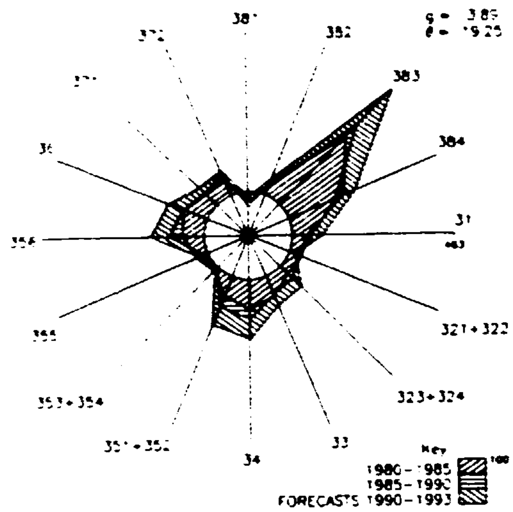




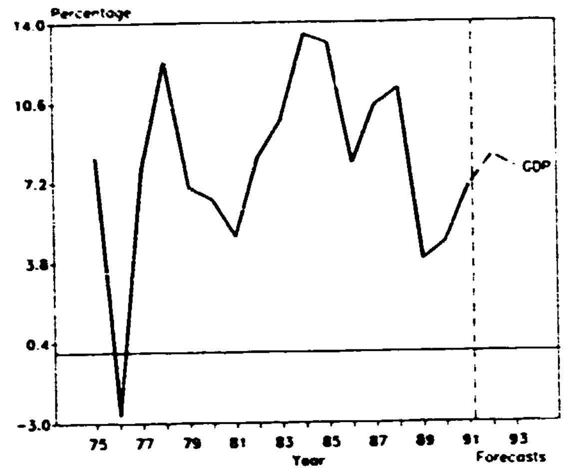


CHINA

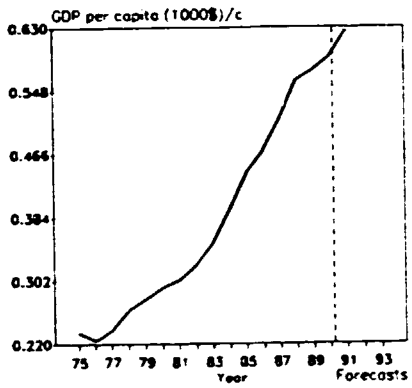
Industrial structure change
(index of value added: 1980=100)

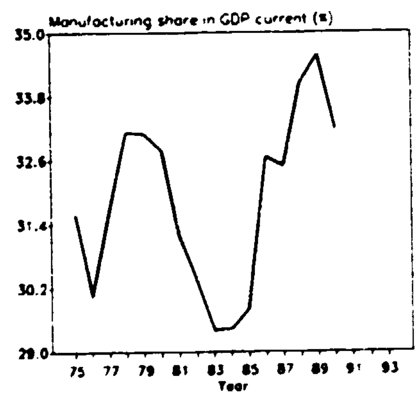


Annual growth rates of GDP and MVA
(Constant 1980 prices)



Source: National Accounts Statistics from UN/UNSO
Estimated by UNIDO/PPD/IPP/GLO

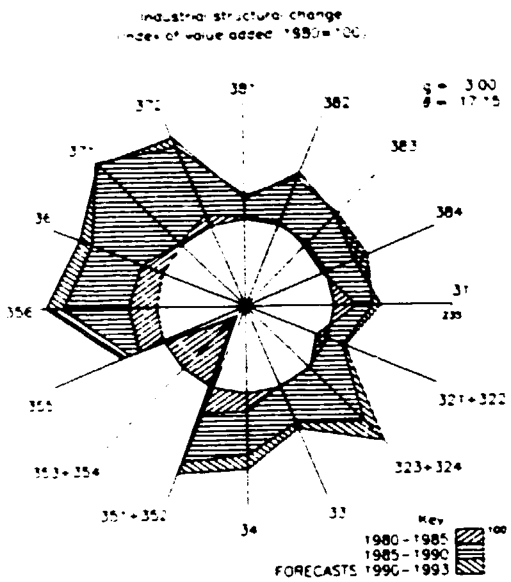


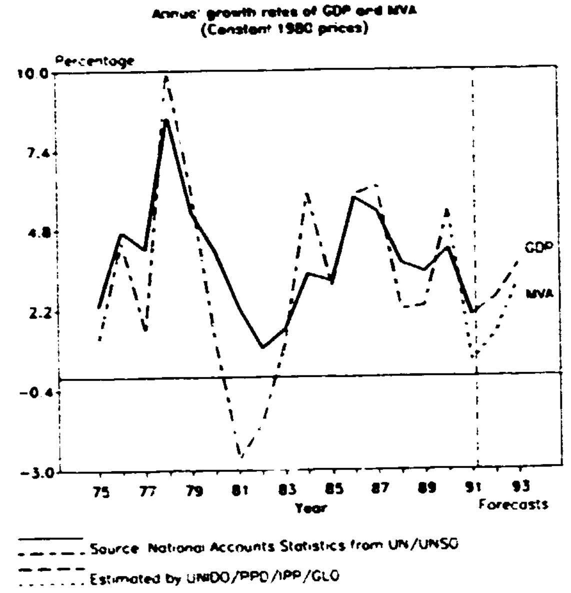


	1980	1985	1990
GDP: (n.a.c. millions of 1980-dollars)	286716	459012	662193
Per capita (1980-dollars) n.a.c	293	441	592
Manufacturing share (%) (n.a. current prices)	32 8	29 8	33 2 /e
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)			
Industrial production index			
Value added (millions of dollars)	97877 /e	85390	88455 /e
Gross output (millions of dollars)	295837	253880	244645 /e
Employment (thousands)	24269	28944	34168 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	67 /e	66	65 /e
Wages and salaries (%)	5	4	7 /e
Operating surplus (%)	29 /e	29	29 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	12190	8771	7160 /e
Value added / worker	4033 /e	2950	2529 /e
Average wage	549	392	486 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	1 75 e	3 98 /e	2 75 /e
as a percentage of average θ in 1970-1975	283 /e	645 /e	446 /e
MVA growth rate / θ	1 68	1 75	0 13
Degree of specialization	12 2	11 1	11 2
-VALUE ADDED: (millions of dollars)			
311 Food products	5627 /e	3678	3697 /e
313 Beverages	1355 e	1819	2010 /e
314 Tobacco products	4821 /e	4029	4923 /e
321 Textiles	11527 /e	9237	8952 /e
322 Wearing apparel	2398a/e	1810a	2049a/e
323 Leather and fur products	1052 /e	807	921 /e
324 Footwear	a	a	a
331 Wood and wood products	787 /e	652	671 /e
332 Furniture and fixtures	551 /e	555	551 /e
341 Paper and paper products	1443 /e	1689	2038 /e
342 Printing and publishing	1175 /e	1051	1086 /e
351 Industrial chemicals	7614 /e	6314	7733 /e
352 Other chemical products	2159 /e	2596	3098 /e
353 Petroleum refineries	5555 /e	3882	3590 /e
354 Miscellaneous petroleum and coal products	48 /e	23	22 /e
355 Rubber products	2106 /e	1670	1477 /e
356 Plastic products	1580 /e	1442	1773 /e
361 Pottery, china and earthenware	631 /e	485	613 /e
362 Glass and glass products	1134 /e	919	791 /e
369 Other non-metal mineral products	4678 e	4864	5107 /e
371 Iron and steel	7568 e	6482	6377 /e
372 Non-ferrous metals	2073 /e	1946	1788 /e
381 Metal products	6512 e	2794	3091 /e
382 Non-electrical machinery	15252 /e	12167	11889 e
383 Electrical machinery	3545 e	6906	7916 e
384 Transport equipment	3141 e	4561	4236 e
385 Professional and scientific equipment	364 e	1104	980 e
390 Other manufacturing industries	2582 e	1908	1077 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

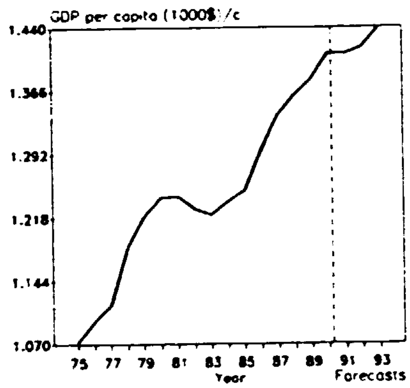
COLOMBIA

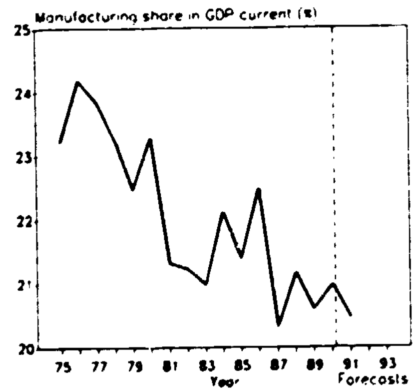


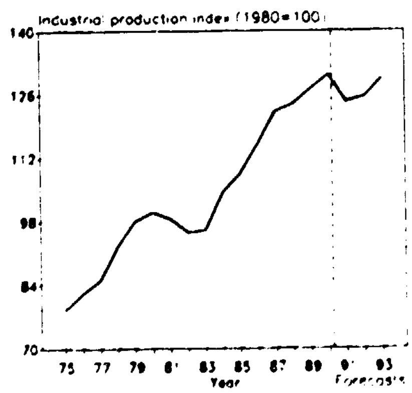


	1980	1985	1990	
GDP (at c. millions of 1980-dollars)	33400	37325	46492	
Per capita (1980-dollars) (at c.)	1241	1249	1409	
Manufacturing share (%) (at current prices)	23.3	21.4	21.0	
MANUFACTURING:				
Value added (at c. millions of 1980-dollars)	7993	8465	10497	
Industrial production index	100	108	130	
Value added (millions of dollars)	7131	6711	7854	e
Gross output (millions of dollars)	16453	16814	20533	e
Employment (thousands)	508	440	486	e
-PROFITABILITY: (in percent of gross output)				
Intermediate input (%)	57	60	62	e
Wages and salaries (%)	8	7	6	e
Operating surplus (%)	35	33	33	e
-PRODUCTIVITY: (dollars)				
Gross output / worker	32374	38206	42296	e
Value added / worker	14031	[illegible]	16179	e
Average wage	2583	2724	7360	e
-STRUCTURAL INDICES:				
Structural change θ (5-year average in degrees)	8.39	6.18	6.56	e
as a percentage of average θ in 1970-1975	129	95	101	e
MVA growth rate / θ	0.86	0.15	0.98	
Degree of specialization	14.5	14.7	13.1	
-VALUE ADDED: (millions of dollars)				
311 Food products	951	1166	1304	e
313 Beverages	1021	1032	952	e
314 Tobacco products	160	224	157	e
321 Textiles	803	619	738	e
322 Wearing apparel	241	206	231	e
323 Leather and fur products	59	47	59	e
324 Footwear	50	54	102	e
331 Wood and wood products	50	46	56	e
332 Furniture and fixtures	34	29	40	e
341 Paper and paper products	227	274	309	e
342 Printing and publishing	185	180	240	e
351 Industrial chemicals	303	405	535	e
352 Other chemical products	419	457	552	e
353 Petroleum refineries	773	90	90	e
354 Miscellaneous petroleum and coal products	17	28	33	e
355 Rubber products	117	138	131	e
356 Plastic products	141	169	227	e
361 Pottery, china and earthenware	44	46	64	e
362 Glass and glass products	76	92	112	e
369 Other non-metal mineral products	232	264	341	e
371 Iron and steel	217	205	412	e
372 Non-ferrous metals	34	36	53	e
381 Metal products	260	242	258	e
382 Non-electrical machinery	120	114	148	e
383 Electrical machinery	244	211	284	e
384 Transport equipment	256	221	301	e
385 Professional and scientific equipment	26	38	52	e
390 Other manufacturing industries	72	78	82	e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

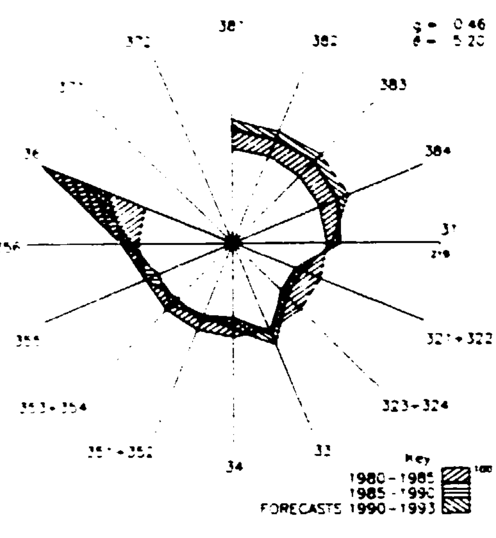




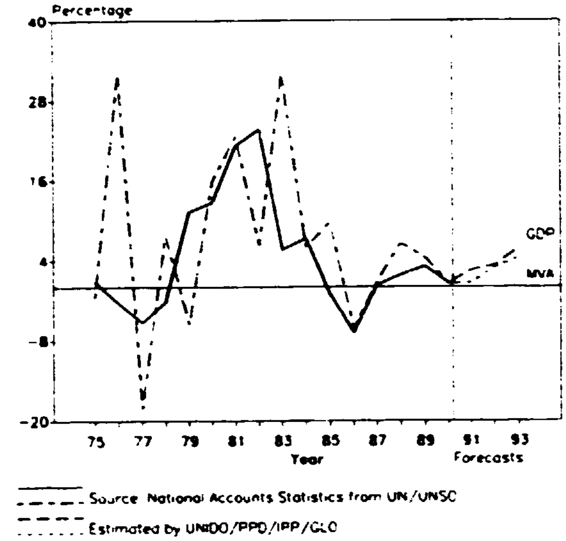


CONGO

Industrial structural change
(index of value added: 1980=100)



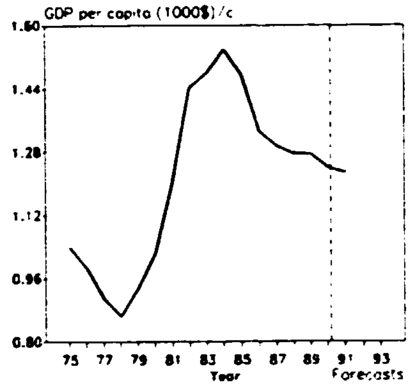
Annual growth rates of GDP and MVA
(Constant 1980 prices)



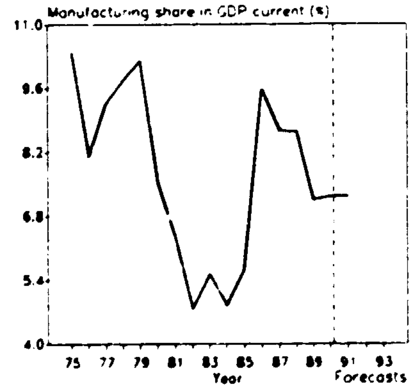
	1980	1985	1990
GDP (n.a.c., millions of 1980-dollars)	1706	2860	2815
Per capita (1980-dollars) (n.a.c)	1022	1474	1241
Manufacturing share (%) (n.a.) (current prices)	7.5	5.6	7.2
MANUFACTURING:			
Value added (n.a.c., millions of 1980-dollars)	135	269	284
Industrial production index	100	182	146
Value added (millions of dollars)	65 /e	56	105 /e
Gross output (millions of dollars)	178 /e	170	310 e
Employment (thousands)	24 /e	9	10 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	63 /e	67	66 /e
Wages and salaries (%)	16 /e	16 /e	15 /e
Operating surplus (%)	20 /e	17 e	18 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	7296 /e	19384	29709 /e
Value added / worker	2688 /e	6367	10041 /e
Average wage	1196 /e	3085 e	4551 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	7.09 /e	11.05 /e	3.86 /e
as a percentage of average θ in 1970-1975	65 /e	101 /e	35 /e
MVA growth rate / θ	-0.53	0.22	-0.06
Degree of specialization	16.7	17.4	18.3
-VALUE ADDED: (millions of dollars)			
311 Food products	11 /e	10	17 /e
313 Beverages	12 e	11	22 /e
314 Tobacco products	3 /e	3	5 /e
321 Textiles	5 /e	3 e	5 /e
322 Wearing apparel	1 e	1 e	1 /e
323 Leather and fur products	- /e	- /e	- /e
324 Footwear	4 e	2	4 e
331 Wood and wood products	7 /e	5 e	11 e
332 Furniture and fixtures	4 /e	3 e	6 /e
341 Paper and paper products	1 /e	1	1 e
342 Printing and publishing	1 e	1	1 e
351 Industrial chemicals	1 /e	1 e	2 /e
352 Other chemical products	3 e	2 /e	3 /e
353 Petroleum refineries	1 /e	1 e	2 e
354 Miscellaneous petroleum and coal products	- e	- /e	/e
355 Rubber products	1 e	1 e	1 e
356 Plastic products	- e	- e	1 e
361 Pottery, china and earthenware	- e	e	1 e
362 Glass and glass products	- e	- e	1 /e
369 Other non-metal mineral products	1 e	2 e	2 e
371 Iron and steel	- /e	-	/e
372 Non-ferrous metals	- e	-	- e
381 Metal products	5 e	5 e	9 e
382 Non-electrical machinery	1 e	1 e	2 e
383 Electrical machinery	1 e	1 e	2 e
384 Transport equipment	3 e	2	5 e
385 Professional and scientific equipment	- e	-	- e
390 Other manufacturing industries	- e	-	e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

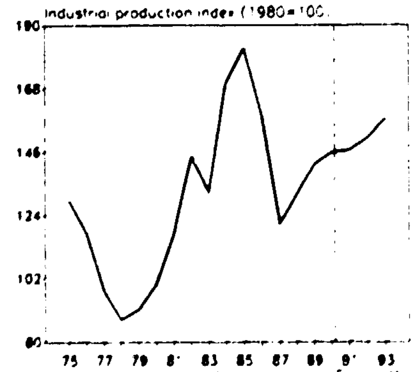
GDP per capita (1000$) /c



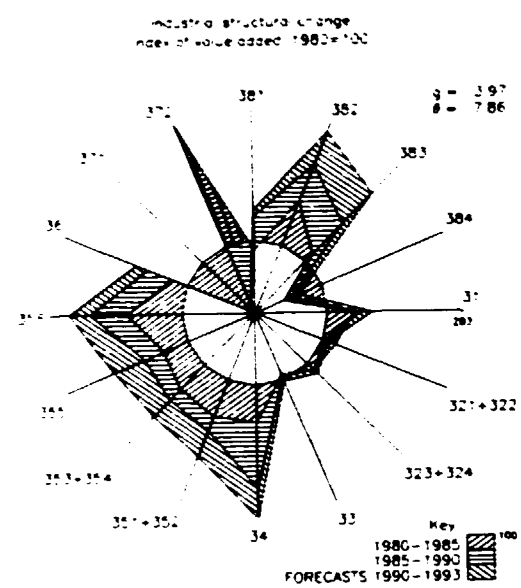
Manufacturing share in GDP current (%)

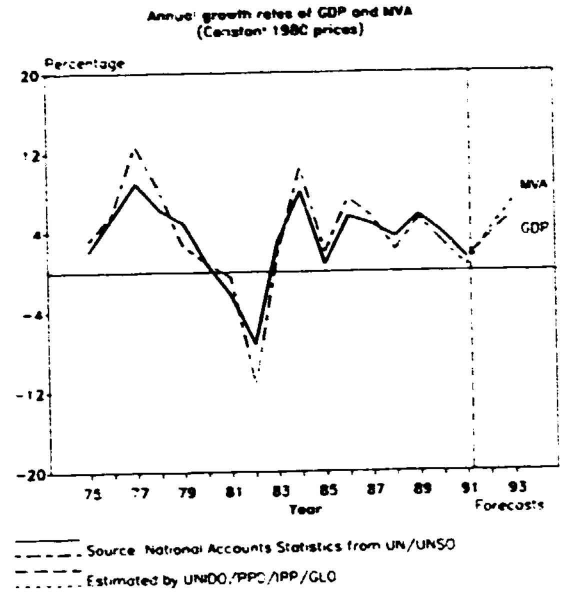


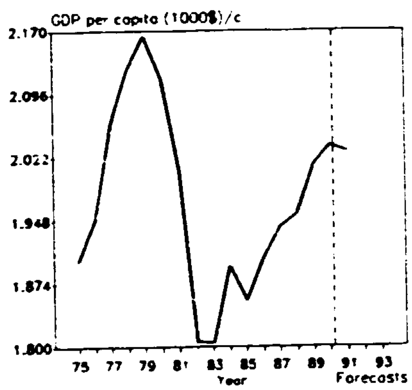
Industrial production index (1980=100)



COSTA RICA

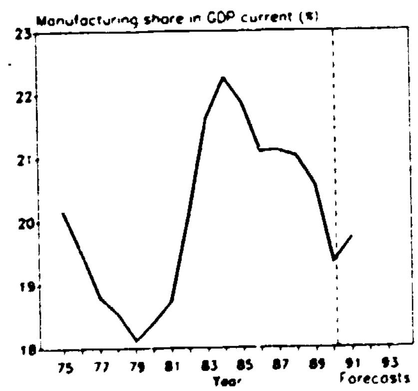


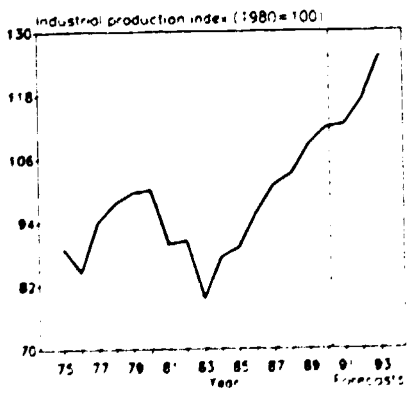




	1980	1985	1990
GDP (n.a.c. millions of 1980-dollars)	4832	4900	6149
Per capita (1980-dollars) (n.a.c.)	2114	1854	2035
Manufacturing share (%) (n.a. current prices)	18.4	21.9	19.3
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)	899	908	1138
Industrial production index	100	89	112
Value added (millions of dollars)	788	761	1041 e
Gross output (millions of dollars)	2743	2466	3472 /e
Employment (thousands)	59 /e	95 e	129 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	71	69	70 /e
Wages and salaries (%)	12	10 e	9 e
Operating surplus (%)	16	21 e	21 e
-PRODUCTIVITY: (dollars)			
Gross output / worker	43027 /e	24173 e	25156 /e
Value added / worker	12579 e	7528 e	7607 /e
Average wage	5311 e	2389 /e	2442 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2.85	7.04	2.94 e
as a percentage of average θ in 1970-1975	81	201	84 /e
MVA growth rate θ	1.02	0.76	0.89
Degree of specialization	20.4	20.7	22.6
-VALUE ADDED: (millions of dollars)			
311 Food products	241	247	329 /e
313 Beverages	96	94	128 /e
314 Tobacco products	24	28	15 /e
321 Textiles	33	23	29 /e
322 Wearing apparel	31	34	30 e
323 Leather and fur products	7	5	7 e
324 Footwear	10	9	10 /e
331 Wood and wood products	30	25	23 /e
332 Furniture and fixtures	26	14	25 e
341 Paper and paper products	20	22	44 /e
342 Printing and publishing	18	21	39 /e
351 Industrial chemicals	19	26	37 e
352 Other chemical products	40	42	57 e
353 Petroleum refineries	40	45	63 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	14	15	21 /e
356 Plastic products	19	26	40 e
361 Pottery, china and earthenware	1	2	3 e
362 Glass and glass products	3	7	9 e
369 Other non metal mineral products	25	19	32 e
371 Iron and steel	4	-	- e
372 Non-ferrous metals	1 e	-	- e
381 Metal products	18	12	22 e
382 Non-electrical machinery	8	10	17 e
383 Electrical machinery	25	21	39 e
384 Transport equipment	31	10	15 e
385 Professional and scientific equipment	-	-	2 e
390 Other manufacturing industries	2	3	4 e

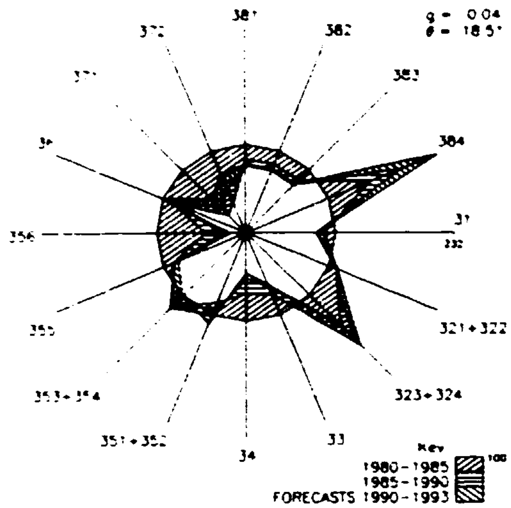
For symbols, footnotes and comments see "Technical notes" at the beginning of this Annex



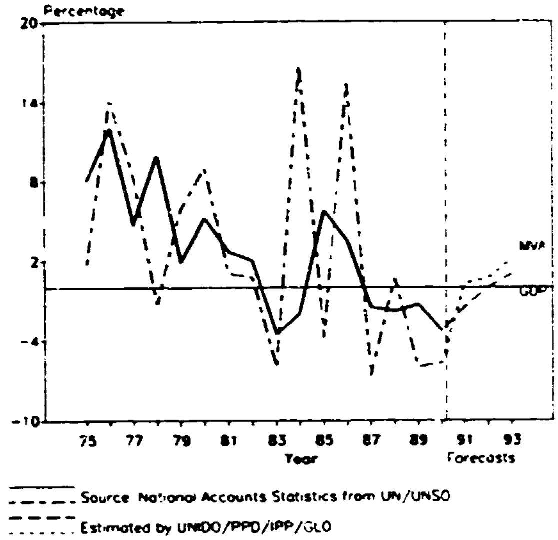


COTE D'IVOIRE

Industrial structural change
(index of value added: 1980=100)

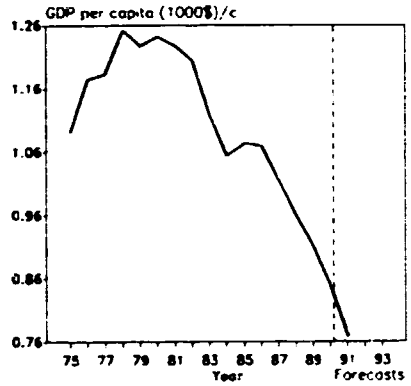


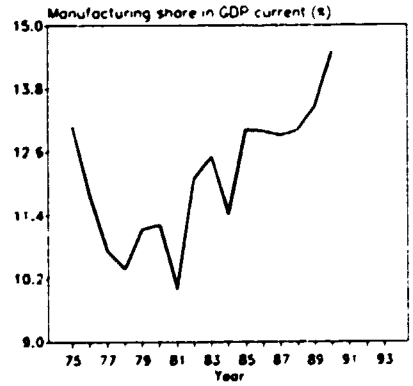
Annual growth rates of GDP and MVA
(Constant 1980 prices)

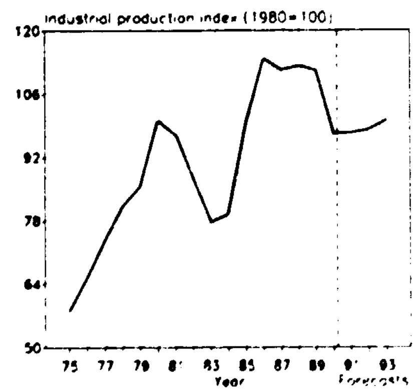


	1980	1985	1990
GDP (na.c millions of 1980-dollars)	10176	10660	10184
Per capita (1980-dollars) (na.c)	1242	1073	849
Manufacturing share (%) (na) (current prices)	11 2	13 0	14 5 /e
MANUFACTURING:			
Value added (na.c millions of 1980-dollars)	1231	1322	1271
Industrial production index	100	100	97
Value added (millions of dollars)	1273	778 /e	1481 /e
Gross output (millions of dollars)	4006	2642 /e	4917 /e
Employment (thousands)	67	56 /e	53 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	68	[illegible] /e	70 /e
Wages and salaries (%)	10 /e	11 /e	15 /e
Operating surplus (%)	22 /e	18 /e	15 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	59631	48049 /e	94362 /e
Value added / worker	18950	13888 /e	27934 /e
Average wage	5744 /e	5237 /e	13964 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	7 81 /e	4 14 /e	2 75 /e
as a percentage of average θ in 1970-1975	82 /e	43 /e	23 /e
MVA growth rate / θ	0 77	0 00	0 00
Degree of specialization	23 5	25 2	26 0
-VALUE ADDED: (millions of dollars)			
311 Food products	303 /e	165 /e	278 /e
313 Beverages	75	38 /e	70 /e
314 Tobacco products	66 /e	35 /e	65 /e
321 Textiles	169 /e	115 /e	218 /e
322 Wearing apparel	8 /e	6 /e	11 /e
323 Leather and fur products	3 /e	3 /e	5 /e
324 Footwear	8 /e	8 /e	13 /e
331 Wood and wood products	67 /e	32 /e	55 /e
332 Furniture and fixtures	21 /e	9 /e	15 /e
341 Paper and paper products	14 /e	7 /e	9 /e
342 Printing and publishing	23 /e	9 /e	14 /e
351 Industrial chemicals	22 /e	11 /e	19 /e
352 Other chemical products	53 /e	29 /e	70 /e
353 Petroleum refineries	181 /e	130 /e	256 /e
354 Miscellaneous petroleum and coal products	- /e	- /e	- /e
355 Rubber products	4	2 /e	4 /e
356 Plastic products	1 /e	- /e	- /e
361 Pottery, china and earthenware	2 /e	2 /e	4 /e
362 Glass and glass products	- /e	- /e	- /e
369 Other non-metal mineral products	27 /e	14 /e	28 /e
371 Iron and steel	[illegible] /e	1 /e	3 /e
372 Non-ferrous metals	[illegible] /e	1 /e	2 /e
381 Metal products	70	36 /e	63 /e
382 Non-electrical machinery	3	1 /e	3 /e
383 Electrical machinery	20	10 /e	18 /e
384 Transport equipment	106	98 /e	234 /e
385 Professional and scientific equipment	-	- /e	- /e
390 Other manufacturing industries	20	17 /e	25 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

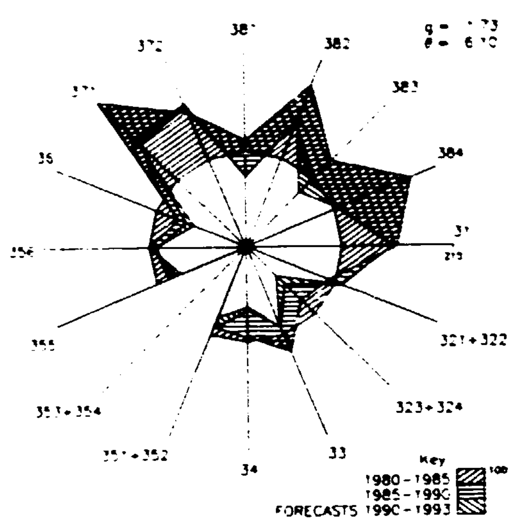




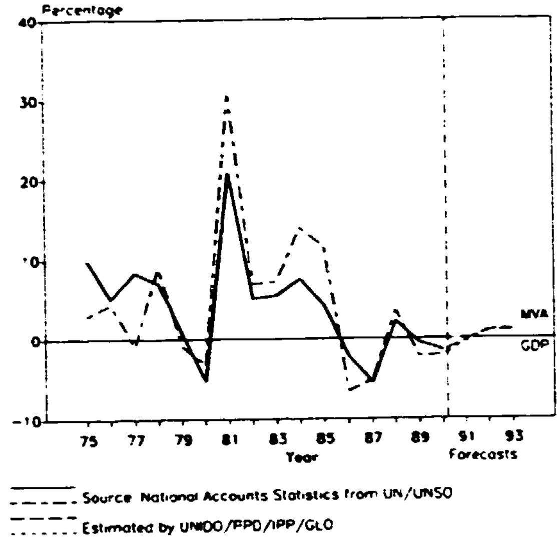


CUBA

Industrial structural change
(index of value added: 1980=100)



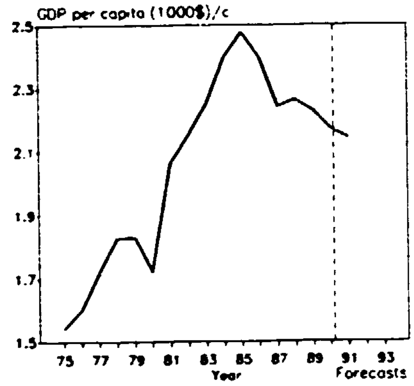
Annual growth rates of GDP and MVA
(Constant 1980 prices)



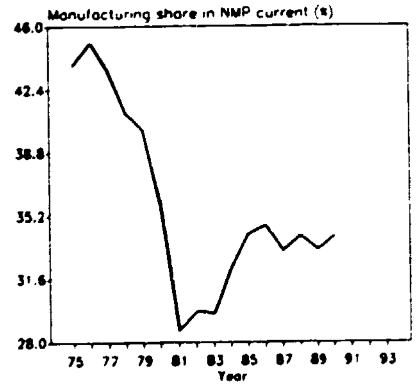
	1980	1985	1990
GDP: (na.c. millions of 1980-dollars)	16653	24937	23051
Per capita (1980-dollars) (na.c	1721	2474	2172
Manufacturing share (%) (na) (current prices)	35 8	34 1	34 0 /e
MANUFACTURING:			
Value added (na.c (millions of 1980-dollars)	5735	10905	9586
Industrial production index	100	130	124
Value added (millions of dollars)	4882	5120	6030 /e
Gross output (millions of dollars)	9725	12032	15651 /e
Employment (thousands)	501	654	710 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	50	57	61 /e
Wages and salaries (%)	13 /e	14 /e	14 /e
Operating surplus (%)	37 /e	29 /e	24 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	19420	18386	22050 /e
Value added / worker	9748	7824	8495 /e
Average wage	2606 /e	2514 /e	3188 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2 91 /e	3 49	3 45 /e
as a percentage of average θ in 1970-1975	185 /e	221	219 /e
MVA growth rate / θ	-0 13	1 96	-0 50
Degree of specialization	26 0	31 4	34 4
-VALUE ADDED: (millions of dollars)			
311 Food products	655	957	1033 /e
313 Beverages	246	273	359 /e
314 Tobacco products	1805	2004	2630 /e
321 Textiles	50	40	109 /e
322 Wearing apparel	146	98	97 /e
323 Leather and fur products	53	32	29 /e
324 Footwear	79	48	44 /e
331 Wood and wood products	58	53	52 /e
332 Furniture and fixtures	48	43	42 /e
341 Paper and paper products	46	44	13 /e
342 Printing and publishing	96	59	81 /e
351 Industrial chemicals	72 /e	48 /e	66 /e
352 Other chemical products	329 /e	230 /e	302 /e
353 Petroleum refineries			
354 Miscellaneous petroleum and coal products			
355 Rubber products	101 /e	56 /e	82 /e
356 Plastic products	87 /e	67 /e	79 /e
361 Pottery, china and earthenware	8	6	8 /e
362 Glass and glass products	17	13	19 /e
369 Other non-metal mineral products	188	104	112 /e
371 Iron and steel	27	44	40 /e
372 Non-ferrous metals	41	48	64 /e
381 Metal products	108	92	79 /e
382 Non electrical machinery	122 /e	170 /e	168 /e
383 Electrical machinery	60	58	56 /e
384 Transport equipment	231 /e	325 /e	234 /e
385 Professional and scientific equipment	9 /e	21 /e	14 /e
390 Other manufacturing industries	201	188	213 /e

For sources, footnotes and comments see "technical notes" at the beginning of this Annex

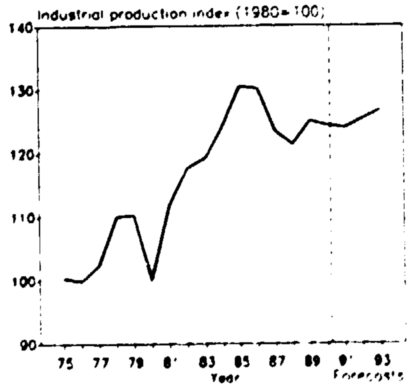
GDP per capita (1000$)/c



Manufacturing share in NMP current (%)

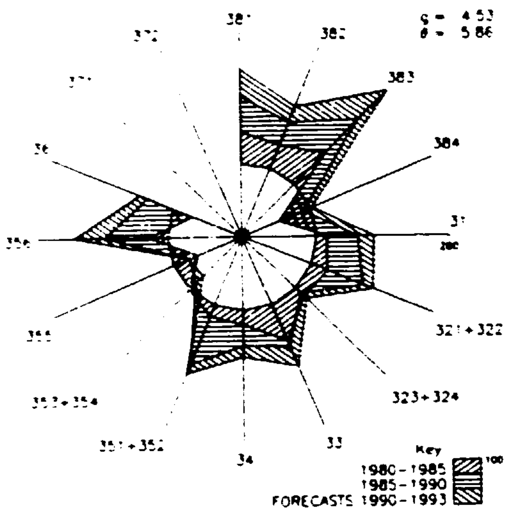


Industrial production index (1980=100)

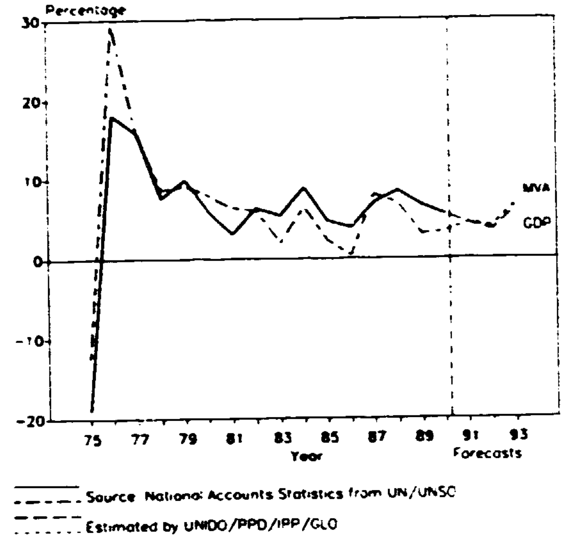


CYPRUS

Industrial structure change
(index of value added 1990=100)



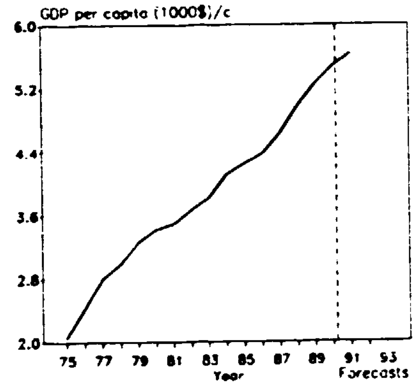
Annual growth rates of GDP and MVA
(Constant 1980 prices)



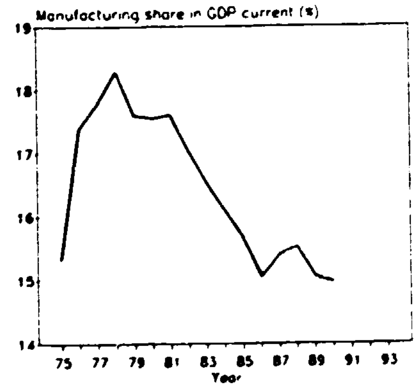
	1980	1985	1990
GDP (na.c. millions of 1980-dollars)	2154	2831	3836
Per capita (1980-dollars) (na.c.)	3419	4251	5472
Manufacturing share (%) (na. current prices)	17 5	15 7	15 0 /e
MANUFACTURING:			
Value added (na.c. millions of 1980-dollars)	405	507	625
Industrial production index	100	118	146
Value added (millions of dollars)	406	378	798 /e
Gross output (millions of dollars)	1134	1122	2210 /e
Employment (thousands)	34	39	44 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	64	66	64 /e
Wages and salaries (%)	13	16	17 /e
Operating surplus (%)	22	18	19 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	33325	28963	50442 /e
Value added / worker	11923	9762	18208 /e
Average wage	4479	4579	8375 /e
-STRUCTURAL INDICES.			
Structural change θ (5-year average in degrees)	7 28	4 59	3 84 /e
as a percentage of average θ in 1970-1975	101	64	53 /e
MVA growth rate / θ	3 03	0 70	1 64
Degree of specialization	11 3	11 7	13 4
-VALUE ADDED: (millions of dollars)			
311 Food products	42	49	104 /e
313 Beverages	37	29	74 /e
314 Tobacco products	36	26	45 /e
321 Textiles	16	14	34 /e
322 Wearing apparel	53	54	119 /e
323 Leather and fur products	5	6	11 /e
324 Footwear	21	19	26 /e
331 Wood and wood products	19	23	37 /e
332 Furniture and fixtures	17	22	37 /e
341 Paper and paper products	11	8	14 /e
342 Printing and publishing	15	18	35 /e
351 Industrial chemicals	3	2	5 /e
352 Other chemical products	12	12	29 /e
353 Petroleum refineries	6	5	7 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	3	2	3 /e
356 Plastic products	11	11	25 /e
361 Pottery, china and earthenware	-	1	2 /e
362 Glass and glass products	-	-	1 /e
369 Other non-metal mineral products	44	24	72 /e
371 Iron and steel	-	-	- /e
372 Non-ferrous metals	-	-	- /e
381 Metal products	23	26	54 /e
382 Non-electrical machinery	11	12	24 /e
383 Electrical machinery	5	6	14 /e
384 Transport equipment	8	4	3 /e
385 Professional and scientific equipment	-	-	/e
390 Other manufacturing industries	7	7	19 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

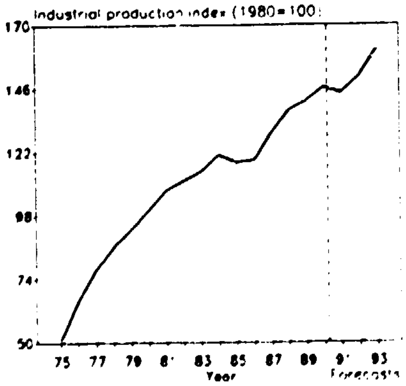
GDP per capita (1000$)/c



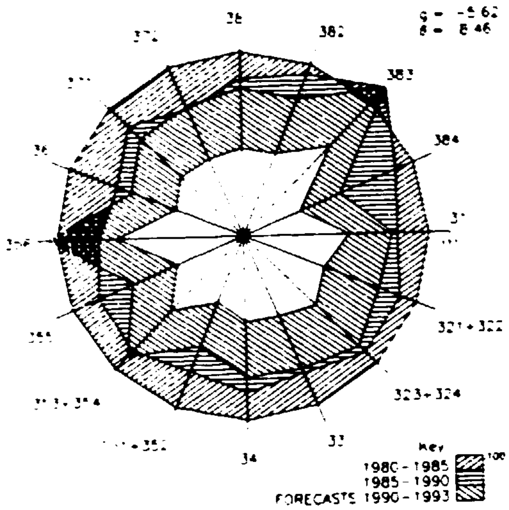
Manufacturing share in GDP current (%)

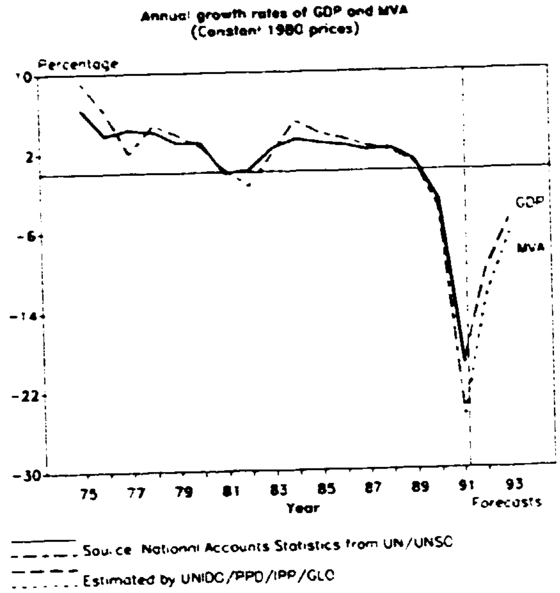


Industrial production index (1980=100)



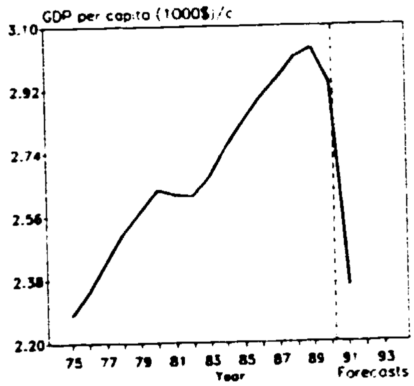
CZECHOSLOVAKIA

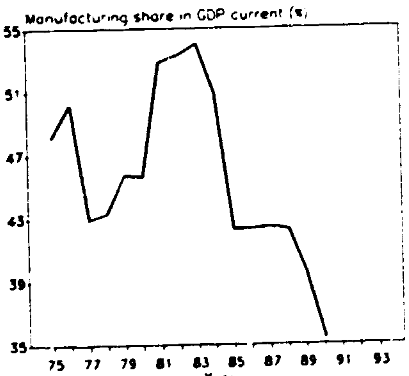


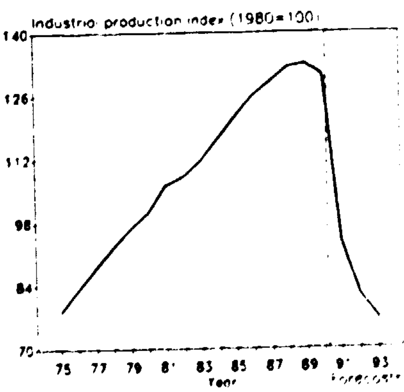


	1980	1985	1990
GDP (nat. c. millions of 1980-dollars)	40327	43826	46011
Per capita (1980-dollars, nat. c.)	2634	2827	2937
Manufacturing share (%, nat. current prices)	45.6	42.3	35.3 e
MANUFACTURING:			
Value added (nat. c. millions of 1980-dollars)	22261	24404	25595
Industrial production index	100	121	130
Value added (millions of dollars)	17194	13083	12471
Gross output (millions of dollars)	41415	45108	44915
Employment (thousands)	2518	2588	2448
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	58	71	72
Wages and salaries (%)	13	12	12
Operating surplus (%)	28	17	16
-PRODUCTIVITY: (dollars)			
Gross output / worker	16448	17430	18348
Value added / worker	6828	5055	5094
Average wage	2217	2058	2178
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	3.32	2.96	4.37
as a percentage of average θ in 1970-1975	91	81	119
MVA growth rate / θ	2.35	-0.71	-0.52
Degree of specialization	15.9	17.0	14.8
-VALUE ADDED: (millions of dollars)			
311 Food products	1257	911	916
313 Beverages	285	209	258
314 Tobacco products	33	23	24
321 Textiles	1100	848	790
322 Wearing apparel	271	236	223
323 Leather and fur products	34	69	66
324 Footwear	299	244	256
331 Wood and wood products	387	259	289
332 Furniture and fixtures	210	162	154
341 Paper and paper products	391	287	255
342 Printing and publishing	136	103	127
351 Industrial chemicals	1262	862	698
352 Other chemical products	178	130	177
353 Petroleum refineries	497	390	316
354 Miscellaneous petroleum and coal products	120	74	209
355 Rubber products	214	158	131
356 Plastic products	50	34	49
361 Pottery, china and earthenware	45	39	46
362 Glass and glass products	422	263	298
369 Other non metal mineral products	773	488	411
371 Iron and steel	1153	1312	1271
372 Non-ferrous metals	327	214	236
381 Metal products	792	590	602
382 Non electrical machinery	3452	2827	2597
383 Electrical machinery	353	823	834
384 Transport equipment	1577	1315	303
385 Professional and scientific equipment	34	67	34
390 Other manufacturing industries	223	140	132

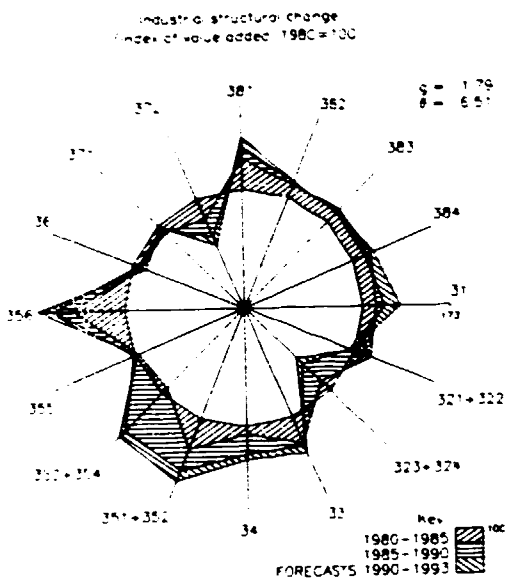
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

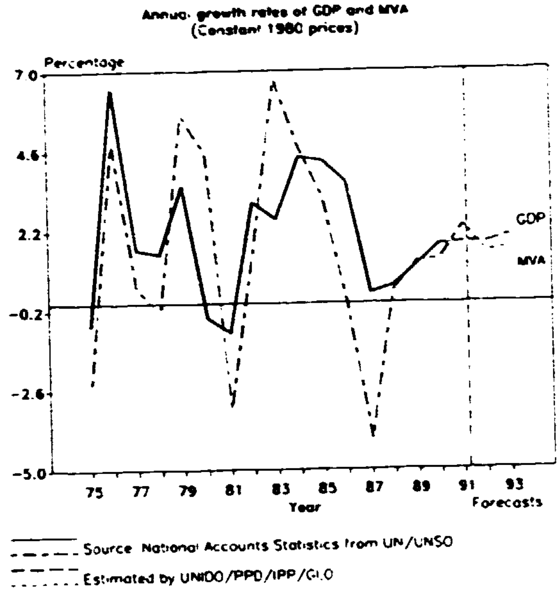


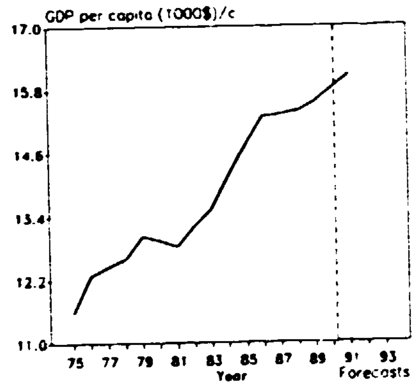




DENMARK

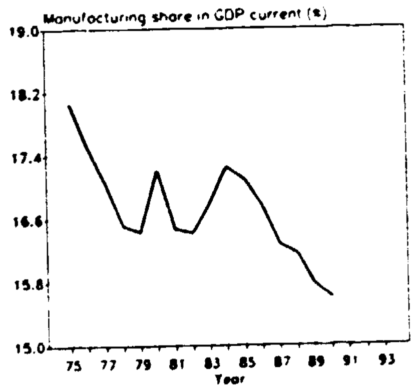


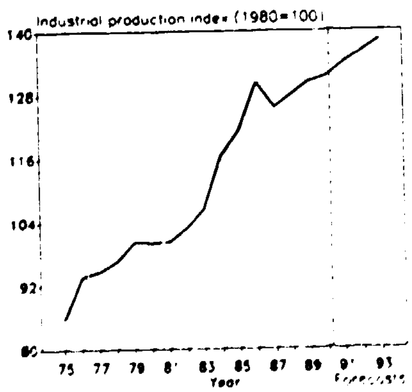




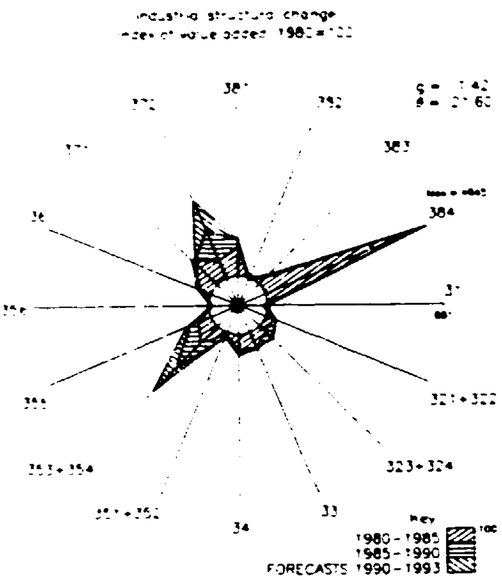
	1980	1985	1990
GDP: (na.c. millions of 1980-dollars)	66321	75577	81276
Per capita (1980-dollars) (na.c)	12943	14752	15803
Manufacturing share (%) (na) (current prices)	17 2	17 1	15 6 /e
MANUFACTURING:			
Value added (na.c. millions of 1980-dollars)	13498	15305	15114
Industrial production index	100	121	131
Value added (millions of dollars)	12774	11184	24622
Gross output (millions of dollars)	31526	27552	56815
Employment (thousands)	381	405	391
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	59	60	57
Wages and salaries (%)	23	21	22 /e
Operating surplus (%)	18	19	21 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	82745	68311	145473
Value added / worker	33526	27629	63045
Average wage	19040	14310	31881 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2 95	2 95	1 96
as a percentage of average θ in 1970-1975	101	101	67
MVA growth rate / θ	0 92	0 91	0 53
Degree of specialization	14 4	14 9	15 1
-VALUE ADDED: (millions of dollars)			
311 Food products	2344	2022	4527
313 Beverages	490	386	780
314 Tobacco products	109	96	270
321 Textiles	423	375	709
322 Wearing apparel	231	199	296
323 Leather and fur products	30	20	26
324 Footwear	62	43	74
331 Wood and wood products	285	219	449 /e
332 Furniture and fixtures	330	371	802 /e
341 Paper and paper products	315	275	683
342 Printing and publishing	941	752	1805
351 Industrial chemicals	551	498	1086
352 Other chemical products	586	618	1609 /e
353 Petroleum refineries	65	55	192
354 Miscellaneous petroleum and coal products	99	53	187 /e
355 Rubber products	79	59	128 /e
356 Plastic products	267	297	684 /e
361 Pottery, china and earthenware	87	41	70 /e
362 Glass and glass products	98	60	115 /e
369 Other non-metal mineral products	627	478	1060
371 Iron and steel	175	124	271 /e
372 Non-ferrous metals	71	45	75 /e
381 Metal products	912	882	1363
382 Non-electrical machinery	1718	1475	3141
383 Electrical machinery	712	631	1280
384 Transport equipment	663	589	1175
385 Professional and scientific equipment	234	304	671 /e
390 Other manufacturing industries	219	211	497 /e

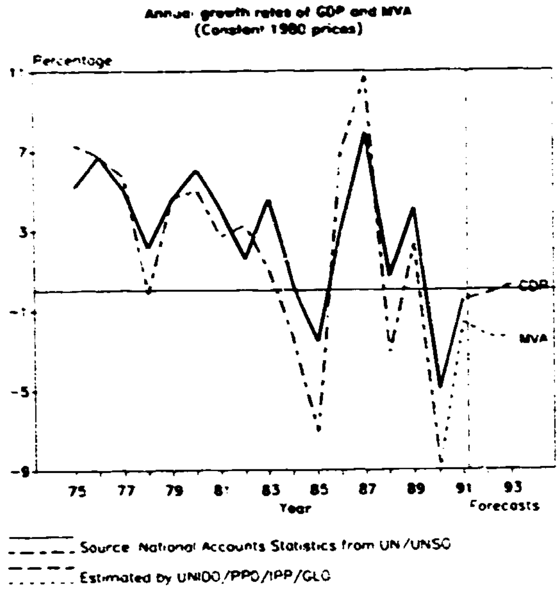
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex





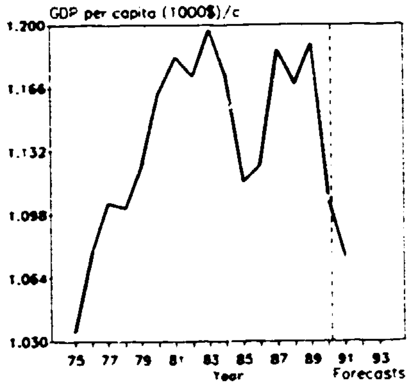
DOMINICAN REPUBLIC

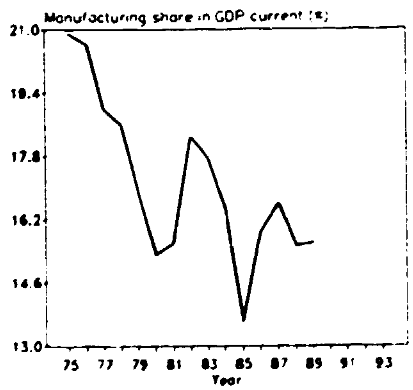


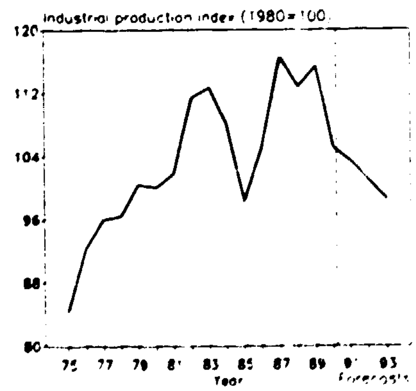


	1980	1985	1990
GDP (na.c. millions of 1980-dollars)	6631	7159	7935
Per capita (1980-dollars) (na.c.)	1164	1116	1105
Manufacturing share (%) (na) (current prices)	15 3	13 6	
MANUFACTURING			
Value added (na.c.) (millions of 1980-dollars)	1015	986	1055
Industrial production index	100	98	105
Value added (millions of dollars)	1013	783 e	1308 /e
Gross output (millions of dollars)	2376	1823 /e	3058 /e
Employment (thousands)	146	131	138 e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	57	57 /e	57 /e
Wages and salaries (%)	11	7 e	6 /e
Operating surplus (%)	31	36 /e	37 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	16284	13883 e	22107 /e
Value added / worker	6940	5967 e	9457 /e
Average wage	1867	998	1348 /e
-STRUCTURAL INDICES:			
Structural change θ 5-year average in degrees	2 23	3 13 /e	2 26 /e
as a percentage of average θ in 1970-1975	67	94 /e	68 /e
MVA growth rate θ	-0 63	0 93	0 68
Degree of specialization	39 0	30 5	28 4
-VALUE ADDED: (millions of dollars)			
311 Food products	510	293 /e	414 e
313 Beverages	103	110 e	178 e
314 Tobacco products	50	42 /e	67 /e
321 Textiles	29	26 /e	45 /e
322 Wearing apparel	13	9 /e	16 /e
323 Leather and fur products	11	8 /e	14 /e
324 Footwear	13	13 /e	25 /e
331 Wood and wood products	2	3 /e	3 /e
332 Furniture and fixtures	11	11 e	19 e
341 Paper and paper products	19	21 e	37 /e
342 Printing and publishing	14	13 /e	22 /e
351 Industrial chemicals	18	16 e	28 e
352 Other chemical products	41	27 /e	44 /e
353 Petroleum refineries	66	81 e	209 /e
354 Miscellaneous petroleum and coal products	1	. e	1 /e
355 Rubber products	6	6 e	12 e
356 Plastic products	21	12 /e	21 e
361 Pottery, china and earthenware	1	1 /e	2 /e
362 Glass and glass products	3	5 e	8 e
369 Other non-metal mineral products	32	29 /e	47 e
371 Iron and steel	10	15 e	23 e
372 Non-ferrous metals	1	1 e	3 e
381 Metal products	21	28 e	48 e
382 Non-electrical machinery	5	3 e	6 e
383 Electrical machinery	[illegible]	6 e	11 e
384 Transport equipment	. e	e	. e
385 Professional and scientific equipment	.	. e	2 e
390 Other manufacturing industries	2	. e	3 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

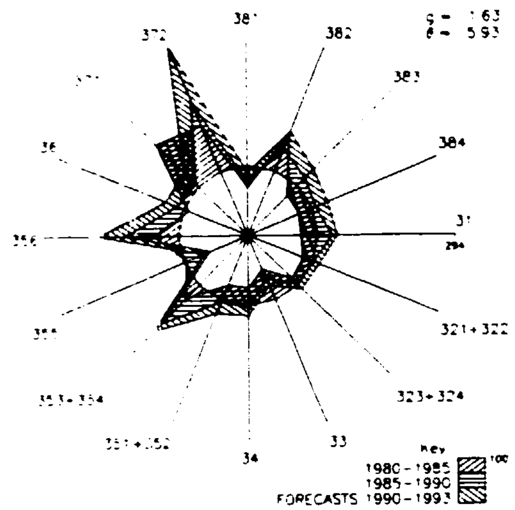




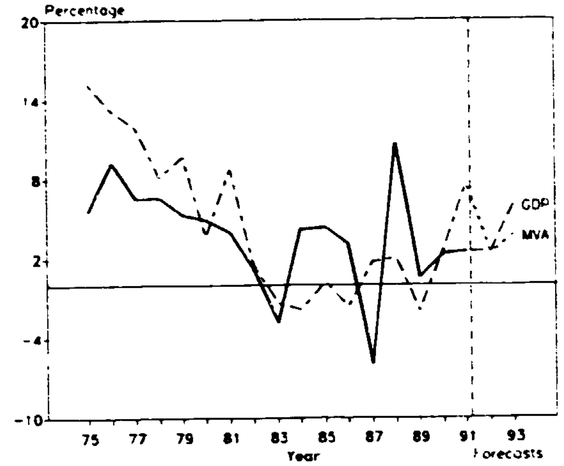


ECUADOR

Industrial structure change
(index of value added: 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)



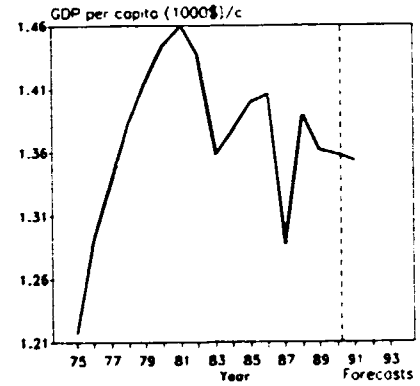
Source: National Accounts Statistics from UN/UNSO

Estimated by UNIDO/PPD/IPP/GLO

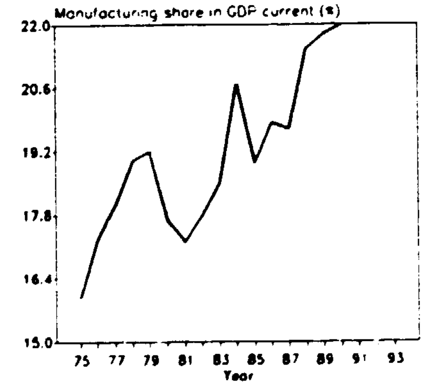
	1980	1985	1990
GDP (n.a.c. millions of 1980-dollars)	11733	13040	14387
Per capita (1980-dollars) (n.a.c.)	1444	1399	1358
Manufacturing share (%) (n.a. current prices)	17.7	18.9	22.0 /e
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)	2161	2314	2375
Industrial production index	100	109	126
Value added (millions of dollars)	1289	1322	1085 /e
Gross output (millions of dollars)	3571	4379	4097 /e
Employment (thousands)	112	97	114 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	64	70	74 /e
Wages and salaries (%)	14	12	9 /e
Operating surplus (%)	22	18	18 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	31961	45232	35869 /e
Value added / worker	11536	13654	9495 /e
Average wage	4547	5393	3133 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	12.08	8.85	4.00 /e
as a percentage of average θ in 1970-1975	221	162	73 /e
MVA growth rate / θ	0.91	-0.23	1.50
Degree of specialization	17.2	16.7	21.2
-VALUE ADDED: (millions of dollars)			
311 Food products	294	328	349 /e
313 Beverages	96	65	41 /e
314 Tobacco products	46	17	11 /e
321 Textiles	134	146	108 /e
322 Wearing apparel	20	15	11 /e
323 Leather and fur products	7	6	4 /e
324 Footwear	6	7	6 /e
331 Wood and wood products	35	18	21 /e
332 Furniture and fixtures	28	23	12 /e
341 Paper and paper products	42	41	32 /e
342 Printing and publishing	40	35	33 /e
351 Industrial chemicals	25	32	34 /e
352 Other chemical products	90	76	55 /e
353 Petroleum refineries	29	38	30 /e
354 Miscellaneous petroleum and coal products	4	14	14 /e
355 Rubber products	25	29	11 /e
356 Plastic products	34	57	46 /e
361 Pottery, china and earthenware	7	15	10 /e
362 Glass and glass products	9	15	11 /e
369 Other non-metal mineral products	100	101	76 /e
371 Iron and steel	25	56	20 /e
372 Non-ferrous metals	5	10	8 /e
381 Metal products	33	78	54 /e
382 Non-electrical machinery	4	7	4 /e
383 Electrical machinery	59	58	52 /e
384 Transport equipment	23	23	19 /e
385 Professional and scientific equipment	2	3	1 /e
390 Other manufacturing industries	7	5	1 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

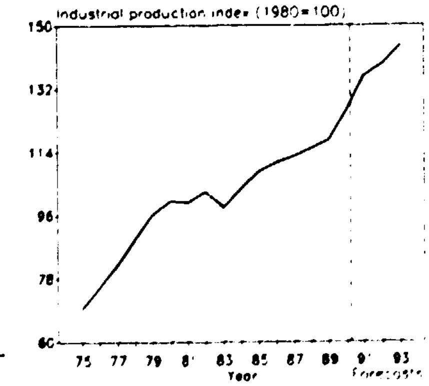
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

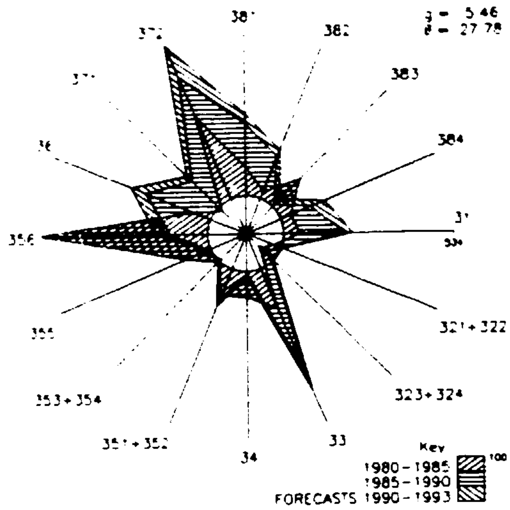


Industrial production index (1980=100)

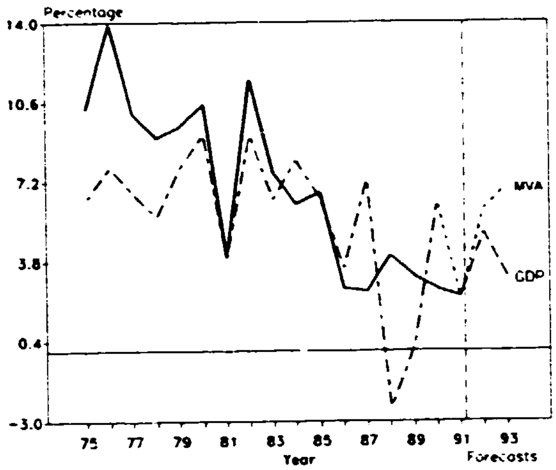


EGYPT

Industrial structural change
(index of value added 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)

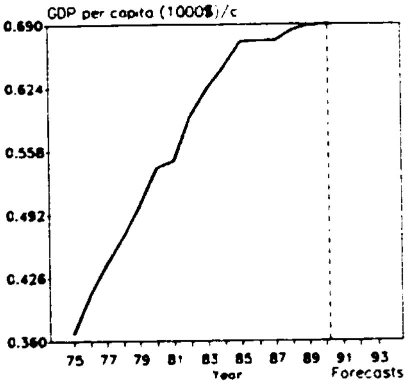


Source National Accounts Statistics from UN/UNSO
Estimated by UNIDO/PPD/IPP/GLO

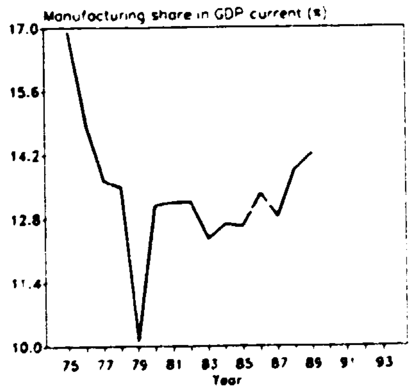
	1980	1985	1990
GDP (n.a.c., millions of 1980-dollars)	22100	31245	36195
Per capita (1980-dollars) (n.a.c.)	541	672	690
Manufacturing share (%) (n.a.) (current prices)	13.1	12.6	
MANUFACTURING:			
Value added (n.a.c., millions of 1980-dollars)	2754	3829	4416
Industrial production index	100	162	169
Value added (millions of dollars)	2243	5503	9530 /e
Gross output (millions of dollars)	8856	18995	29901 /e
Employment (thousands)	868	917	1086 /e
-PROFITABILITY (in percent of gross output)			
Intermediate input (%)	75	71	68 /e
Wages and salaries (%)	14	16	12 /e
Operating surplus (%)	11	13	20 /e
-PRODUCTIVITY (dollars)			
Gross output / worker	10205	20708	27525 /e
Value added / worker	2585	5999	8773 /e
Average wage	1473	3336	3253 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	6.87	15.44	14.92 /e
as a percentage of average θ in 1970-1975	98	221	214 /e
MVA growth rate / θ	0.60	0.32	0.57
Degree of specialization	22.6	15.0	18.5
-VALUE ADDED (millions of dollars)			
311 Food products	391	789	2071 /e
313 Beverages	18	132	180 /e
314 Tobacco products	26	245	337 /e
321 Textiles	641	954	1433 /e
322 Wearing apparel	7	28	60 /e
323 Leather and fur products	3	13	22 /e
324 Footwear	28	18	46 /e
331 Wood and wood products	11	45	55 /e
332 Furniture and fixtures	9	36	129 /e
341 Paper and paper products	54	142	112 /e
342 Printing and publishing	50	189	140 /e
351 Industrial chemicals	87	272	275 /e
352 Other chemical products	110	384	585 /e
353 Petroleum refineries	50	110	185 /e
354 Miscellaneous petroleum and coal products	77	145	99 /e
355 Rubber products	16	52	40 /e
356 Plastic products	42	-39	195 /e
361 Pottery, china and earthenware	8	22	66 /e
362 Glass and glass products	22	41	70 /e
369 Other non-metal mineral products	99	312	713 /e
371 Iron and steel	112	184	514 /e
372 Non-ferrous metals	81	523	845 /e
381 Metal products	53	178	359 /e
382 Non-electrical machinery	68	156	348 /e
383 Electrical machinery	88	338	220 /e
384 Transport equipment	82	199	348 /e
385 Professional and scientific equipment	5	25	73 /e
390 Other manufacturing industries	2	11	9 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

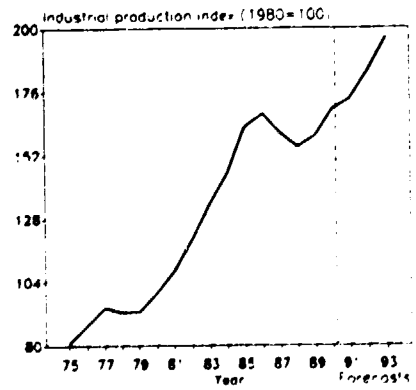
GDP per capita (1000$)/c



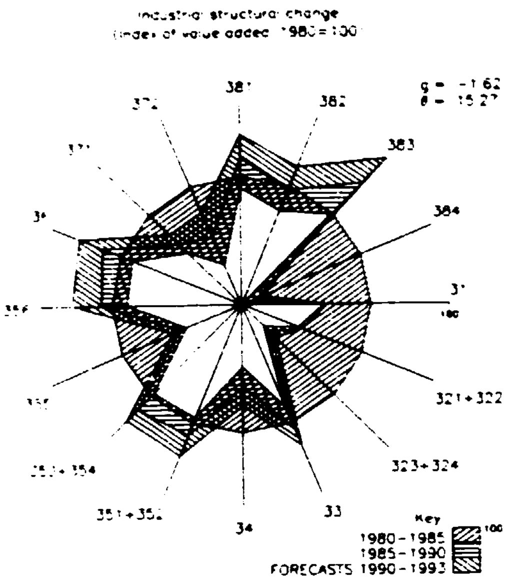
Manufacturing share in GDP current (%)

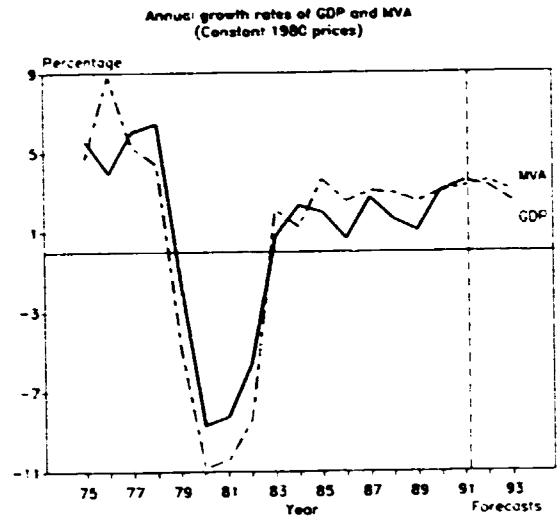


Industrial production index (1980=100)



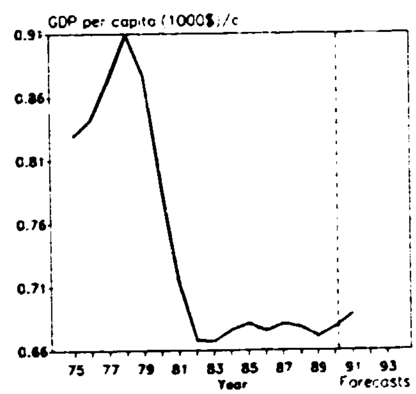
EL SALVADOR

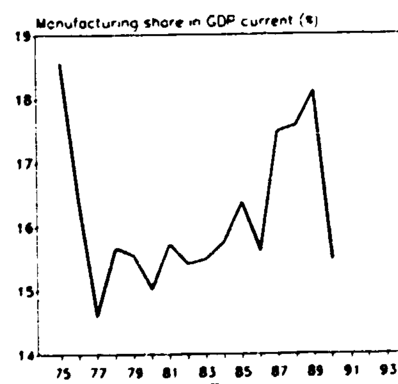


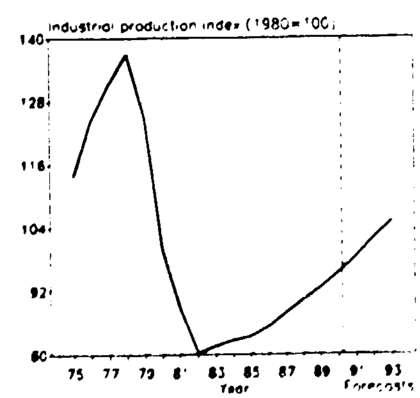


	1980	1985	1990
GDP (na.c millions of 1980-dollars)	3567	3247	3549
Per capita (1980-dollars) (na.c)	788	681	678
Manufacturing share (%) (na, current prices)	15.0	16.4	15.5 /e
MANUFACTURING:			
Value added (na.c millions of 1980-dollars)	536	471	540
Industrial production index	100	83	95
Value added (millions of dollars)	448	393	581 /e
Gross output (millions of dollars)	1130	860	1247 /e
Employment (thousands)	39	25	26 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	60	54	53 /e
Wages and salaries (%)	12	9 /e	9 /e
Operating surplus (%)	27	37 /e	37 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	28857	34129	48333 /e
Value added / worker	11426	15595	22538 /e
Average wage	3583	3048 /e	4573 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	11.59	9.32	1.64 /e
as a percentage of average θ in 1970-1975	202	163	29 /e
MVA growth rate / θ	-0.32	-0.77	1.49
Degree of specialization	19.1	18.0	17.9
-VALUE ADDED: (millions of dollars)			
311 Food products	78	55	63 /e
313 Beverages	61	59	86 /e
314 Tobacco products	26	29	41 /e
321 Textiles	62	40	60 /e
322 Wearing apparel	16	10	11 /e
323 Leather and fur products	5	5	7 /e
324 Footwear	13	1	3 /e
331 Wood and wood products	1	-	- /e
332 Furniture and fixtures	3	4	6 /e
341 Paper and paper products	40	24	39 /e
342 Printing and publishing	8	8	16 /e
351 Industrial chemicals	4	7	11 /e
352 Other chemical products	46	57	86 /e
353 Petroleum refineries	14	20	30 /e
354 Miscellaneous petroleum and coal products	2	-	2 /e
355 Rubber products	4	3	4 /e
356 Plastic products	13	15	25 /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	-	-	- /e
369 Other non-metal mineral products	11	13	22 /e
371 Iron and steel	9	7	10 /e
372 Non-ferrous metals	1	1	1 /e
381 Metal products	10	12	20 /e
382 Non-electrical machinery	6	7	11 /e
383 Electrical machinery	9	12	21 /e
384 Transport equipment	1	-	/e
385 Professional and scientific equipment	-	1	1 /e
390 Other manufacturing industries	4	2	4 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

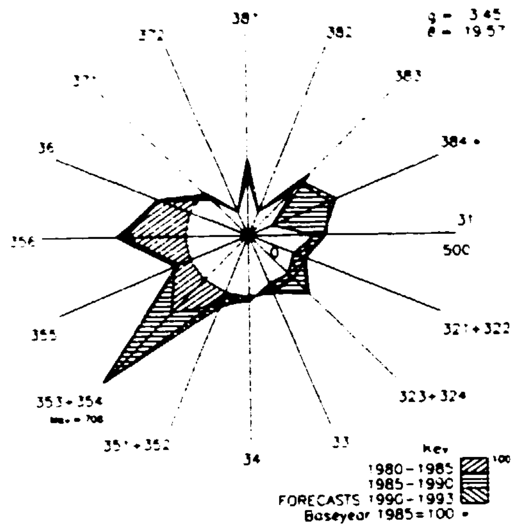




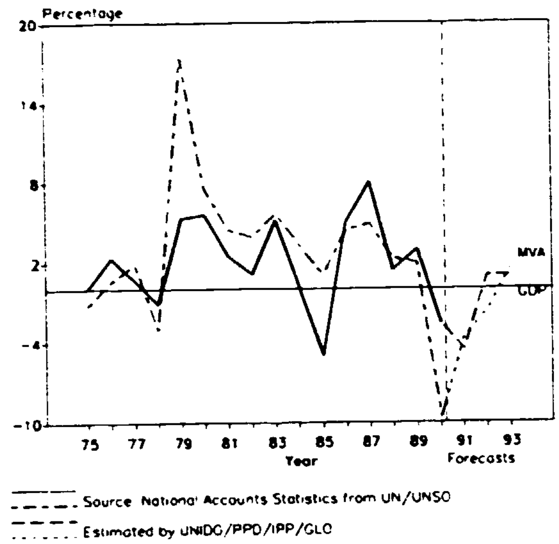


ETHIOPIA

Industrial structural change
Index of value added 1980=100

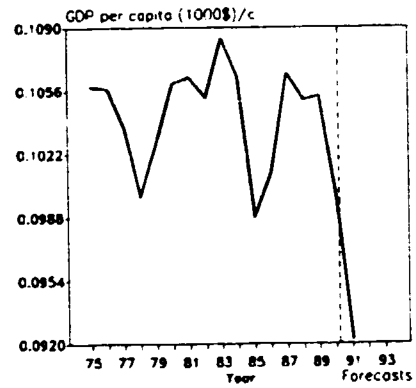


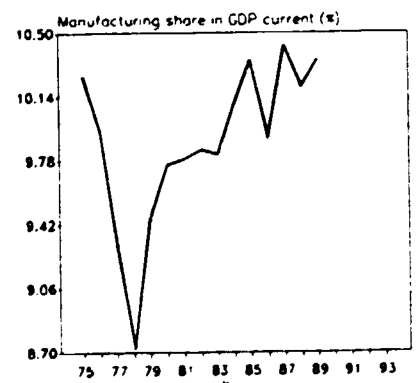
Annual growth rates of GDP and MVA
(Constant 1980 prices)

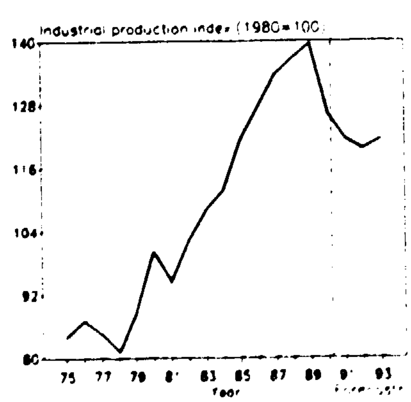


	1980	1985	1990
GDP: (n.a.c. millions of 1980-dollars)	4106	4255	4907
Per capita (1980-dollars) (n.a.c.)	106	99	100
Manufacturing share (%) (n.a. current prices)	9.8	10.3	
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)	445	532	549
Industrial production index	100	121	126
Value added (millions of dollars)	459	577 /e	830 /e
Gross output (millions of dollars)	1016	1375	1721 /e
Employment (thousands)	77	88 /e	103 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	55	58 e	52 e
Wages and salaries (%)	8	9	9 e
Operating surplus (%)	37	33 /e	39 e
-PRODUCTIVITY: (dollars)			
Gross output / worker	13263	15628 /e	16673 /e
Value added / worker	5993	6557 /e	8036 /e
Average wage	1079	1332 /e	1531 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	9.90	5.78 e	4.30 e
as a percentage of average θ in 1970-1975	162	95 e	71 e
MVA growth rate / θ	0.59	0.24	1.45
Degree of specialization	25.8	21.7	24.0
-VALUE ADDED: (millions of dollars)			
311 Food products	110	114 e	130 /e
313 Beverages	83	141	189 e
314 Tobacco products	30	35	60 /e
321 Textiles	106	69	115 e
322 Wearing apparel	3	11	10 e
323 Leather and fur products	14	13	35 e
324 Footwear	10	10	12 e
331 Wood and wood products	8	6	9 e
332 Furniture and fixtures	2	4	5 e
341 Paper and paper products	3	9	7 e
342 Printing and publishing	11	17	19 e
351 Industrial chemicals	1	1	2 e
352 Other chemical products	13	21	23 e
353 Petroleum refineries	20	54	123 e
354 Miscellaneous petroleum and coal products	-	-	. e
355 Rubber products	8	13	14 e
356 Plastic products	3	11	12 e
361 Pottery, china and earthenware	-	.	. e
362 Glass and glass products	2	4	5 e
369 Other non-metal mineral products	8	19	20 e
371 Iron and steel	9	3	11 e
372 Non-ferrous metals	-	.	. e
381 Metal products	7	12	12 e
382 Non-electrical machinery	.	-	e
383 Electrical machinery	.	1	1 e
384 Transport equipment	.	7	14 e
385 Professional and scientific equipment	.		. e
390 Other manufacturing industries	.		e

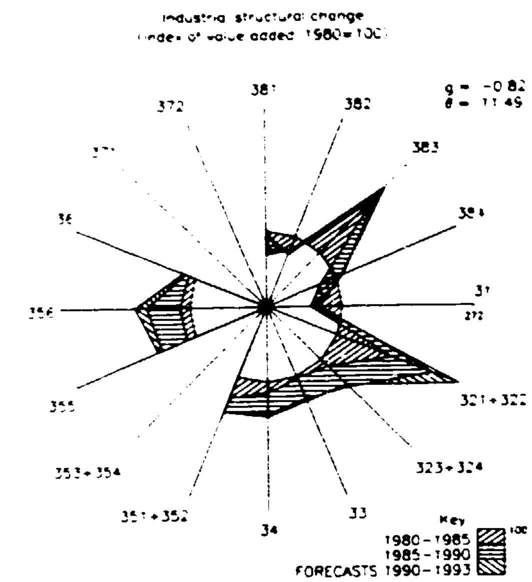
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

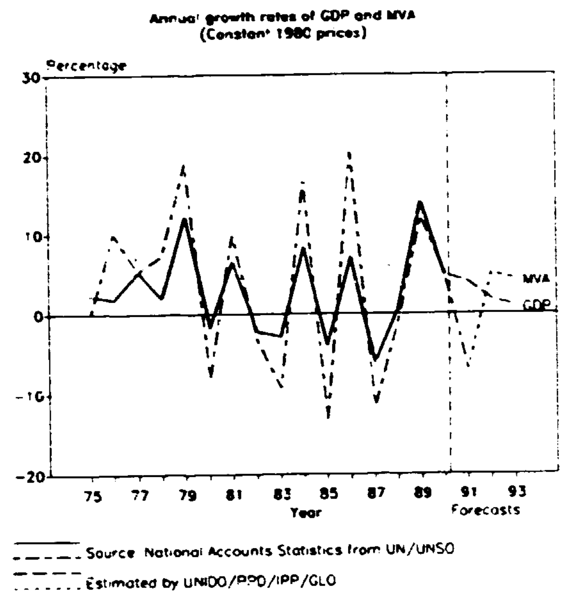






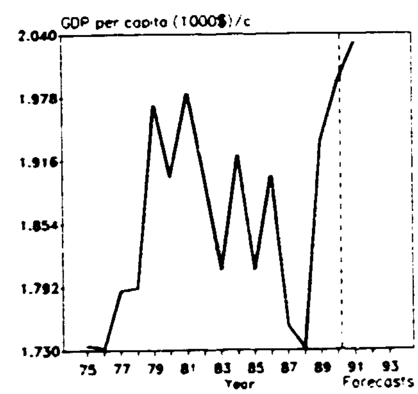
FIJI

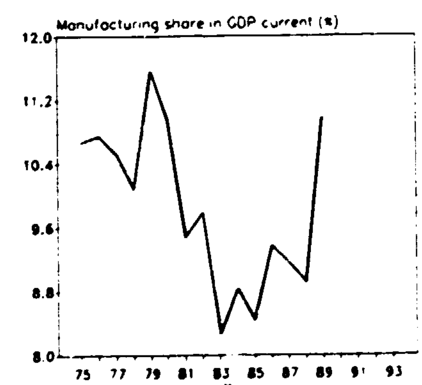


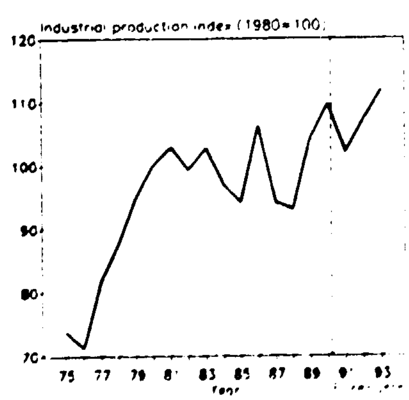


	1980	1985	1990
GDP (na.c) (millions of 1980-dollars)	1204	1266	1526
Per capita (1980-dollars) (na.c)	1900	1809	1992
Manufacturing share (%) (na) (current prices)	10 9	8 4	
MANUFACTURING:			
Value added (na.c) (millions of 1980-dollars)	144	141	174
Industrial production index	100	94	110
Value added (millions of dollars)	121	90	119 /e
Gross output (millions of dollars)	489	395	529 /e
Employment (thousands)	13	13	15 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	75	77	78 /e
Wages and salaries (%)	11	13	13 /e
Operating surplus (%)	14	9	10 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	38543	29825	35187 /e
Value added / worker	9577	6808	7885 /e
Average wage	4114	3990	4457 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	3 75	6 69 /e	0 97 /e
as a percentage of average θ in 1970-1975	76	135 /e	20 /e
MVA growth rate θ	1 43	-0 67	5 74
Degree of specialization	40 4	24 3	23 3
-VALUE ADDED: (millions of dollars)			
311 Food products	71	37	47 /e
313 Beverages	6	7	10 /e
314 Tobacco products	2	2	3 /e
321 Textiles	-	-	- /e
322 Wearing apparel	2	4	6 /e
323 Leather and fur products	-	-	- /e
324 Footwear	-	-	- /e
331 Wood and wood products	7	6	9 /e
332 Furniture and fixtures	3	3	4 e
341 Paper and paper products	2	2 e	3 e
342 Printing and publishing	4	5	6 e
351 Industrial chemicals	-	-	- e
352 Other chemical products	4	5	6 e
353 Petroleum refineries	-	-	- e
354 Miscellaneous petroleum and coal products	-	-	- e
355 Rubber products	1	1	1 e
356 Plastic products	2	2	3 e
361 Pottery, china and earthenware	-	-	- e
362 Glass and glass products	-	-	- e
369 Other non-metal mineral products	6	7	7 e
371 Iron and steel	-	-	- e
372 Non-ferrous metals	-	-	- e
381 Metal products	6	4	6 e
382 Non-electrical machinery	1	1	1 e
383 Electrical machinery	-	1	1 e
384 Transport equipment	4	3	5 e
385 Professional and scientific equipment	-	-	- e
390 Other manufacturing industries	-	1	1 e

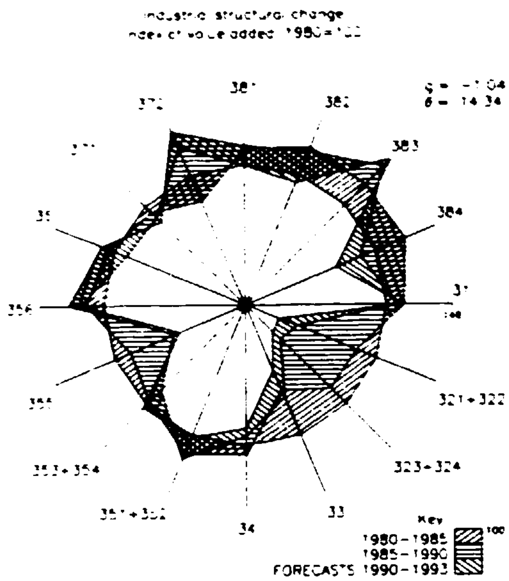
For sources, footnotes and comments see "Technical notes" at the beginning of the Annex

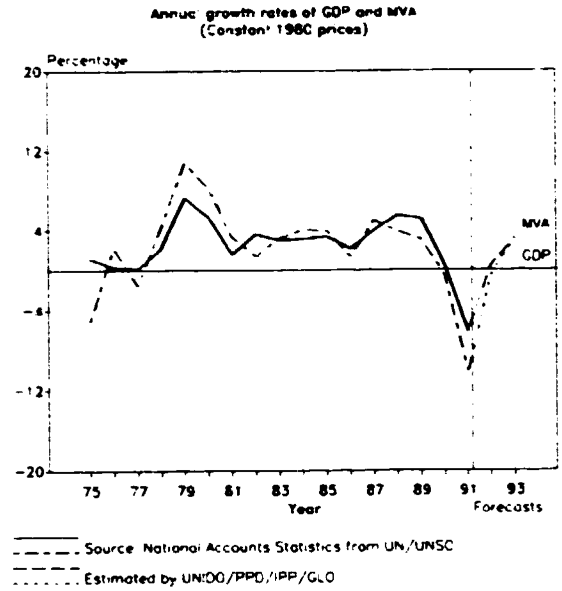






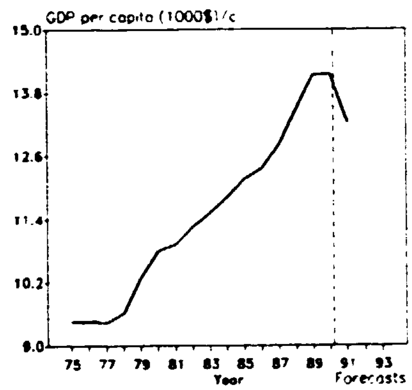
FINLAND

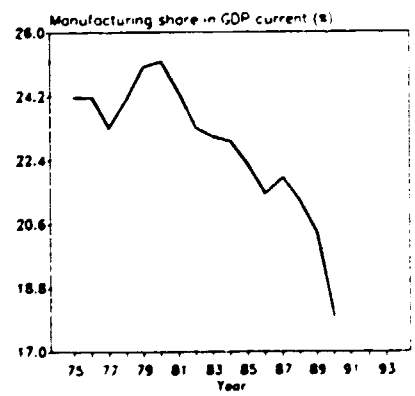


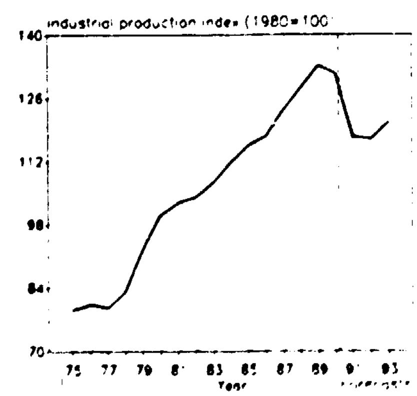


	1980	1985	1990
GDP (natc. millions of 1980-dollars)	51637	59582	70420
Per capita (1980-dollars) (natc)	10803	12152	14143
Manufacturing share (%) (natc) (current prices)	25.2	22.3	18.0 e
MANUFACTURING:			
Value added (natc) (millions of 1980-dollars)	14507	16948	19191
Industrial production index	100	115	131
Value added (millions of dollars)	14343	13598	25850
Gross output (millions of dollars)	40839	36968	71771
Employment (thousands)	531	496	408
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	65	63	64
Wages and salaries (%)	15	16	17
Operating surplus (%)	20	21	19
-PRODUCTIVITY: (dollars)			
Gross output / worker	76910	74563	176009
Value added / worker	27012	27426	63394
Average wage	11904	11388	29227
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	6.33	5.51	5.38
as a percentage of average θ in 1970-1975	82	71	70
MVA growth rate / θ	0.58	0.17	-0.23
Degree of specialization	13.3	13.8	14.2
-VALUE ADDED (millions of dollars)			
311 Food products	1402	1418	2515
313 Beverages	225	227	664
314 Tobacco products	46	58	177
321 Textiles	469	310	350
322 Wearing apparel	499	434	360
323 Leather and fur products	54	37	43
324 Footwear	134	106	80
331 Wood and wood products	1196	652	1447
332 Furniture and fixtures	257	215	493
341 Paper and paper products	2088	1346	3604
342 Printing and publishing	1080	1223	1927
351 Industrial chemicals	555	561	1285
352 Other chemical products	349	371	704
353 Petroleum refineries	445	384	674
354 Miscellaneous petroleum and coal products	46	47	110
355 Rubber products	105	84	108
356 Plastic products	164	168	380
361 Pottery, china and earthenware	46	40	72
362 Glass and glass products	105	77	148
369 Other non-metal mineral products	434	432	978
371 Iron and steel	544	463	856
372 Non-ferrous metals	142	103	356
381 Metal products	756	766	1606
382 Non-electrical machinery	1469	1618	3251
383 Electrical machinery	634	763	1807
384 Transport equipment	323	915	1365
385 Professional and scientific equipment	110	156	318
390 Other manufacturing industries	107	...	172

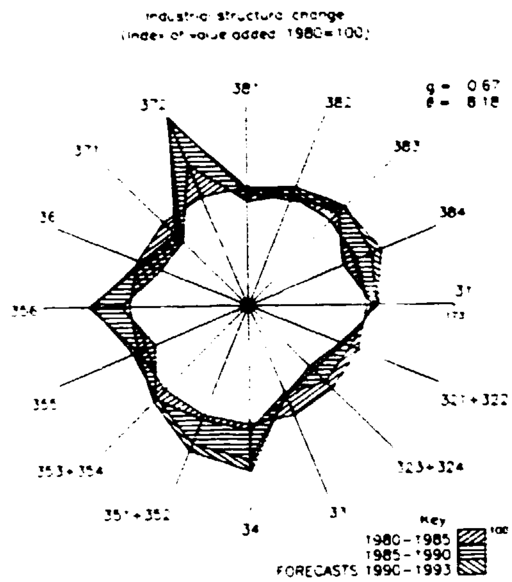
For symbols, footnotes and comments see "Technical notes" at the beginning of this Annex

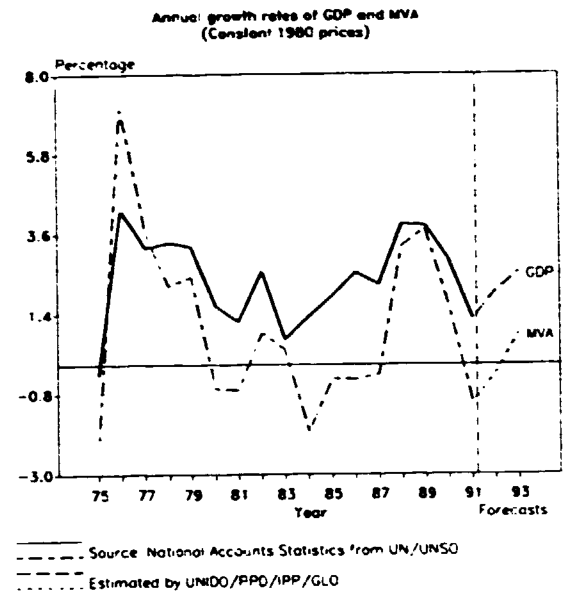


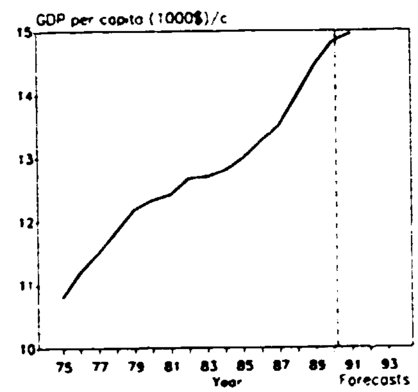




FRANCE







	1980	1985	1990
GDP: na.c. (millions of 1980-dollars)	664529	716607	832472
Per capita (1980-dollars) na.c	12333	12989	14826
Manufacturing share (%) na (current prices)	24 2	22 0	21 2 /e
MANUFACTURING:			
Value added na.c. (millions of 1980-dollars)	176386	173506	187548
Industrial production index	100	95	108
Value added (millions of dollars)	161552	115430	252318
Gross output (millions of dollars)	453635	326412	675761
Employment (thousands)	5103	4470	4195
-PROFITABILITY: (in percent of gross output			
Intermediate input (%)	64	65	63
Wages and salaries (%)	24	23	23 /e
Operating surplus (%)	11	12	14 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	88896	73020	161090
Value added / worker	31658	25822	60148
Average wage	21643	17129	37063 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	3 70 /e	2 82	2 46
as a percentage of average θ in 1970-1975	61 /e	62	54
MVA growth rate / θ	0 47	-0 15	0 88
Degree of specialization	10 4	11 1	11 5
-VALUE ADDED: (millions of dollars)			
311 Food products	15952	12825	26446
313 Beverages	3486	2268	4289
314 Tobacco products	1497	948	1879
321 Textiles	6130	4239	7892
322 Wearing apparel	4742	3104	5680
323 Leather and fur products	757	527	920
324 Footwear	1411	929	1489
331 Wood and wood products	2888	1704	2905 e
332 Furniture and fixtures	2846	1632	3945 e
341 Paper and paper products	3592	2317	6193
342 Printing and publishing	6660	5069	12900
351 Industrial chemicals	6462	4669	11799 e
352 Other chemical products	6302	4996	11265 e
353 Petroleum refineries	3973	5127	15763
354 Miscellaneous petroleum and coal products	118	78	181 /e
355 Rubber products	2483	1544	3746 /e
356 Plastic products	3083	2415	5822 /e
361 Pottery, china and earthenware	639	367	839 e
362 Glass and glass products	2170	1355	3263
369 Other non-metal mineral products	5653	3153	7833
371 Iron and steel	6741	3788	8267
372 Non-ferrous metals	2479	2340	5031
381 Metal products	12119	7792	17314
382 Non electrical machinery	15245	11998	25162
383 Electrical machinery	14411	11491	24303
384 Transport equipment	17733	11316	28848
385 Professional and scientific equipment	2206	1752	4155 e
390 Other manufacturing industries	2772	2178	3178 e

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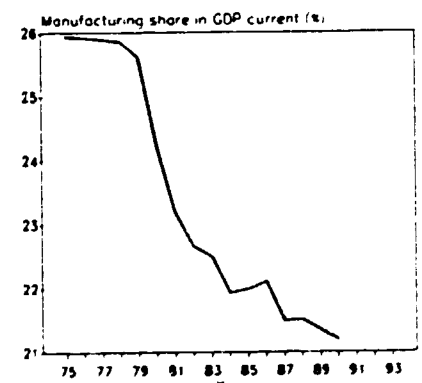
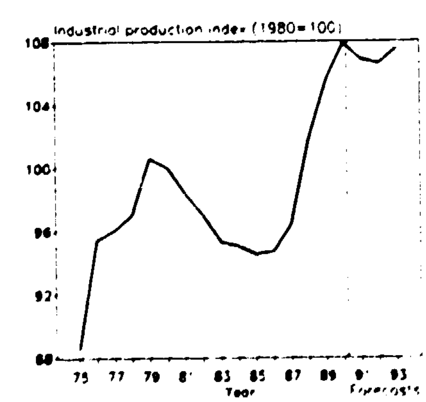
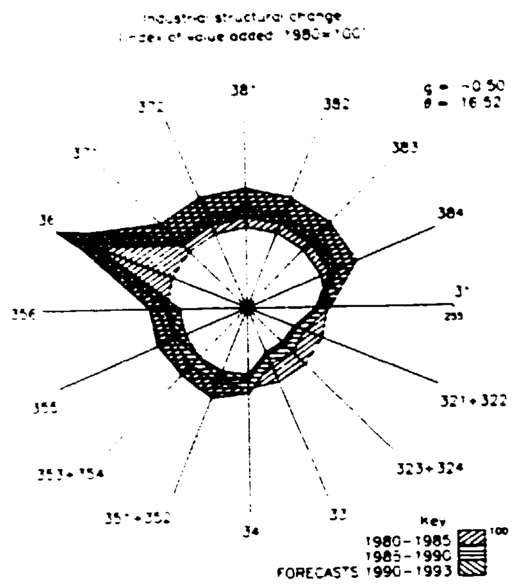
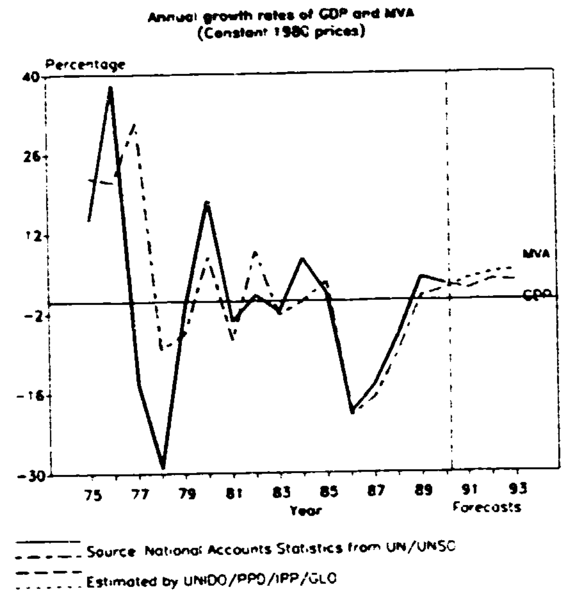




GABON





	1980	1985	1990
GDP: (nat. c. millions of 1980-dollars)	4281	4459	3076
Per capita (1980-dollars) (nat.c)	5305	4522	2622
Manufacturing share (%) (na, current prices)	5 6 /e	4 8 /e	
MANUFACTURING:			
value added (nat.c. millions of 1980-dollars)	301	308	191
Industrial production index	100	102	77
value added (millions of dollars)	224	183 /e	263 /e
Gross output (millions of dollars)	690	616 /e	884 /e
Employment (thousands)	18 /e	18 /e	16 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input	68 /e	70 /e	70 /e
Wages and salaries	16 /e	17 /e	18 /e
Operating surplus	16 /e	13 /e	12 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	38481 /e	34388 /e	56868 /e
Value added / worker	12470 /e	10240 /e	16938 /e
Average wage	6283 /e	5785 /e	10294 /e
-STRUCTURAL INDICES:			
structural change θ (5-year average in degrees)	13 62 /e	4 65 /e	1 29 /e
as a percentage of average θ in 1970-1975	164 /e	56 /e	16 /e
MVA growth rate / θ	0 14	0 42	-3 45
Degree of specialization	21 0	16 5	17 0
-VALUE ADDED: (millions of dollars)			
311 Food products	18 /e	17 /e	27 /e
313 Beverages	19	13 /e	20 /e
314 Tobacco products	17	12 /e	17 /e
321 Textiles	3	2 /e	3 /e
322 Wearing apparel	5	3 /e	5 /e
323 Leather and fur products	1	- /e	1 /e
324 Footwear	1	- /e	1 /e
331 Wood and wood products	54	36 /e	53 /e
332 Furniture and fixtures	9	5 /e	7 /e
341 Paper and paper products	2	1 /e	2 /e
342 Printing and publishing	3	3 /e	4 /e
351 Industrial chemicals	6	6 /e	7 /e
352 Other chemical products	3	2 /e	3 /e
353 Petroleum refineries	18	16 /e	21 /e
354 Miscellaneous petroleum and coal products	-	- /e	- /e
355 Rubber products	-	- /e	- /e
356 Plastic products	-	- /e	/e
361 Pottery, china and earthenware	-	- /e	- /e
362 Glass and glass products	1	2 /e	3 /e
369 Other non metal mineral products	8	14 /e	22 /e
371 Iron and steel	3	3 /e	4 /e
372 Non-ferrous metals	3	3 /e	4 /e
381 Metal products	13	15 /e	20 /e
382 Non-electrical machinery	2	2 /e	3 /e
383 Electrical machinery	3	9 /e	12 /e
384 Transport equipment	11	12 /e	17 /e
385 Professional and scientific equipment	1	1 /e	1 /e
390 Other manufacturing industries	5	5 /e	7 /e

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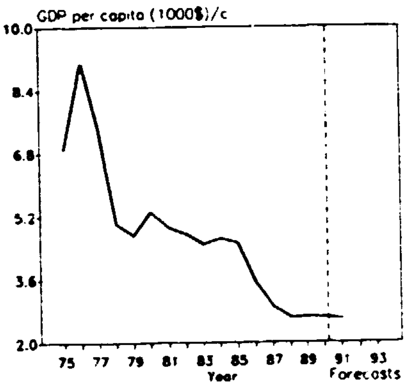
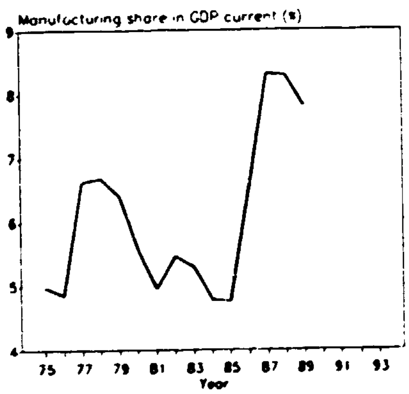
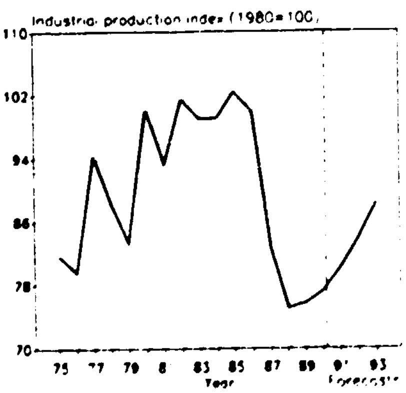
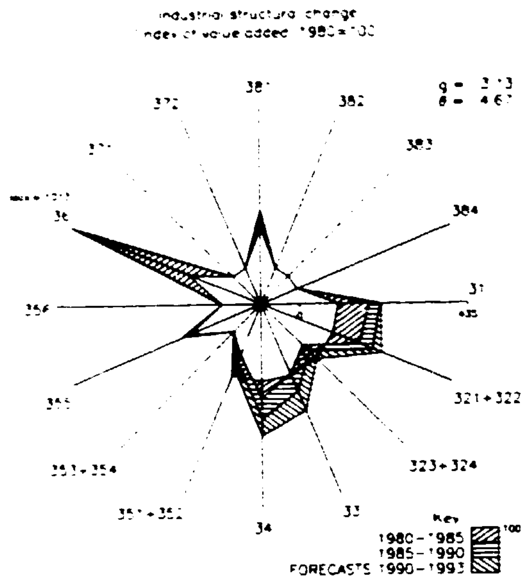
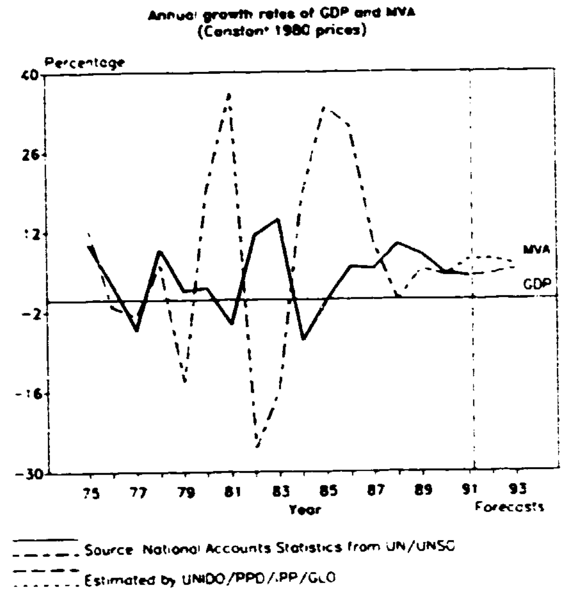


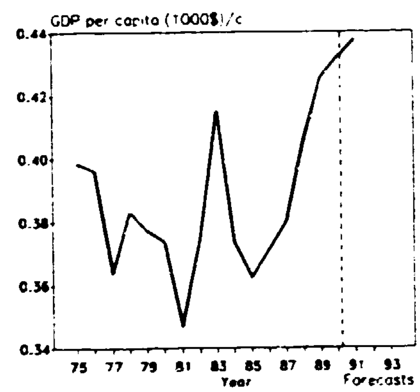




GAMBIA

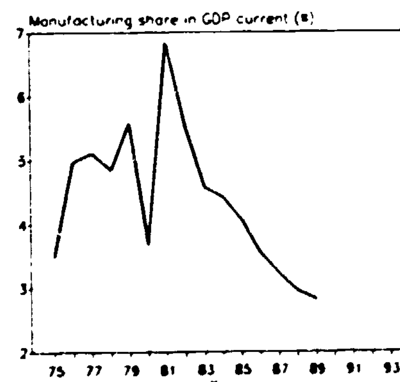


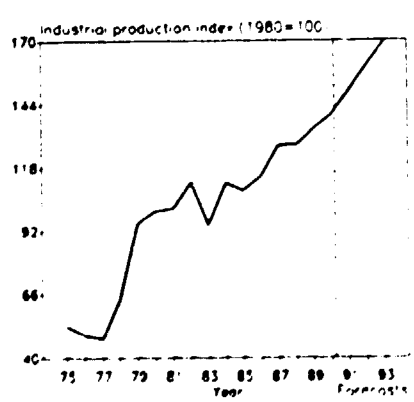




	1980	1985	1990
GDP (na c millions of 1980-dollars)	239	270	372
Per capita (1980-dollars) (na c)	374	362	432
Manufacturing share (%) (na) (current prices)	3 7	4 1	
MANUFACTURING:			
Value added (na c) (millions of 1980-dollars)	16	22	35
Industrial production index	100	108	139
Value added (millions of dollars)	11	9 e	16 e
Gross output (millions of dollars)	30	43 e	54 e
Employment (thousands)	2	3 e	3 e
-PROFITABILITY: in percent of gross output			
Intermediate input (%)	62	79 e	76 e
Wages and salaries (%)	10	7 e	7 e
Operating surplus (%)	28	15 e	17 e
-PRODUCTIVITY: dollars			
Gross output / worker	16350	16571 e	24457 e
Value added / worker	6183	3551 e	5987 e
Average wage	1566	1113 e	1712 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	17 04	9 82 e	2 11 e
as a percentage of average θ in 1970-1975	1397	805 e	173 e
MVA growth rate (θ)	1 31	-0 02	2 63
Degree of specialization	36 7	36 1	32 2
-VALUE ADDED: millions of dollars			
311 Food products	3	5 e	7 e
313 Beverages	1	1 e	2 e
314 Tobacco products	-	- e	- e
321 Textiles	-	- e	- e
322 Wearing apparel	-	- e	- e
323 Leather and fur products	-	- e	- e
324 Footwear	-	- e	- e
331 Wood and wood products	-	- e	- e
332 Furniture and fixtures	-	1 e	1 e
341 Paper and paper products	-	- e	- e
342 Printing and publishing	- e	- e	- e
351 Industrial chemicals	-	- e	- e
352 Other chemical products	-	- e	- e
353 Petroleum refineries	-	- e	- e
354 Miscellaneous petroleum and coal products	-	- e	- e
355 Rubber products	e	- e	e
356 Plastic products	-	- e	- e
361 Pottery, china and earthenware		- e	- e
362 Glass and glass products	-	- e	- e
369 Other non-metal mineral products	-	- e	- e
371 Iron and steel	-	- e	e
372 Non-ferrous metals	-	e	- e
381 Metal products	-	- e	- e
382 Non electrical machinery	-	- e	e
383 Electrical machinery		e	- e
384 Transport equipment		- e	e
385 Professional and scientific equipment		e	e
390 Other manufacturing industries	6	- e	4 e

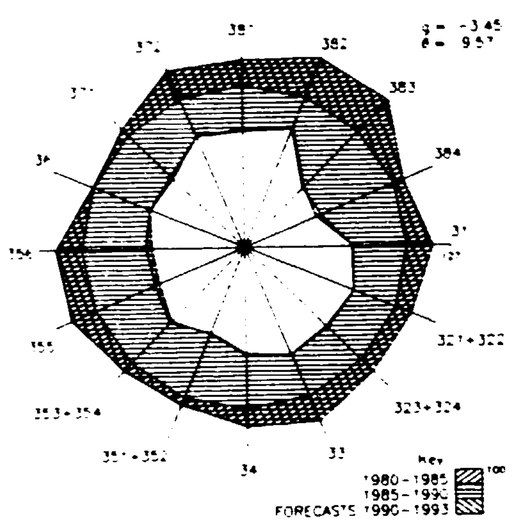
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex



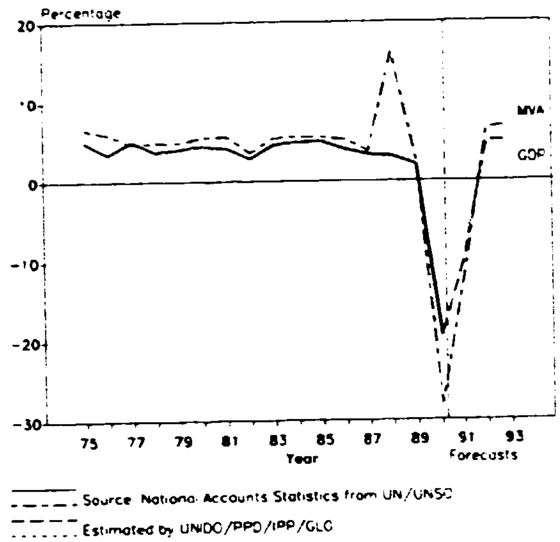


GERMANY, EASTERN PART

Industrial structural change
index of value added (1980=100)



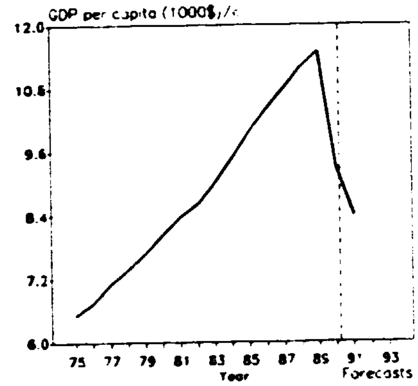
Annual growth rates of GDP and MVA
(Constant 1980 prices)



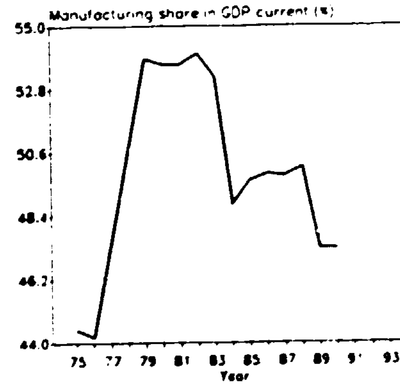
	1980	1985	1990
GDP (n.a.c. millions of 1980-dollars)	134459	165880	150819
Per capita (1980-dollars) (n.a.c.)	8033	9966	9294
Manufacturing share (%) (n.a.) (current prices)	53.7	49.6	47.3 e
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)	60486 e	77757 e	72700
Industrial production index	100	113	63
Value added (millions of 1980-dollars)	75600	86430	48449 e
Gross output (millions of dollars)	132646	159661	
Employment (thousands)	2895	2988	2716 e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)			
Wages and salaries (%)			
Operating surplus (%)			
-PRODUCTIVITY: (dollars)			
Gross output / worker	45819	53434	
Value added / worker	26460	28926	17839 e
Average wage	6771 e	4836 e	
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	1.99	1.61	2.36 e
as a percentage of average θ in 1970-1975	105	85	157 e
MVA growth rate (%)	1.50	1.52	-2.75
Degree of specialization	13.2	14.0	13.7
-VALUE ADDED: (millions of 1980-dollars)			
311 Food products	6043	7070	3988 e
313 Beverages	1040	1207	780 e
314 Tobacco products	254	236	117 e
321 Textiles	6276	5841	4544
322 Wearing apparel	2199	2485	1473
323 Leather and fur products	839	923	587
324 Footwear	631	694	441
331 Wood and wood products	1178	1378	848
332 Furniture and fixtures	1081	1265	778
341 Paper and paper products	931	1089	438
342 Printing and publishing	727	748	576
351 Industrial chemicals	8697	9132	5131 e
352 Other chemical products	1220	1269	622 e
353 Petroleum refineries	2853	3052	1826 e
354 Miscellaneous petroleum and coal products	141	145	86 e
355 Rubber products	3202	3715	1825
356 Plastic products	1528	1773	871
361 Pottery, china and earthenware	516	629	302 e
362 Glass and glass products	473	477	236 e
369 Other non-metal mineral products	1768	1758	1255
371 Iron and steel	2651	2133	1670 e
372 Non-ferrous metals	884	1061	563 e
381 Metal products	3171	3679	2283 e
382 Non-electrical machinery	9950	12537	7361 e
383 Electrical machinery	1480	3439	1815 e
384 Transport equipment	6838	7311	3518 e
385 Professional and scientific equipment	3254	3035	[illegible] e
390 Other manufacturing industries	608	638	504 e

For symbols, footnotes and comments see "Technical notes" at the beginning of this Annex

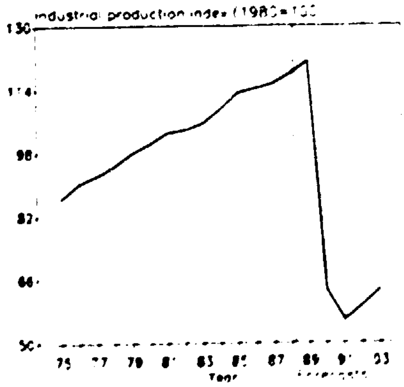
GDP per capita (1000$)/c



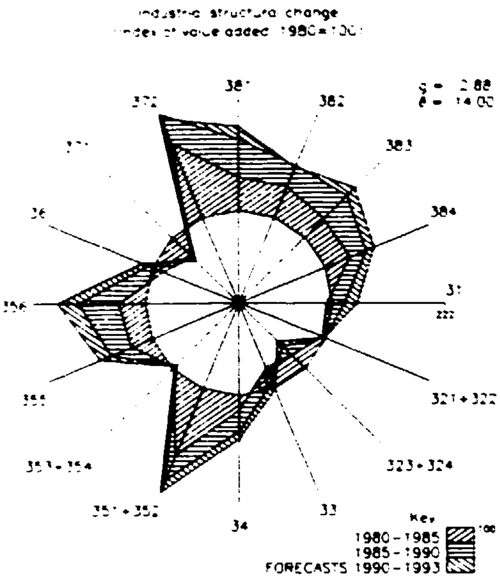
Manufacturing share in GDP current (%)

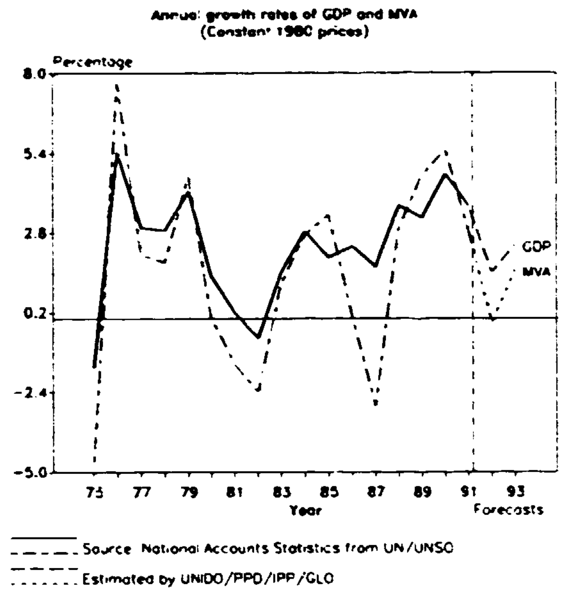


Industrial production index (1980=100)



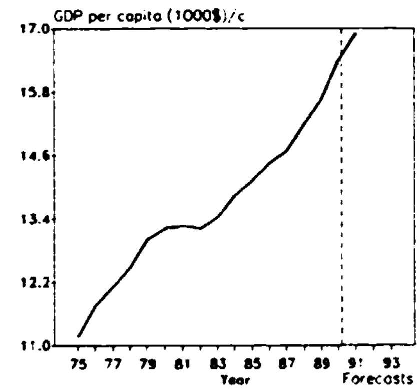
GERMANY, WESTERN PART

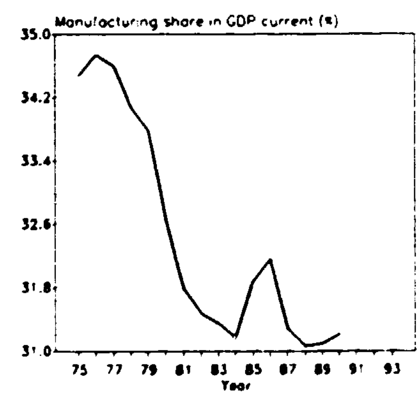


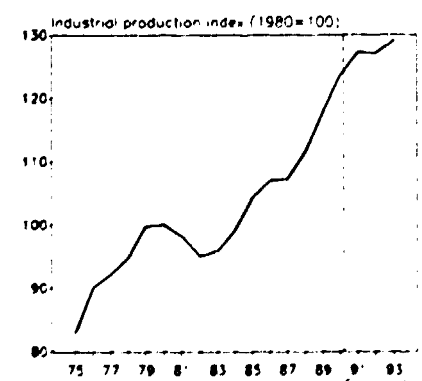


	1980	1985	1990
GDP (n.a.c.; millions of 1980-dollars)	813498	861650	1004823
Per capita (1980-dollars; n.a.c.)	13213	14120	16381
Manufacturing share (%) (n.a.; current prices)	32.6	31.9	31.2 /e
MANUFACTURING:			
Value added (n.a.c.; millions of 1980-dollars)	286924	296200	326979
Industrial production index	100	104	124
Value added (millions of dollars)	265588	224215	543592
Gross output (millions of dollars)	632160	490046	1095480
Employment (thousands)	7229	6614	7119
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	58	54	50
Wages and salaries (%)	21	19	20
Operating surplus (%)	21	27	29
-PRODUCTIVITY: dollars			
Gross output / worker	87448	74092	153881
Value added / worker	36739	33900	76358
Average wage	18471	14124	31233
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2.72	3.47	1.70
as a percentage of average θ in 1970-1975	81	104	51
MVA growth rate / θ	0.83	0.95	1.93
Degree of specialization	12.1	14.5	15.1
-VALUE ADDED: (millions of dollars)			
311 Food products	18570	10829	28228
313 Beverages	6452	5048	12711
314 Tobacco products	6909	5720	12892
321 Textiles	6964	5510	11995
322 Wearing apparel	4934	2302	5683
323 Leather and fur products	935	499	956
324 Footwear	1205	727	1158
331 Wood and wood products	4485	2429	5369 e
332 Furniture and fixtures	5548	3084	8609 e
341 Paper and paper products	5099	5221	12778
342 Printing and publishing	6150	4141	10307
351 Industrial chemicals	13944	15569	39319 e
352 Other chemical products	8003	11596	28033 e
353 Petroleum refineries	14637	10126	19676
354 Miscellaneous petroleum and coal products	390	985	2250
355 Rubber products	3201	2880	7099 e
356 Plastic products	6095	5639	15525 e
361 Pottery, china and earthenware	1204	569	1537 e
362 Glass and glass products	2492	1916	4887
369 Other non-metal mineral products	7937	4874	12014
371 Iron and steel	13872	9538	19707
372 Non-ferrous metals	2508	3414	8289
381 Metal products	14455	14161	38209
382 Non-electrical machinery	34253	33811	82020
383 Electrical machinery	30501	28329	74440
384 Transport equipment	31232	29676	68673
385 Professional and scientific equipment	6205	3448	8157 e
390 Other manufacturing industries	[illegible]	[illegible]	3063 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

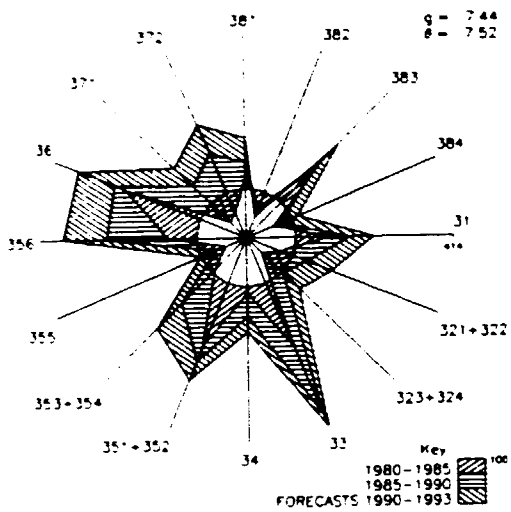




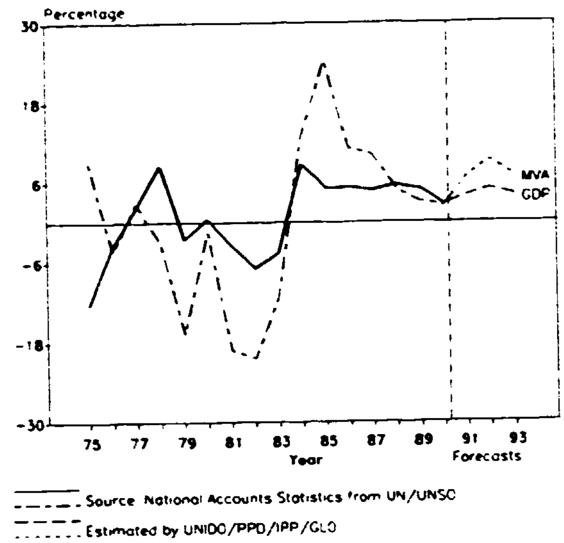


GHANA

Industrial structural change
(index of value added 1980=100)



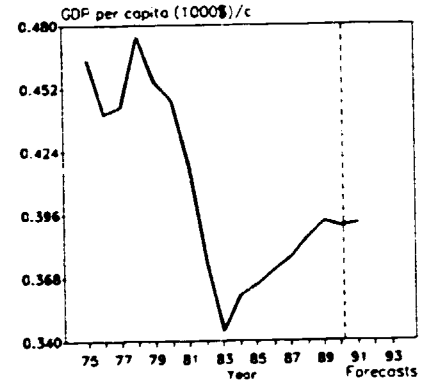
Annual growth rates of GDP and MVA
(Constant 1980 prices)



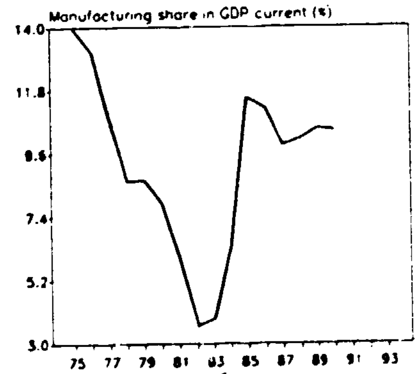
	1980	1985	1990
GDP: (na.c (millions of 1980-dollars)	4788	4686	5876
Per capita (1980-dollars) /na.c	446	365	391
Manufacturing share (%) /na (current prices)	7 8	11 5	10 4 /e
MANUFACTURING:			
Value added (na.c (millions of 1980-dollars)	377	302	410
Industrial production index	100	70	103
Value added (millions of dollars)	244	338	573 /e
Gross output (millions of dollars)	505	696	1114 /e
Employment (thousands)	80	61	76 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	52	51	49 /e
Wages and salaries (%)	10	6	7 /e
Operating surplus (%)	39	42	44 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	6293	11351	14578 /e
Value added / worker	3034	5517	7499 /e
Average wage	606	711	1047 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	13 44	14 29	4 33 /e
as a percentage of average θ in 1970-1975	112	119	36 /e
MVA growth rate / θ	-0 69	1 03	2 02
Degree of specialization	23 1	26 3	26 0
-VALUE ADDED: (millions of dollars)			
311 Food products	20	35	53 /e
313 Beverages	38	51	83 /e
314 Tobacco products	32	68	80 /e
321 Textiles	22	18	36 /e
322 Wearing apparel	3	1	1 /e
323 Leather and fur products	1	-	1 /e
324 Footwear	1	-	1 /e
331 Wood and wood products	16	41	76 /e
332 Furniture and fixtures	2	2	4 /e
341 Paper and paper products	1	2	4 /e
342 Printing and publishing	5	4	5 /e
351 Industrial chemicals	2	1	2 /e
352 Other chemical products	9	26	32 /e
353 Petroleum refineries	37	34	80 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	5	2	4 /e
356 Plastic products	1	2	4 /e
361 Pottery, china and earthenware	1	-	- /e
362 Glass and glass products	-	1	2 /e
369 Other non-metallic mineral products	6	16	19 /e
371 Iron and steel	1	1	2 /e
372 Non-ferrous metals	29	16	63 /e
381 Metal products	7	8	12 /e
382 Non-electrical machinery	-	-	- /e
383 Electrical machinery	2	3	4 /e
384 Transport equipment	3	2	3 /e
385 Professional and scientific equipment	1	1	1 /e
390 Other manufacturing industries	.	.	/e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

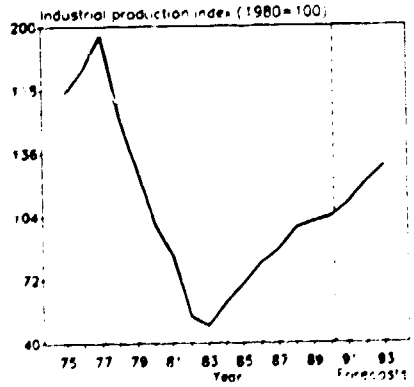
GDP per capita (1000$)/c



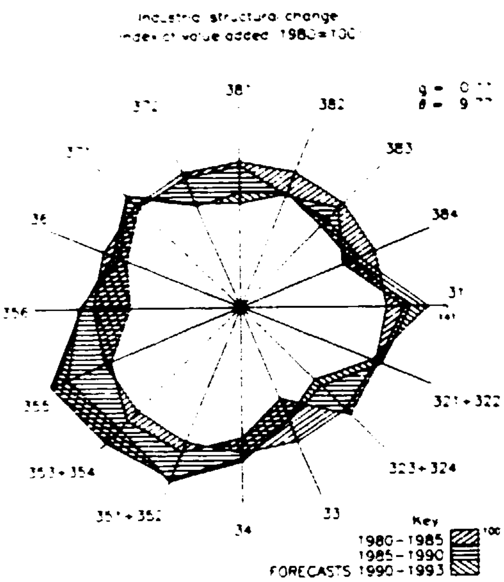
Manufacturing share in GDP current (%)

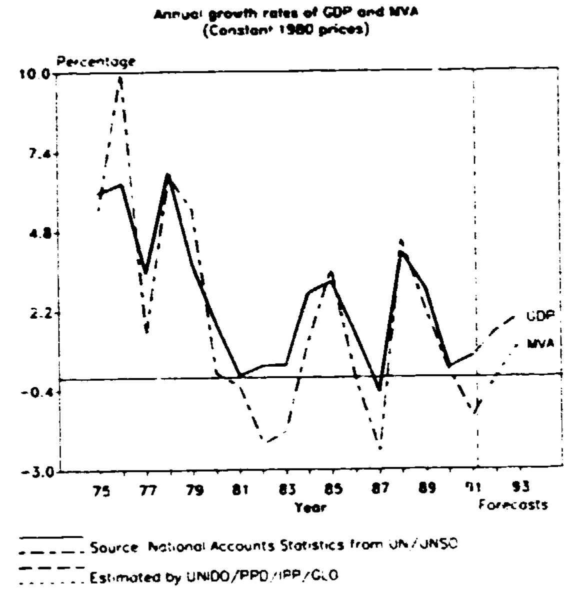


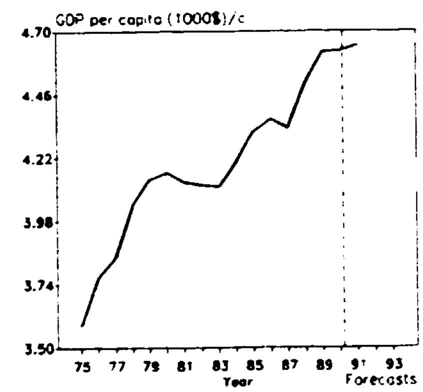
Industrial production index (1980=100)



GREECE

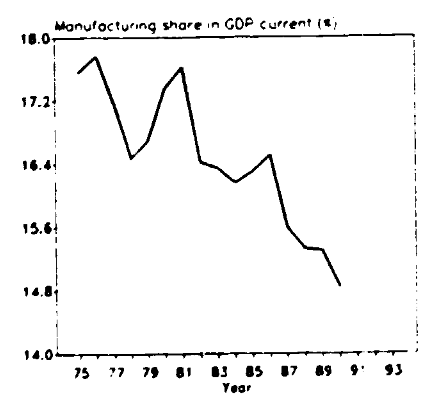


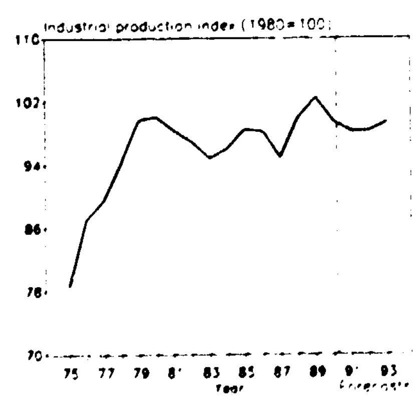




	1980	1985	1990	
GDP (real, millions of 1980-dollars)	40147	42902	46483	
Per capita (1980-dollars, real)	4163	4318	4623	
Manufacturing share (%, real, current prices)	17.4	16.3	14.8	/e
MANUFACTURING:				
Value added (real, millions of 1980-dollars)	7324	7860	8200	
Industrial production index	100	98	99	
Value added (millions of dollars)	7591	5759	10859	/e
Gross output (millions of dollars)	25525	20633	36604	/e
Employment (thousands)	474	441	437	/e
-PROFITABILITY (in percent of gross output)				
Intermediate input (%)	70	72	70	/e
Wages and salaries (%)	12	12	12	/e
Operating surplus (%)	18	16	18	/e
-PRODUCTIVITY (dollars)				
Gross output / worker	53865	46766	83805	/e
Value added / worker	16018	13052	24861	/e
Average wage	6247	5539	9935	/e
-STRUCTURAL INDICES				
Structural change θ (5-year average in degrees)	3.56	4.41	4.07	e
as a percentage of average θ in 1970-1975	61	76	70	e
MVA growth rate (θ)	1.68	-0.10	0.20	
Degree of specialization	10.9	11.8	11.6	
-VALUE ADDED (millions of dollars)				
311 Food products	1039	397	1627	
313 Beverages	264	246	524	
314 Tobacco products	138	114	208	
321 Textiles	1063	820	1590	
322 Wearing apparel	494	409	695	
323 Leather and fur products	105	88	142	
324 Footwear	111	88	92	
331 Wood and wood products	241	114	307	e
332 Furniture and fixtures	148	93	159	
341 Paper and paper products	126	101	249	e
342 Printing and publishing	216	138	251	
351 Industrial chemicals	185	197	349	e
352 Other chemical products	339	241	593	
353 Petroleum refineries	153	140	302	e
354 Miscellaneous petroleum and coal products	37	22	49	e
355 Rubber products	77	58	154	e
356 Plastic products	214	126	328	e
361 Pottery, china and earthenware	67	48	80	e
362 Glass and glass products	53	24	52	
369 Other non-metal mineral products	483	321	668	e
371 Iron and steel	203	155	311	
372 Non-ferrous metals	245	184	262	
381 Metal products	512	387	573	
382 Non-electrical machinery	131	116	218	
383 Electrical machinery	334	248	368	
384 Transport equipment	483	285	561	
385 Professional and scientific equipment	[illegible]	[illegible]	[illegible]	e
390 Other manufacturing industries	[illegible]	31	135	e

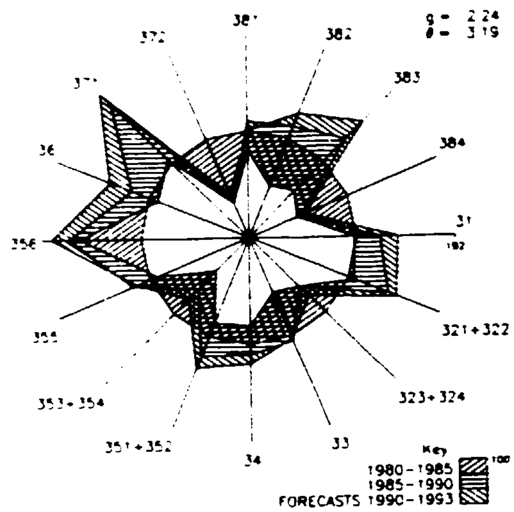
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



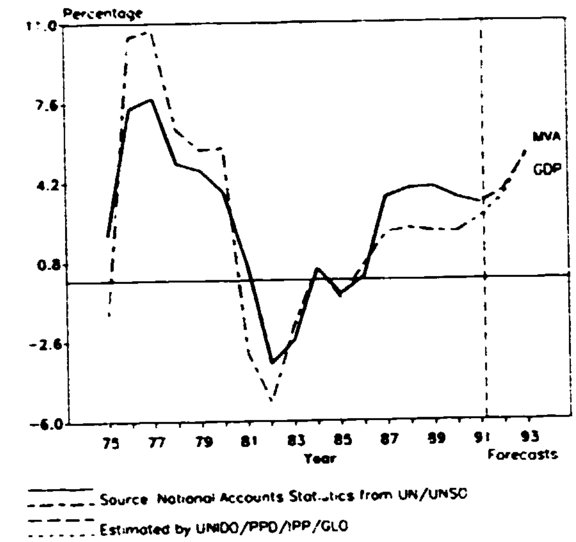


GUATEMALA

Industrial structure change
(index of value added 1980=100)



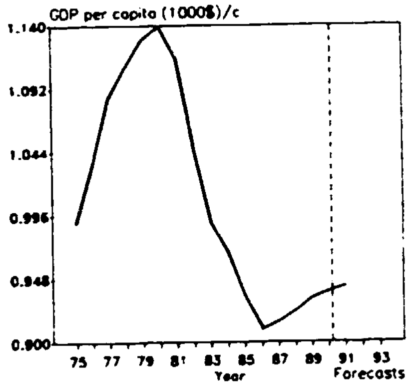
Annual growth rates of GDP and MVA
(Constant 1980 prices)



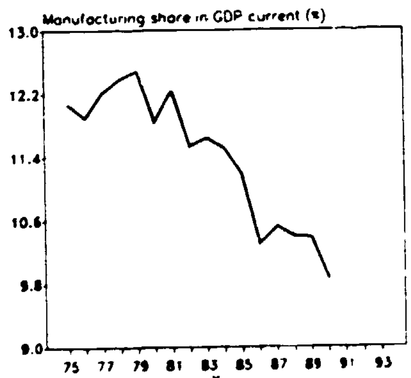
	1980	1985	1990
GDP (n.a.c., millions of 1980-dollars)	7879	7446	8631
Per capita (1980-dollars) (n.a.c.)	1139	935	938
Manufacturing share (%) (n.a.) (current prices)	11.8	11.2	9.9 /e
MANUFACTURING:			
Value added (n.a.c., millions of 1980-dollars)	1312	1179	1289
Industrial production index	100	102	112
Value added (millions of dollars)	794	906	819 /e
Gross output (millions of dollars)	1968	2195	2025 /e
Employment (thousands)	82	73	95 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	60	59	60 /e
Wages and salaries (%)	9	9 /e	8 /e
Operating surplus (%)	31	32 /e	33 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	23872	30057	21213 /e
Value added / worker	9635	12408	3577 /e
Average wage	2165	2773 /e	1610 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	5.21 /e	6.85	5.53 /e
as a percentage of average θ in 1970-1975	91 /e	120	97 /e
MVA growth rate / θ	0.71	-0.22	1.43
Degree of specialization	20.4	24.6	22.7
-VALUE ADDED: (millions of dollars)			
311 Food products	204	276	249 /e
313 Beverages	91	90	50 /e
314 Tobacco products	14	15	24 /e
321 Textiles	45	71	53 /e
322 Wearing apparel	19	13	24 /e
323 Leather and fur products	3	3	3 /e
324 Footwear	15	12	8 /e
331 Wood and wood products	10	7	8 /e
332 Furniture and fixtures	4	3	4 /e
341 Paper and paper products	19	21	15 /e
342 Printing and publishing	24	34	35 /e
351 Industrial chemicals	28	28	28 /e
352 Other chemical products	110	121	114 /e
353 Petroleum refineries	14	8	9 /e
354 Miscellaneous petroleum and coal products	2	-	- /e
355 Rubber products	21	24	21 /e
356 Plastic products	19	37	27 /e
361 Pottery, china and earthenware	2	8	8 /e
362 Glass and glass products	22	17	13 /e
369 Other non-metal mineral products	34	41	38 /e
371 Iron and steel	16	21	24 /e
372 Non-ferrous metals	1	-	- /e
381 Metal products	23	23	22 /e
382 Non-electrical machinery	6	4	5 /e
383 Electrical machinery	25	19	28 /e
384 Transport equipment	8	5	4 /e
385 Professional and scientific equipment	1	1	1 /e
390 Other manufacturing industries	4	3	4 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

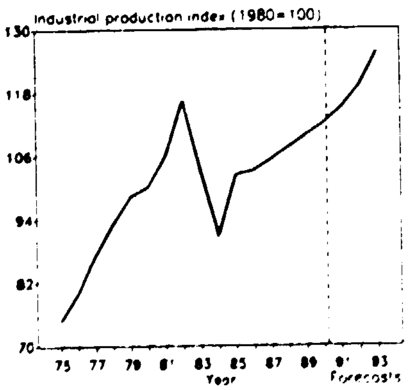
GDP per capita (1000$)/c



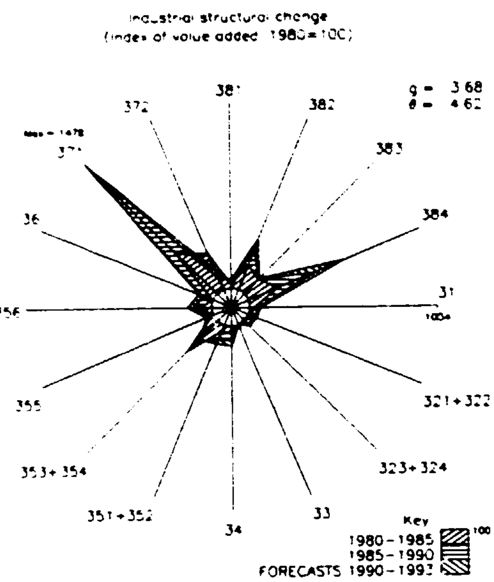
Manufacturing share in GDP current (%)

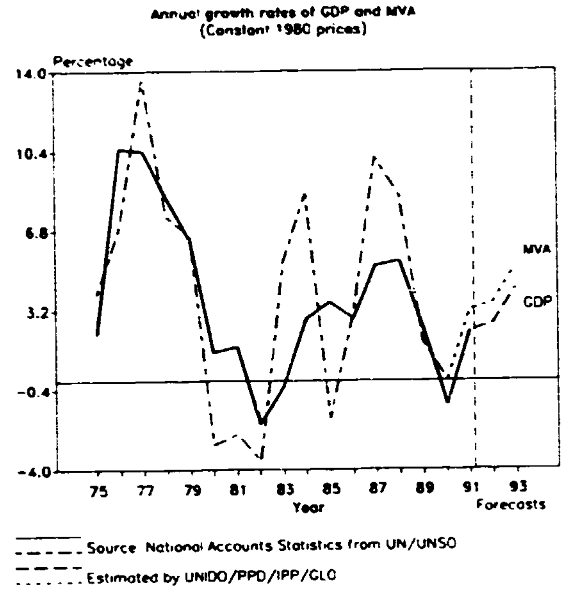


Industrial production index (1980=100)



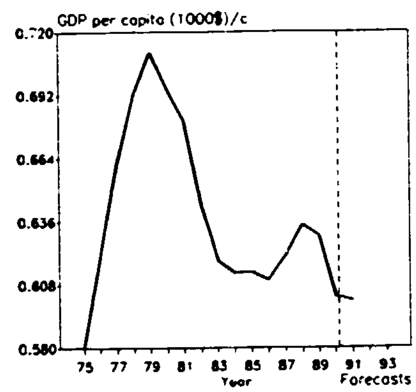
HONDURAS

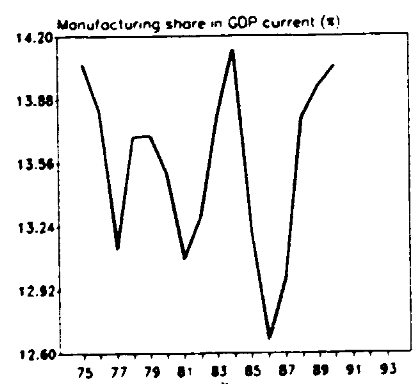


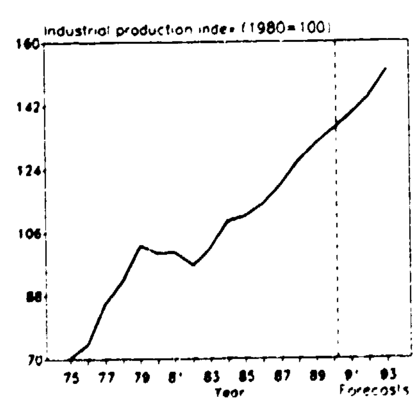


	1980	1985	1990
GDP: na.c (millions of 1980-dollars)	2544	2689	3101
Per capita (1980-dollars) /na.c	695	613	603
Manufacturing share (%) /na (current prices)	13.5	13.2	14.0 /e
MANUFACTURING:			
Value added (na.c (millions of 1980-dollars)	384	405	507
Industrial production index	100	111	135
Value added (millions of dollars)	280 /e	493	869 /e
Gross output (millions of dollars)	1019 /e	1611	2994 /e
Employment (thousands)	55 /e	64	70 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	73 /e	69	71 /e
Wages and salaries (%)	12 /e	13	12 /e
Operating surplus (%)	16 /e	18	17 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	18484 /e	25167	42601 /e
Value added / worker	5073 /e	7707	12369 /e
Average wage	2146 /e	3173	4942 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2.55 /e	4.01 /e	2.44 /e
as a percentage of average θ in 1970-1975	46 /e	73 /e	44 /e
MVA growth rate / θ	2.05	1.29	1.30
Degree of specialization	25.3	22.4	22.6
-VALUE ADDED: (millions of dollars)			
311 Food products	75 /e	129	248 /e
313 Beverages	57 /e	79	144 /e
314 Tobacco products	19 /e	42	56 /e
321 Textiles	12 /e	13 /e	33 /e
322 Wearing apparel	6 /e	14	21 /e
323 Leather and fur products	2 /e	2	5 /e
324 Footwear	1 /e	2	5 /e
331 Wood and wood products	20 /e	30	35 /e
332 Furniture and fixtures	5 /e	8	12 /e
341 Paper and paper products	4 /e	9	23 /e
342 Printing and publishing	8 /e	13	22 /e
351 Industrial chemicals	1 /e	2	4 /e
352 Other chemical products	11 /e	20	38 /e
353 Petroleum refineries	9 /e	38	47 /e
354 Miscellaneous petroleum and coal products	- /e	-	- /e
355 Rubber products	5 /e	8	14 /e
356 Plastic products	8 /e	18	33 /e
361 Pottery, china and earthenware	- /e	-	1 /e
362 Glass and glass products	- /e	-	- /e
369 Other non-metal mineral products	16 /e	24	54 /e
371 Iron and steel	- /e	1	5 /e
372 Non-ferrous metals	- /e	1	1 /e
381 Metal products	13 /e	21	33 /e
382 Non-electrical machinery	1 /e	3	7 /e
383 Electrical machinery	3 /e	8	12 /e
384 Transport equipment	/e	2	4 /e
385 Professional and scientific equipment	- /e	1	2 /e
390 Other manufacturing industries	1 /e	5	10 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

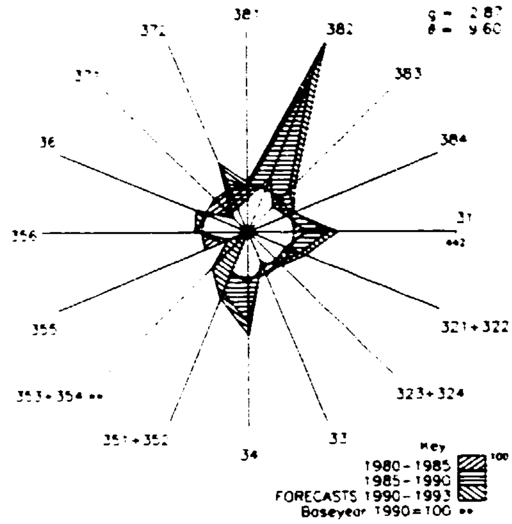




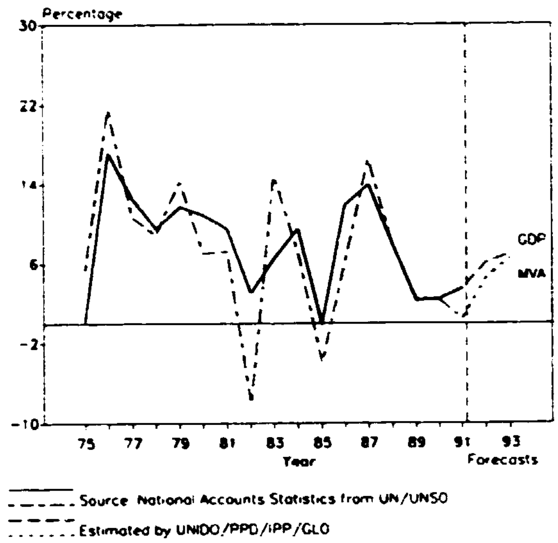


HONG KONG

Industrial structural change
(index of value added 1980=100)



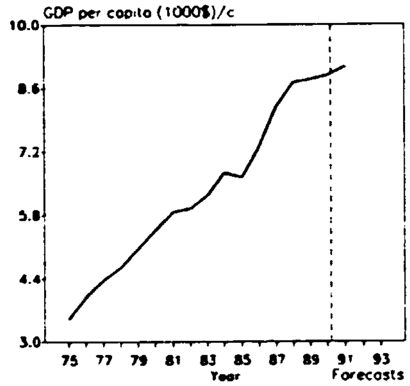
Annual growth rates of GDP and MVA
(Constant 1980 prices)



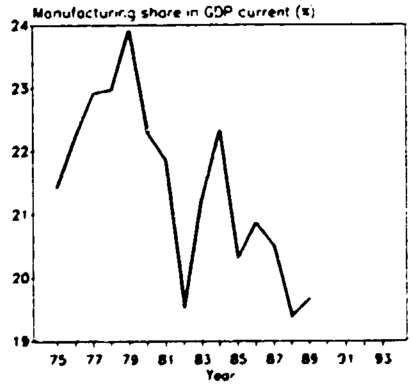
	1980	1985	1990
GDP: (na.c.) (millions of 1980-dollars)	27526	36134	52061
Per capita (1980-dollars) (na.c)	5463	6622	8873
Manufacturing share (%) (na.) (current prices)	22.3	20.3	
MANUFACTURING:			
Value added (na.c.) (millions of 1980-dollars)	6548	7613	10671
Industrial production index	100	129	189
Value added (millions of dollars)	7343	6582	13801 /e
Gross output (millions of dollars)	22187	22835	52910 /e
Employment (thousands)	937	908	917 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	67	71	74 /e
Wages and salaries (%)	17	18	15 /e
Operating surplus (%)	16	11	12 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	23686	25140	57683 /e
Value added / worker	7840	7246	15046 /e
Average wage	4079	4583	8408 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	4.54	4.42	4.06 /e
as a percentage of average θ in 1970-1975	66	64	59 /e
MVA growth rate (θ)	3.20	-0.35	1.91
Degree of specialization	24.2	22.6	23.5
-VALUE ADDED: (millions of dollars)			
311 Food products	161	171	390 /e
313 Beverages	99	125	199 /e
314 Tobacco products	81	127	252 /e
321 Textiles	1027	964	2150 /e
322 Wearing apparel	1920	1594	2998 /e
323 Leather and fur products	43	26	52 /e
324 Footwear	59	62	85 /e
331 Wood and wood products	45	32	41 /e
332 Furniture and fixtures	62	54	75 /e
341 Paper and paper products	110	90	299 /e
342 Printing and publishing	290	350	841 /e
351 Industrial chemicals	40	36	87 /e
352 Other chemical products	77	71	149 /e
353 Petroleum refineries	-	-	- /e
354 Miscellaneous petroleum and coal products	-	-	7 /e
355 Rubber products	29	17	19 /e
356 Plastic products	563	612	900 /e
361 Pottery, china and earthenware	5	3	6 /e
362 Glass and glass products	10	17	18 /e
369 Other non-metal mineral products	55	47 /e	78 /e
371 Iron and steel	31	17	24 /e
372 Non-ferrous metals	35	20	63 /e
381 Metal products	638	460	899 /e
382 Non-electrical machinery	188	236	373 /e
383 Electrical machinery	987	752	1826 /e
384 Transport equipment	176	157	272 /e
385 Professional and scientific equipment	362	289	656 /e
390 Other manufacturing industries	250	253	445 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

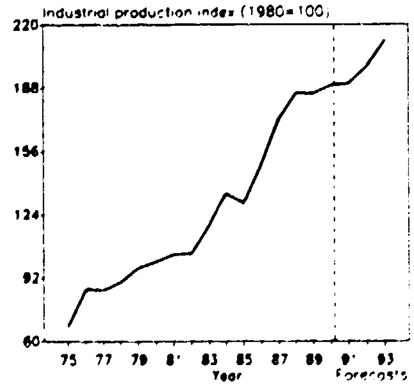
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

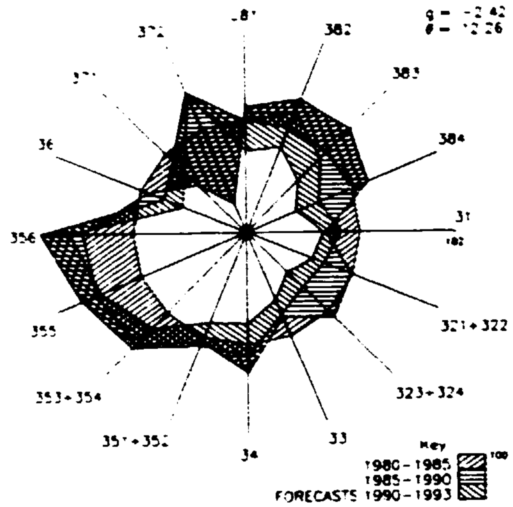


Industrial production index (1980=100)

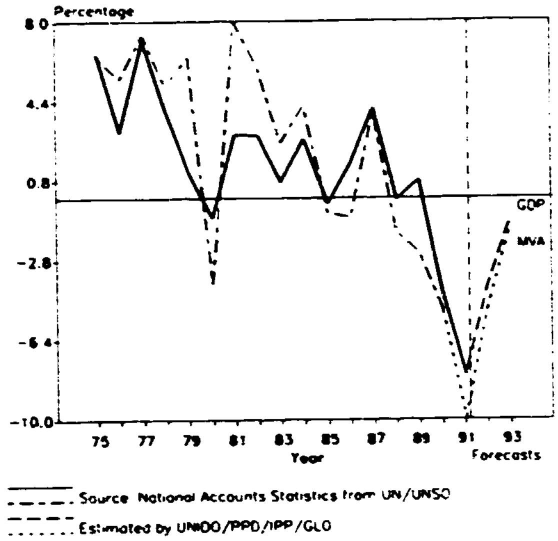


HUNGARY

Industrial structural change (index of value added 1980=100)



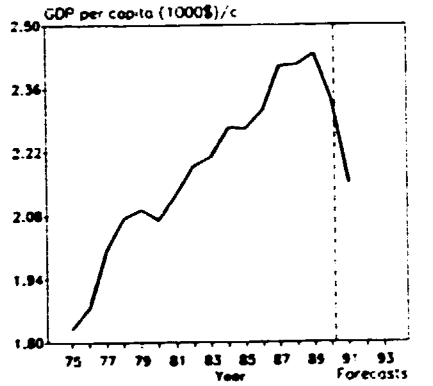
Annual growth rates of GDP and MVA (Constant 1980 prices)



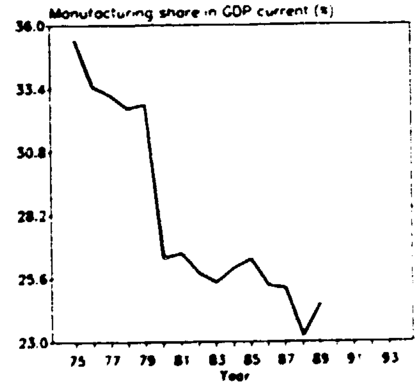
	1980	1985	1990
GDP: (na.c millions of 1980-dollars)	22165	24184	24641
Per capita (1980-dollars) (na.c)	2069	2271	2336
Manufacturing share (%) (na) (current prices)	26.4	26.4	
MANUFACTURING:			
Value added (na.c millions of 1980-dollars)	6541	7931	7443
Industrial production index	100	111	106
Value added (millions of dollars)	5907	5356	7799 /e
Gross output (millions of dollars)	24898	21690	25081
Employment (thousands)	1384	1278	1117
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	76	75	69 /e
Wages and salaries (%)	8	8	11
Operating surplus (%)	16	16	20 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	17990	16972	22454
Value added / worker	4268	4191	6982 /e
Average wage	1437	1403	2441
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	5.33	4.99	6.77 /e
as a percentage of average θ in 1970-1975	105	98	134 /e
MVA growth rate / θ	-1.29	0.05	-0.19
Degree of specialization	9.9	10.9	9.5
-VALUE ADDED: (millions of dollars)			
311 Food products	555	281	600 /e
313 Beverages	83	107	138 /e
314 Tobacco products	27	28	41 /e
321 Textiles	353	325	369 /e
322 Wearing apparel	194	158	201 /e
323 Leather and fur products	48	39	42 /e
324 Footwear	79	85	82 /e
331 Wood and wood products	81	42	82 /e
332 Furniture and fixtures	101	92	124 /e
341 Paper and paper products	94	106	125 /e
342 Printing and publishing	83	94	152 /e
351 Industrial chemicals	417	320	552 /e
352 Other chemical products	242	303	459 /e
353 Petroleum refineries	152 /e	192 /e	308 /e
354 Miscellaneous petroleum and coal products	3 /e	3 /e	7 /e
355 Rubber products	55	71	123 /e
356 Plastic products	61	80	158 /e
361 Pottery, china and earthenware	57	46	62 /e
362 Glass and glass products	70	71	90 /e
369 Other non-metal mineral products	204	161	215 /e
371 Iron and steel	370	200	476 /e
372 Non-ferrous metals	215	54	412 /e
381 Metal products	214	215	300 /e
382 Non-electrical machinery	497	569	809 /e
383 Electrical machinery	655	758	854 /e
384 Transport equipment	486	507	480 /e
385 Professional and scientific equipment	272	287	386 /e
390 Other manufacturing industries	237	164	151 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

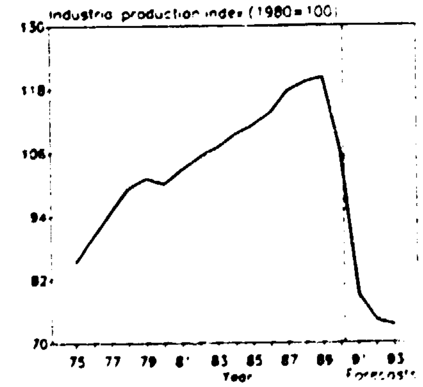
GDP per capita (1000$)/c



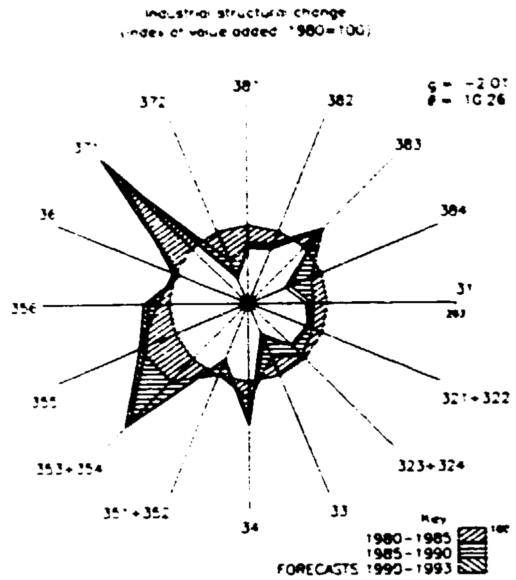
Manufacturing share in GDP current (%)

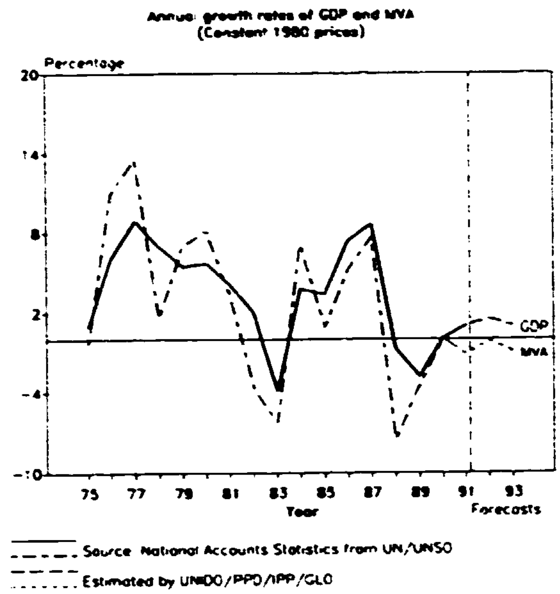


Industrial production index (1980=100)



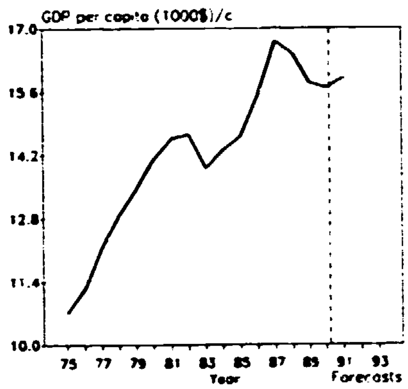
ICELAND

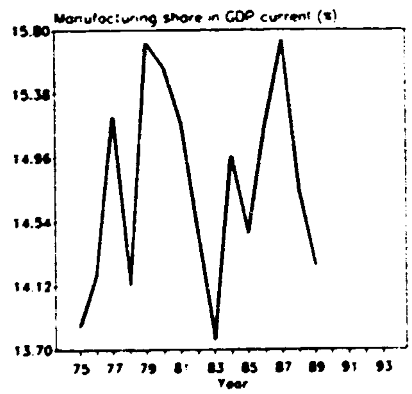


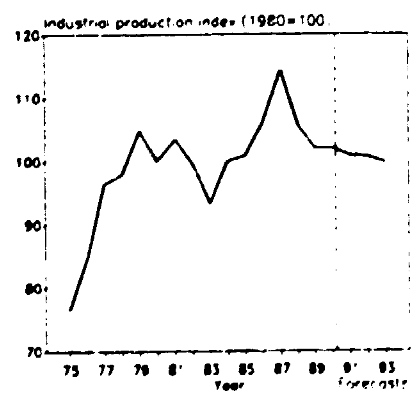


	1980	1985	1990
GDP (n.a.c., millions of 1980-dollars)	3230	3534	3981
Per capita (1980-dollars, n.a.c.)	14104	14605	15675
Manufacturing share (%, n.a., current prices)	15.6	14.5	
MANUFACTURING:			
Value added (n.a.c., millions of 1980-dollars)	685	690	698
Industrial production index	100	101	102
Value added (millions of dollars)	765	553	914 e
Gross output (millions of dollars)	1969	1629	2917 e
Employment (thousands)	28	30	28 e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	61	66	69 e
Wages and salaries (%)	20 e	19 e	21 e
Operating surplus (%)	19 e	15 e	11 e
-PRODUCTIVITY: (dollars)			
Gross output / worker	69709	54610	104768 e
Value added / worker	21097	18556	32815 e
Average wage	13686 e	10407 e	21549 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2.44	4.37	2.38 e
as a percentage of average θ in 1970-1975	75	135	74 e
MVA growth rate (θ)	4.07	-0.42	-0.65
Degree of specialization	31.8	27.8	30.3
-VALUE ADDED: (millions of dollars)			
311 Food products	330	221	383 e
313 Beverages	11	10	14 e
314 Tobacco products			
321 Textiles	26	21	41 e
322 Wearing apparel	17	11	10 e
323 Leather and fur products	8	6	10 e
324 Footwear	1	1	1 e
331 Wood and wood products	-	-	1 e
332 Furniture and fixtures	53	32	38 e
341 Paper and paper products	5	5	8 e
342 Printing and publishing	36	37	83 e
351 Industrial chemicals	11	9	14 e
352 Other chemical products	11	9	12 e
353 Petroleum refineries	-	-	- e
354 Miscellaneous petroleum and coal products	-	-	- e
355 Rubber products	5	6	11 e
356 Plastic products	12	11	22 e
361 Pottery, china and earthenware	1	-	- e
362 Glass and glass products	4	3	3 e
369 Other non metal mineral products	22	19	33 e
371 Iron and steel	6	11	22 e
372 Non-ferrous metals	50	24	28 e
381 Metal products	22 e	14 e	23 e
382 Non-electrical machinery	48 e	33 e	58 e
383 Electrical machinery	15	16	27 e
384 Transport equipment	55	47	55 e
385 Professional and scientific equipment	2	1	2 e
390 Other manufacturing industries	3	4	7 e

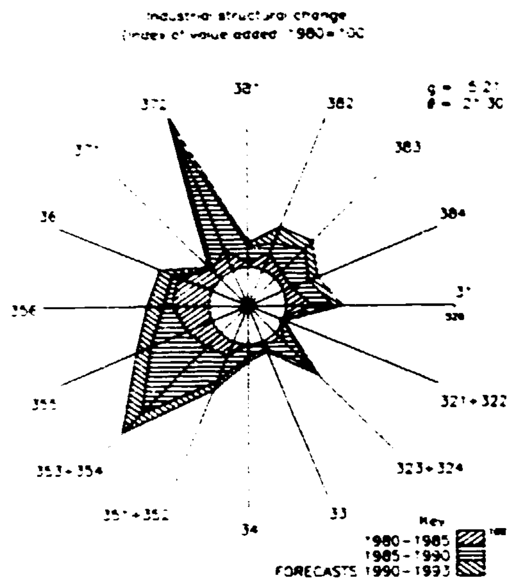
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

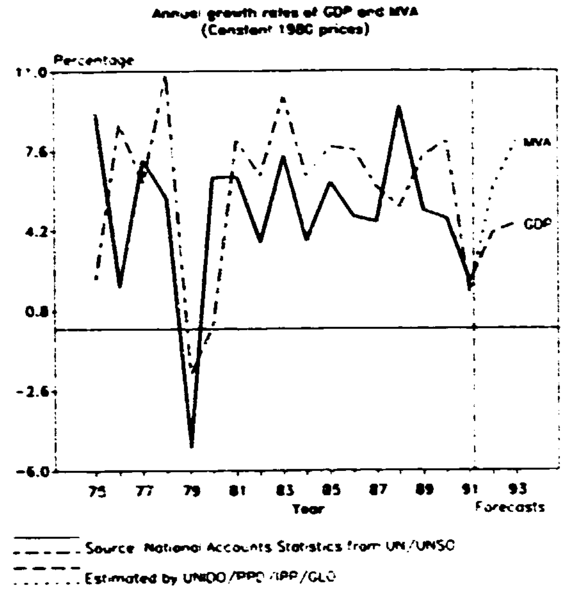






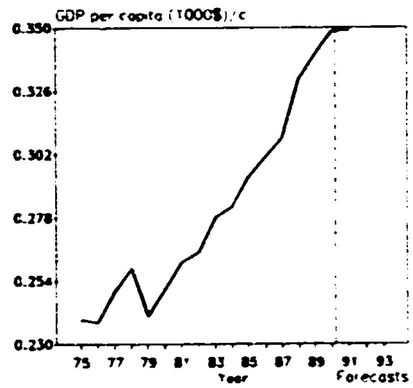
INDIA

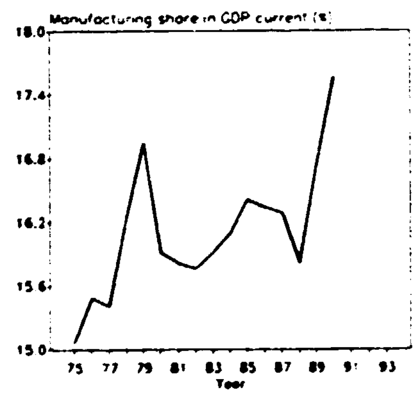


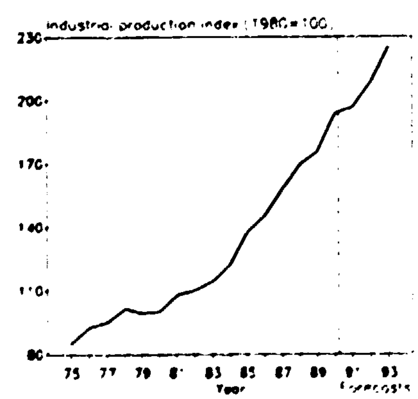


	1980	1985	1990
GDP: (n.a.c.) (millions of 1980-dollars)	172723	225652	297411
Per capita (1980-dollars) (n.a.c.)	251	293	349
Manufacturing share (%) (n.a.) (current prices)	15.9	16.4	17.6 e
MANUFACTURING:			
Value added (n.a.c.) (millions of 1980-dollars)	30586	44400	61796
Industrial production index	100	137	194
Value added (millions of dollars)	13086	15526	21395 e
Gross output (millions of dollars)	71387	88304	120389 e
Employment (thousands)	6992	6578	7746 e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	82	82	82 e
Wages and salaries (%)	9	8	8 e
Operating surplus (%)	9	9	9 e
-PRODUCTIVITY: (dollars)			
Gross output / worker	10210	13423	15541 e
Value added / worker	1872	2360	2762 e
Average wage	949	1136	1303 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	4.85	7.59	4.32 e
as a percentage of average θ in 1970-1975	83	130	74 e
MVA growth rate / θ	0.42	0.68	1.40
Degree of specialization	19.3	16.9	14.9
-VALUE ADDED: (millions of dollars)			
311 Food products	899	1436	1907 e
313 Beverages	39	135	234 e
314 Tobacco products	136	230	318 e
321 Textiles	2642	2135	2207 e
322 Wearing apparel	62	87	256 e
323 Leather and fur products	48	52	71 e
324 Footwear	37	52	107 e
331 Wood and wood products	74	73	92 e
332 Furniture and fixtures	8	7	10 e
341 Paper and paper products	296	233	317 e
342 Printing and publishing	256	230	363 e
351 Industrial chemicals	778	1200	1794 e
352 Other chemical products	1062	1146	1855 e
353 Petroleum refineries	203	344	1101 e
354 Miscellaneous petroleum and coal products	151	152	200 e
355 Rubber products	234	363	600 e
356 Plastic products	93	166	191 e
361 Pottery, china and earthenware	47	27	59 e
362 Glass and glass products	67	101	101 e
369 Other non-metal mineral products	399	775	856 e
371 Iron and steel	1489	1790	1842 e
372 Non-ferrous metals	81	115	361 e
381 Metal products	421	425	603 e
382 Non-electrical machinery	1130	1506	1847 e
383 Electrical machinery	1061	1231	2086 e
384 Transport equipment	1288	1231	1733 e
385 Professional and scientific equipment	32	118	[illegible] e
390 Other manufacturing industries	72	145	123 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

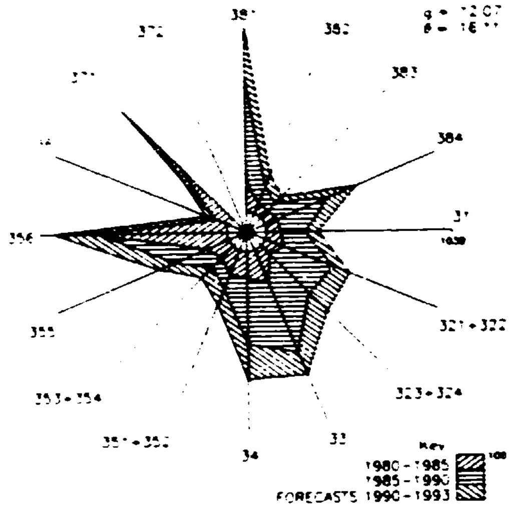




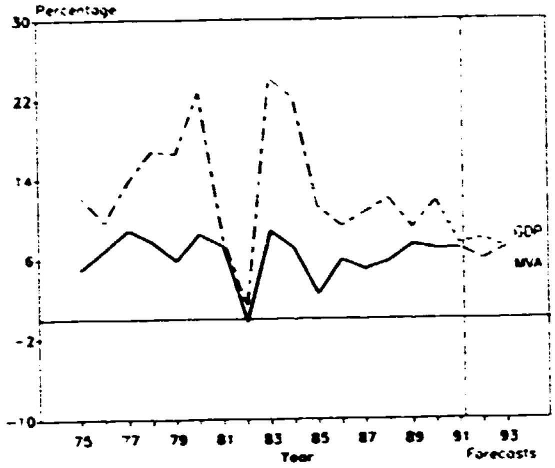


INDONESIA

Industrial structure change
Index of value added (1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)



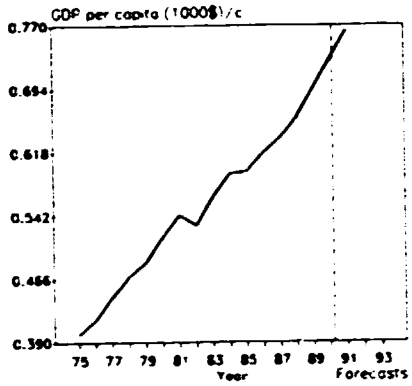
Source: National Accounts Statistics from UN/UNSO

Estimated by UNIDO/PPD/IPP/GLO

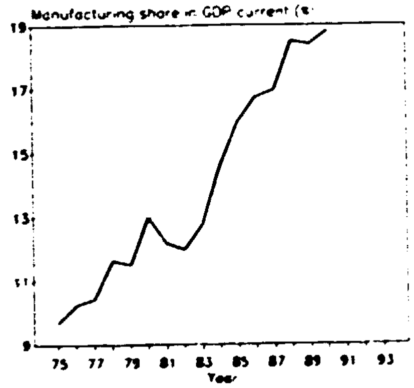
	1980	1985	1990
GDP (real) (millions of 1980-dollars)	78013	99479	134223
Per capita (1980-dollars) (real)	517	595	728
Manufacturing share (%) (real) (current prices)	13.0	16.0	18.3 e
MANUFACTURING:			
Value added (real) (millions of 1980-dollars)	10133	18632	30765
Industrial production index	100	138	174
Value added (millions of dollars)	4368	5098 e	12554 e
Gross output (millions of dollars)	13205	22559	38538 e
Employment (thousands)	963	1672	2378 e
-PROFITABILITY (in percent of gross output)			
Intermediate input (%)	69	69	71 e
Wages and salaries (%)	7	7	6 e
Operating surplus (%)	25	24	23 e
-PRODUCTIVITY (dollars)			
Gross output / worker	11290	12401	15357 e
Value added / worker	3519	3880	4467 e
Average wage	743	921	935 e
-STRUCTURAL INDICES			
Structural change θ (5-year average in degrees)	12.26	11.69 e	6.71 e
as a percentage of average θ in 1970-1975	104	99 e	57 e
MVA growth rate / θ	1.10	1.36	1.32
Degree of specialization	20.5	16.5	16.0
-VALUE ADDED (millions of dollars)			
311 Food products	376	370	1283 e
313 Beverages	51	77	30 e
314 Tobacco products	649	741	1158 e
321 Textiles	420	687	1373 e
322 Wearing apparel	15	105	244 e
323 Leather and fur products	5	14	15 e
324 Footwear	26	31	94 e
331 Wood and wood products	239	612	1230 e
332 Furniture and fixtures	6	18	51 e
341 Paper and paper products	43	110	269 e
342 Printing and publishing	51	92	156 e
351 Industrial chemicals	145	385	475 e
352 Other chemical products	241	430	486 e
353 Petroleum refineries	378	1611 e	1333 e
354 Miscellaneous petroleum and coal products	-	-	. e
355 Rubber products	164	328	516 e
356 Plastic products	25	175	148 e
361 Pottery, china and earthenware	8	24	49 e
362 Glass and glass products	36	38	58 e
369 Other non metal mineral products	200	262	[illegible] e
371 Iron and steel	107	459b	142b e
372 Non ferrous metals	-	b	b
381 Metal products	118	278	132 e
382 Non electrical machinery	53	75	118 e
383 Electrical machinery	130	245	291 e
384 Transport equipment	211	331	169 e
385 Professional and scientific equipment	2	4	1 e
390 Other manufacturing industries	13	24	54 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

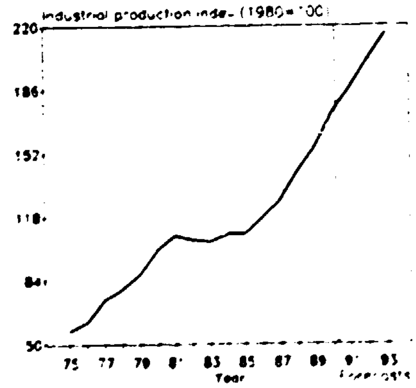
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

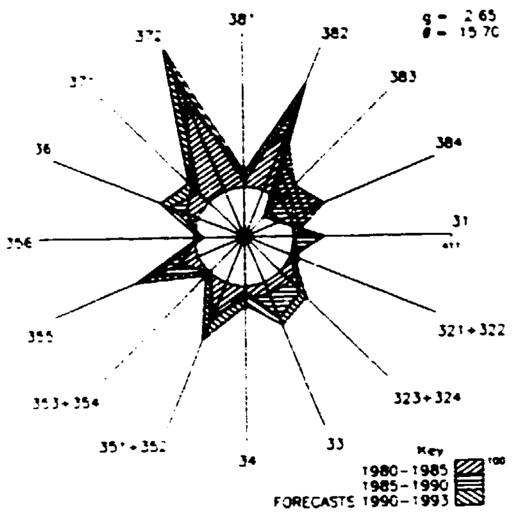


Industrial production index (1980=100)

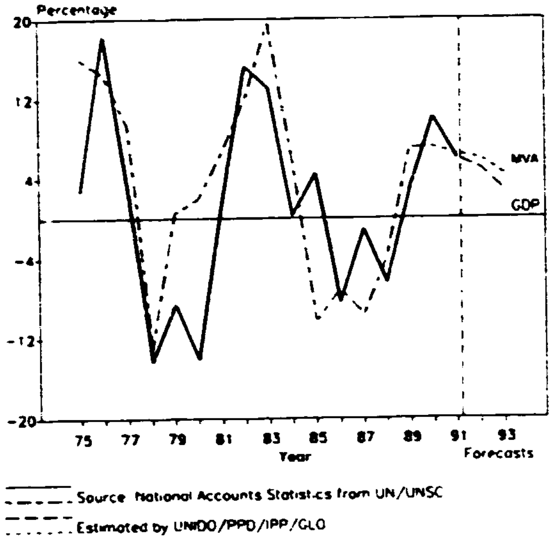


IRAN (ISLAMIC REPUBLIC OF)

Industrial structural change
(index of value added 1980=100)



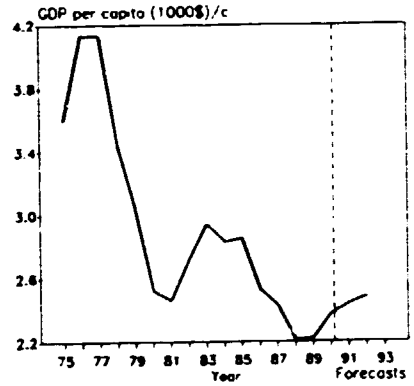
Annual growth rates of GDP and MVA
(Constant 1980 prices)



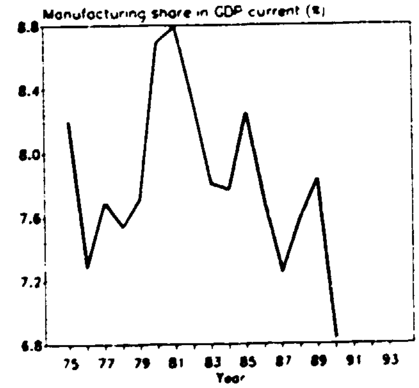
	1980	1985	1990
GDP: (na.c) (millions of 1980-dollars)	98081	135805	130327
Per capita (1980-dollars) /na.c	2521	2852	2373
Manufacturing share (%) /na (current prices)	8 7	8 2	6 8 /e
MANUFACTURING:			
value added (na c) (millions of 1980-dollars)	8739	11867	10947
Industrial production index	100	135	115
value added (millions of dollars)	8186	13446 /e	44486 /e
Gross output (millions of dollars)	15871	26458 /e	81216 /e
Employment (thousands)	470	614	737 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	48	49 /e	45 /e
wages and salaries (%)	29	26 /e	24 /e
Operating surplus (%)	23	25 /e	31 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	33756	43072 /e	110213 /e
value added / worker	17411	21889 /e	60369 /e
Average wage	9668	11294	26448 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	10 92 /e	5 56 /e	7 75 /e
as a percentage of average θ in 1970-1975	166 /e	84 /e	118 /e
MVA growth rate θ	0 46	0 79	0 20
Degree of specialization	20 3	17 5	16 0
-VALUE ADDED: (millions of dollars)			
311 Food products	930	1259	3608 /e
313 Beverages	145	302	972 /e
314 Tobacco products	190 /e	103	4134 /e
321 Textiles	1329	2119	5562 /e
322 Wearing apparel	78	76	471 /e
323 Leather and fur products	36	67	379 /e
324 Footwear	100	165	538 /e
331 Wood and wood products	68	120	591 /e
332 Furniture and fixtures	33	48	177 /e
341 Paper and paper products	135	261	516 /e
342 Printing and publishing	80	97	501 /e
351 Industrial chemicals	93	232	901 /e
352 Other chemical products	278	606	2027 /e
353 Petroleum refineries	1652	2087 /e	6461 /e
354 Miscellaneous petroleum and coal products	2	32	245 /e
355 Rubber products	93	180	815 /e
356 Plastic products	198	235	691 /e
361 Pottery, china and earthenware	45	76	192 /e
362 Glass and glass products	115	167	465 /e
369 Other non-metal mineral products	819	1368	6031 /e
371 Iron and steel	367	713	1968 /e
372 Non-ferrous metals	48	131	742 /e
381 Metal products	319	555	1499 /e
382 Non-electrical machinery	208	632	2584 /e
383 Electrical machinery	391	749	924 /e
384 Transport equipment	399	927	1271 /e
385 Professional and scientific equipment	24	55	104 /e
390 Other manufacturing industries	11	26	116 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

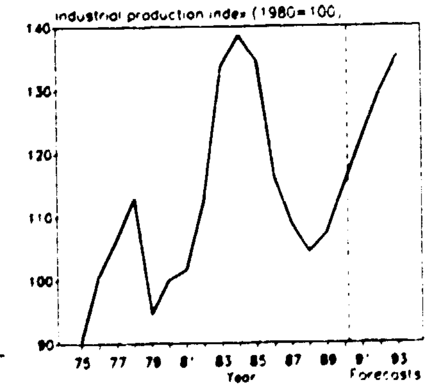
GDP per capita (1000$)/c



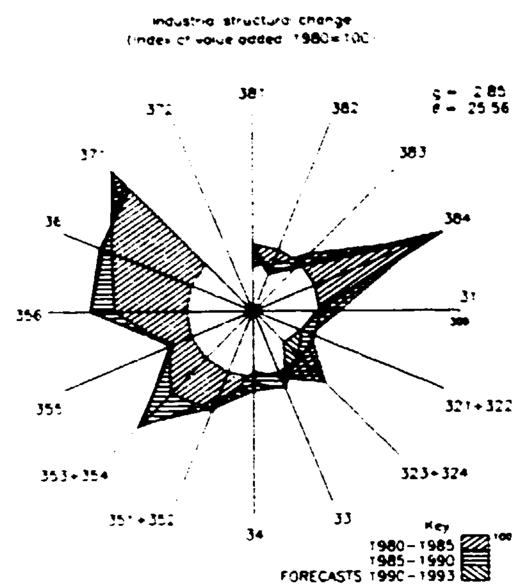
Manufacturing share in GDP current (%)

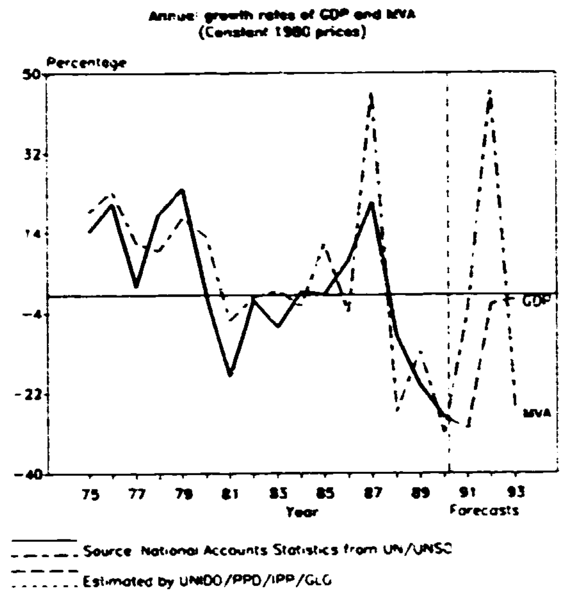


Industrial production index (1980=100)



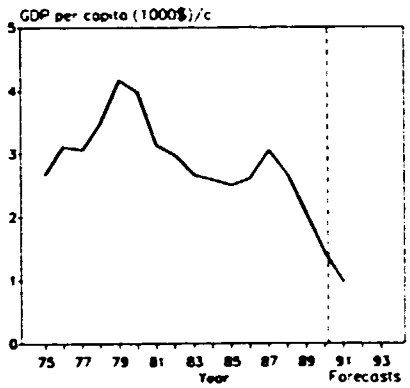
IRAQ

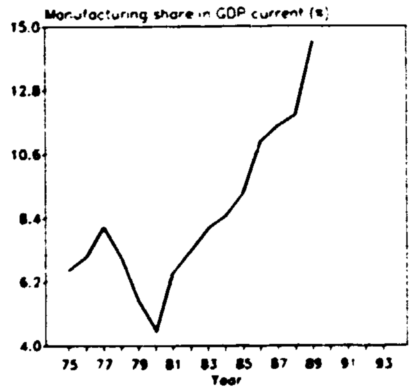


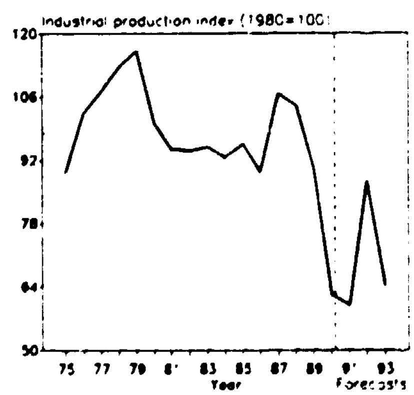


	1980	1985	1990
GDP: (na.c) (millions of 1980-dollars)	52749	39805	27174
Per capita (1980-dollars) (na.c)	3969	2504	1436
Manufacturing share (%) (na) (current prices)	4.5	9.3	
MANUFACTURING:			
Value added (na.c) (millions of 1980-dollars)	2363	2437	1520
Industrial production index	100	95	62
Value added (millions of dollars)	2081 /e	3676	3605 /e
Gross output (millions of dollars)	5214 /e	7162	6584 /e
Employment (thousands)	177	174	161 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	60 /e	49	45 /e
Wages and salaries (%)	13 /e	13	13 /e
Operating surplus (%)	27 /e	39	42 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	29842 /e	41090	40853 /e
Value added / worker	11947 /e	21088	22367 /e
Average wage	3700	5242	5376 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	6.56 /e	5.13 /e	4.03 /e
as a percentage of average θ in 1970-1975	43 /e	34 /e	26 /e
MVA growth rate / θ	1.94	1.66	0.31
Degree of specialization	20.1	24.2	27.9
-VALUE ADDED: (millions of dollars)			
311 Food products	227 /e	396	271 /e
313 Beverages	81 /e	125	105 /e
314 Tobacco products	105 /e	140	104 /e
321 Textiles	233 /e	248	204 /e
322 Wearing apparel	30 /e	53	40 /e
323 Leather and fur products	24 /e	1	1 /e
324 Footwear	19 /e	81	48 /e
331 Wood and wood products	1 /e	1	2 /e
332 Furniture and fixtures	10 /e	13	13 /e
341 Paper and paper products	48 /e	52	66 /e
342 Printing and publishing	27 /e	33	40 /e
351 Industrial chemicals	79 /e	151	142 /e
352 Other chemical products	190 /e	389	356 /e
353 Petroleum refineries	392 /e	868	1135 /e
354 Miscellaneous petroleum and coal products	27 /e	40	38 /e
355 Rubber products	6 /e	10	10 /e
356 Plastic products	13 /e	33	37 /e
361 Pottery, china and earthenware	1 /e	1	1 /e
362 Glass and glass products	21 /e	35	29 /e
369 Other non-metal mineral products	190 /e	565	579 /e
371 Iron and steel	5 /e	20 /e	18 /e
372 Non-ferrous metals	- /e	- /e	- /e
381 Metal products	55 /e	47	64 /e
382 Non-electrical machinery	161 /e	149	120 /e
383 Electrical machinery	123 /e	185	140 /e
384 Transport equipment	12 /e	40	43 /e
385 Professional and scientific equipment	1 /e	-	- /e
390 Other manufacturing industries	1 /e	-	- /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

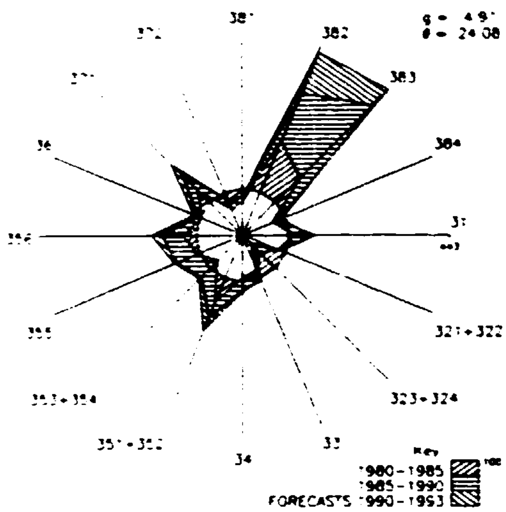




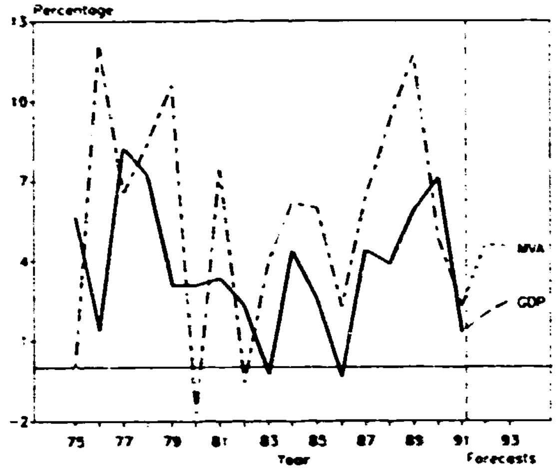


IRELAND

Industrial structural change
Index of value added 1980=100



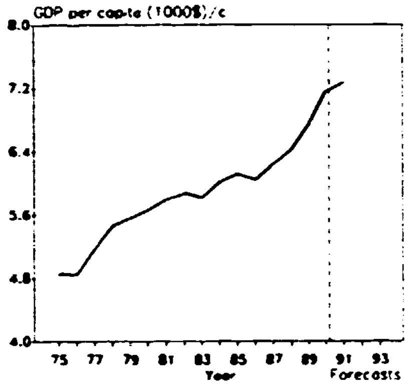
Annual growth rates of GDP and MVA
(Constant 1980 prices)



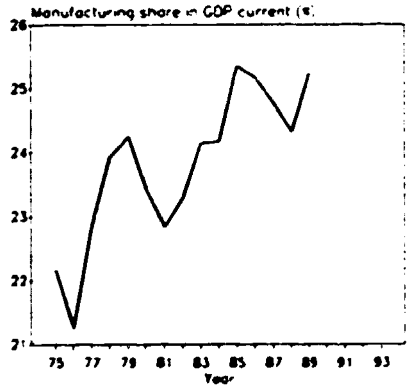
	1980	1985	1990	
GDP (nat.c., millions of 1980-dollars)	19261	21722	26607	
Per capita (1980-dollars) (nat.c.)	5662	6114	7154	
Manufacturing share (%) (nat. current prices)	23.4	25.3		
MANUFACTURING:				
Value added (nat.c., millions of 1980-dollars)	4917	6145	8540	
Industrial production index	100	122	175	
Value added (millions of dollars)	5700	5988	15415	
Gross output (millions of dollars)	15905	15394	34894	
Employment (thousands)	225	186	194	
-PROFITABILITY (in percent of gross output)				
Intermediate input (%)	64	61	56	
Wages and salaries (%)	16	13	11	e
Operating surplus (%)	20	26	33	e
-PRODUCTIVITY (dollars)				
Gross output / worker	70785	82588	179922	e
Value added / worker	25369	32126	79483	e
Average wage	11067	10455	20537	e
-STRUCTURAL INDICES				
Structural change θ (5-year average in degrees)	4.50	4.53	3.60	
as a percentage of average θ in 1970-1975	94	95	75	
MVA growth rate / θ	1.41	0.87	1.88	
Degree of specialization	14.9	18.8	21.8	
-VALUE ADDED (millions of dollars)				
311 Food products	1264	1194	3126	
313 Beverages	325	331	750	
314 Tobacco products	83	83	136	
321 Textiles	256	181	373	
322 Wearing apparel	147	118	195	
323 Leather and fur products	28	12	16	e
324 Footwear	42	22	21	e
331 Wood and wood products	93	66	177	e
332 Furniture and fixtures	59	40	76	e
341 Paper and paper products	105	75	167	
342 Printing and publishing	265	219	538	
351 Industrial chemicals	236	315	737	e
352 Other chemical products	536	715	1653	e
353 Petroleum refineries	22	15	46	
354 Miscellaneous petroleum and coal products	-	-	-	e
355 Rubber products	52	48	130	e
356 Plastic products	113	128	322	e
361 Pottery, china and earthenware	28	13	33	e
362 Glass and glass products	109	113	210	e
369 Other non metal mineral products	322	260	536	e
371 Iron and steel	31	37	94	e
372 Non ferrous metals	15	8	20	e
381 Metal products	335	216	457	
382 Non-electrical machinery	449	354	2408	
383 Electrical machinery	337	512	2168	
384 Transport equipment	190	116	275	
385 Professional and scientific equipment	168	251	637	e
390 Other manufacturing industries	79	39	115	e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

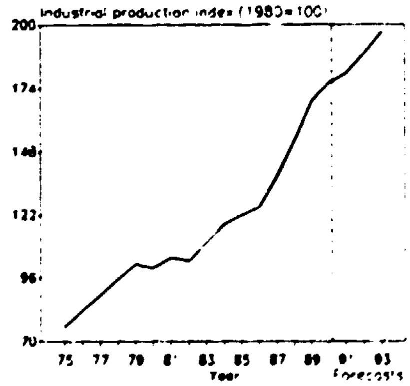
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

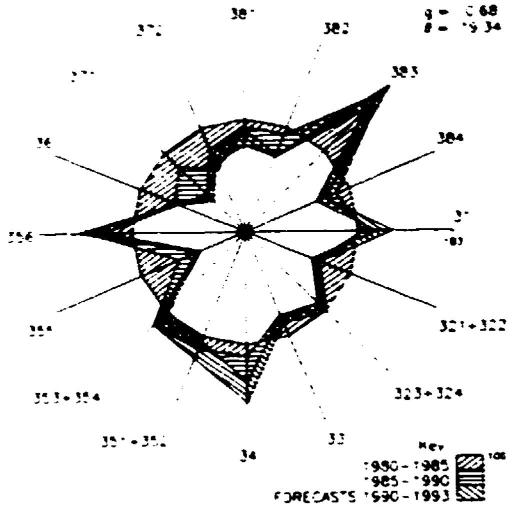


Industrial production index (1980=100)

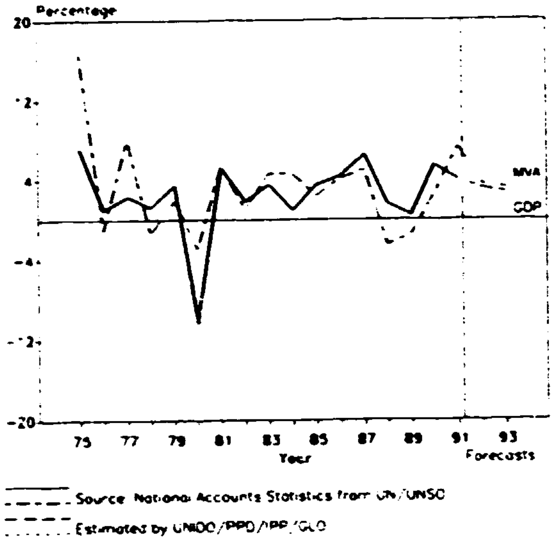


ISRAEL

Industrial structure change
(index of value added: 1980=100)



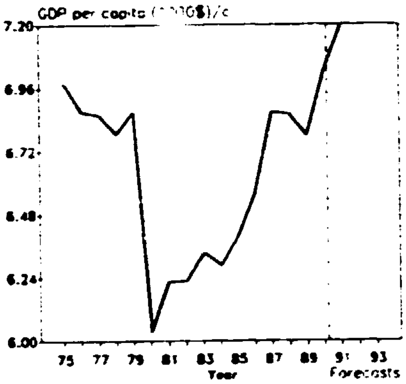
Annual growth rates of GDP and MVA
(Constant 1980 prices)



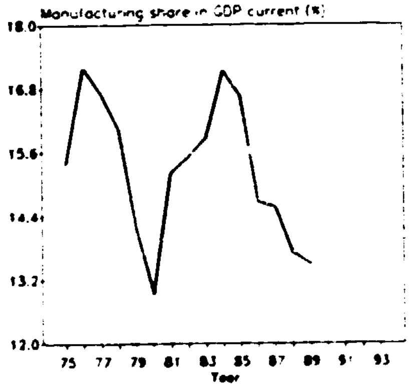
	1980	1985	1990	
GDP (nat. c.) millions of 1980-dollars	23400	27066	32337	
Per capita (1980-dollars) (nat. c.)	6034	6394	7024	
Manufacturing share (%) (nat. current prices)	12.9	16.6		
MANUFACTURING.				
Value added (nat. c.) millions of 1980-dollars	4200	5006	5388	
Industrial production index	100	119	133	
Value added (millions of dollars)	6490	5655	10497	e
Gross output (millions of dollars)	14332	16351	27990	e
Employment (thousands)	259	292	277	e
-PROFITABILITY (in percent of gross output)				
Intermediate input (%)	55	59	62	e
Wages and salaries (%)	24	24	17	e
Operating surplus (%)	21	17	21	e
-PRODUCTIVITY (dollars)				
Gross output / worker	55422	55940	100950	e
Value added / worker	25096	22768	37858	e
Average wage	13433	13373	16869	e
-STRUCTURAL INDICES:				
Structural change θ: 5-year average in degrees	5.50	6.41	4.53	e
as a percentage of average θ in 1970-1975	99	115	81	e
MVA growth rate (%)	1.76	0.87	-0.36	
Degree of specialization	14.8	18.3	18.0	
-VALUE ADDED: (millions of dollars)				
311 Food products	706	748	1395	e
313 Beverages	56	56	155	e
314 Tobacco products	24	10	17	e
321 Textiles	422	243	382	e
322 Wearing apparel	293	229	395	e
323 Leather and fur products	18	13	21	e
324 Footwear	38	42	65	e
331 Wood and wood products	112	78	119	e
332 Furniture and fixtures	90	81	158	e
341 Paper and paper products	150	135	294	e
342 Printing and publishing	184	227	462	e
351 Industrial chemicals	256	317	473	e
352 Other chemical products	250	241	425	e
353 Petroleum refineries	93	106	155	e
354 Miscellaneous petroleum and coal products	93	106	155	e
355 Rubber products	104	64	75	e
356 Plastic products	212	290	451	e
361 Pottery, china and earthenware	26	25	25	e
362 Glass and glass products	30	23	24	e
369 Other non-metal mineral products	239	143	272	e
371 Iron and steel	148	118	37	e
372 Non-ferrous metals	61	36	70	e
381 Metal products	1160	367	1385	e
382 Non electrical machinery	245	224	297	e
383 Electrical machinery	331	1415	2148	e
384 Transport equipment	510	522	1108	e
385 Professional and scientific equipment	55	129	161	e
390 Other manufacturing industries	53	67	113	e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

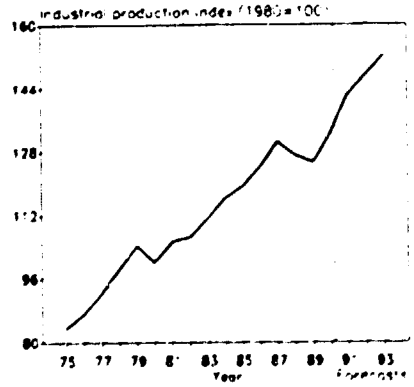
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

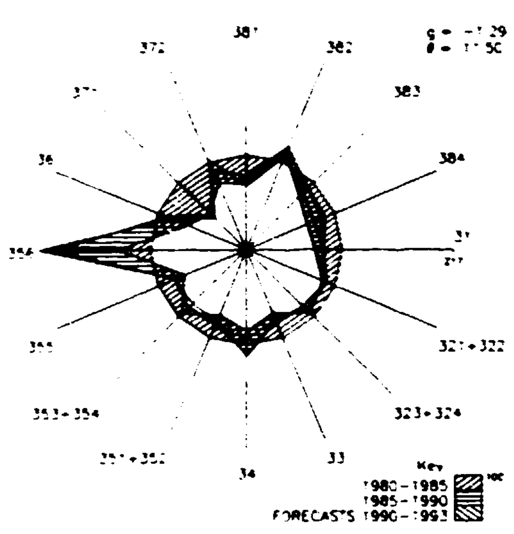


Industrial production index (1980=100)

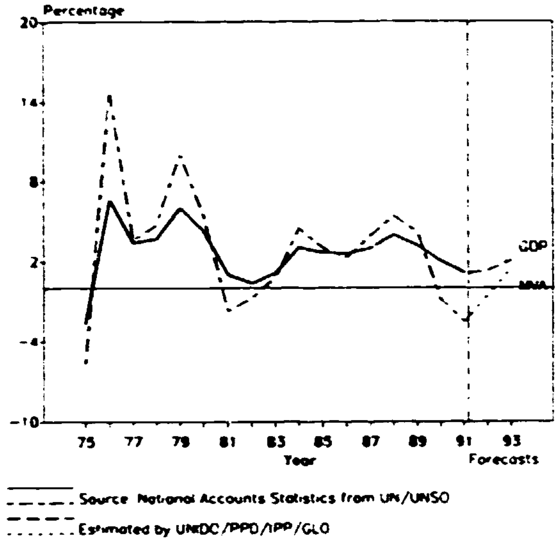


ITALY

Industrial structure change
Index of value added (1980=100)



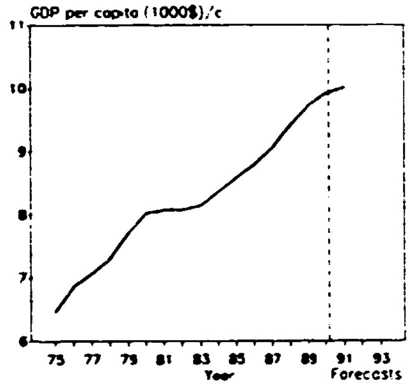
Annual growth rates of GDP and MVA
(Constant 1980 prices)



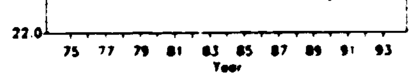
	1980	1985	1990
GDP (n.a.c., millions of 1980-dollars)	452646	490149	566053
Per capita (1980-dollars, n.a.c.)	8021	8578	9918
Manufacturing share (%) (n.a., current prices)	27.8	24.1	22.7 /e
MANUFACTURING:			
Value added (n.a.c., millions of 1980-dollars)	128890	136338	157616
Industrial production index	100	96	112
Value added (millions of dollars)	97032	64726	163844 /e
Gross output (millions of dollars)	250912	212912	500625 /e
Employment (thousands)	3333	2875	2957 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	61	70	67 /e
Wages and salaries (%)	15	13	13 /e
Operating surplus (%)	24	17	20 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	75281	74057	169298 /e
Value added / worker	29112	22513	55407 /e
Average wage	10926	9556	21826 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2.82	6.13	1.99 /e
as a percentage of average θ in 1970-1975	67	145	47 /e
MVA growth rate / θ	0.89	-0.80	1.43
Degree of specialization	10.1	10.9	10.8
-VALUE ADDED: (millions of dollars)			
311 Food products	6362	3618	8793
313 Beverages	1672	1354	3434
314 Tobacco products	307	224	695
321 Textiles	6716	5062	11734
322 Wearing apparel	3197	2322	5541
323 Leather and fur products	718	560	1394
324 Footwear	1495	1260	2401
331 Wood and wood products	1318	786	1745 /e
332 Furniture and fixtures	1936	1257	3215 /e
341 Paper and paper products	2260	1661	3976
342 Printing and publishing	3017	2271	7129
351 Industrial chemicals	5983	3994	9527 /e
352 Other chemical products	4439	2696	7605
353 Petroleum refineries	1275	1065	2106
354 Miscellaneous petroleum and coal products	58	42	79 /e
355 Rubber products	1832	1107	2856 /e
356 Plastic products	1465	1729	5571 /e
361 Pottery, china and earthenware	1897	1139	3381 /e
362 Glass and glass products	1116	666	1868
369 Other non-metal mineral products	3667	2043	6327
371 Iron and steel	8354	3846	8535
372 Non-ferrous metals	1315	875	2286
381 Metal products	5687	3405	8543
382 Non-electrical machinery	9326	8914	20985
383 Electrical machinery	5435	5813	14796
384 Transport equipment	10280	6172	17597
385 Professional and scientific equipment	2032	550	1229 /e
390 Other manufacturing industries	871	297	499 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

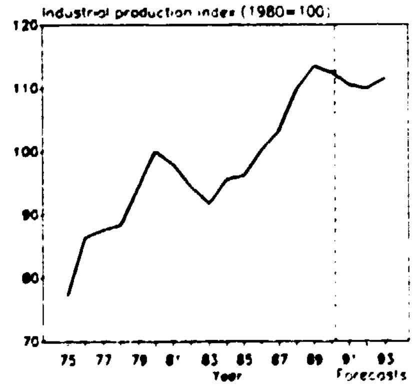
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

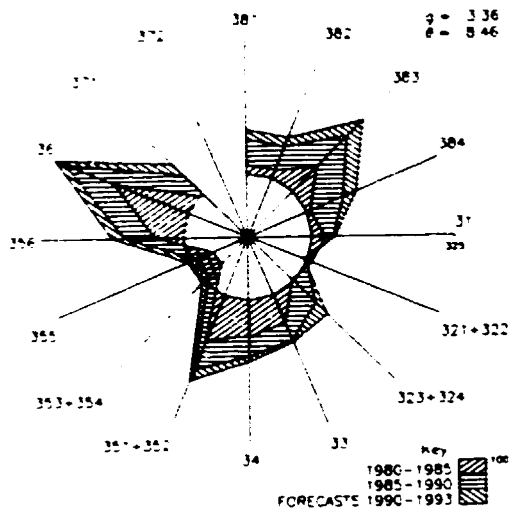


Industrial production index (1980=100)

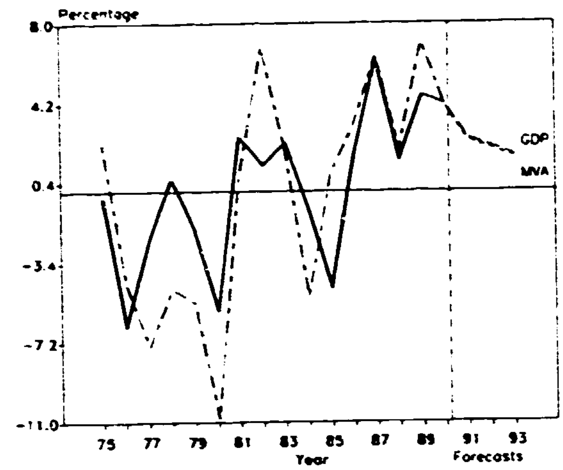


JAMAICA

Industrial structure change (index of value added 1980=100)



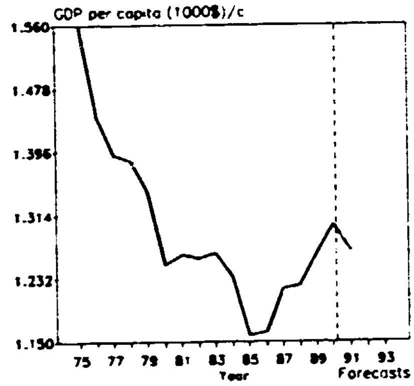
Annual growth rates of GDP and MVA (Constant 1980 prices)



Source National Accounts Statistics from UN/UNSO

Estimated by UNIDO/PPD/IPP/GLO

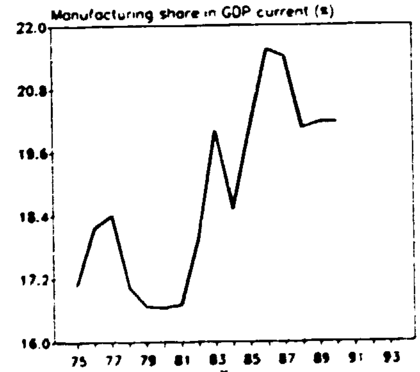
GDP per capita (1000$)/c



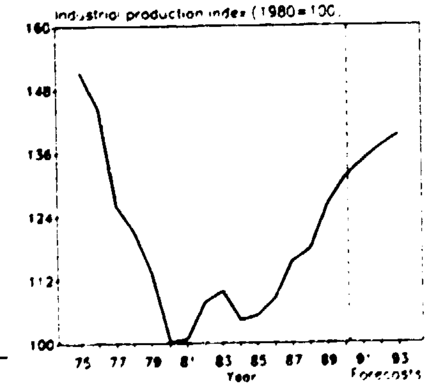
	1980	1985	1990
GDP (n.a.c. millions of 1980-dollars)	2667	2678	3197
Per capita (1980-dollars) (n.a.c.	1250	1158	1301
Manufacturing share (%) (n.a. current prices)	16 6	20 0	20 2 /e
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)	446	469	585
Industrial production index	100	105	131
Value added (millions of dollars	429	352 /e	615 /e
Gross output (millions of dollars)	1661	1464	2541 /e
Employment (thousands)	44	46	65 /e
-PROFITABILITY (in percent of gross output)			
Intermediate input (%)	74	76 /e	76 /e
Wages and salaries (%)	12	10	11 /e
Operating surplus (%)	14	14 /e	13 /e
-PRODUCTIVITY (dollars)			
Gross output / worker	37512 /e	31521	39151 /e
Value added / worker	9694 /e	7573 /e	9471 /e
Average wage	4560 /e	3066	4369 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	6 02	6 39 /e	1 54 /e
as a percentage of average θ in 1970-1975	122	129 /e	31 /e
MVA growth rate θ	-1 39	0 59	2 62
Degree of specialization	18 9	17 9	15 9
-VALUE ADDED (millions of dollars)			
311 Food products	78	77 /e	115 /e
313 Beverages	63	47 /e	77 /e
314 Tobacco products	61	46 /e	76 /e
321 Textiles	3	2 /e	3 /e
322 Wearing apparel	15	11 /e	14 /e
323 Leather and fur products	2	2 /e	4 /e
324 Footwear	8	4 /e	10 /e
331 Wood and wood products	3	2 /e	3 /e
332 Furniture and fixtures	12	14 /e	24 /e
341 Paper and paper products	7	7 /e	11 /e
342 Printing and publishing	15	16 /e	29 /e
351 Industrial chemicals	13	24 /e	43 /e
352 Other chemical products	3	4 /e	8 /e
353 Petroleum refineries	55	22 /e	46 /e
354 Miscellaneous petroleum and coal products	2	1 /e	2 /e
355 Rubber products	10	4 /e	9 /e
356 Plastic products	9	9 /e	18 /e
361 Pottery, china and earthenware	1	2 /e	4 /e
362 Glass and glass products	2	3 /e	5 /e
369 Other non-metal mineral products	8	12 /e	25 /e
371 Iron and steel	5	3 /e	7 /e
372 Non-ferrous metals	-	- /e	- /e
381 Metal products	10	8 /e	15 /e
382 Non-electrical machinery	6	5 /e	10 /e
383 Electrical machinery	6	6 /e	13 /e
384 Transport equipment	23	17 /e	38 /e
385 Professional and scientific equipment	-	- /e	- /e
390 Other manufacturing industries	4	3 /e	5 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

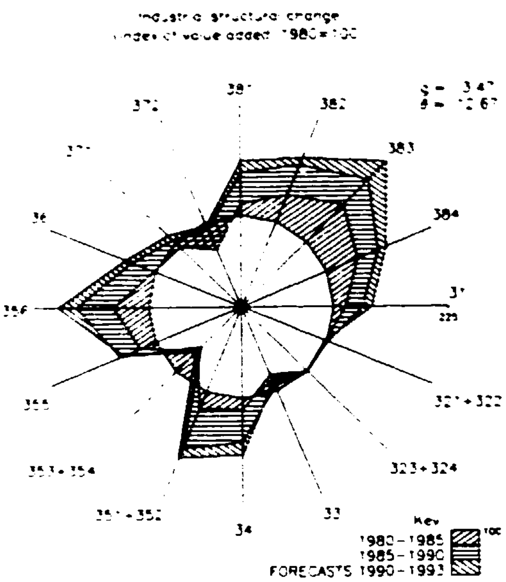
Manufacturing share in GDP current (%)

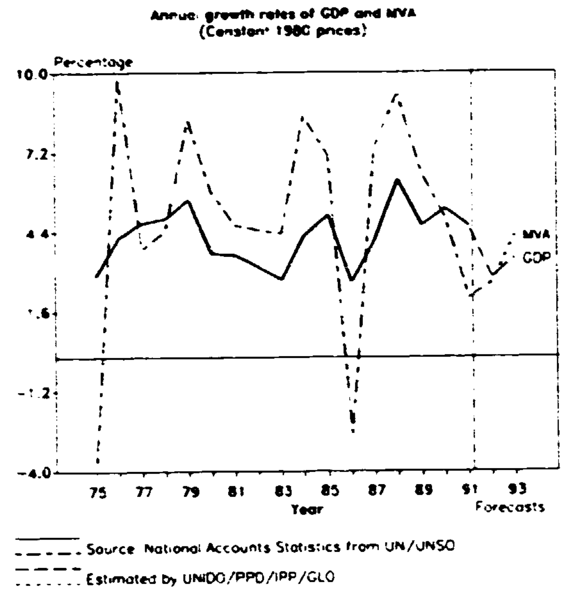


Industrial production index (1980=100)



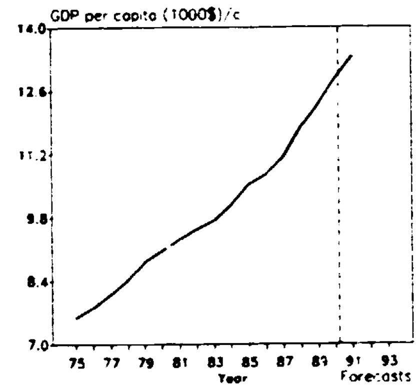
JAPAN

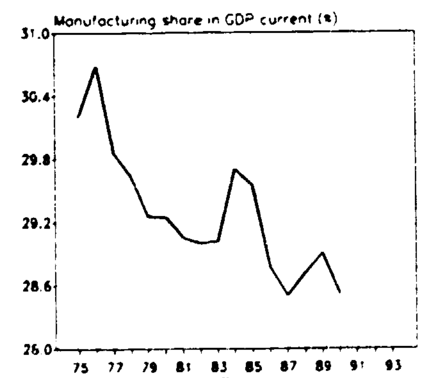


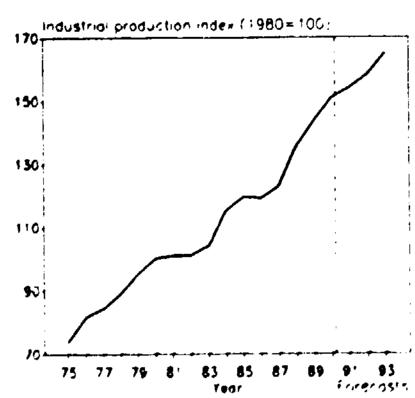


	1980	1985	1990
GDP (n.a.c. millions of 1980-dollars)	1059262	1272427	1589093
Per capita (1980-dollars) (n.a.c.)	9068	10530	12865
Manufacturing share (%) (n.a. current prices)	29.2	29.5	28.5 /e
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)	311745	412885	525949
Industrial production index	100	119	151
Value added (millions of dollars)	339234	412504	882095
Gross output (millions of dollars)	970569	1114673	2204726
Employment (thousands)	10253	10646	11075
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	65	63	60
Wages and salaries (%)	12	13	13 /e
Operating surplus (%)	23	24	27 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	94662	104704	199066
Value added / worker	33086	38747	79645
Average wage	11522	13653	26104 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2.96	3.12	2.32
as a percentage of average θ in 1970-1975	70	74	55
MVA growth rate / θ	1.82	1.07	1.85
Degree of specialization	11.8	15.1	15.6
-VALUE ADDED: (millions of dollars)			
311 Food products	25889	32032	65122
313 Beverages	5015	5307	10107
314 Tobacco products	1888	700	2139
321 Textiles	15436	15259	25970
322 Wearing apparel	5156	5622	11297 /e
323 Leather and fur products	886	981	1508 /e
324 Footwear	697	658	1305 /e
331 Wood and wood products	8997	6888	12837 /e
332 Furniture and fixtures	3788	3798	8799 /e
341 Paper and paper products	9310	9759	23326
342 Printing and publishing	17099	20789	46916
351 Industrial chemicals	13809	16811	33867 /e
352 Other chemical products	15471	19758	54183 /e
353 Petroleum refineries	6620	4595	6943
354 Miscellaneous petroleum and coal products	1063	713	1538 /e
355 Rubber products	4150	5077	10621
356 Plastic products	9478	13570	30375
361 Pottery, china and earthenware	1623	1627	3083 /e
362 Glass and glass products	2876	4029	8927
369 Other non-metal mineral products	12565	12321	27161
371 Iron and steel	26444	25224	49402
372 Non-ferrous metals	7458	5236	12385
381 Metal products	22409	26356	59293
382 Non-electrical machinery	39270	53580	118214
383 Electrical machinery	38868	63176	136897
384 Transport equipment	32107	45158	93034
385 Professional and scientific equipment	5585	5972	13834 /e
390 Other manufacturing industries	5178	6510	13013 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

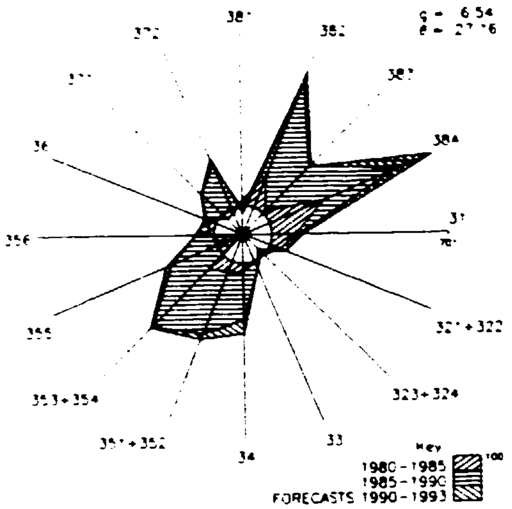




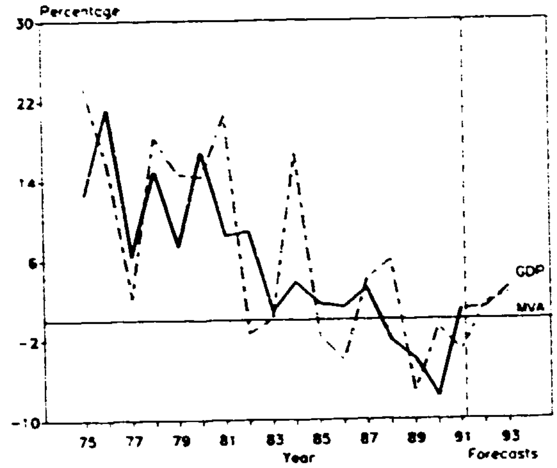


JORDAN

Industrial structure change
(index of value added 1990=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)



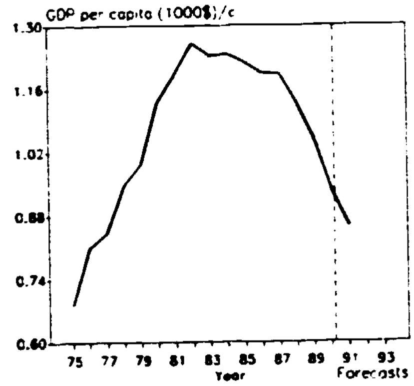
Source National Accounts Statistics from UN/UNSO

Estimated by UNIDO/PPD/IPP/GLO

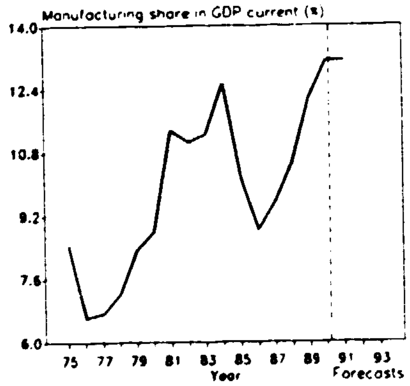
	1980	1985	1990
GDP: (na.c) (millions of 1980-dollars)	3303	4147	3755
Per capita (1980-dollars) (na.c)	1130	1217	937
Manufacturing share (%) (na) (current prices)	8.8	10.2	13.1 /e
MANUFACTURING:			
Value added (na.c) (millions of 1980-dollars)	403	551	536
Industrial production index	100	157	163
Value added (millions of dollars)	406	581	831 /e
Gross output (millions of dollars)	917	1997	2063 /e
Employment (thousands)	25	42	46 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	56	71	60 /e
Wages and salaries (%)	12	9	9 /e
Operating surplus (%)	32	20	32 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	37178	47681	44959 /e
Value added / worker	16452	13862	18100 /e
Average wage	4418	4326	3891 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	12.81	6.91	8.49 /e
as a percentage of average θ in 1970-1975	88	48	58 /e
MVA growth rate / θ	1.23	1.16	1.12
Degree of specialization	19.4	21.1	21.1
-VALUE ADDED: (millions of dollars)			
311 Food products	24	48	53 /e
313 Beverages	20	27	28 /e
314 Tobacco products	50	92	94 /e
321 Textiles	10	14	13 /e
322 Wearing apparel	8	10	12 /e
323 Leather and fur products	2	2	3 /e
324 Footwear	8	8	4 /e
331 Wood and wood products	7	7	8 /e
332 Furniture and fixtures	11	11	13 /e
341 Paper and paper products	9	9	23 /e
342 Printing and publishing	7	11	18 /e
351 Industrial chemicals	10	14	55 /e
352 Other chemical products	20	28	44 /e
353 Petroleum refineries	53	87	213 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	-	-	1 /e
356 Plastic products	12	13	17 /e
361 Pottery, china and earthenware	2	3	5 /e
362 Glass and glass products	2	3	4 /e
369 Other non-metal mineral products	98	123	112 /e
371 Iron and steel	11 /e	8	20
372 Non-ferrous metals	5 /e	4	12 /e
381 Metal products	26 /e	31	21 /e
382 Non-electrical machinery	2 /e	4	10 /e
383 Electrical machinery	2	2	7 /e
384 Transport equipment	-	1	2 /e
385 Professional and scientific equipment	-	-	1 /e
390 Other manufacturing industries	1	23	37 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

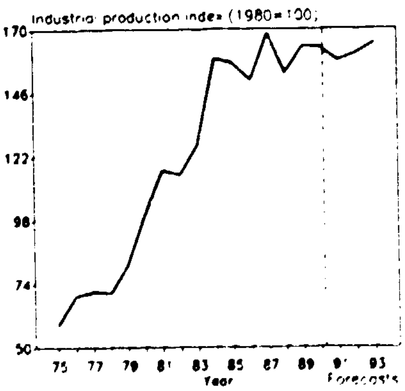
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

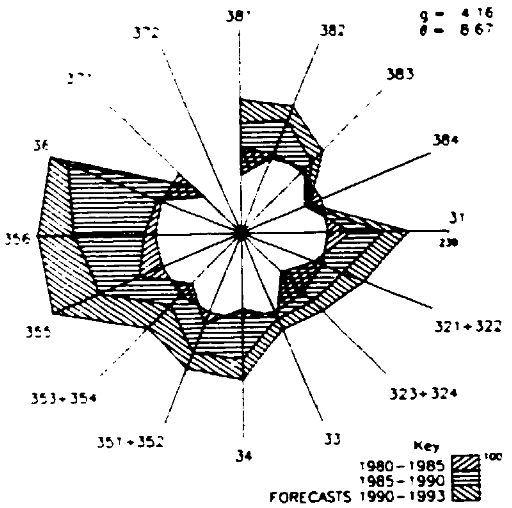


Industrial production index (1980=100)

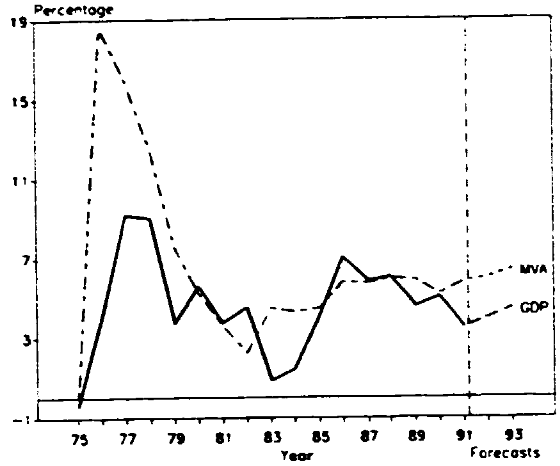


KENYA

Industrial structural change
(index of value added 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)

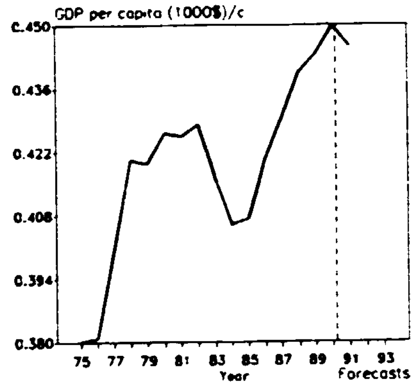


Source: National Accounts Statistics from UN/UNSO
Estimated by UNIDO/PPD/IPP/GLO

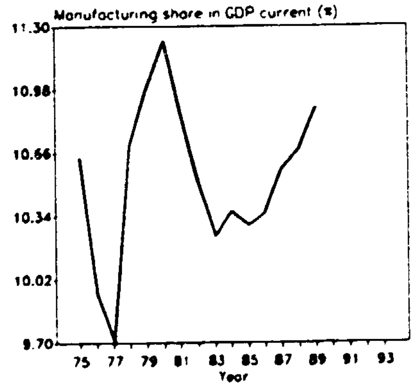
	1980	1985	1990
GDP: na.c (millions of 1980-dollars)	7088	8185	10798
Per capita (1980-dollars) /na.c	426	407	450
Manufacturing share (%) (na) (current prices)	11 2	10 3	
MANUFACTURING:			
Value added /na.c (millions of 1980-dollars)	937	1131	1494
Industrial production index	100	111	149
Value added (millions of dollars)	755	671	961 /e
Gross output (millions of dollars)	3744	4368	7452 /e
Employment (thousands)	143 /e	163	193 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	80	85	87 /e
Wages and salaries (%)	9 /e	7 /e	6 /e
Operating surplus (%)	12 /e	9 /e	7 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	26154 /e	26839	38509 /e
Value added / worker	5278 /e	4122	4966 /e
Average wage	2269 /e	1795 /e	2218 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	7 06	5 16	2 64 /e
as a percentage of average θ in 1970-1975	88	64	33 /e
MVA growth rate / θ	0 68	0 21	2 49
Degree of specialization	15 3	17 7	17 1
-VALUE ADDED: (millions of dollars)			
311 Food products	177	185	261 /e
313 Beverages	56 /e	61 /e	78 /e
314 Tobacco products	19 /e	25 /e	26 /e
321 Textiles	59	40	63 /e
322 Wearing apparel	17	19	22 /e
323 Leather and fur products	6	3	5 /e
324 Footwear	9	6	11 /e
331 Wood and wood products	20	17	19 /e
332 Furniture and fixtures	9	8	9 /e
341 Paper and paper products	34	23	45 /e
342 Printing and publishing	22	19	29 /e
351 Industrial chemicals	25	16	19 /e
352 Other chemical products	39	47	66 /e
353 Petroleum refineries	15	10	15 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	25	27	39 /e
356 Plastic products	14	13	24 /e
361 Pottery, china and earthenware	1	-	1 /e
362 Glass and glass products	3	4	6 /e
369 Other non-metal mineral products	20	17	39 /e
371 Iron and steel	12 /e	6 /e	8 /e
372 Non-ferrous metals	- /e	- /e	- /e
381 Metal products	55	32	63 /e
382 Non-electrical machinery	6	4	7 /e
383 Electrical machinery	40	36	41 /e
384 Transport equipment	64	43	46 /e
385 Professional and scientific equipment	1	1	2 /e
390 Other manufacturing industries	6	8	19 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

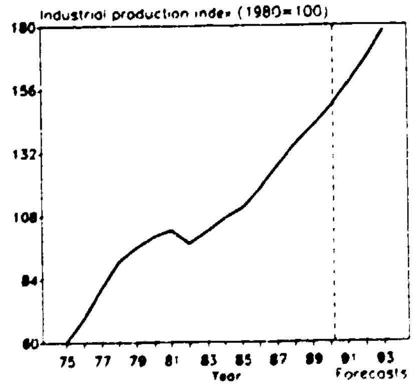
GDP per capita (1000$)/c



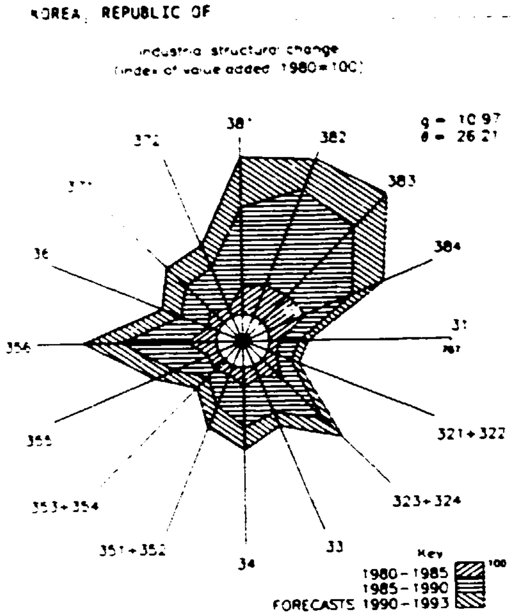
Manufacturing share in GDP current (%)

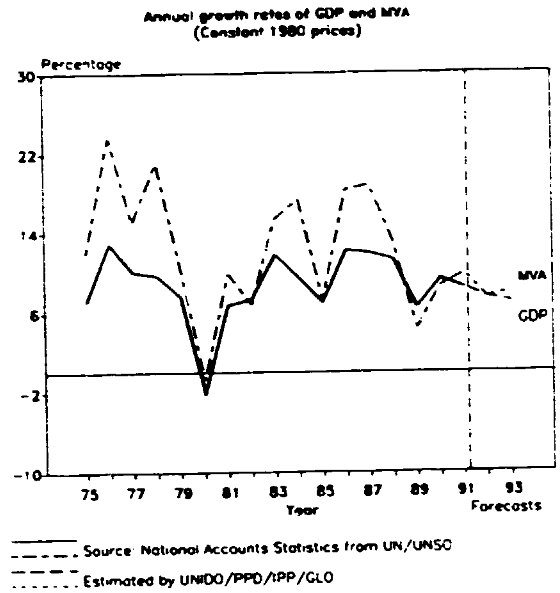


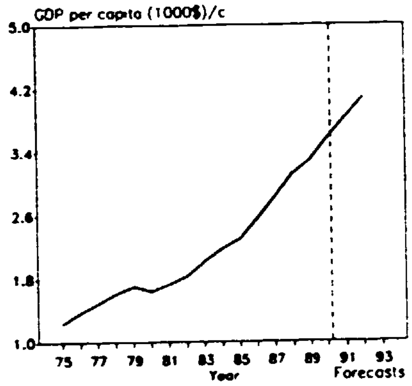
Industrial production index (1980=100)



KOREA, REPUBLIC OF

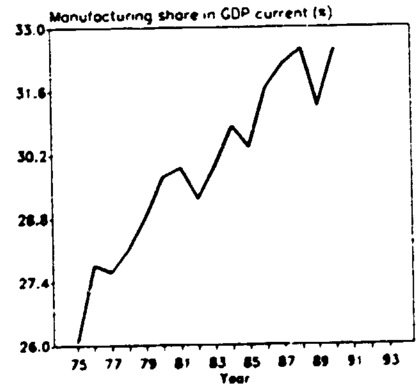


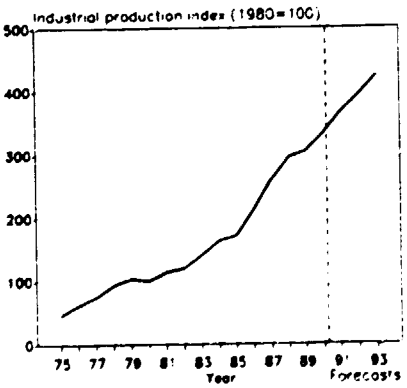




	1980	1985	1990
GDP (na.c millions of 1980-dollars)	52626	93782	152454
Per capita (1980-dollars) (na.c	1643	2298	3559
Manufacturing share (%) (na current prices)	29 7	30 3	32 5 /e
MANUFACTURING:			
Value added (na.c millions of 1980-dollars)	19173	32602	58676
Industrial production index	100	171	332
Value added (millions of dollars)	19520	30731	91721 /e
Gross output (millions of dollars)	59725	88541	248220 /e
Employment (thousands	2015	2395	2975 /e
-PROFITABILITY: in percent of gross output)			
Intermediate input (%)	67	55	63 /e
Wages and salaries (%)	10	9	10 /e
Operating surplus (%)	23	25	27 /e
-PRODUCTIVITY: dollars)			
Gross output worker	29645	36963	83438 /e
Value added worker	9689	12829	30832 /e
Average wage	2837	3476	8561 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	7 55	4 81	3 50 /e
as a percentage of average θ in 1970-1975	80	51	37 /e
MVA growth rate θ	1 58	2 16	3 88
Degree of specialization	9 1	9 5	10 3
-VALUE ADDED: millions of dollars)			
311 Food products	1526	2048	5478 /e
313 Beverages	571	764	1781 /e
314 Tobacco products	1143	1442	3094 /e
321 Textiles	2649	3295	7373 /e
322 Wearing apparel	905	1293	3131 /e
323 Leather and fur products	138	270	1011 /e
324 Footwear	112	211	561 /e
331 Wood and wood products	239	262	711 /e
332 Furniture and fixtures	100	203	790 /e
341 Paper and paper products	426	682	2047 /e
342 Printing and publishing	440	732	2188 /e
351 Industrial chemicals	998	1275	3348 /e
352 Other chemical products	1016	1422	4741 /e
353 Petroleum refineries	757	1079	2218 /e
354 Miscellaneous petroleum and coal products	211	291	541 /e
355 Rubber products	657	910	2783 /e
356 Plastic products	359	709	2487 /e
361 Pottery, china and earthenware	89	107	286 /e
362 Glass and glass products	198	307	790 /e
369 Other non-metal mineral products	838	1064	3154 /e
371 Iron and steel	1256	2040	5650 /e
372 Non-ferrous metals	265	334	1208 /e
381 Metal products	635	1237	4867 /e
382 Non-electrical machinery	672	1453	6265 /e
383 Electrical machinery	1587	3621	14322 /e
384 Transport equipment	1152	2791	7793 /e
385 Professional and scientific equipment	214	290	1191 /e
390 Other manufacturing industries	367	598	1912 /e

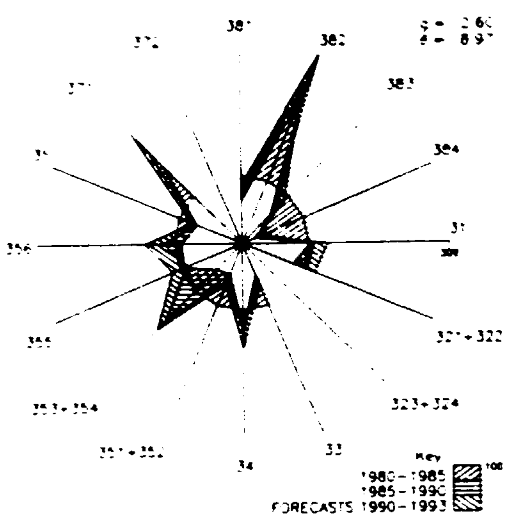
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex



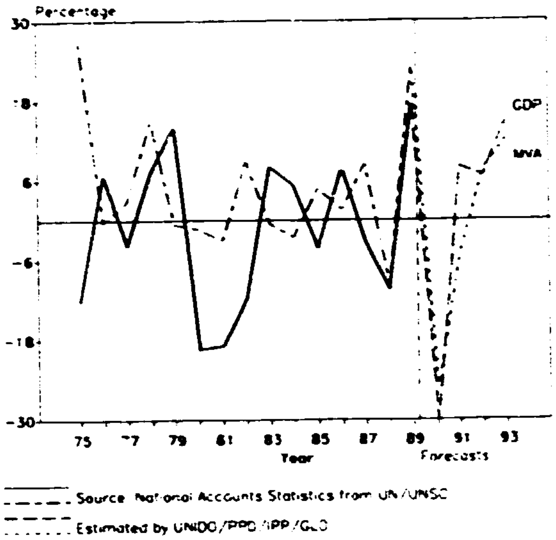


KUWAIT

Industrial structure change
Index of value added 1980=100

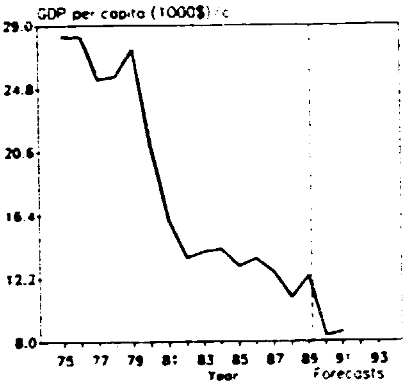


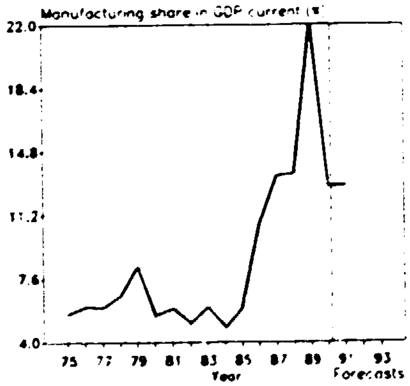
Annual growth rates of GDP and MVA
(Constant 1980 prices)

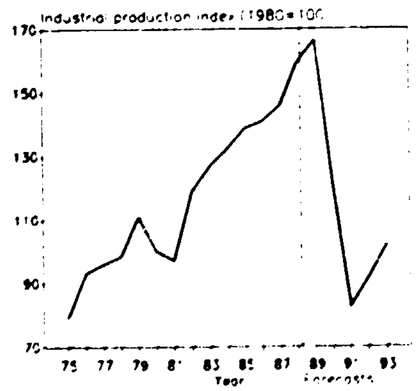


	1980	1985	1990
GDP (na.c. millions of 1980-dollars)	28722	22346	17107 e
Per capita (1980-dollars) (na.c)	20889	12984	8357 e
Manufacturing share (%) (na) (current prices)	5.5	5.9	12.8 e
MANUFACTURING:			
Value added (na.c) (millions of 1980-dollars)	1481	1582	1451 e
Industrial production index	100	138	122 e
Value added (millions of dollars)	1752	1280	2710 e
Gross output (millions of dollars)	6218	7445	5161 e
Employment (thousands)	43	45	54 e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	72	83	47 e
Wages and salaries (%)	6	7	15 e
Operating surplus (%)	22	10	37 e
-PRODUCTIVITY: (dollars)			
Gross output / worker	144834	163535	96262 e
Value added / worker	40802	28120	50548 e
Average wage	9037	12032	14999 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	6.80	17.44	3.28 e
as a percentage of average θ in 1970-1975	53	162	31 e
MVA growth rate / θ	2.84	-0.35	4.86
Degree of specialization	39.7	31.0	54.0
-VALUE ADDED: (millions of dollars)			
311 Food products	96	101	126 e
313 Beverages	20	31	30 e
314 Tobacco products	-	-	- e
321 Textiles	7	8	13 e
322 Wearing apparel	84	75	105 e
323 Leather and fur products	-	-	- e
324 Footwear	-	-	- e
331 Wood and wood products	40	14	14 e
332 Furniture and fixtures	41	31	40 e
341 Paper and paper products	5	12	23 e
342 Printing and publishing	40	52	51 e
351 Industrial chemicals	118	56	71 e
352 Other chemical products	13	16	26 e
353 Petroleum refineries	915	561	1856 e
354 Miscellaneous petroleum and coal products	1	1	2 e
355 Rubber products	5	5	5 e
356 Plastic products	24	24	35 e
361 Pottery, china and earthenware	2	-	1 e
362 Glass and glass products	2	4 e	9 e
369 Other non-metal mineral products	143	115	126 e
371 Iron and steel	7	14	18 e
372 Non-ferrous metals	-	-	- e
381 Metal products	99	88	80 e
382 Non electrical machinery	10	30	30 e
383 Electrical machinery	22	15	25 e
384 Transport equipment	45	15 e	11 e
385 Professional and scientific equipment	5	5 e	1 e
390 Other manufacturing industries	7	5	[illegible] e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex







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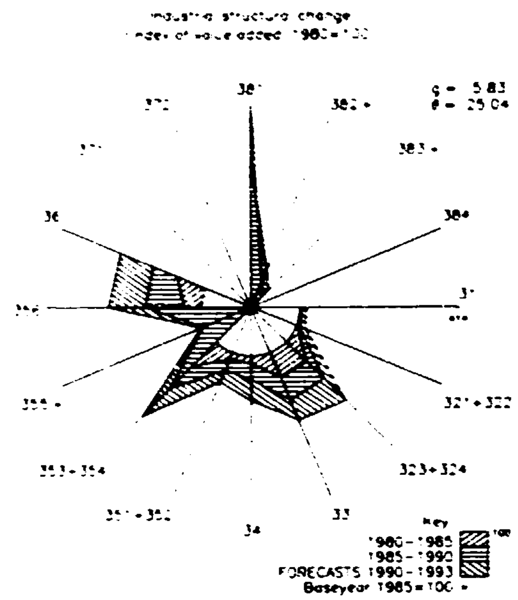

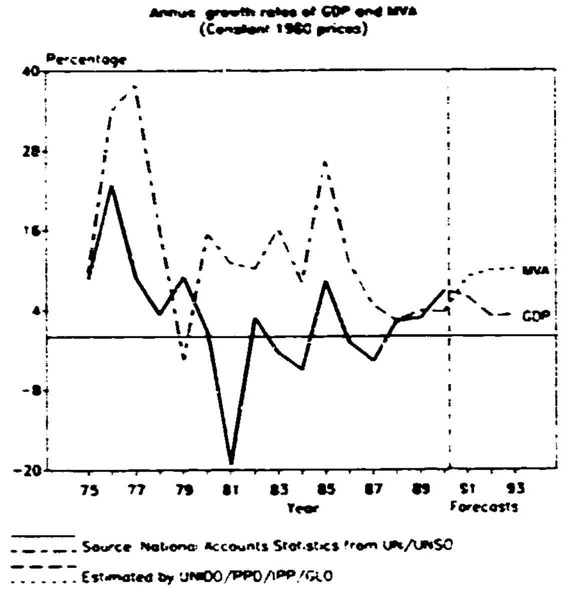

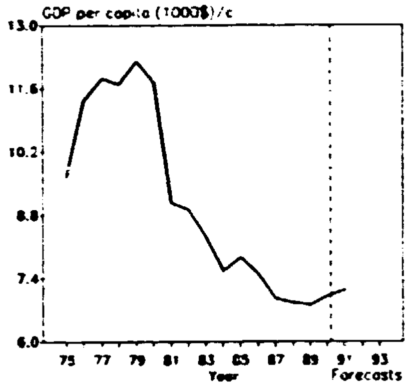

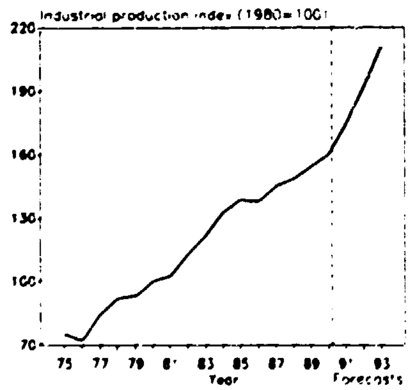

	1980	1985	1990
GDP: (real, millions of 1980-dollars)	35727	29777	31908
Per capita (1980-dollars, real)	11737	7865	7014
Manufacturing share (%) (in current prices)	1.6	4.4	
MANUFACTURING:			
Value added (real, millions of 1980-dollars)	679	1320	1691
Industrial production index	100	138	160
Value added (millions of dollars)	358	634 e	1200 e
Gross output (millions of dollars)	1177	1935 e	3754 e
Employment (thousands)	18	22 e	27 e
-PROFITABILITY (in percent of gross output)			
Intermediate input (%)	70	67 e	68 e
Wages and salaries (%)	13	12 e	12 e
Operating surplus (%)	17	20 e	20 e
-PRODUCTIVITY (dollars)			
Gross output / worker	64391 e	87715 e	139056 e
Value added / worker	19584 e	28744 e	44473 e
Average wage	8326 e	10900 e	16280 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	12.51 e	2.66 e	1.31 e
as a percentage of average θ in 1970-1975	173 e	37 e	18 e
MVA growth rate (%)	0.47	2.21	3.45
Degree of specialization	18.9	25.3	27.6
-VALUE ADDED (millions of dollars)			
311 Food products	35	42 e	57 e
313 Beverages	17	20 e	34 e
314 Tobacco products	55	83 e	122 e
321 Textiles	14	19 e	30 e
322 Wearing apparel	5 e	6 e	9 e
323 Leather and fur products	7	16 e	33 e
324 Footwear	14	28 e	53 e
331 Wood and wood products	3 e	6 e	11 e
332 Furniture and fixtures	2 e	4 e	9 e
341 Paper and paper products	3	3 e	5 e
342 Printing and publishing	-	1 e	3 e
351 Industrial chemicals	35	46 e	87 e
352 Other chemical products	21	38 e	70 e
353 Petroleum refineries	61	179 e	374 e
354 Miscellaneous petroleum and coal products	-	- e	- e
355 Rubber products	-	1 e	1 e
356 Plastic products	2	4 e	10 e
361 Pottery, china and earthenware	1	1 e	1 e
362 Glass and glass products	-	- e	- e
369 Other non-metal mineral products	51	110 e	222 e
371 Iron and steel	-	- e	- e
372 Non-ferrous metals	-	- e	- e
381 Metal products	3	8 e	21 e
382 Non-electrical machinery	-	- e	- e
383 Electrical machinery	-	- e	- e
384 Transport equipment		- e	- e
385 Professional and scientific equipment	-	- e	- e
390 Other manufacturing industries	9	19 e	39 e

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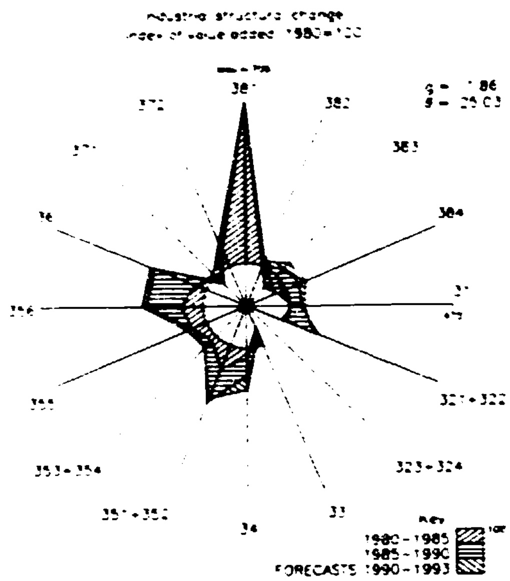
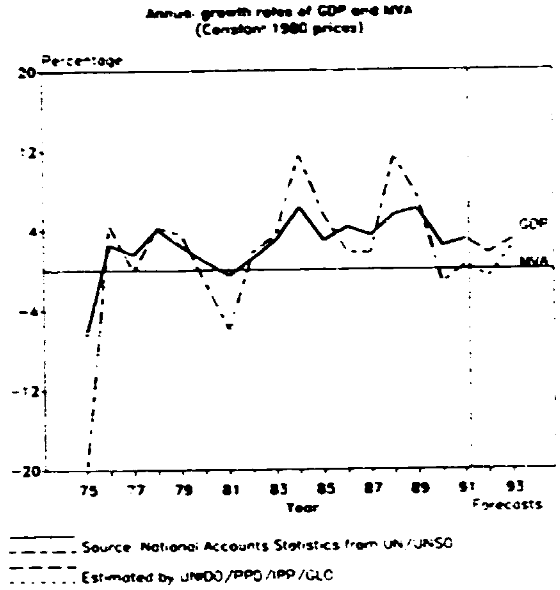
LUXEMBOURG





	1980	1985	1990
GDP (mil. millions of 1980-dollars)	4546	5146	5355
Per capita (1980-dollars mil.)	12454	14021	17039
Manufacturing share (%) (current prices)	28 5	30 0	28 2 e
MANUFACTURING:			
Value added (mil. millions of 1980-dollars)	1408	1641	2000
Industrial production index	100	118	141
Value added (millions of dollars)	1168	933	2006 e
Gross output (millions of dollars)	3269	2806	5941 e
Employment (thousands)	38	35	33
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	64	67	66 e
Wages and salaries (%)	23 e	17 e	16 e
Operating surplus (%)	13 e	16 e	18 e
-PRODUCTIVITY: dollars			
Gross output / worker	36605	30789	180111 e
Value added / worker	30957	26866	60821 e
Average wage	20109 e	13604 e	28944 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	3 06 e	3 01 e	3 46 e
as a percentage of average θ in 1970-1975	111 e	110 e	126 e
MVA growth rate (%)	-0 78	1 21	0 42
Degree of specialization	37 4	34 0	23 7
-VALUE ADDED: (millions of dollars)			
311 Food products	31	20	47
313 Beverages	32 e	24 e	66
314 Tobacco products	9 e	6 e	11 e
321 Textiles	24	14	59e
322 Wearing apparel	5	3	13e
323 Leather and fur products	.	.	-
324 Footwear	.	.	-
331 Wood and wood products	2 e	1 e	2 e
332 Furniture and fixtures	3 e	1 e	3 e
341 Paper and paper products	14 e	12 e	31 e
342 Printing and publishing	18 e	14 e	38 e
351 Industrial chemicals	33 e	37 e	104 e
352 Other chemical products	3	7	33 e
353 Petroleum refineries	.	.	. e
354 Miscellaneous petroleum and coal products	2 e	2 e	4 e
355 Rubber products	114 e	104 e	212 e
356 Plastic products	18 e	18 e	55 e
361 Pottery, china and earthenware	11 e	10 e	29 e
362 Glass and glass products	15 e	15 e	59 e
369 Other non-metal mineral products	43 e	35 e	130 e
371 Iron and steel	532	415	643
372 Non-ferrous metals	32	34	62
381 Metal products	24	78	213
382 Non-electrical machinery	98	63	135
383 Electrical machinery	13	7	31 e
384 Transport equipment	7	4	14 e
385 Professional and scientific equipment	12	4	11 e
390 Other manufacturing industries	1 e	e	1 e

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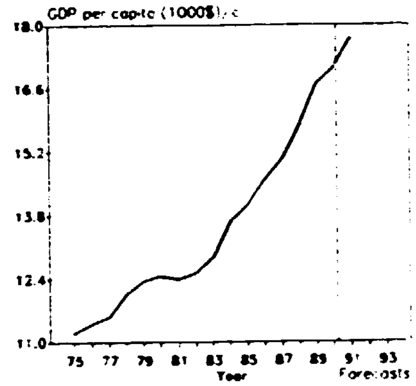
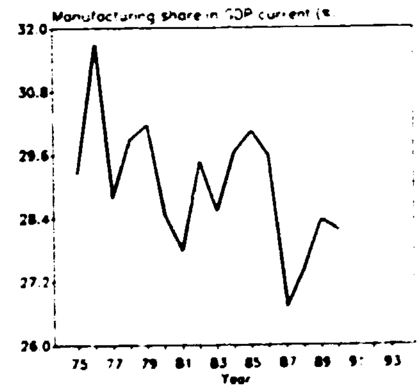
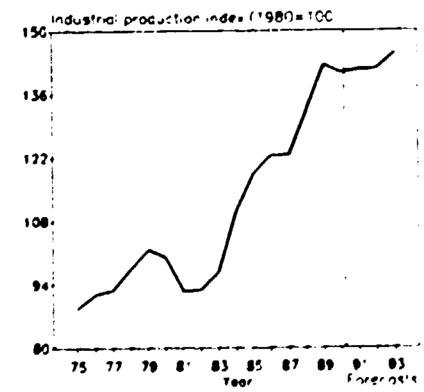
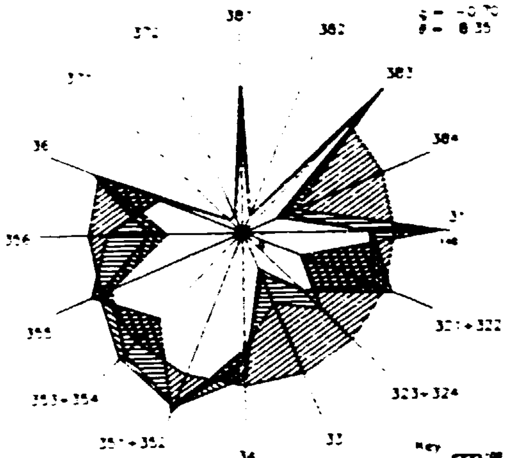




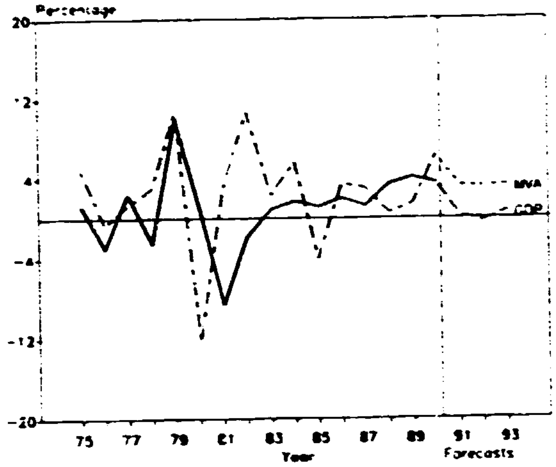


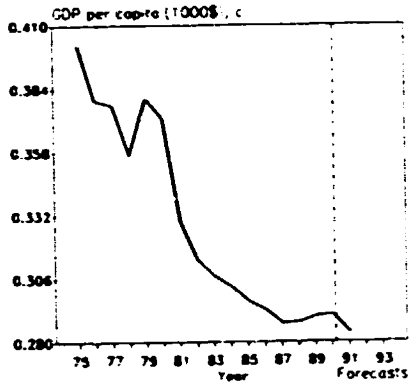
MADAGASCAR

Industrial structure change
(index of value added, 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)





	1980	1985	1990
GDP (ma.c) (millions of 1980-dollars)	3265	3039	3494
Per capita (1980-dollars) (ma.c)	372	297	291
Manufacturing share (%) (ma) (current prices)	11.3 e	9.9 e	
MANUFACTURING:			
Value added (ma.c) (millions of 1980-dollars)	384	454	525
Industrial production index	100	89	99
Value added (millions of dollars)	221	132	134 e
Gross output (millions of dollars)	569	328	329 e
Employment (thousands)	41	47	48 e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	61	60	59 e
Wages and salaries (%)	15	16	14 e
Operating surplus (%)	24	25	27 e
-PRODUCTIVITY (dollars)			
Gross output / worker	14040	5917	6879 e
Value added / worker	5452	2796	2796 e
Average wage	2083	1099	949 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	7.69	14.30	10.53 e
as a percentage of average θ in 1970-1975	106	197	145 e
MVA growth rate / θ	0.15	-0.34	0.22
Degree of specialization	22.4	25.1	32.1
-VALUE ADDED: (millions of dollars)			
311 Food products	23	45	17 e
313 Beverages	34	16	16 e
314 Tobacco products	3	3	2 e
321 Textiles	67	16	54 e
322 Wearing apparel	19	6	2 e
323 Leather and fur products	3	1	1 e
324 Footwear	8	5	3 e
331 Wood and wood products	2	1	- e
332 Furniture and fixtures	2	-	- e
341 Paper and paper products	4	3	5 e
342 Printing and publishing	6	2	1 e
351 Industrial chemicals	1	-	- e
352 Other chemical products	10	11	9 e
353 Petroleum refineries	11 e	7 e	9 e
354 Miscellaneous petroleum and coal products	-	-	- e
355 Rubber products	1	1	1 e
356 Plastic products	3	2	1 e
361 Pottery, china and earthenware	-	-	- e
362 Glass and glass products	2	- e	- e
369 Other non-metal mineral products	2 e	1	3 e
371 Iron and steel	-	-	- e
372 Non-ferrous metals	-	-	- e
381 Metal products	9	5	5 e
382 Non electrical machinery	-	-	e
383 Electrical machinery	3	3	3 e
384 Transport equipment	7	2 e	1 e
385 Professional and scientific equipment	-	-	- e
390 Other manufacturing industries	2	1	- e

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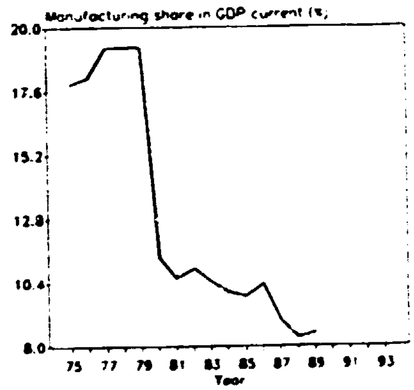

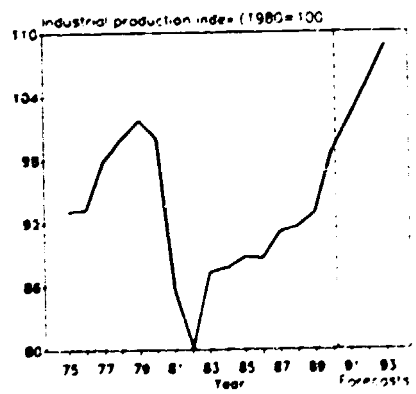

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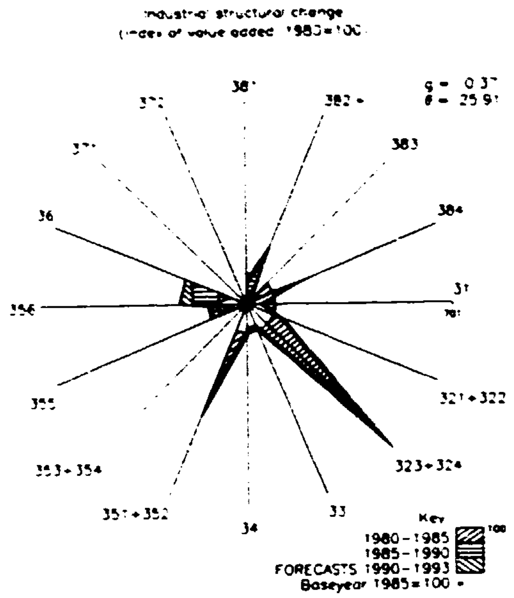
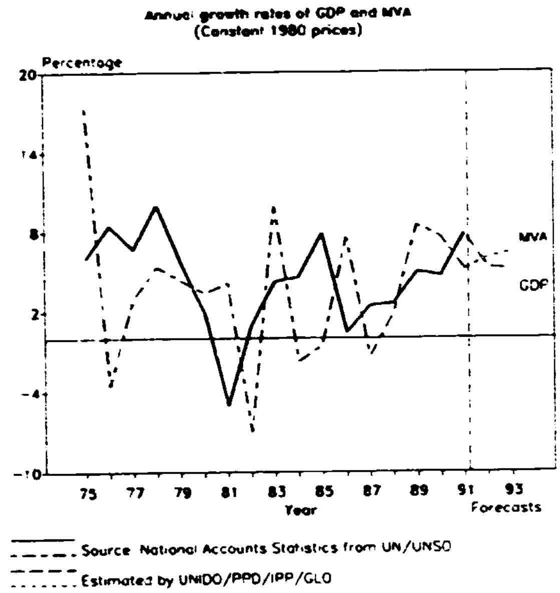
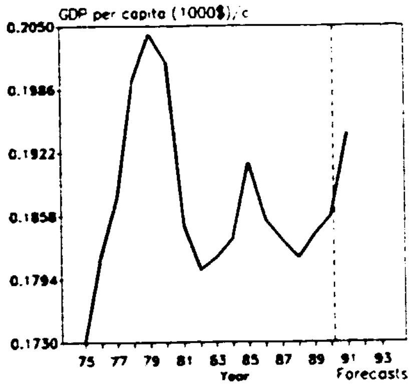
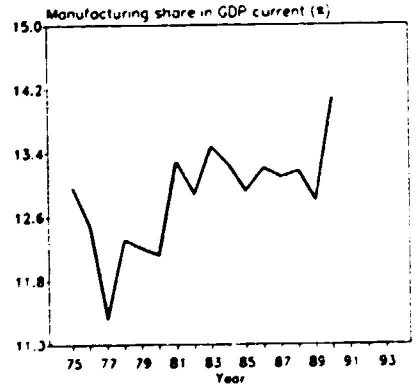


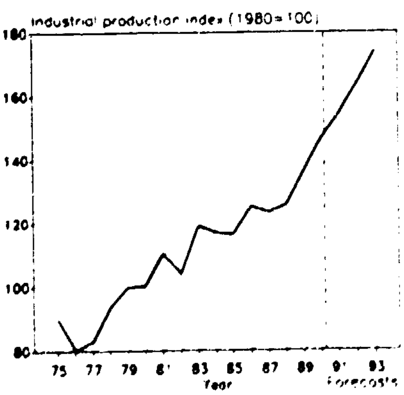


	1980	1985	1990
GDP (n.a.c., millions of 1980-dollars)	1245	1403	1626
Per capita (1980-dollars) (n.a.c.)	201	191	186
Manufacturing share (%) (n.a.) (current prices)	12.1	12.9	14.1 /e
MANUFACTURING:			
Value added (n.a.c.) (millions of 1980-dollars)	192	200	252
Industrial production index	100	116	146
Value added (millions of dollars)	123	90	133 /e
Gross output (millions of dollars)	340	330	552 /e
Employment (thousands)	39	31	46 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	64	73	76 /e
Wages and salaries (%)	12	10	10 /e
Operating surplus (%)	24	18	14 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	8783	10745	12044 /e
Value added / worker	3174	2923	2909 /e
Average wage	1046	1035	1246 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	10.51 /e	14.12	4.87 /e
as a percentage of average θ in 1970-1975	130 /e	174	60 /e
MVA growth rate / θ	1.25	-0.07	0.21
Degree of specialization	27.7	16.7	18.0
-VALUE ADDED: (millions of dollars)			
311 Food products	54	14	27 /e
313 Beverages	8	7	12 /e
314 Tobacco products	9	5	9 /e
321 Textiles	12	14	18 /e
322 Wearing apparel	2	1	2 /e
323 Leather and fur products	-	- e	- /e
324 Footwear	1 e	3	4 /e
331 Wood and wood products	2	2	2 /e
332 Furniture and fixtures	1	1	1 /e
341 Paper and paper products	2	2	1 e
342 Printing and publishing	8	6	9 e
351 Industrial chemicals	2	8	5 /e
352 Other chemical products	5	14	21 /e
353 Petroleum refineries	-	-	- /e
354 Miscellaneous petroleum and coal products	-	-	- e
355 Rubber products	1	1	- e
356 Plastic products	2	2	5 e
361 Pottery, china and earthenware	-	-	- e
362 Glass and glass products	-	-	- e
369 Other non-metal mineral products	3	1	8 e
371 Iron and steel	-	-	- /e
372 Non-ferrous metals	-	-	- e
381 Metal products	6	6	5 /e
382 Non-electrical machinery	-	1	3 e
383 Electrical machinery	5	1	1 /e
384 Transport equipment	1 e	1	1 e
385 Professional and scientific equipment	-	-	- e
390 Other manufacturing industries	-	-	- e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex







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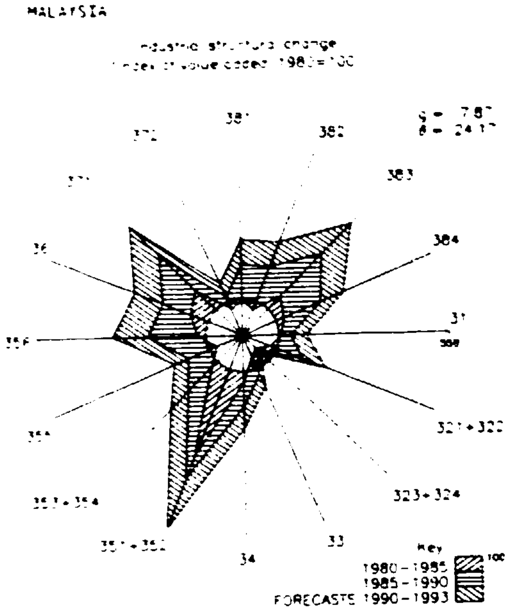
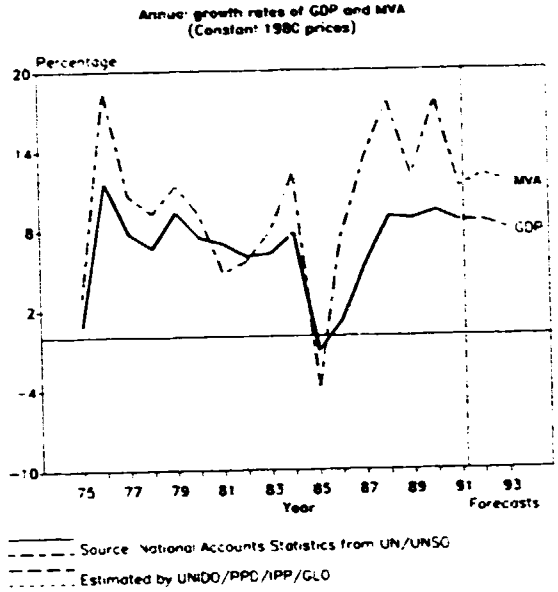
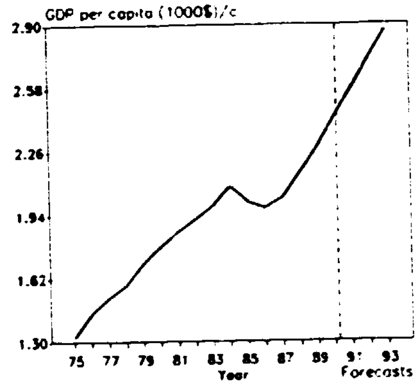
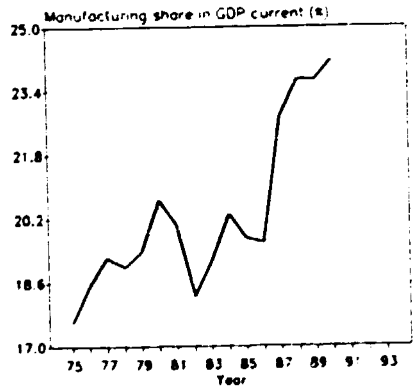


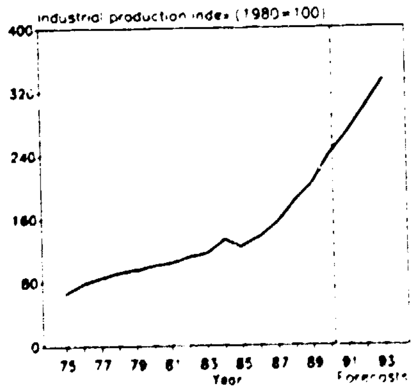


	1980	1985	1990
GDP (n.a.c. millions of 1980-dollars)	24487	31408	43398
Per capita (1980-dollars) (n.a.c.)	1779	2003	2422
Manufacturing share (%) (n.a.) (current prices)	20.6	19.7	24.2 e
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)	5054	6511	12319
Industrial production index	100	124	240
Value added (millions of dollars)	3714 e	4879	8782 e
Gross output (millions of dollars)	13308 e	18359	36355 e
Employment (thousands)	464 e	473	738 e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	72 e	73	76 e
Wages and salaries (%)	7 e	8	6 e
Operating surplus (%)	21 e	19	18 e
-PRODUCTIVITY: (dollars)			
Gross output / worker	28692 e	38789	49276 e
Value added / worker	8007 e	10308	11903 e
Average wage	2064 e	3084	3065 e
-STRUCTURAL INDICES			
Structural change θ (5-year average in degrees)	4.98 e	8.17	5.48 e
as a percentage of average θ in 1970-1975	51 e	84	57 e
MVA growth rate / θ	3.10	0.46	2.02
Degree of specialization	15.7	15.3	14.3
-VALUE ADDED: (millions of dollars)			
311 Food products	688 e	703	1050 e
313 Beverages	108 e	122	160 e
314 Tobacco products	95 e	205	163 e
321 Textiles	191 e	133	281 e
322 Wearing apparel	68 e	100	260 e
323 Leather and fur products	3 e	2	4 e
324 Footwear	11 e	5	5 e
331 Wood and wood products	402 e	263	534 e
332 Furniture and fixtures	35 e	40	62 e
341 Paper and paper products	35 e	55	167 e
342 Printing and publishing	146 e	197	245 e
351 Industrial chemicals	81 e	616	751 e
352 Other chemical products	120 e	153	237 e
353 Petroleum refineries	117 e	137	264 e
354 Miscellaneous petroleum and coal products	2 e	21	32 e
355 Rubber products	300 e	250	566 e
356 Plastic products	70 e	92	212 e
361 Pottery, china and earthenware	10 e	13	44 e
362 Glass and glass products	24 e	23	62 e
369 Other non-metal mineral products	171 e	297	456 e
371 Iron and steel	80 e	153	293 e
372 Non-ferrous metals	40 e	35	54 e
381 Metal products	141 e	147	321 e
382 Non-electrical machinery	119 e	99	284 e
383 Electrical machinery	454 e	738	1561 e
384 Transport equipment	156 e	211	424 e
385 Professional and scientific equipment	26 e	30	39 e
390 Other manufacturing industries	23 e	39	31 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex







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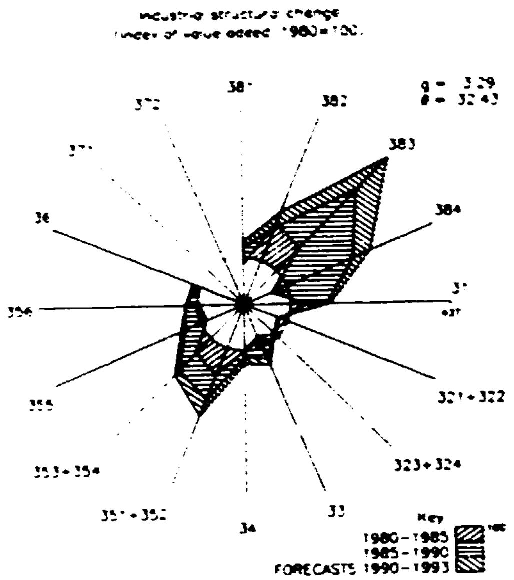
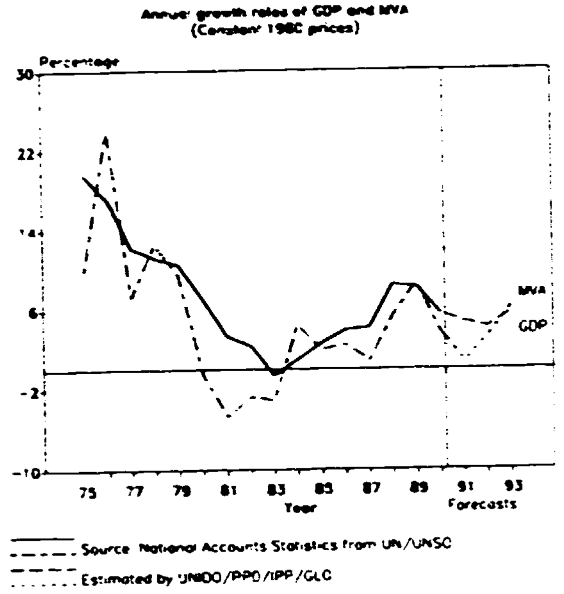
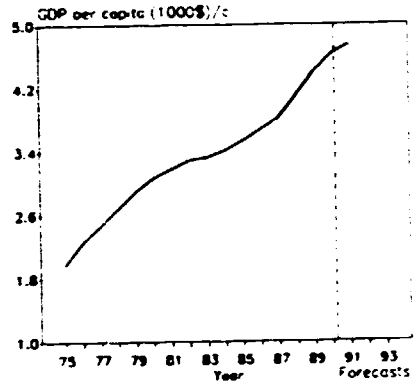
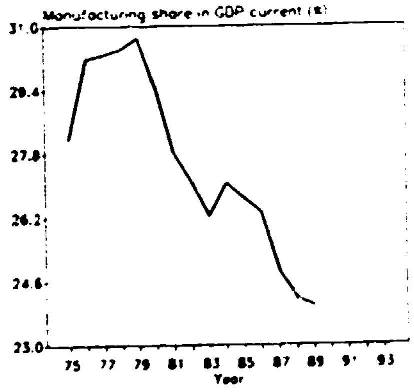


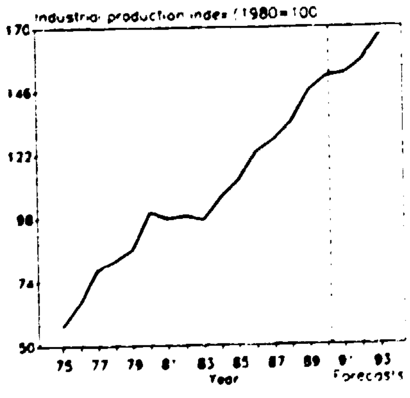


	1980	1985	1990
GDP (n.a.c., millions of 1980-dollars)	1120	1218	1630
Per capita (1980-dollars) (n.a.c.)	3068	3530	4617
Manufacturing share (%) (n.a., current prices)	29.4	26.7	
MANUFACTURING:			
Value added (n.a.c., millions of 1980-dollars)	371	354	434
Industrial production index	100	112	151
Value added (millions of dollars)	302	265	557 e
Gross output (millions of dollars)	706	650	1439 e
Employment (thousands)	29	26	29 e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	57	59	61 e
Wages and salaries (%)	22	20	18 e
Operating surplus (%)	21	20	21 e
-PRODUCTIVITY: (dollars)			
Gross output / worker	24517	25439	48973 e
Value added / worker	10481	10391	18958 e
Average wage	5283	5199	8775 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	5.54	5.63	6.06 e
as a percentage of average θ in 1970-1975	39	40	43 e
MVA growth rate / θ	2.43	0.12	0.96
Degree of specialization	18.3	17.7	17.3
-VALUE ADDED: (millions of dollars)			
311 Food products	20	25	52 e
313 Beverages	20	22	53 e
314 Tobacco products	8	8	8 e
321 Textiles	17	8	12 e
322 Wearing apparel	88	65	97 e
323 Leather and fur products	4	1	1 e
324 Footwear	8	9	13 e
331 Wood and wood products	2	1	2 e
332 Furniture and fixtures	14	9	25 e
341 Paper and paper products	2	3	6 e
342 Printing and publishing	22	17	31 e
351 Industrial chemicals	1	2	3 e
352 Other chemical products	5	6	14 e
353 Petroleum refineries	-	-	- e
354 Miscellaneous petroleum and coal products	-	-	- e
355 Rubber products	10	7	19 e
356 Plastic products	6	4	9 e
361 Pottery, china and earthenware	1	-	1 e
362 Glass and glass products	2	1	1 e
369 Other non-metal mineral products	6	7	11 e
371 Iron and steel	-	-	- e
372 Non-ferrous metals	-	-	- e
381 Metal products	14	10	22 e
382 Non-electrical machinery	5	8	12 e
383 Electrical machinery	22	31	100 e
384 Transport equipment	6	3	22 e
385 Professional and scientific equipment	12	12	22 e
390 Other manufacturing industries	8	5	20 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

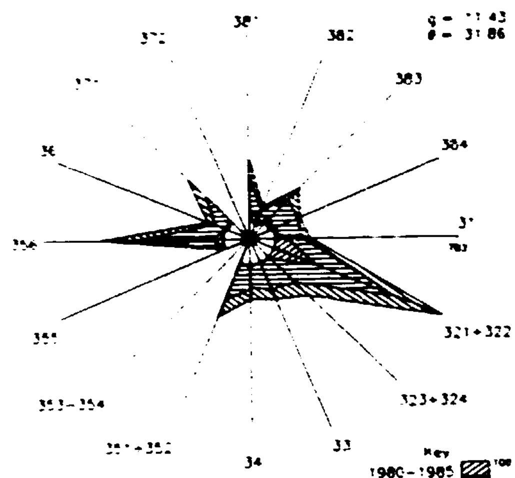




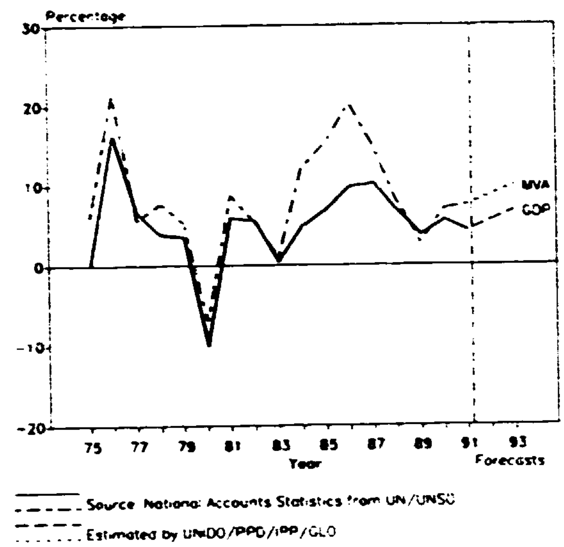


MAURITIUS

Industrial structure change
(index of value added: 1980=100)



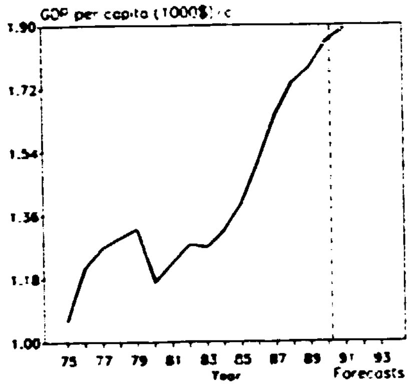
Annual growth rates of GDP and MVA
(Constant 1980 prices)



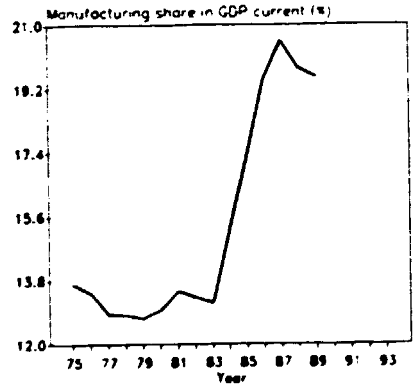
	1980	1985	1990
GDP (real, millions of 1980-dollars)	1132	1421	2008
Per capita (1980-dollars, real)	1170	1392	1854
Manufacturing share (%, real, current prices)	13.0	17.2	
MANUFACTURING:			
Value added (real, millions of 1980-dollars)	173	258	422
Industrial production index	100	149	244
Value added (millions of dollars)	136	172	494 /e
Gross output (millions of dollars)	633	729	1796 /e
Employment (thousands)	43	75	122 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	79	76	72 /e
Wages and salaries (%)	11	11	13 /e
Operating surplus (%)	10	13	15 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	14745	9771	14730 /e
Value added / worker	3163	2309	4053 /e
Average wage	1654	1066	1844 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	7.55	6.91	3.44 /e
as a percentage of average θ in 1970-1975	211	194	96 /e
MVA growth rate / θ	-0.22	1.59	4.32
Degree of specialization	21.2	35.0	33.5
-VALUE ADDED: (millions of dollars)			
311 Food products	36	43	78 /e
313 Beverages	10	7	26 /e
314 Tobacco products	2	4	7 /e
321 Textiles	9	10	27 /e
322 Wearing apparel	28	68	219 /e
323 Leather and fur products	1	1	6 /e
324 Footwear	2	2	3 /e
331 Wood and wood products	1	1	3 /e
332 Furniture and fixtures	2	1	4 /e
341 Paper and paper products	1	2	3 /e
342 Printing and publishing	5	4	11 /e
351 Industrial chemicals	3	3	13 /e
352 Other chemical products	4	4	10 /e
353 Petroleum refineries	-	-	- /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	1	1	1 /e
356 Plastic products	1	2	7 /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	-	-	- /e
369 Other non-metal mineral products	6	4	10 /e
371 Iron and steel	3	2	7 /e
372 Non-ferrous metals	-	-	- /e
381 Metal products	5	3	13 /e
382 Non-electrical machinery	3	1	4 /e
383 Electrical machinery	3	2	6 /e
384 Transport equipment	2	1	5 /e
385 Professional and scientific equipment	2	3	15 /e
390 Other manufacturing industries	4	5	16 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

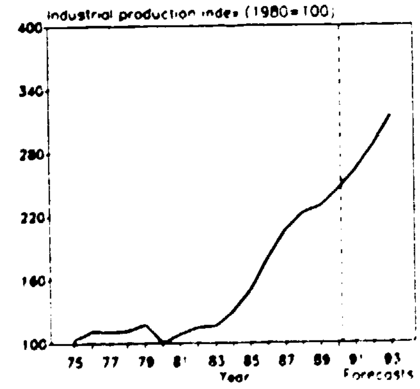
GDP per capita (1000$) c



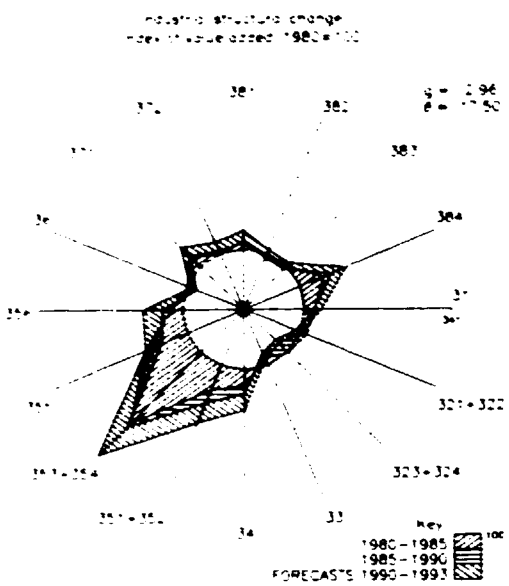
Manufacturing share in GDP current (%)

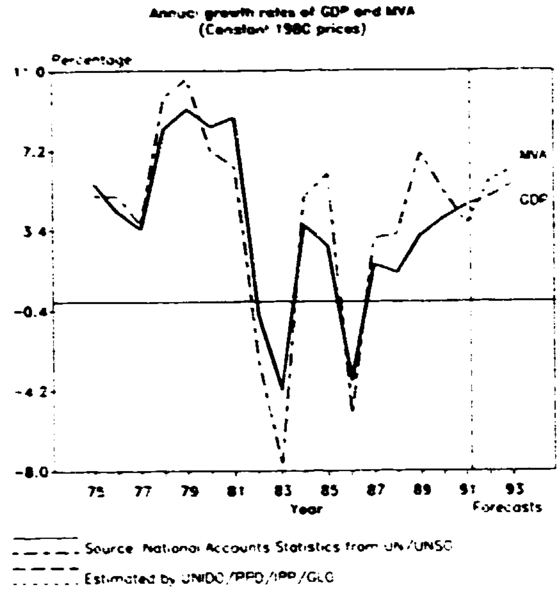


Industrial production index (1980=100)



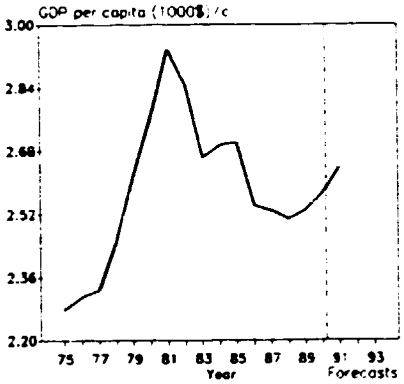
MEXICO

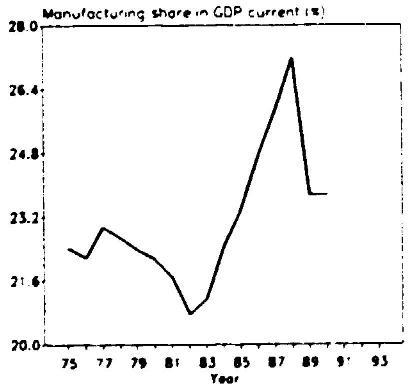


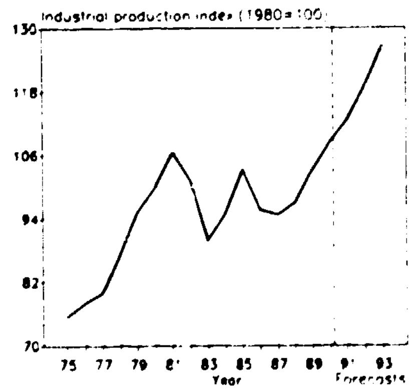


	1980	1985	1990
GDP (real, millions of 1980-dollars)	194766	214370	228248
Per capita (1980-dollars, real)	2766	2701	2574
Manufacturing share (%) (real, current prices)	22.1	23.4	23.8 e
MANUFACTURING:			
Value added (real, millions of 1980-dollars)	43200	45924	52086
Industrial production index	100	103	109
Value added (millions of dollars)	43048	46373 e	57482 e
Gross output (millions of dollars)	102047	106972 e	132792 e
Employment (thousands)	2417	2314 e	2145 e
-PROFITABILITY (in percent of gross output)			
Intermediate input (%)	58	57 e	57 e
Wages and salaries (%)	14	9 e	9 e
Operating surplus (%)	28	34 e	35 e
-PRODUCTIVITY (dollars)			
Gross output / worker	42221	46227 e	61903 e
Value added / worker	17811	20040 e	26796 e
Average wage	5846	4192 e	5373 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	3.56	5.63 e	3.90 e
as a percentage of average θ in 1970-1975	112	177 e	123 e
MVA growth rate / θ	1.79	0.85	0.01
Degree of specialization	8.9	9.6	10.4
-VALUE ADDED (millions of dollars)			
311 Food products	6989	7015 e	8661 e
313 Beverages	2723	2589 e	3299 e
314 Tobacco products	523	740 e	793 e
321 Textiles	3133	3099 e	3075 e
322 Wearing apparel	1277	1094 e	1198 e
323 Leather and fur products	366	397 e	347 e
324 Footwear	345	658 e	575 e
331 Wood and wood products	919	786 e	345 e
332 Furniture and fixtures	734	498 e	565 e
341 Paper and paper products	1189	1180 e	1660 e
342 Printing and publishing	1050	1250 e	1654 e
351 Industrial chemicals	2235	2982 e	3801 e
352 Other chemical products	2235	2562 e	4124 e
353 Petroleum refineries	1917	4341 e	5533 e
354 Miscellaneous petroleum and coal products	222	529 e	679 e
355 Rubber products	767	1164 e	1201 e
356 Plastic products	754	767 e	1074 e
361 Pottery, china and earthenware	383	420 e	398 e
362 Glass and glass products	566	529 e	709 e
369 Other non-metal mineral products	1464	1113 e	1044 e
371 Iron and steel	2070	2227 e	2713 e
372 Non-ferrous metals	562	506 e	597 e
381 Metal products	1961	1849 e	2384 e
382 Non-electrical machinery	2074	1643 e	2030 e
383 Electrical machinery	1900	1635 e	1907 e
384 Transport equipment	2980	3621 e	4315 e
385 Professional and scientific equipment	305	381 e	674 e
390 Other manufacturing industries	754	798 e	1024 e

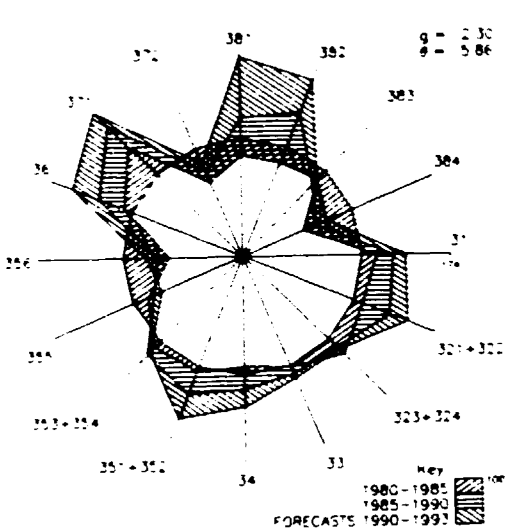
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

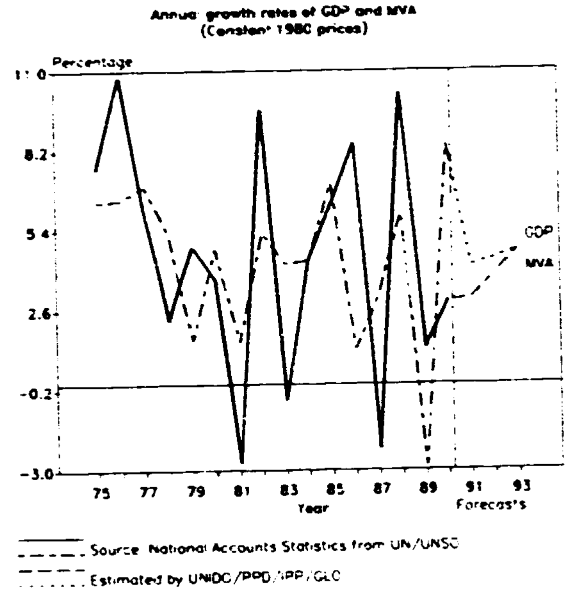






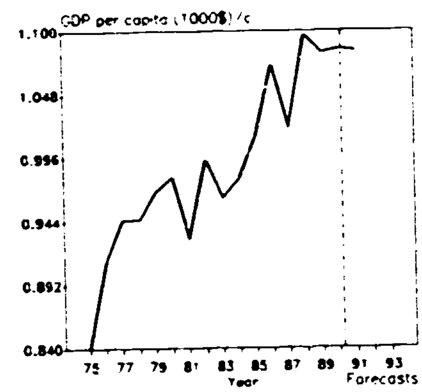
MOROCCO

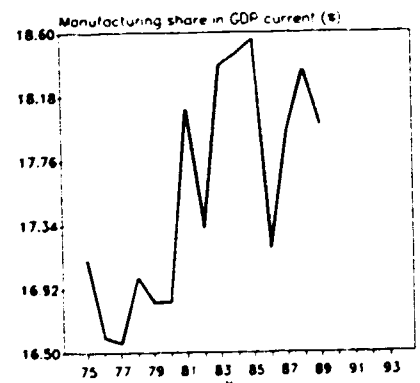


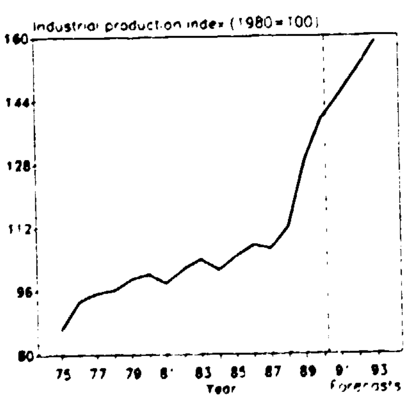


	1980	1985	1990
GDP (nat. c. millions of 1980-dollars)	18997	22336	27194
Per capita (1980-dollars) (nat. c.)	980	1014	1085
Manufacturing share (%) (nat. current prices)	16.8	18.6	
MANUFACTURING:			
Value added (nat. c.) (millions of 1980-dollars)	3469	4312	5019
Industrial production index	100	104	139
Value added (millions of dollars)	1659	1059 e	1899 e
Gross output (millions of dollars)	7038	5956	11790 e
Employment (thousands)	191	252	348 e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	78	84 e	85 e
Wages and salaries (%)	12	10	9 e
Operating surplus (%)	10	6 e	5 e
-PRODUCTIVITY: (dollars)			
Gross output / worker	36921	23589	33896 e
Value added / worker	8102	3891 e	5094 e
Average wage	4455	2423	3165 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	5.62 e	3.42 e	1.93 e
as a percentage of average θ in 1970-1975	221 e	135 e	76 e
MVA growth rate / θ	0.59	0.14	1.62
Degree of specialization	15.6	17.8	18.2
-VALUE ADDED: (millions of dollars)			
311 Food products	304	215 e	373 e
313 Beverages	62	44 e	78 e
314 Tobacco products	38	24 e	39 e
321 Textiles	202	127 e	239 e
322 Wearing apparel	32	31 e	59 e
323 Leather and fur products	15	11 e	20 e
324 Footwear	24	18 e	20 e
331 Wood and wood products	30	27 e	45 e
332 Furniture and fixtures	19	5 e	7 e
341 Paper and paper products	64	31 e	60 e
342 Printing and publishing	26	21 e	37 e
351 Industrial chemicals	127	88 e	165 e
352 Other chemical products	97	59 e	105 e
353 Petroleum refineries	114 e	77 e	127 e
354 Miscellaneous petroleum and coal products			
355 Rubber products	34	18 e	27 e
356 Plastic products	20	8 e	14 e
361 Pottery, china and earthenware	6	2 e	4 e
362 Glass and glass products	10	2 e	2 e
369 Other non-metal mineral products	154	110 e	206 e
371 Iron and steel	7	6 e	11 e
372 Non-ferrous metals	8	3 e	6 e
381 Metal products	110	59 e	124 e
382 Non-electrical machinery	30	15 e	37 e
383 Electrical machinery	51	35 e	50 e
384 Transport equipment	62	22 e	39 e
385 Professional and scientific equipment	1	1 e	1 e
390 Other manufacturing industries	2	1 e	2 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

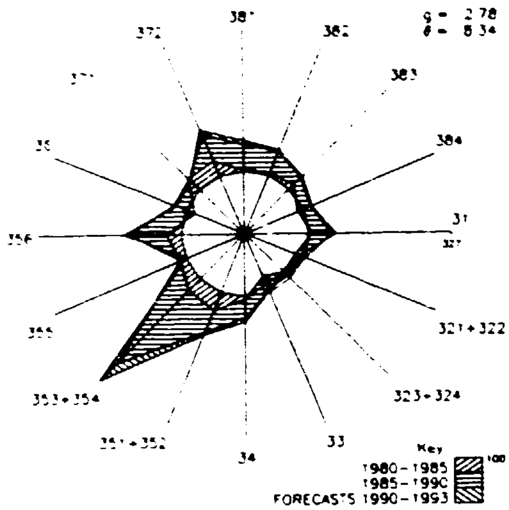




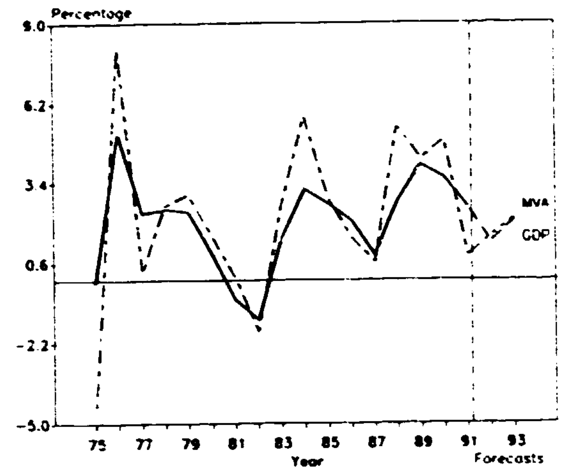


NETHERLANDS

Industrial structural change
(index of value added 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)



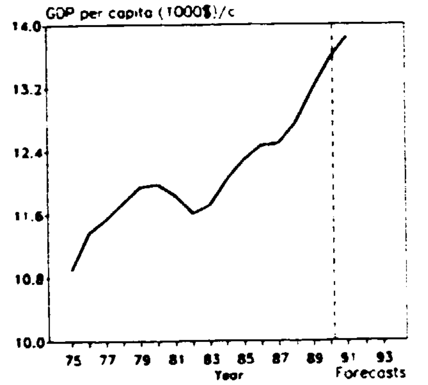
Source: National Accounts Statistics from UN/UNSO

Estimated by UNIDO/PPD/IPP/GLO

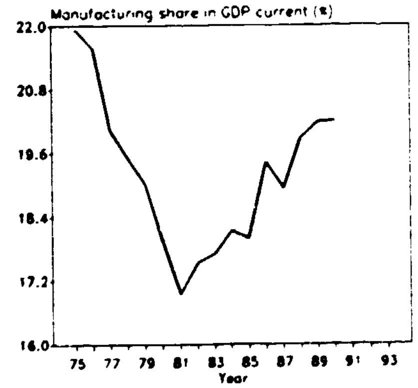
	1980	1985	1990
GDP (m.a.c. millions of 1980-dollars)	169386	178038	202650
Per capita (1980-dollars) (m.a.c.)	11976	12291	13557
Manufacturing share (%) (na, current prices)	17.9	18.0	20.2 /e
MANUFACTURING:			
Value added (m.a.c. millions of 1980-dollars)	33229	36390	42777
Industrial production index	100	106	122
Value added (millions of dollars)	29080	21919	55025
Gross output (millions of dollars)	109617	85086	168228
Employment (thousands)	945	842	906
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	73	74	67
Wages and salaries (%)	15	13	14 /e
Operating surplus (%)	11	13	19 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	115997	101052	185682
Value added / worker	30772	26032	60734
Average wage	17892	13097	26029 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2.83	3.42	2.00 /e
as a percentage of average θ in 1970-1975	75	90	53 /e
MVA growth rate θ	-0.44	0.38	2.67
Degree of specialization	15.4	16.0	15.4
-VALUE ADDED: (millions of dollars)			
311 Food products	4562	3388	8322
313 Beverages	654	458	1259
314 Tobacco products	282	238	736
321 Textiles	734	485	1150
322 Wearing apparel	372	190	398
323 Leather and fur products	68	46	115
324 Footwear	118	69	118
331 Wood and wood products	594	308	671 /e
332 Furniture and fixtures	418	216	680 /e
341 Paper and paper products	805	647	1660
342 Printing and publishing	2480	1771	4330
351 Industrial chemicals	2263	2163	5442 /e
352 Other chemical products	913	802	1911 /e
353 Petroleum refineries	533	515	2245
354 Miscellaneous petroleum and coal products	101	54	241 /e
355 Rubber products	156	122	236 /e
356 Plastic products	472	413	1194 /e
361 Pottery, china and earthenware	15	8	15 /e
362 Glass and glass products	176	106	278 /e
369 Other non-metal mineral products	1081	653	1800 /e
371 Iron and steel	734	653	1233 /e
372 Non-ferrous metals	518	461	1220 /e
381 Metal products	2455	1780	4779
382 Non-electrical machinery	2369	1774	4607
383 Electrical machinery	3687	2864	6372
384 Transport equipment	1927	1244	2951
385 Professional and scientific equipment	382	319	629
390 Other manufacturing industries	211	174	435 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

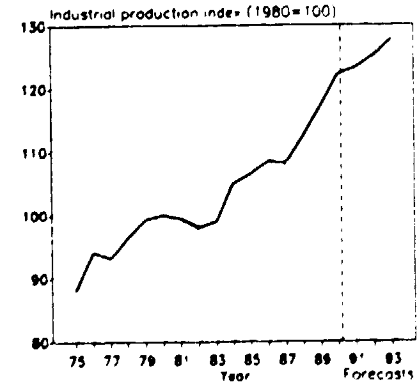
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

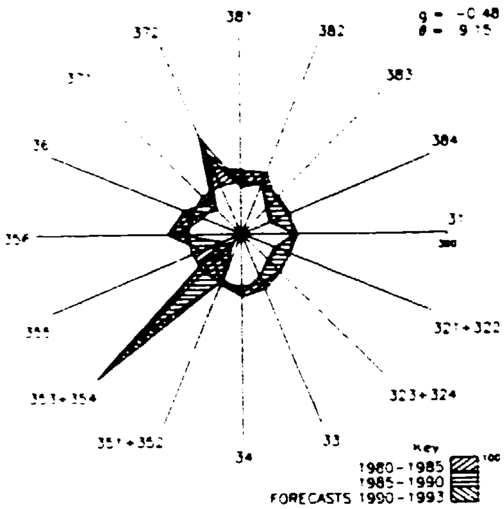


Industrial production index (1980=100)

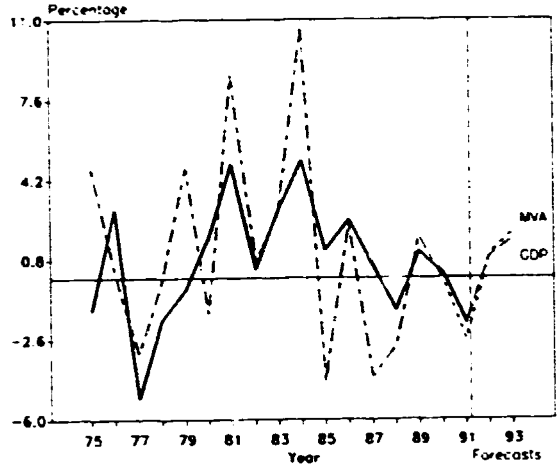


NEW ZEALAND

Industrial structural change
(index of value added 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)



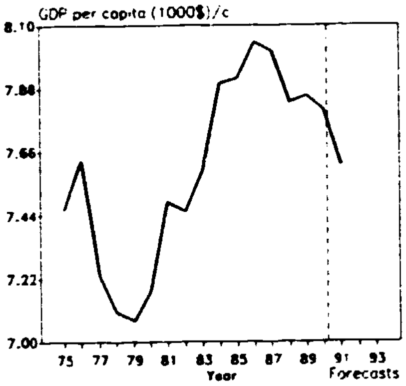
Source National Accounts Statistics from UN/UNSO

Estimated by UNIDO/PPD/IPP/GLO

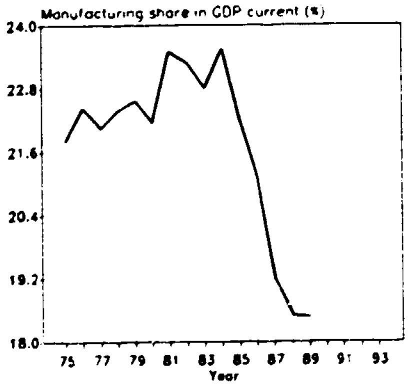
	1980	1985	1990
GDP: (na.c millions of 1980-dollars)	22344	25706	26464
Per capita (1980-dollars) (na.c)	7178	7914	7802
Manufacturing share (%) (na) (current prices)	22 1	22 2	
MANUFACTURING:			
Value added (na.c millions of 1980-dollars)	5007	5955	5765
Industrial production index	100	116	105
Value added (millions of dollars)	4756	4657	7553 /e
Gross output (millions of dollars)	14790	15399	23639 /e
Employment (thousands)	285 /e	280	222
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	68	70	68 /e
Wages and salaries (%)	21	18	15 /e
Operating surplus (%)	11	12	17 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	51964 /e	55005	106279 /e
Value added / worker	16711 /e	16636	33954 /e
Average wage	11050 /e	9833	16194 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2 08 /e	2 29	4 26 /e
as a percentage of average θ in 1970-1975	39 /e	43	80 /e
MVA growth rate / θ	0 64	0 75	-0 64
Degree of specialization	14 6	14 7	14 6
-VALUE ADDED: (millions of dollars)			
311 Food products	1098	1082	1801 /e
313 Beverages	110	93	224 /e
314 Tobacco products	30	19	51 /e
321 Textiles	222	193	250 /e
322 Wearing apparel	185	170	250 /e
323 Leather and fur products	45	46	67 /e
324 Footwear	55	46	52 /e
331 Wood and wood products	253	257	367 /e
332 Furniture and fixtures	92	95	139 /e
341 Paper and paper products	266	276	491 /e
342 Printing and publishing	294	326	569 /e
351 Industrial chemicals	140	134	248 /e
352 Other chemical products	155	142	220 /e
353 Petroleum refineries	26	-1	216 /e
354 Miscellaneous petroleum and coal products	9	7	13 /e
355 Rubber products	96	70	67 /e
356 Plastic products	110	138	216 /e
361 Pottery, china and earthenware	13	11	20 /e
362 Glass and glass products	44	41	62 /e
369 Other non-metal mineral products	114	127	177 /e
371 Iron and steel	93	71	100 /e
372 Non-ferrous metals	82	102	225 /e
381 Metal products	371	404	564 /e
382 Non-electrical machinery	235	264	410 /e
383 Electrical machinery	239	200	290 /e
384 Transport equipment	318	274	333 /e
385 Professional and scientific equipment	14	20	30 /e
390 Other manufacturing industries	45	48	100 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

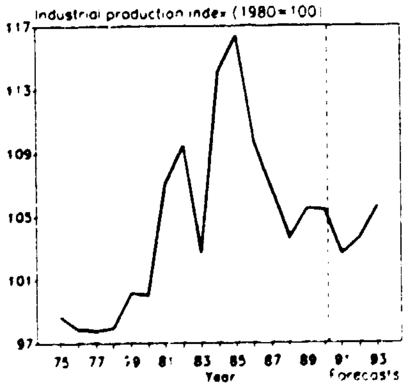
GDP per capita (1000$)/c



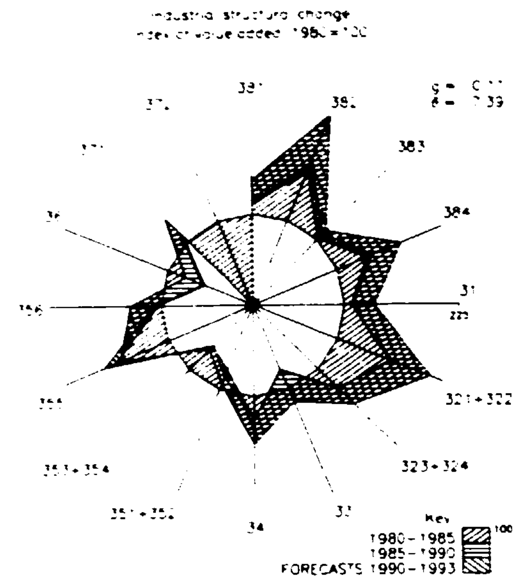
Manufacturing share in GDP current (%)

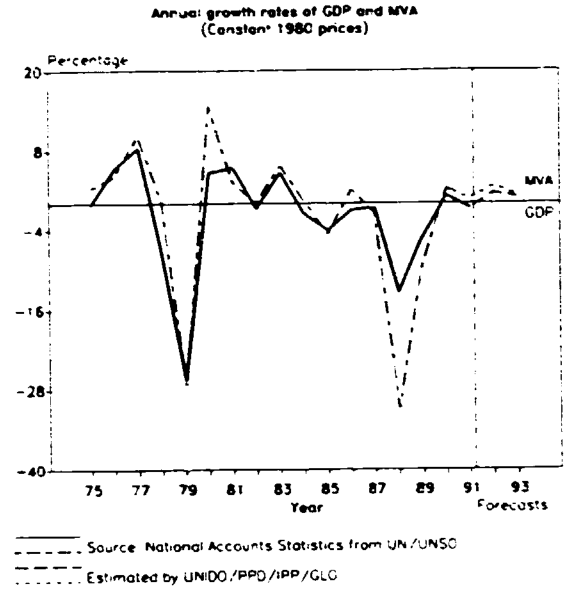


Industrial production index (1980=100)



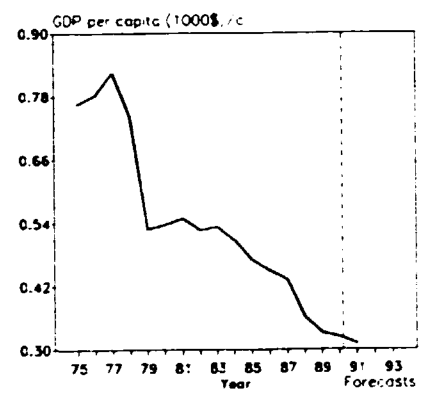
NICARAGUA

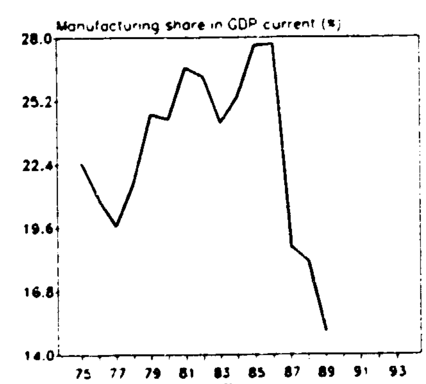


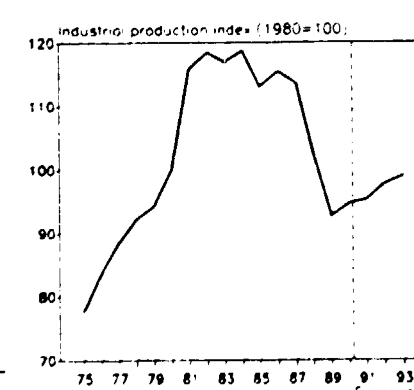


	1980	1985	1990
GDP (n.a.c. millions of 1980-dollars)	1489	1537	1255
Per capita (1980-dollars) (n.a.c.)	537	470	324
Manufacturing share (%) (n.a.) (current prices)	24 4	27 6	
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)	351	366	236
Industrial production index	100	113	95
Value added (millions of dollars)	242	982	1696 e
Gross output (millions of dollars)	612	1587	2667 e
Employment (thousands)	34	39	47 e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	60	38	36 e
Wages and salaries (%)	12	10	11 e
Operating surplus (%)	28	52	52 e
-PRODUCTIVITY: (dollars)			
Gross output / worker	18017	40773	57305 e
Value added / worker	7132	25225	36438 e
Average wage	2078	4152	5400 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	7 80 e	12 88	2 00 e
as a percentage of average θ in 1970-1975	176 e	289	45 e
MVA growth rate (θ)	-1 09	0 38	-1 92
Degree of specialization	27 7	29 6	29 9
-VALUE ADDED: (millions of dollars)			
311 Food products	52	268	443 e
313 Beverages	48	227	406 e
314 Tobacco products	28	64	108 e
321 Textiles	9	70	114 e
322 Wearing apparel	4	23	41 e
323 Leather and fur products	2	6	12 e
324 Footwear	4	27	47 e
331 Wood and wood products	3	10	15 e
332 Furniture and fixtures	1	4	5 e
341 Paper and paper products	1	3	3 e
342 Printing and publishing	4	22	40 e
351 Industrial chemicals	11	23	34 e
352 Other chemical products	14	56	102 e
353 Petroleum refineries	35	78	157 e
354 Miscellaneous petroleum and coal products	-	1	2 e
355 Rubber products	1	6	12 e
356 Plastic products	4	20	33 e
361 Pottery, china and earthenware	-	2	2 e
362 Glass and glass products	-	1	2 e
369 Other non-metal mineral products	7	17	26 e
371 Iron and steel	-	1	2 e
372 Non-ferrous metals	-	-	- e
381 Metal products	9	40	68 e
382 Non-electrical machinery	-	3	4 e
383 Electrical machinery	1	5	9 e
384 Transport equipment	1	3	5 e
385 Professional and scientific equipment	1	-	- e
390 Other manufacturing industries	-	2	3 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex







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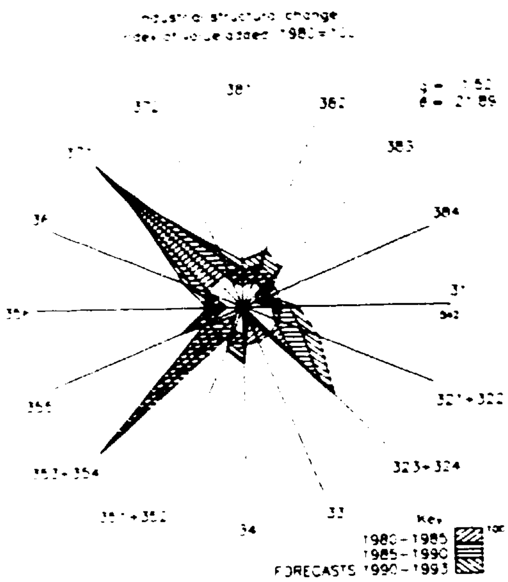
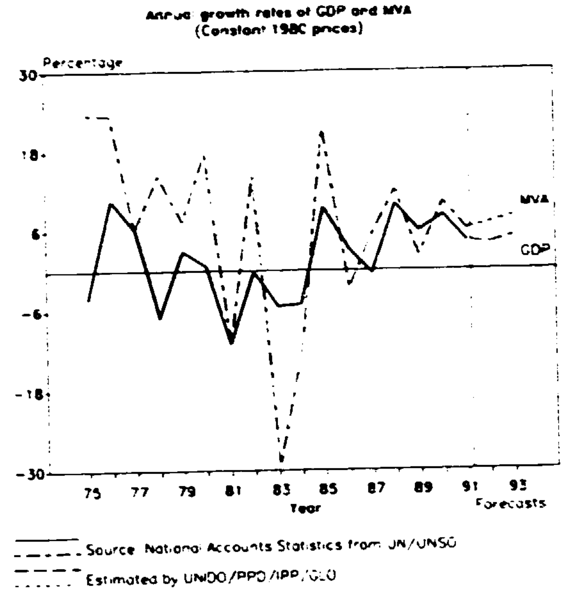
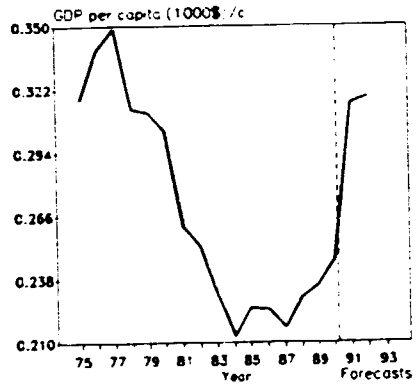
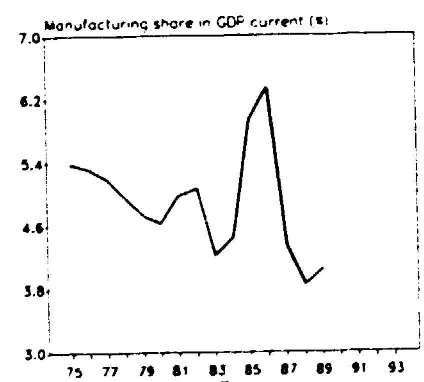


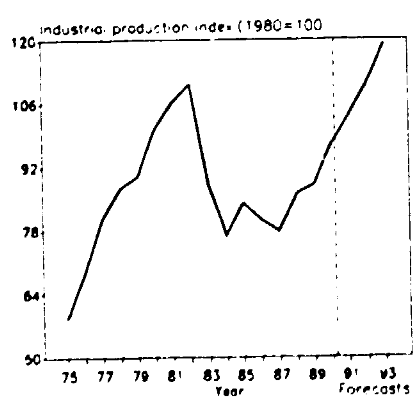


	1980	1985	1990
GDP (n.a.c.: millions of 1980-dollars)	23795	20724	26758
Per capita (1980-dollars; n.a.c.)	303	225	247
Manufacturing share (%, n.a., current prices)	4.6	5.9 e	
MANUFACTURING:			
Value added (n.a.c.: millions of 1980-dollars)	1191	910	1177
Industrial production index	100	84	97
Value added (millions of dollars)	2422	1667	3612 e
Gross output (millions of dollars)	4740	3454	5797 e
Employment (thousands)	432	330	400 e
-PROFITABILITY (in percent of gross output)			
Intermediate input (%)	49	52	38 e
Wages and salaries (%)	11 e	10 e	10 e
Operating surplus (%)	40 e	38 e	52 e
-PRODUCTIVITY: dollars			
Gross output / worker	10966	10472	14491 e
Value added / worker	5604	5054	9027 e
Average wage	1226 e	1038 e	1455 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	16.40 e	25.99 e	2.14 e
as a percentage of average θ in 1970-1975	135 e	214 e	18 e
MVA growth rate (θ)	1.13	-0.28	5.12
Degree of specialization	18.5	18.8	20.7
-VALUE ADDED (millions of dollars)			
311 Food products	149	251	523 e
313 Beverages	267	173 e	352 e
314 Tobacco products	96	32 e	53 e
321 Textiles	231	233	573 e
322 Wearing apparel	3	1	2 e
323 Leather and fur products	12	23	44 e
324 Footwear	12	28	57 e
331 Wood and wood products	88	14	23 e
332 Furniture and fixtures	56	14	30 e
341 Paper and paper products	38	51	113 e
342 Printing and publishing	75	45	105 e
351 Industrial chemicals	30	9	16 e
352 Other chemical products	265	213	446 e
353 Petroleum refineries	71 e	-6 e	35 e
354 Miscellaneous petroleum and coal products	7 e	-1 e	4 e
355 Rubber products	26	31	63 e
356 Plastic products	38	49	106 e
361 Pottery, china and earthenware	-	2	2 e
362 Glass and glass products	24	7	16 e
369 Other non-metal mineral products	37	106	221 e
371 Iron and steel	3	17	20 e
372 Non-ferrous metals	33	27	70 e
381 Metal products	140	92	200 e
382 Non-electrical machinery	23	19	42 e
383 Electrical machinery	46	36	77 e
384 Transport equipment	526	193	398 e
385 Professional and scientific equipment	-	-	- e
390 Other manufacturing industries	13	6	10 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex







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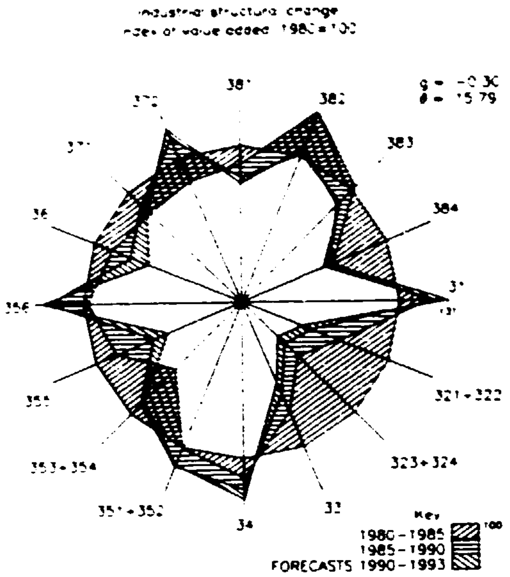
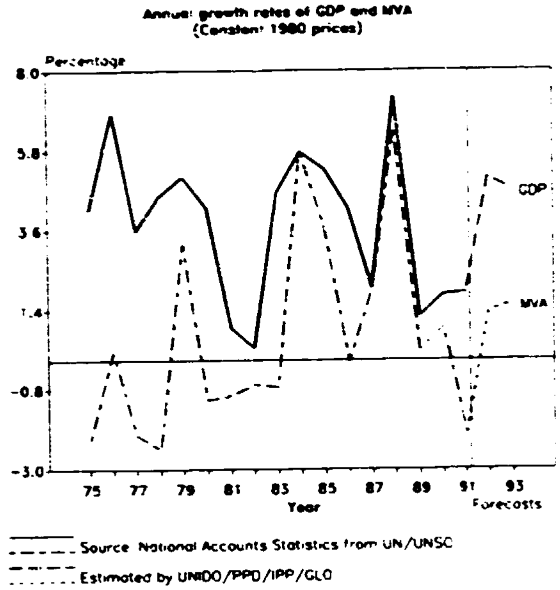
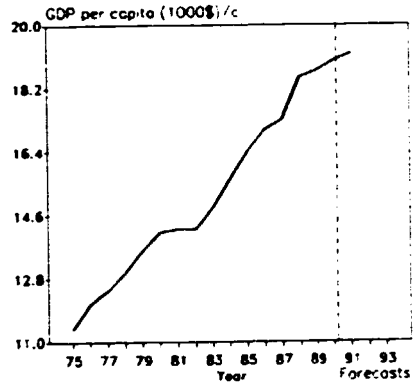
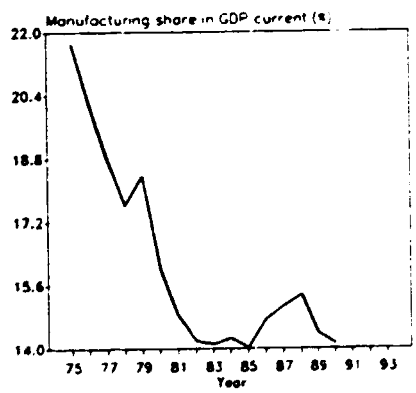


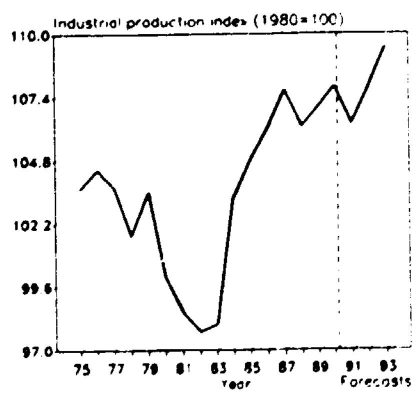


	1980	1985	1990
GDP: na.c millions of 1980-dollars)	57713	68041	79915
Per capita (1980-dollars) na.c	14125	16383	18969
Manufacturing share (%) na (current prices)	16 0	14 0	14 1 /e
MANUFACTURING:			
Value added na.c millions of 1980-dollars)	10331	11058	12127
Industrial production index	100	105	108
Value added (millions of dollars)	9338	7948	14577
Gross output (millions of dollars)	31936	28185	50243
Employment (thousands)	354	312	269
-PROFITABILITY: in percent of gross output			
Intermediate input (%)	71	72	71
Wages and salaries (%)	18	16	15 /e
Operating surplus (%)	12	12	14 /e
-PRODUCTIVITY: dollars)			
Gross output / worker	90239	90309	187045
Value added / worker	26387	25465	54269
Average wage	15916	14784	28815 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	5 11	6 97	4 50
as a percentage of average θ in 1970-1975	84	115	74
MVA growth rate / θ	-0 19	-0 10	-0 06
Degree of specialization	12 2	13 9	13 6
-VALUE ADDED: (millions of dollars)			
311 Food products	908	922	1648
313 Beverages	292	297	645
314 Tobacco products	168	220	464
321 Textiles	213	126	189
322 Wearing apparel	101	59	55
323 Leather and fur products	18	9	16
324 Footwear	24	9	11
331 Wood and wood products	587	365	614 /e
332 Furniture and fixtures	196	164	214 /e
341 Paper and paper products	452	400	833
342 Printing and publishing	668	717	1378
351 Industrial chemicals	452	422	867
352 Other chemical products	227	184	392 /e
353 Petroleum refineries	103	24	119 /e
354 Miscellaneous petroleum and coal products	53	58	114 /e
355 Rubber products	51	38	50 /e
356 Plastic products	170	147	343 /e
361 Pottery, china and earthenware	26	17	25 /e
362 Glass and glass products	55	50	80 /e
369 Other non-metal mineral products	281	215	348
371 Iron and steel	385	276	560
372 Non-ferrous metals	743	550	1379
381 Metal products	595	465	780
382 Non-electrical machinery	933	1079	1562
383 Electrical machinery	547	498	800
384 Transport equipment	1000	555	938
385 Professional and scientific equipment	32	38	87 /e
390 Other manufacturing industries	59	42	70 /e

For sources, footnotes and comments see 'Technical notes' at the beginning of this Annex







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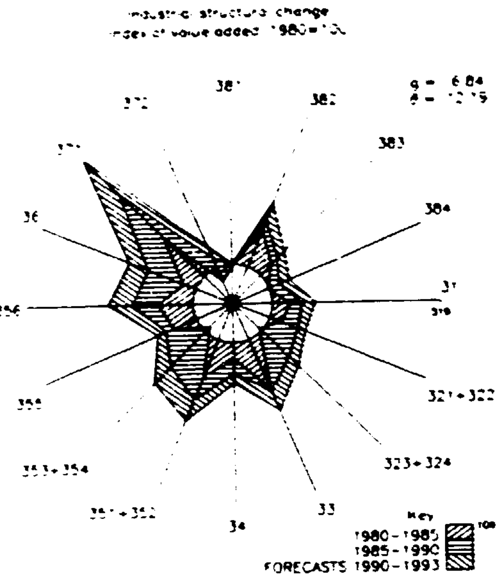
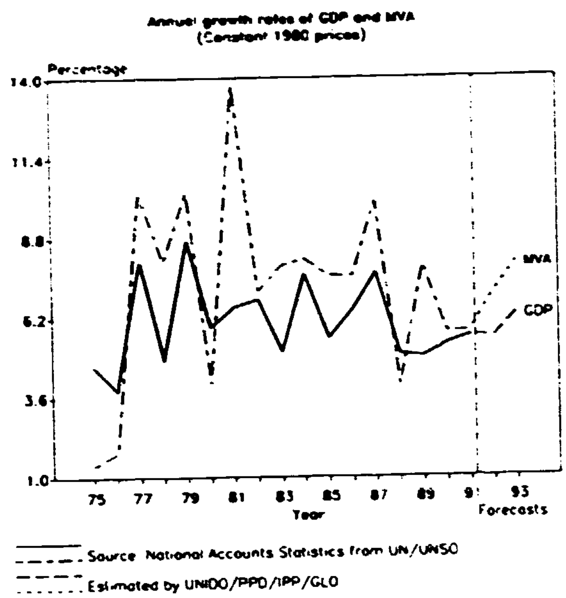
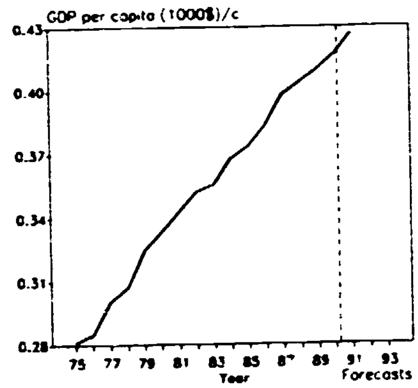
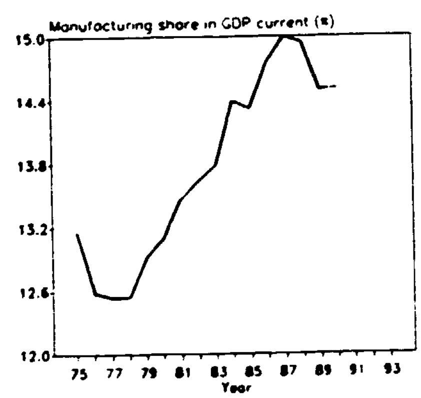


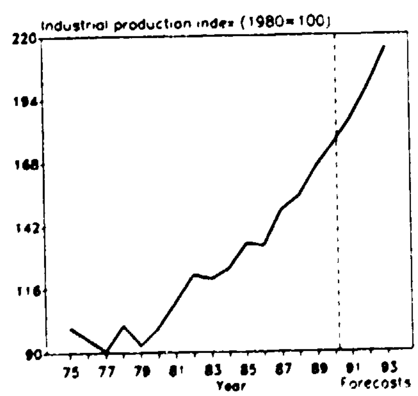


	1980	1985	1990
GDP (n.a.c. millions of 1980-dollars)	28418	38555	51249
Per capita (1980-dollars) (n.a.c.)	333	373	417
Manufacturing share (%) (n.a. current prices)	13 1	14 3	14 5 /e
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)	4294	6557	9193
Industrial production index	100	134	175
Value added (millions of dollars)	2423	3174	4356 /e
Gross output (millions of dollars)	7144	10132	13160 /e
Employment (thousands)	452	493	602 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	56	69	67 /e
Wages and salaries (%)	7	6	7 /e
Operating surplus (%)	27	25	26 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	15807	20560	21852 /e
Value added / worker	5361	6440	7232 /e
Average wage	1122	1324	1570 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	6 88	7 24	3 83 /e
as a percentage of average θ in 1970-1975	102	107	57 /e
MVA growth rate / θ	0 73	1 03	1 76
Degree of specialization	23 2	22 6	21 4
-VALUE ADDED: (millions of dollars)			
311 Food products	431	580	631 /e
313 Beverages	45	74	72 /e
314 Tobacco products	300	372	513 /e
321 Textiles	483	562	727 /e
322 Wearing apparel	7	18	47 /e
323 Leather and fur products	41	35	59 /e
324 Footwear	4	3	20 /e
331 Wood and wood products	4	9	10 /e
332 Furniture and fixtures	3	6	5 /e
341 Paper and paper products	29	33	38 /e
342 Printing and publishing	24	36	48 /e
351 Industrial chemicals	127	281	373 /e
352 Other chemical products	156	230	297 /e
353 Petroleum refineries	158	108	312 /e
354 Miscellaneous petroleum and coal products	9	17	24 /e
355 Rubber products	28	41	46 /e
356 Plastic products	12	21	27 /e
361 Pottery, china and earthenware	5	8	12 /e
362 Glass and glass products	11	17	26 /e
369 Other non-metal mineral products	171	199	349 /e
371 Iron and steel	99	216	358 /e
372 Non-ferrous metals	1	1	2 /e
381 Metal products	38	33	34 /e
382 Non-electrical machinery	43	80	89 /e
383 Electrical machinery	78	98	112 /e
384 Transport equipment	97	83	110 /e
385 Professional and scientific equipment	6	6	5 /e
390 Other manufacturing industries	11	11	11 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex







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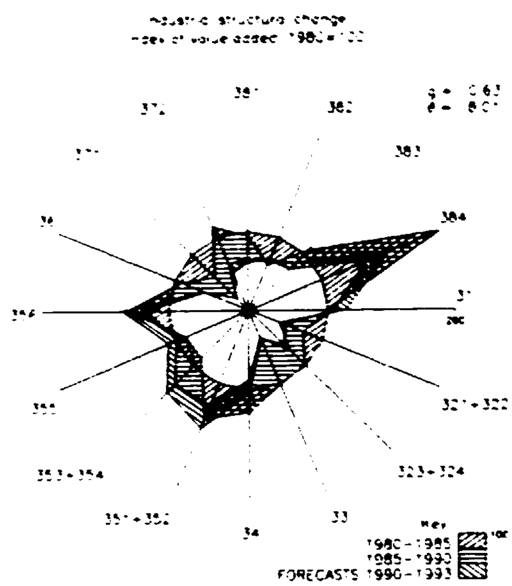
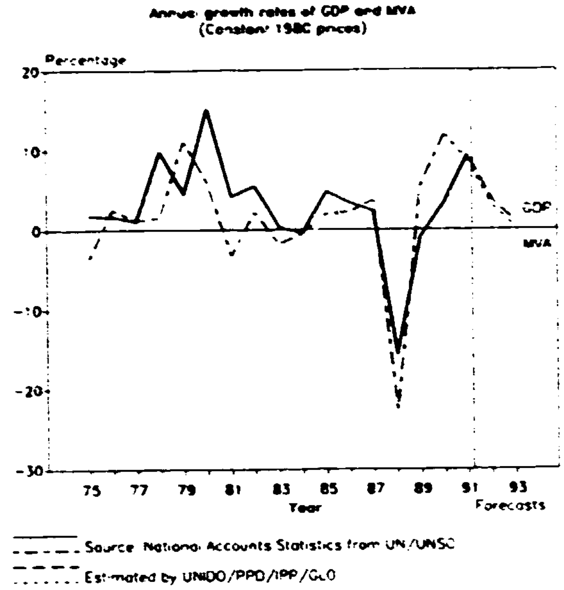
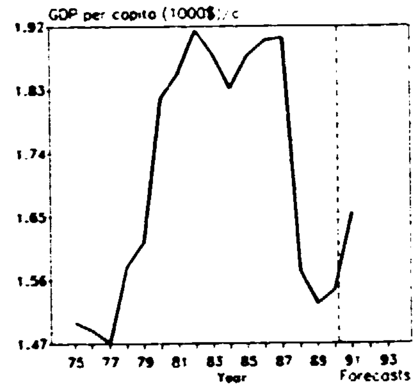
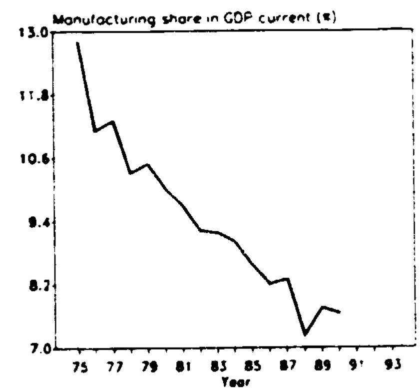


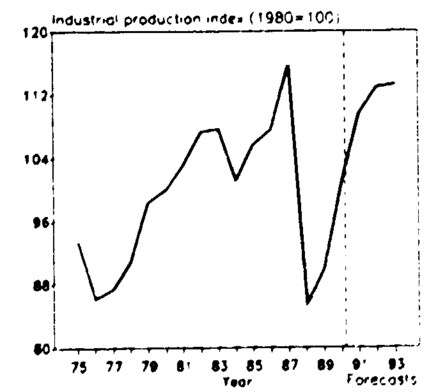


	1980	1985	1990
GDP: na.c millions of 1980-dollars	3559	4094	3743
Per capita 1980-dollars na.c	1818	1877	1547
Manufacturing share (%) na current prices	10 0	8 6	7 6 /e
MANUFACTURING:			
value added na.c millions of 1980-dollars	400	394	381
Industrial production index	100	106	101
value added millions of dollars	477	585	544 e
Gross output millions of dollars	1473 e	1765	1492 e
Employment thousands	31 e	36	34 e
-PROFITABILITY: in percent of gross output			
Intermediate input (%)	68 e	67	64 /e
Wages and salaries (%)	8 e	11	12 e
Operating surplus (%)	24 e	22	24 /e
-PRODUCTIVITY: dollars			
Gross output worker	46756 e	48890	44047 e
Value added worker	15159 e	16203	16053 e
Average wage	3805 e	5558	5473 e
-STRUCTURAL INDICES:			
Structural change θ 5-year average in degrees	5 56	4 46	3 16 /e
as a percentage of average θ in 1970-1975	85	68	49 /e
MVA growth rate θ	0 74	0 25	-0 32
Degree of specialization	24 2	22 8	28 4
-VALUE ADDED: millions of dollars			
311 Food products	155	179	193 /e
313 Beverages	52	63	74 e
314 Tobacco products	26	31	28 /e
321 Textiles	4	3	5 e
322 Wearing apparel	31	27	15 /e
323 Leather and fur products	4	4	2 /e
324 Footwear	7	9	6 /e
331 Wood and wood products	8	8	2 /e
332 Furniture and fixtures	8	11	5 /e
341 Paper and paper products	20	34	22 /e
342 Printing and publishing	22	30	22 /e
351 Industrial chemicals	4	10	8 e
352 Other chemical products	26	42	39 /e
353 Petroleum refineries	27	25	40 /e
354 Miscellaneous petroleum and coal products	-	2	3 /e
355 Rubber products	2	2	2 /e
356 Plastic products	12	21	19 /e
361 Pottery, china and earthenware	-	-	- e
362 Glass and glass products	1 /e	7	6 /e
369 Other non-metal mineral products	31	27	17 /e
371 Iron and steel	5	4	1 e
372 Non-ferrous metals	2	3	2 e
381 Metal products	19	21	14 /e
382 Non-electrical machinery	1	1	1 /e
383 Electrical machinery	3	4	3 /e
384 Transport equipment	4	13	8 e
385 Professional and scientific equipment	1	3	3 e
390 Other manufacturing industries	2	2	3 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

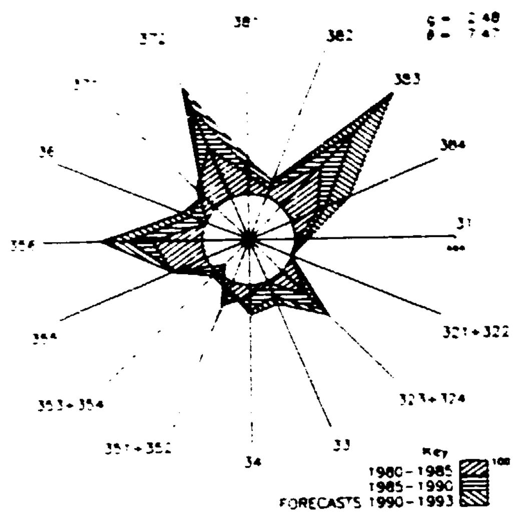




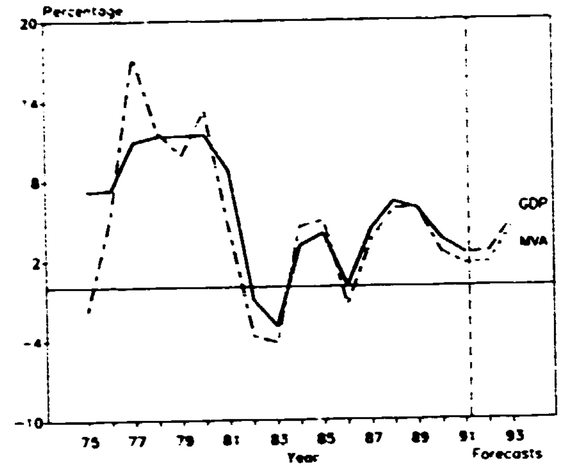


PARAGUAY

Industrial structure change
(Index of value added 1980=100)



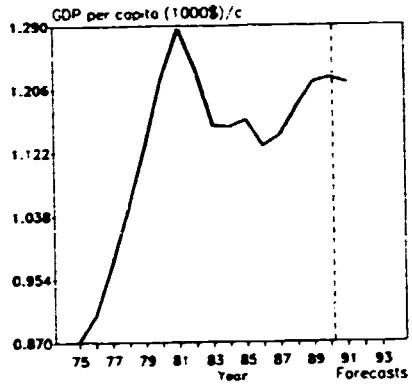
Annual growth rates of GDP and MVA
(Constant 1980 prices)

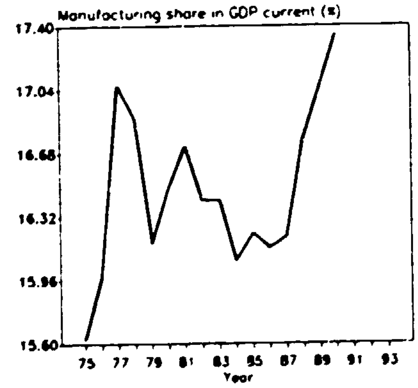


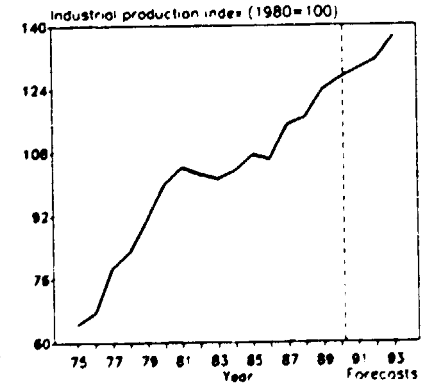
Source: National Accounts Statistics from UN/UNSO
Estimated by UNIDO/PPD/IPP/GLO

	1980	1985	1990
GDP (n.a.c. millions of 1980-dollars)	3844	4302	5227
Per capita (1980-dollars) (n.a.c.)	1222	1154	1220
Manufacturing share (%) (n.a.) (current prices)	16 5	16 2	17 3 /e
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)	633	669	784
Industrial production index	100	107	127
Value added (millions of dollars)	575	601 /e	611 /e
Gross output (millions of dollars)	1707	1792 /e	1844 /e
Employment (thousands)	95 /e	106 /e	132 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)			
Wages and salaries (%)			
Operating surplus (%)			
-PRODUCTIVITY: (dollars)			
Gross output / worker	17873 /e	16911 /e	14015 /e
Value added / worker	6024 /e	5668 /e	4646 /e
Average wage			
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	7 33	4 75 /e	2 20 /e
as a percentage of average θ in 1970-1975	137	89 /e	41 /e
MVA growth rate / θ	1 19	0 28	1 60
Degree of specialization	31 7	25 8	26 3
-VALUE ADDED: (millions of dollars)			
311 Food products	170	166 /e	160 /e
313 Beverages	43	49 /e	50 /e
314 Tobacco products	6	8 /e	8 /e
321 Textiles	44	42 /e	36 /e
322 Wearing apparel	2	3 /e	2 /e
323 Leather and fur products	7	19 /e	21 /e
324 Footwear	18	23 /e	23 /e
331 Wood and wood products	95	95 /e	106 /e
332 Furniture and fixtures	6	10 /e	10 /e
341 Paper and paper products	-	2 /e	2 /e
342 Printing and publishing	24	27 /e	29 /e
351 Industrial chemicals	4	14 /e	9 /e
352 Other chemical products	10	9 /e	6 /e
353 Petroleum refineries	94	70 /e	78 /e
354 Miscellaneous petroleum and coal products	- /e	- /e	- /e
355 Rubber products	-	- /e	- /e
356 Plastic products	6	12 /e	13 /e
361 Pottery, china and earthenware	-	- /e	- /e
362 Glass and glass products	1	3 /e	4 /e
369 Other non-metal mineral products	26	22 /e	26 /e
371 Iron and steel	-	- /e	- /e
372 Non-ferrous metals	1	2 /e	3 /e
381 Metal products	9	12 /e	12 /e
382 Non-electrical machinery	1	1 /e	1 /e
383 Electrical machinery	-	- /e	1 /e
384 Transport equipment	5	8 /e	8 /e
385 Professional and scientific equipment	1	1 /e	1 /e
390 Other manufacturing industries	2	3 /e	3 /e

For sources, footnotes and comments see "technical notes" at the beginning of this Annex

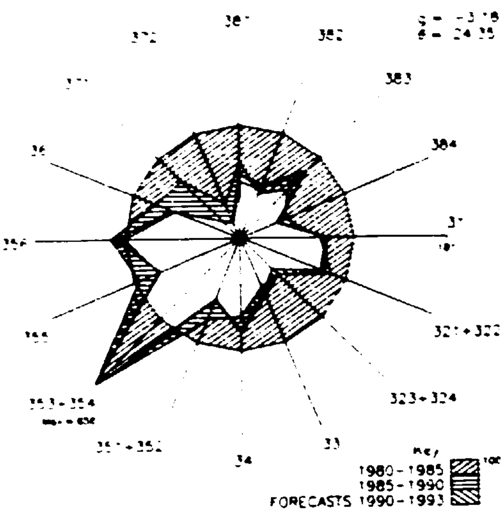




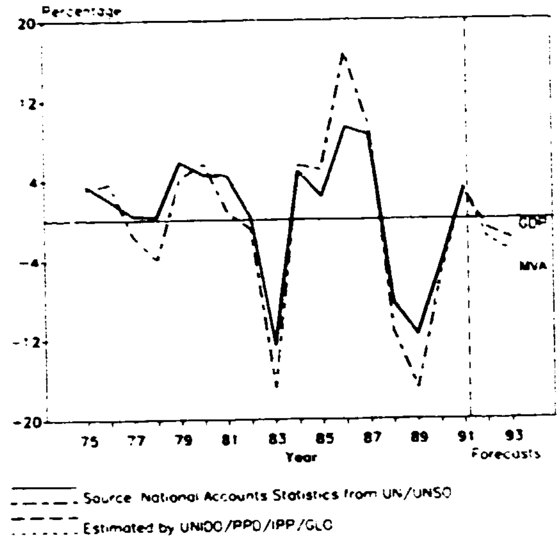


PERU

Industrial structural change
Index of value added (1980 = 100)



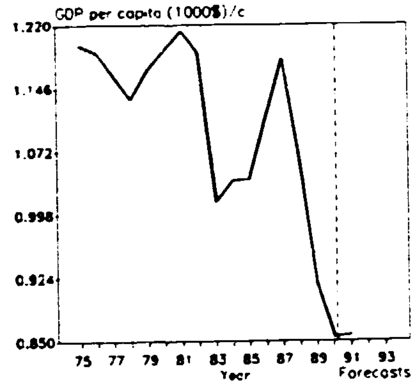
Annual growth rates of GDP and MVA
(Constant 1980 prices)



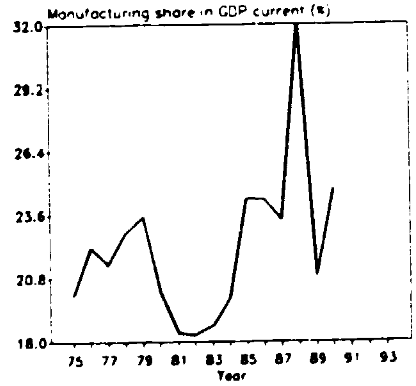
	1980	1985	1990
GDP: (n.a.c. millions of 1980-dollars)	20579	20167	18419
Per capita (1980-dollars, n.a.c.)	1190	1039	854
Manufacturing share (% n.a. current prices)	20 2	24 3	24 7 e
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)	4272	3922	3484
Industrial production index	100	86	77
Value added (millions of dollars)	4984	3918	7180 e
Gross output (millions of dollars)	12977	9573	29095 e
Employment (thousands)	273	263	274 e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	62	59	75 e
Wages and salaries (%)	6	5	8 e
Operating surplus (%)	32	36	17 e
-PRODUCTIVITY: (dollars)			
Gross output / worker	47484	36349	106200 e
Value added / worker	18238	14877	26208 e
Average wage	2824	1874	8400 e
-STRUCTURAL INDICES:			
Structural change θ 5-year average in degrees	10 22	16 82	7 53 e
as a percentage of average θ in 1970-1975	150	246	110 e
MVA growth rate / θ	0 32	-0 03	-0 61
Degree of specialization	12 7	21 3	14 4
-VALUE ADDED: (millions of dollars)			
311 Food products	767	402	987 e
313 Beverages	379	303	871 e
314 Tobacco products	84	61	151 e
321 Textiles	466	352	693 e
322 Wearing apparel	65	52	213 e
323 Leather and fur products	56	20	42 e
324 Footwear	41	20	54 e
331 Wood and wood products	81	32	84 e
332 Furniture and fixtures	40	19	62 e
341 Paper and paper products	156	77	152 e
342 Printing and publishing	100	80	307 e
351 Industrial chemicals	215	158	219 e
352 Other chemical products	289	193	423 e
353 Petroleum refineries	192	1154	369 e
354 Miscellaneous petroleum and coal products	6	1	2 e
355 Rubber products	62	52	100 e
356 Plastic products	89	90	208 e
361 Pottery, china and earthenware	15	8	17 e
362 Glass and glass products	47	15	54 e
369 Other non-metal mineral products	129	113	194 e
371 Iron and steel	192	123	83 e
372 Non-ferrous metals	504	172	203 e
381 Metal products	188	113	228 e
382 Non-electrical machinery	156	58	168 e
383 Electrical machinery	211	111	380 e
384 Transport equipment	278	106	215 e
385 Professional and scientific equipment	14	10	30 e
390 Other manufacturing industries	58	25	71 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

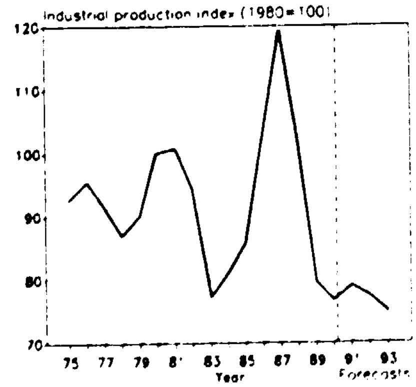
GDP per capita (1000$)/c



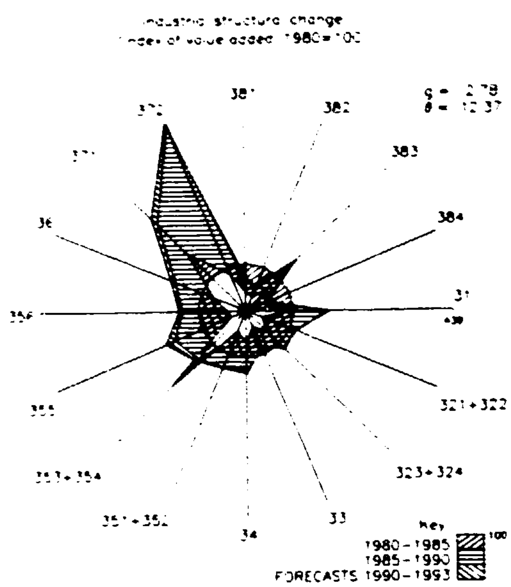
Manufacturing share in GDP current (%)

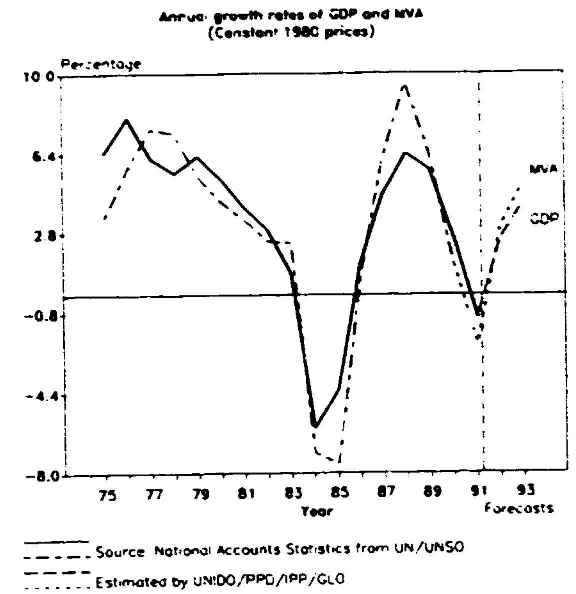


Industrial production index (1980=100)



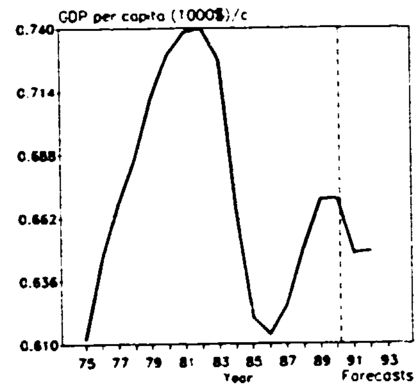
PHILIPPINES

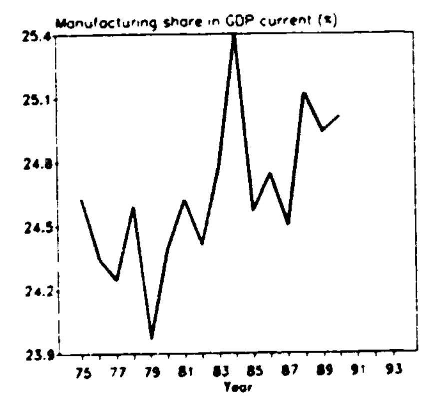


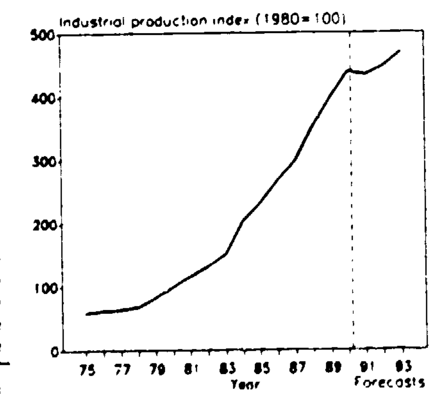


	1980	1985	1990
GDP (n.a.c.) (millions of 1980-dollars)	35235	34221	41832
Per capita (1980-dollars) (n.a.c.)	729	621	570
Manufacturing share (%) (n.a.) (current prices)	24.4	24.6	25.0 /e
MANUFACTURING:			
Value added (n.a.c.) (millions of 1980-dollars)	8595	7983	10109
Industrial production index	100	231	438
Value added (millions of dollars)	4861	3448	7280 /e
Gross output (millions of dollars)	17369	12081	21195 /e
Employment (thousands)	949	618	900 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	72	71	66 /e
Wages and salaries (%)	6	6	8 /e
Operating surplus (%)	22	22	26 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	18308	19540	23558 /e
Value added / worker	5124	5576	8092 /e
Average wage	1127	1258	1909 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	12.12	14.07	9.12 /e
as a percentage of average θ in 1970-1975	107	125	81 /e
MVA growth rate / θ	0.39	-0.27	1.59
Degree of specialization	14.4	22.0	15.5
-VALUE ADDED: (millions of dollars)			
311 Food products	969	658	1342 /e
313 Beverages	195	423	915 /e
314 Tobacco products	309	209	458 /e
321 Textiles	395	109	317 /e
322 Wearing apparel	205	105	420 /e
323 Leather and fur products	8	3	11 /e
324 Footwear	13	9	14 /e
331 Wood and wood products	229	86	197 /e
332 Furniture and fixtures	75	22	89 /e
341 Paper and paper products	128	97	195 /e
342 Printing and publishing	89	46	102 /e
351 Industrial chemicals	296	101	299 /e
352 Other chemical products	389	205	652 /e
353 Petroleum refineries	328	715	506 /e
354 Miscellaneous petroleum and coal products	2	3	6 /e
355 Rubber products	103	34	182 /e
356 Plastic products	85	32	122 /e
361 Pottery, china and earthenware	33	9	26 /e
362 Glass and glass products	42	28	93 /e
369 Other non-metal mineral products	63	60	118 /e
371 Iron and steel	98	164	281 /e
372 Non-ferrous metals	35	28	160 /e
381 Metal products	127	49	97 /e
382 Non-electrical machinery	98	31	58 /e
383 Electrical machinery	260	156	411 /e
384 Transport equipment	234	35	126 /e
385 Professional and scientific equipment	5	5	19 /e
390 Other manufacturing industries	49	28	53 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

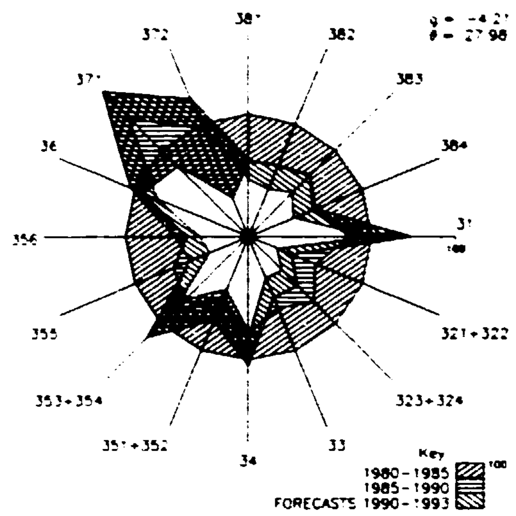




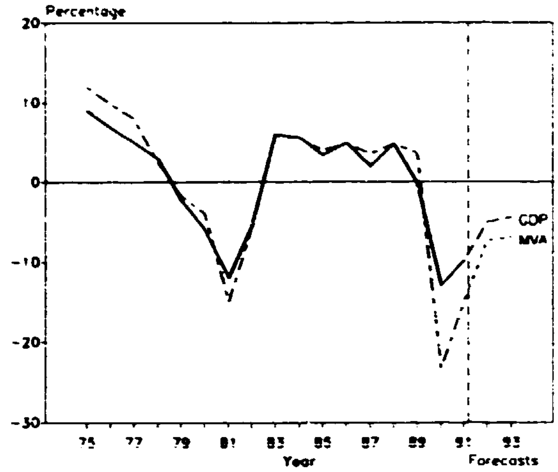


POLAND

Industrial structure change
(Index of value added 1980=100)



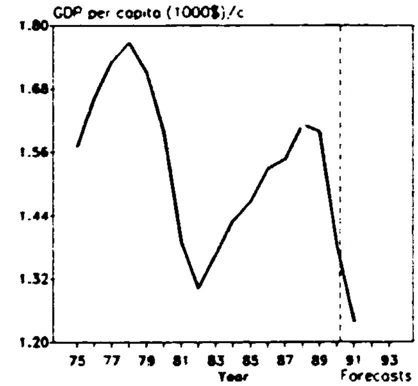
Annual growth rates of GDP and MVA
(Constant 1980 prices)



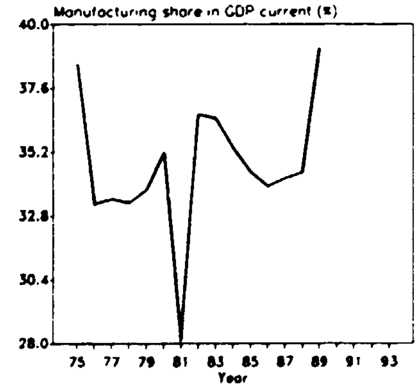
	1980	1985	1990
GDP: (na.c (millions of 1980-dollars)	56707	54570	53163
Per capita (1980-dollars) (na.c	1594	1467	1382
Manufacturing share (%) (na current prices)	35 2	34 4	
MANUFACTURING:			
Value added (na.c (millions of 1980-dollars)	26384	24563	22213
Industrial production index	100	99	84
Value added (millions of dollars)	22833	24432	23017
Gross output (millions of dollars)			
Employment (thousands)	4126	3578	3014
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)			
Wages and salaries (%)			
Operating surplus (%)			
-PRODUCTIVITY: (dollars)			
Gross output / worker			
Value added / worker	5534	6828	7637
Average wage	1551	1627	1257
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	6 03	14 02	11 51
as a percentage of average θ in 1970-1975	118	275	226
MVA growth rate / θ	0 06	-0 52	0 49
Degree of specialization	11 7	14 4	11 3
-VALUE ADDED: (millions of dollars)			
311 Food products	-889	144	2595
313 Beverages	3062	3582	1838
314 Tobacco products	636	74	379
321 Textiles	2795	2444	1222
322 Wearing apparel	572	801	432
323 Leather and fur products	122	221	120
324 Footwear	403	430	263
331 Wood and wood products	423	434	325
332 Furniture and fixtures	491	500	307
341 Paper and paper products	224	269	348
342 Printing and publishing	154	208	166
351 Industrial chemicals	837	734	1056
352 Other chemical products	961	644	649
353 Petroleum refineries	1058	1239	1419
354 Miscellaneous petroleum and coal products	54	60	249
355 Rubber products	317	341	209
356 Plastic products	360	296	274
361 Pottery, china and earthenware	97	146	107
362 Glass and glass products	269	282	227
369 Other non-metal mineral products	335	634	602
371 Iron and steel	868	1161	1887
372 Non-ferrous metals	602	336	951
381 Metal products	1343	1347	1081
382 Non-electrical machinery	3263	3360	2604
383 Electrical machinery	1558	1801	1420
384 Transport equipment	2436	2255	1855
385 Professional and scientific equipment	244	251	173
390 Other manufacturing industries	237	438	258

For sources, footnotes and comments see 'Technical notes' at the beginning of this Annex

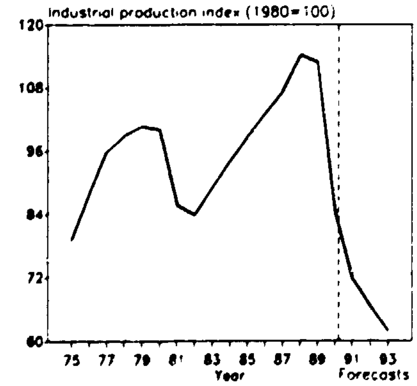
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

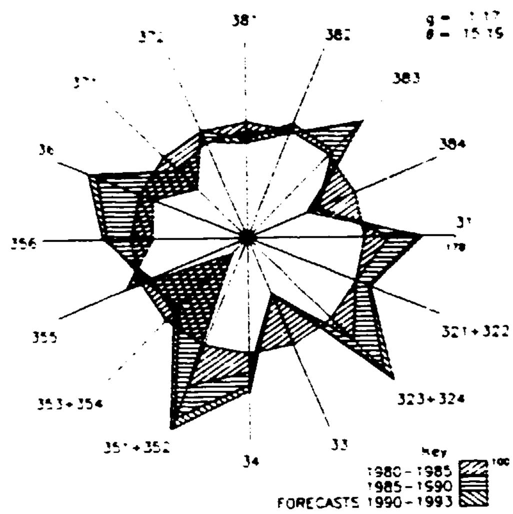


Industrial production index (1980=100)

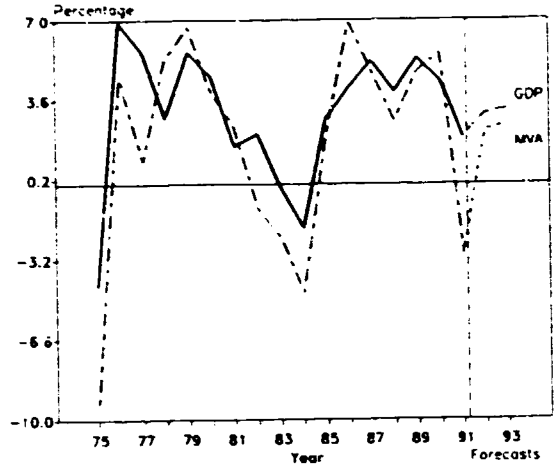


PORTUGAL

Industrial structural change
(index of value added 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)



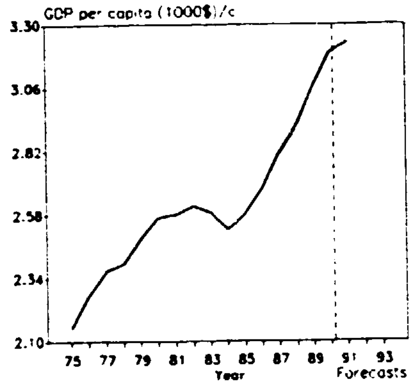
Source: National Accounts Statistics from UN/UNSO

Estimated by UNIDO/PPD/IPP/GLO

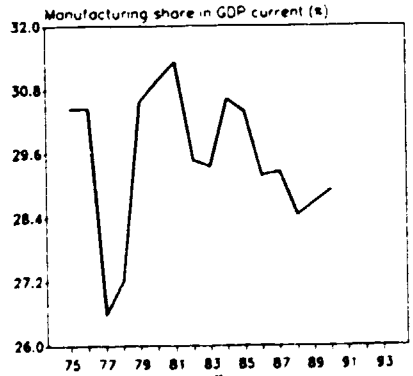
	1980	1985	1990
GDP (n.a.c., millions of 1980-dollars)	25090	26223	32855
Per capita (1980-dollars) (n.a.c.)	2569	2581	3193
Manufacturing share (%) (n.a.) (current prices)	31.0	30.4	28.9 e
MANUFACTURING:			
Value added (n.a.c., millions of 1980-dollars)	7674	7400	9422
Industrial production index	100	96	114
Value added (millions of dollars)	5602	4191	11713 e
Gross output (millions of dollars)	17932	15793	37281 e
Employment (thousands)	680	623	577
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	69	73	69 e
Wages and salaries (%)	13	10	10 e
Operating surplus (%)	18	16	22 e
-PRODUCTIVITY: (dollars)			
Gross output / worker	26355	25362	64610 e
Value added / worker	8233	6731	20299 e
Average wage	3554	2635	6200 e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	5.31	7.15	4.67 e
as a percentage of average θ in 1970-1975	83	112	73 e
MVA growth rate / θ	1.44	-0.15	0.83
Degree of specialization	11.2	12.0	10.8
-VALUE ADDED: (millions of dollars)			
311 Food products	544	490	1360
313 Beverages	135	133	408
314 Tobacco products	64	93	226
321 Textiles	905	679	1738
322 Wearing apparel	186	182	486
323 Leather and fur products	41	41	91
324 Footwear	86	86	293
331 Wood and wood products	325	150	292 e
332 Furniture and fixtures	106	30	135 e
341 Paper and paper products	274	276	715 e
342 Printing and publishing	180	140	341 e
351 Industrial chemicals	147	215	601
352 Other chemical products	224	190	541 e
353 Petroleum refineries	219 e	33 e	338 e
354 Miscellaneous petroleum and coal products	1 e	- e	1 e
355 Rubber products	58	52	101 e
356 Plastic products	128	82	285 e
361 Pottery, china and earthenware	80	67	250 e
362 Glass and glass products	87	53	215
369 Other non-metal mineral products	295	200	712
371 Iron and steel	207	98	318
372 Non-ferrous metals	33	26	55
381 Metal products	323	219	546
382 Non-electrical machinery	170	143	303
383 Electrical machinery	319	263	809
384 Transport equipment	428	222	477
385 Professional and scientific equipment	15	16	49 e
390 Other manufacturing industries	20	11	29 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

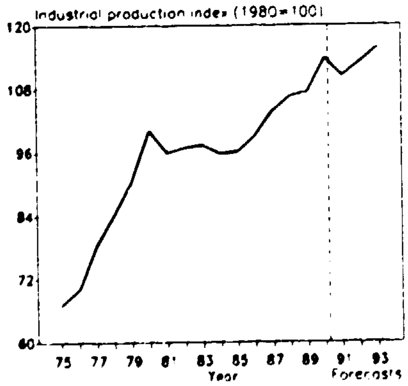
GDP per capita (1000$)/c



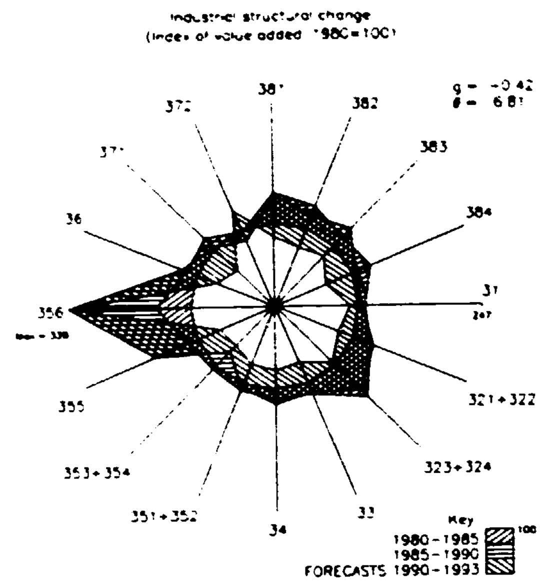
Manufacturing share in GDP current (%)

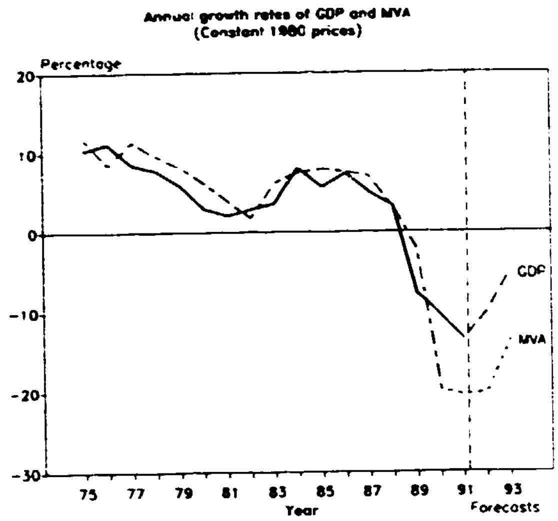


Industrial production index (1980=100)



ROMANIA

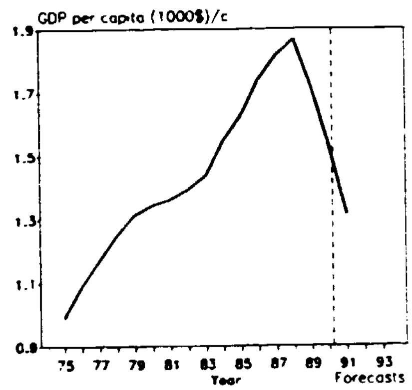


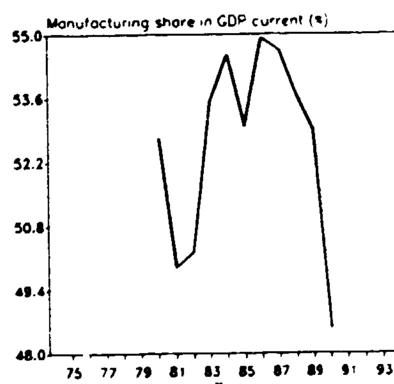


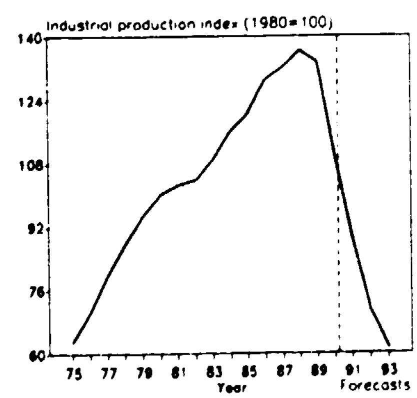
Source: National Accounts Statistics from UN/UNSO
Estimated by UNIDO/PPD/IPP/GLO

	1980	1985	1990
GDP: na.c (millions of 1980-dollars)	29633	36983	35528
Per capita (1980-dollars) na.c	1344	1627	1527
Manufacturing share (%) (na) (current prices)	52.7	53.0	48.5 /e
MANUFACTURING:			
Value added (na.c (millions of 1980-dollars)	16763	21808	20322
Industrial production index	100	120	110
Value added (millions of dollars)	20390 /e	24563 /e	15944
Gross output (millions of dollars)	41526 /e	60429	44146
Employment (thousands)	2884	3197	3599
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	53 /e	61 /e	64
Wages and salaries (%)	2 /e	3 /e	14
Operating surplus (%)	45 /e	36 /e	22
-PRODUCTIVITY: (dollars)			
Gross output / worker	14399 /e	18902	12266
Value added / worker	6826 /e	7456 /e	4430
Average wage	312 /e	644 /e	1728
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2.49 /e	2.67 /e	4.17 /e
as a percentage of average θ in 1970-1975	88 /e	94 /e	147 /e
MVA growth rate / θ	3.75	1.47	0.09
Degree of specialization	11.6	11.7	11.0
-VALUE ADDED: (millions of dollars)			
311 Food products	1957 /e	2114 /e	1345
313 Beverages	915 /e	988 /e	660
314 Tobacco products	19 /e	21 /e	15
321 Textiles	2028 /e	2312 /e	1607
322 Wearing apparel	903 /e	1309 /e	877
323 Leather and fur products	291 /e	381 /e	246
324 Footwear	250 /e	460 /e	275
331 Wood and wood products	776 /e	885 /e	577
332 Furniture and fixtures	472 /e	538 /e	357
341 Paper and paper products	268 /e	298 /e	205
342 Printing and publishing	85 /e	97 /e	72
351 Industrial chemicals	537 /e	650 /e	439
352 Other chemical products	647 /e	641 /e	393
353 Petroleum refineries	600 /e	612 /e	288
354 Miscellaneous petroleum and coal products	53 /e	75 /e	43
355 Rubber products	272 /e	307 /e	231
356 Plastic products	132 /e	176 /e	205
361 Pottery, china and earthenware	109	136 /e	98
362 Glass and glass products	182	228 /e	148
369 Other non-metal mineral products	634 /e	685 /e	487
371 Iron and steel	1012 /e	1184 /e	693
372 Non-ferrous metals	395 /e	387 /e	225
381 Metal products	906 /e	1241 /e	808
382 Non-electrical machinery	2912 /e	3782 /e	2296
383 Electrical machinery	951 /e	1103 /e	829
384 Transport equipment	1308 /e	1635 /e	913
385 Professional and scientific equipment	328 /e	426 /e	397
390 Other manufacturing industries	744	1167 /e	1216

For sources, footnotes and comments see Technical notes at the beginning of this Annex

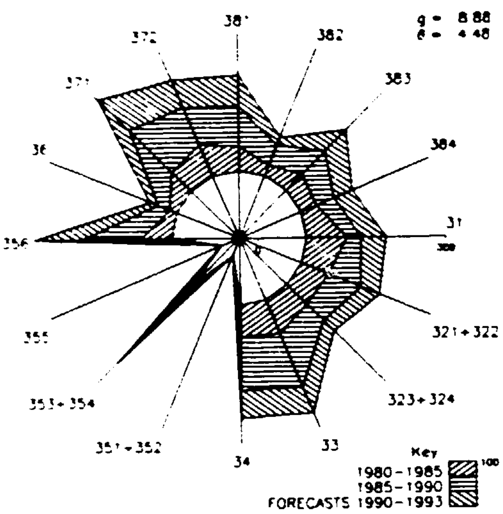




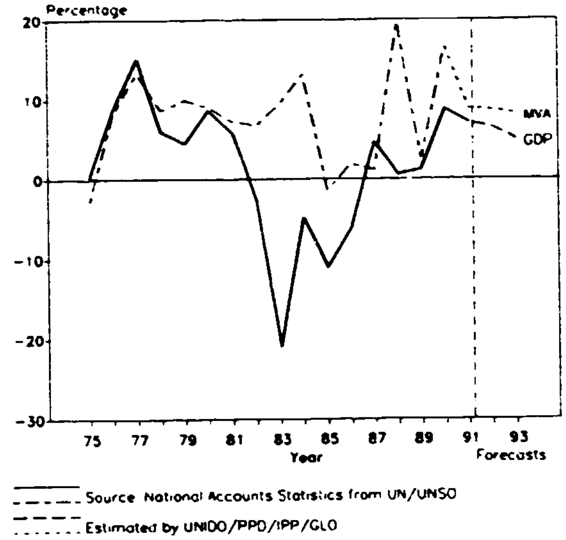


SAUDI ARABIA

Industrial structural change
(index of value added, 1980=100)



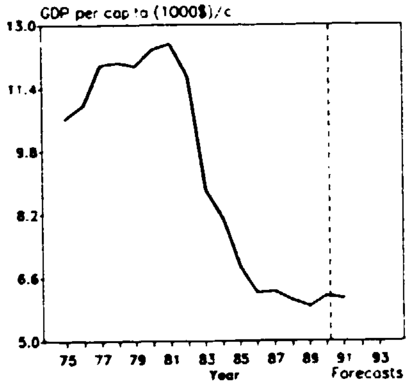
Annual growth rates of GDP and MVA
(Constant 1980 prices)



	1980	1985	1990
GDP: (na.c) (millions of 1980-dollars)	115962	79863	86894
Per capita (1980-dollars) /na.c	12372	6887	6143
Manufacturing share (%) /na (current prices)	5.0	7.8	8.9 /e
MANUFACTURING:			
Value added (na.c) (millions of 1980-dollars)	5833	8160	12042
Industrial production index	100	169	253
Value added (millions of 1980-dollars)	5819	9845 /e	14709 /e
Gross output (millions of dollars)			
Employment (thousands)			
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)			
Wages and salaries (%)			
Operating surplus (%)			
-PRODUCTIVITY: (dollars)			
Gross output / worker			
Value added / worker /c			
Average wage			
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	1.47 /e	1.53 /e	0.78 /e
as a percentage of average θ in 1970-1975	185 /e	193 /e	99 /e
MVA growth rate / θ	4.29	7.29	10.72
Degree of specialization	47.4	50.4	52.2
-VALUE ADDED: (millions of 1980-dollars)			
311 Food products	415 /e	782 /e	914 /e
313 Beverages	50 /e	72 /e	97 /e
314 Tobacco products	77 /e	143 /e	143 /e
321 Textiles	86	140 /e	224 /e
322 Wearing apparel	105 /e	163 /e	219 /e
323 Leather and fur products	26	43 /e	63 /e
324 Footwear	39 /e	59 /e	70 /e
331 Wood and wood products	76 /e	132 /e	217 /e
332 Furniture and fixtures	23 /e	42 /e	75 /e
341 Paper and paper products	58	97 /e	164 /e
342 Printing and publishing	58	96 /e	158 /e
351 Industrial chemicals			
352 Other chemical products			
353 Petroleum refineries	3579	6371	9818 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products			
356 Plastic products	396	657 /e	1138 /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	-	-	- /e
369 Other non-metal mineral products	506	582	720 /e
371 Iron and steel	13 /e	20 /e	36 /e
372 Non-ferrous metals	5 /e	8 /e	12 /e
381 Metal products	74 /e	112 /e	174 /e
382 Non-electrical machinery	57 /e	71 /e	96 /e
383 Electrical machinery	68 /e	101 /e	147 /e
384 Transport equipment	80 /e	107 /e	139 /e
385 Professional and scientific equipment			
390 Other manufacturing industries	29	49 /e	85 /e

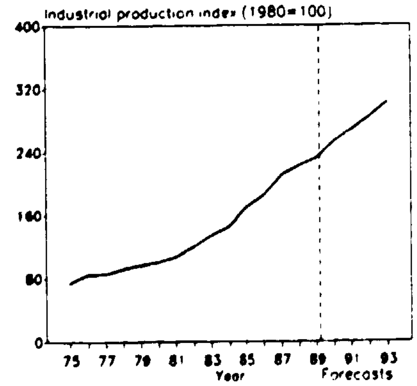
For sources, footnotes and comments see 'Technical notes' at the beginning of this Annex

GDP per capita (1000$)/c



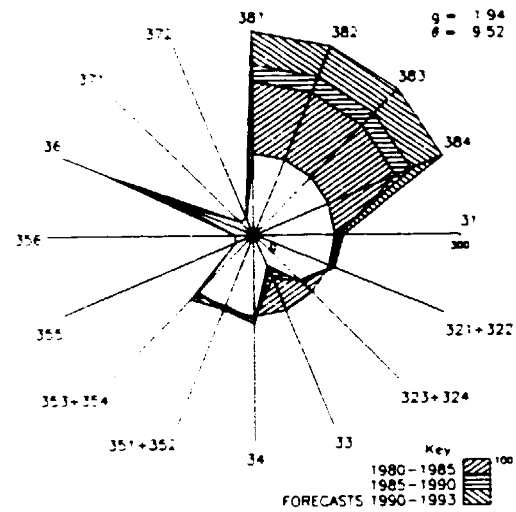
Manufacturing share in GDP current (%)

Industrial production index (1980=100)

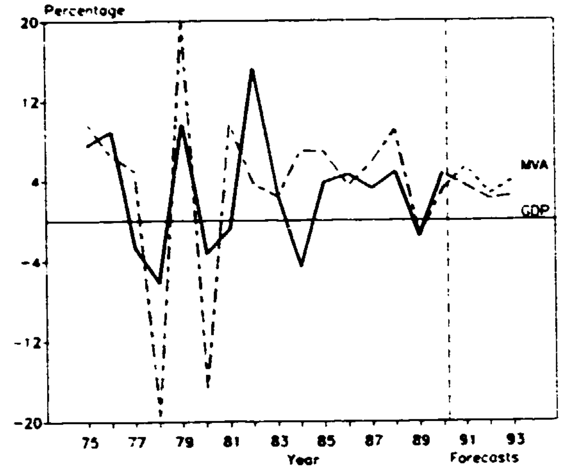


SENEGAL

Industrial structural change
(index of value added 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)



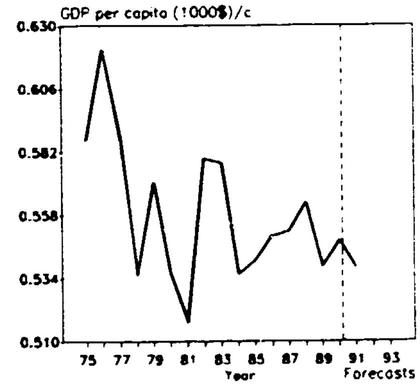
Source National Accounts Statistics from UN/UNSO

Estimated by UNIDO/PPD/IPP/GLO

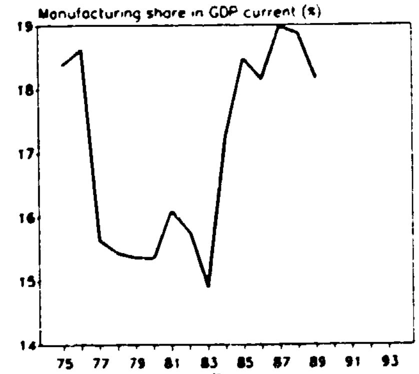
	1980	1985	1990
GDP: (na.c. millions of 1980-dollars)	2970	3447	4016
Per capita (1980-dollars) (na.c)	536	541	548
Manufacturing share (%) (na. current prices)	15 3	18 5	
MANUFACTURING:			
Value added (na.c. millions of 1980-dollars)	438	582	706
Industrial production index	100	93	114
Value added (millions of dollars)	258	231 /e	383 /e
Gross output (millions of dollars)	1070	1022 /e	1330 /e
Employment (thousands)	32	37 /e	46 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	76	77 /e	71 /e
Wages and salaries (%)	10 /e	10 /e	16 /e
Operating surplus (%)	14 /e	13 /e	13 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	33812	27639 /e	29136 /e
Value added / worker	8164	6252 /e	8392 /e
Average wage	3508 /e	2768 /e	4532 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	7 47	4 43 /e	1 59 /e
as a percentage of average θ in 1970-1975	143	85 /e	30 /e
MVA growth rate / θ	-0 38	0 89	0 21
Degree of specialization	25 8	23 2	23 1
-VALUE ADDED: (millions of dollars)			
311 Food products	106	85 /e	136 /e
313 Beverages	11	10 /e	17 /e
314 Tobacco products	7	8 /e	9 /e
321 Textiles	33	28 /e	48 /e
322 Wearing apparel	10	8 /e	11 /e
323 Leather and fur products	5	3 /e	5 /e
324 Footwear	2	1 /e	1 /e
331 Wood and wood products	2	1 /e	1 /e
332 Furniture and fixtures	2	1 /e	1 /e
341 Paper and paper products	4	2 /e	4 /e
342 Printing and publishing	6	6 /e	9 /e
351 Industrial chemicals	16	12 /e	18 /e
352 Other chemical products	5	4 /e	7 /e
353 Petroleum refineries	18	14 /e	24 /e
354 Miscellaneous petroleum and coal products	-	- /e	- /e
355 Rubber products	-	- /e	- /e
356 Plastic products	-	- /e	- /e
361 Pottery, china and earthenware	-	- /e	- /e
362 Glass and glass products	-	- /e	- /e
369 Other non-metal mineral products	12	17 /e	30 /e
371 Iron and steel	-	- /e	- /e
372 Non-ferrous metals	-	- /e	- /e
381 Metal products	10	18 /e	33 /e
382 Non-electrical machinery	3	6 /e	11 /e
383 Electrical machinery	1	2 /e	3 /e
384 Transport equipment	5	8 /e	16 /e
385 Professional and scientific equipment	-	- /e	- /e
390 Other manufacturing industries	-	- /e	- /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

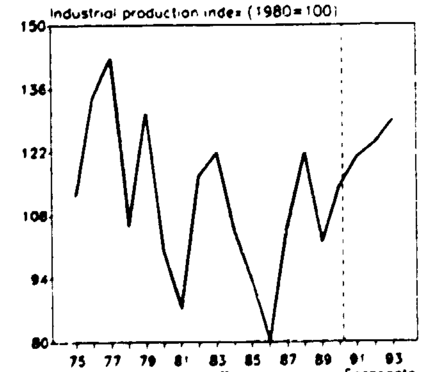
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

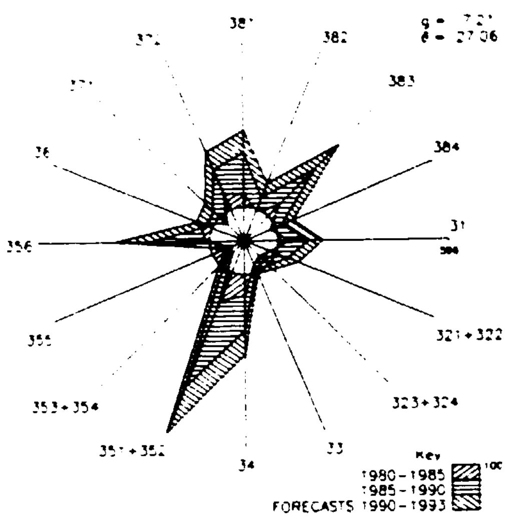


Industrial production index (1980=100)

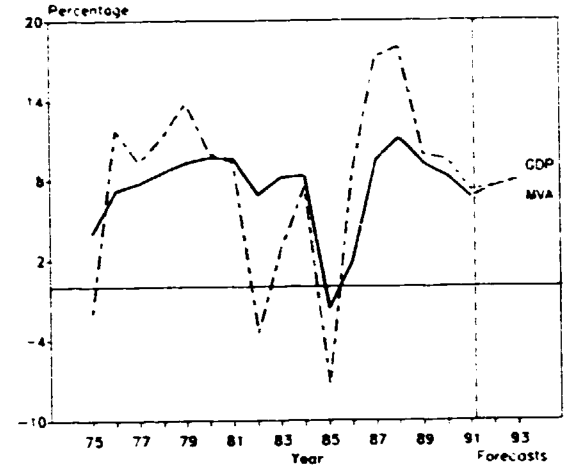


SINGAPORE

Industrial structure change
(index of value added 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)



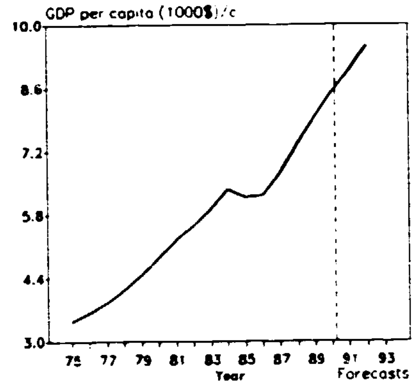
Source: National Accounts Statistics from UN/UNSO

Estimated by UNIDO/PPD/IPP/GLO

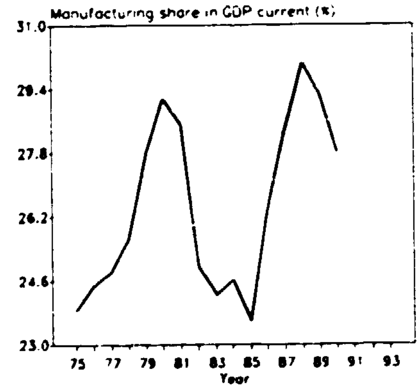
	1980	1985	1990
GDP: (n.a.c.) (millions of 1980-dollars)	11719	15821	23184
Per capita (1980-dollars) (n.a.c.)	4853	6182	8508
Manufacturing share (%) (n.a.) (current prices)	29.1	23.6	27.8 e
MANUFACTURING:			
Value added (n.a.c.) (millions of 1980-dollars)	3474	3753	6778
Industrial production index	100	103	165
Value added (millions of dollars)	4004	4868	11513 /e
Gross output (millions of dollars)	15279	17570	37155 /e
Employment (thousands)	285	252	355 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	74	72	69 /e
Wages and salaries (%)	8	11	10 /e
Operating surplus (%)	18	17	21 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	53591	69632	104535 /e
Value added / worker	14045	19294	32390 /e
Average wage	4170	7317	10003 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	5.08	7.34	3.95 e
as a percentage of average θ in 1970-1975	47	68	37 /e
MVA growth rate / θ	3.13	0.20	3.10
Degree of specialization	19.6	22.8	26.0
-VALUE ADDED: (millions of dollars)			
311 Food products	122	180	352 /e
313 Beverages	51	76	151 /e
314 Tobacco products	25	35	58 /e
321 Textiles	74	28	67 e
322 Wearing apparel	124	157	342 /e
323 Leather and fur products	6	5	14 /e
324 Footwear	9	5	9 /e
331 Wood and wood products	85	43	66 /e
332 Furniture and fixtures	39	51	103 /e
341 Paper and paper products	44	81	185 /e
342 Printing and publishing	130	235	495 /e
351 Industrial chemicals	51	138	745 /e
352 Other chemical products	142	267	595 /e
353 Petroleum refineries	444 /e	230 /e	466 /e
354 Miscellaneous petroleum and coal products	243 /e	167 /e	322 /e
355 Rubber products	44	21	41 /e
356 Plastic products	91	102	336 /e
361 Pottery, china and earthenware	1 /e	1 /e	2 /e
362 Glass and glass products	10 /e	4 /e	12 /e
369 Other non-metal mineral products	81	140	145 /e
371 Iron and steel	62	48	118 /e
372 Non-ferrous metals	10	17	35 /e
381 Metal products	194	298	760 /e
382 Non-electrical machinery	348	370	712 /e
383 Electrical machinery	946	1538	4145 /e
384 Transport equipment	495	470	894 /e
385 Professional and scientific equipment	80	89	213 /e
390 Other manufacturing industries	62	58	128 /e

For sources, footnotes and comments see 'Technical notes' at the beginning of this Annex

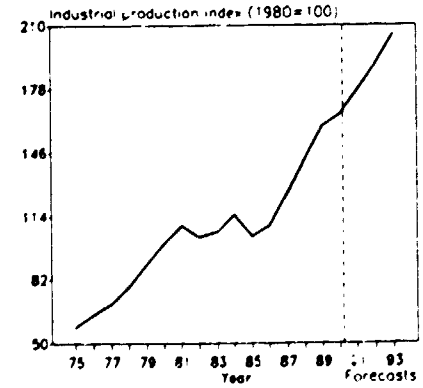
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

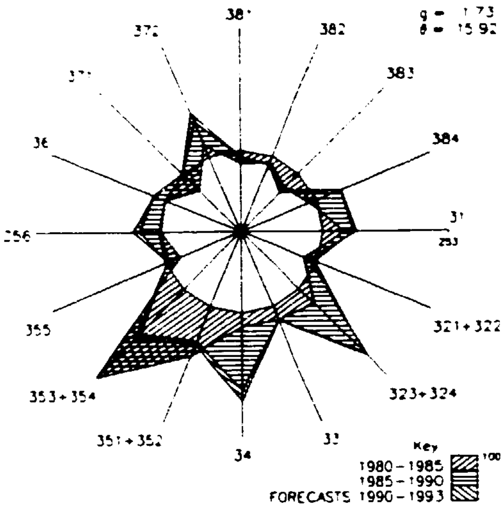


Industrial production index (1980=100)

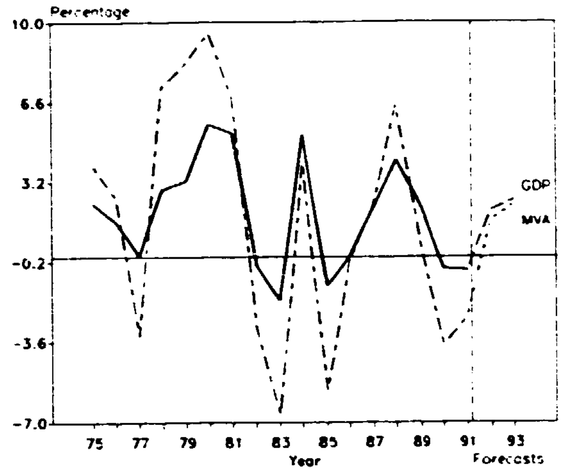


SOUTH AFRICA

Industrial structural change
(index of value added 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)



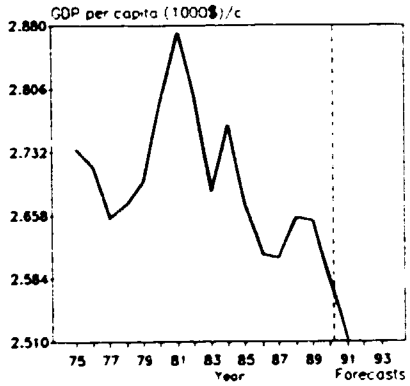
Source National Accounts Statistics from UN/UNSO

Estimated by UNIDO/PPD/IPP/GLO

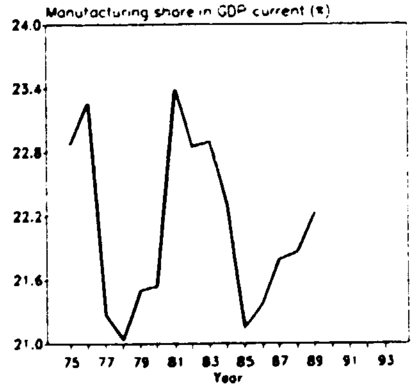
	1980	1985	1990
GDP: (na.c) (millions of 1980-dollars)	78828	84289	91027
Per capita (1980-dollars) (na.c)	2788	2670	2580
Manufacturing share (%) (na) (current prices)	21.5	21.1	
MANUFACTURING:			
Value added (na.c) (millions of 1980-dollars)	18482	17526	18407
Industrial production index	100	95	102
Value added (millions of dollars)	17866	12584	23530 /e
Gross output (millions of dollars)	53686 /e	36062	65811 /e
Employment (thousands)	1392	1423	1462
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	67 /e	65	64 /e
Wages and salaries (%)	16 /e	17	17 /e
Operating surplus (%)	17 /e	17	19 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	38568 /e	25342	45014 /e
Value added / worker	12835	8843	16094 /e
Average wage	6118	4419	7678
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	4.22 /e	6.23	5.89 /e
as a percentage of average θ in 1970-1975	136 /e	201	190 /e
MVA growth rate / θ	1.24	0.29	0.43
Degree of specialization	10.7	9.2	8.5
-VALUE ADDED: (millions of dollars)			
311 Food products	1626	1277	2007 /e
313 Beverages	458	418	1078 /e
314 Tobacco products	111	108	153 /e
321 Textiles	386	408	768 /e
322 Wearing apparel	477	334	647 /e
323 Leather and fur products	40	44	104 /e
324 Footwear	152	113	330 /e
331 Wood and wood products	213	190	311 /e
332 Furniture and fixtures	219	138	230 /e
341 Paper and paper products	591	471	1708 /e
342 Printing and publishing	549	392	685 /e
351 Industrial chemicals	1006	717	1361 /e
352 Other chemical products	639	1047	1206 /e
353 Petroleum refineries	634	1038	1205 /e
354 Miscellaneous petroleum and coal products	111	182	210 /e
355 Rubber products	297	157	311 /e
356 Plastic products	355	225	475 /e
361 Pottery, china and earthenware	28	24	38 /e
362 Glass and glass products	154	102	253 /e
369 Other non-metal mineral products	754	481	870 /e
371 Iron and steel	2135	986	2310 /e
372 Non-ferrous metals	555	418	876 /e
381 Metal products	1576	860	1560 /e
382 Non-electrical machinery	1351	805	1287 /e
383 Electrical machinery	1229	607	948 /e
384 Transport equipment	1258	741	1792 /e
385 Professional and scientific equipment	49	54	168 /e
390 Other manufacturing industries	415	246	641 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

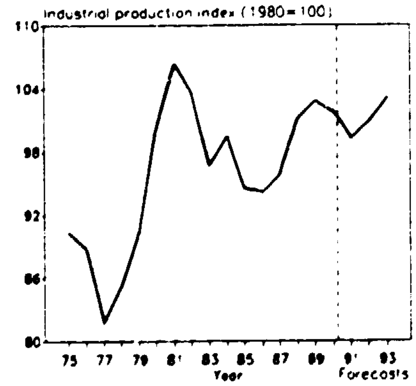
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

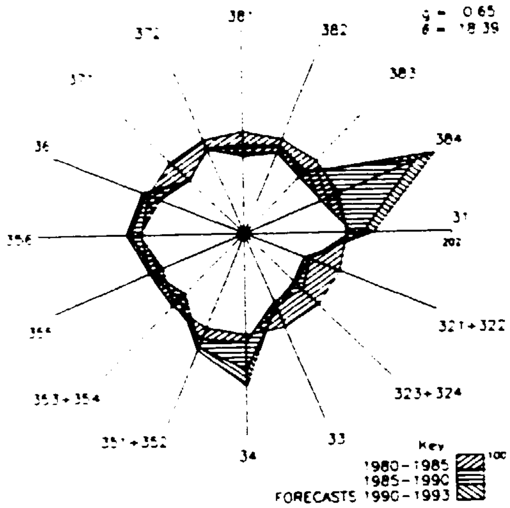


Industrial production index (1980=100)

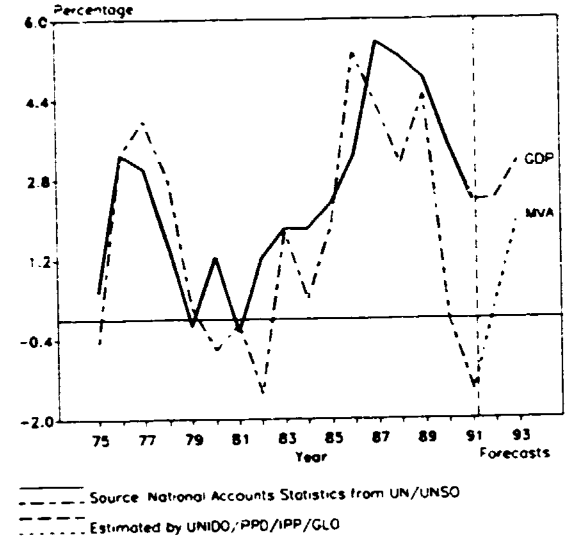


SPAIN

Industrial structure change
(Index of value added: 1980=100)



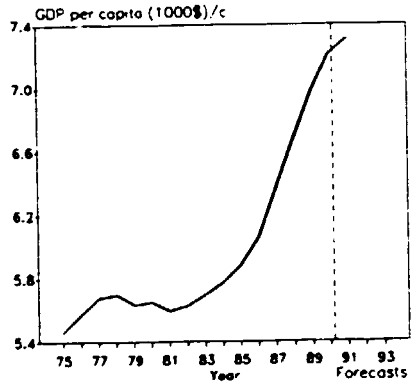
Annual growth rates of GDP and MVA
(Constant 1980 prices)



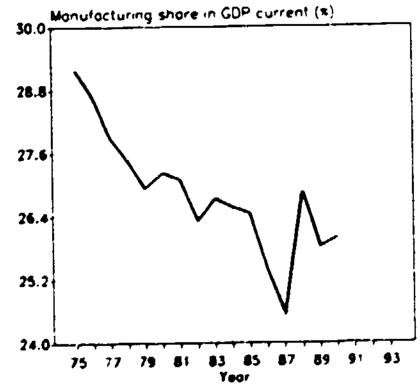
	1980	1985	1990
GDP (n.a.c., millions of 1980-dollars)	212115	227090	282594
Per capita (1980-dollars) (n.a.c.)	5650	5883	7211
Manufacturing share (%) (n.a., current prices)	27.2	26.4	26.0 /e
MANUFACTURING:			
Value added (n.a.c.) (millions of 1980-dollars)	60838	62255	73644
Industrial production index	100	99	120
Value added (millions of dollars)	51944	33140	93221
Gross output (millions of dollars)	149786	104581	278573
Employment (thousands)	2383	1792	1867 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	65	68	67
Wages and salaries (%)	16	13	12 /e
Operating surplus (%)	19	19	21 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	62856	58360	149249 /e
Value added / worker	21798	18494	49944 /e
Average wage	9795	7362	18623 /e
-STRUCTURAL INDICES:			
Structural change θ, 5-year average in degrees	5.46	3.43	6.05
as a percentage of average θ in 1970-1975	95	60	106
MVA growth rate (%)	1.76	-0.70	0.57
Degree of specialization	8.4	8.5	11.3
-VALUE ADDED: (millions of dollars)			
311 Food products	5665	4193	11368 /e
313 Beverages	1932	1576	4083 /e
314 Tobacco products	649	471	996
321 Textiles	3289	1613	3467
322 Wearing apparel	1502	753	2153 /e
323 Leather and fur products	375	269	608
324 Footwear	810	415	830
331 Wood and wood products	1258	707	2116 /e
332 Furniture and fixtures	1262	617	1308 /e
341 Paper and paper products	1278	947	2260 /e
342 Printing and publishing	1506	1198	4176
351 Industrial chemicals	2006	1737	4238 /e
352 Other chemical products	2506	1922	5086 /e
353 Petroleum refineries	1409	969	1949
354 Miscellaneous petroleum and coal products	229	191	391 /e
355 Rubber products	955	597	1598 /e
356 Plastic products	1098	814	2100 /e
361 Pottery, china and earthenware	346	174	431 /e
362 Glass and glass products	640	442	1278
369 Other non-metal mineral products	2522	1617	4524
371 Iron and steel	3255	1756	4151
372 Non-ferrous metals	948	616	1486
381 Metal products	3720	2044	5545
382 Non-electrical machinery	3595	2225	5777
383 Electrical machinery	3669	2064	5379
384 Transport equipment	4743	2776	14705
385 Professional and scientific equipment	205	122	379 /e
390 Other manufacturing industries	573	316	842 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

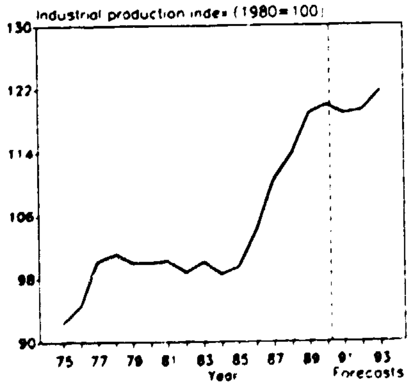
GDP per capita (1000$)/c



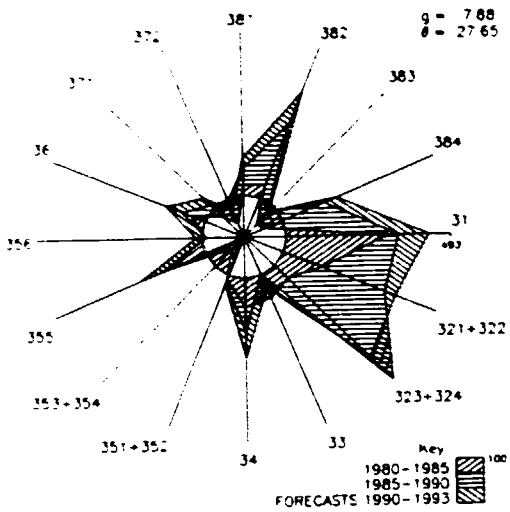
Manufacturing share in GDP current (%)

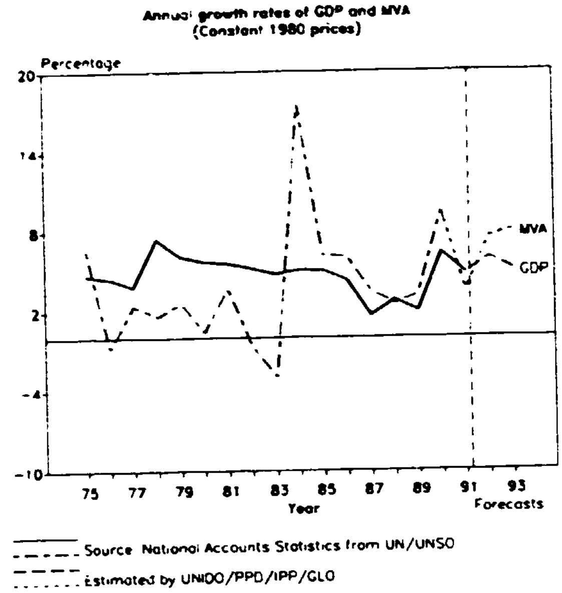


Industrial production index (1980=100)



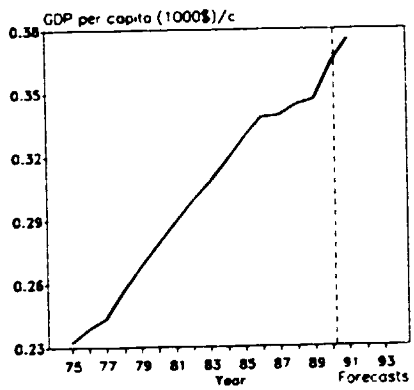
SRI LANKA

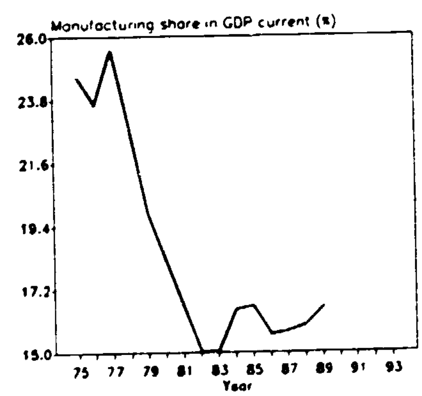


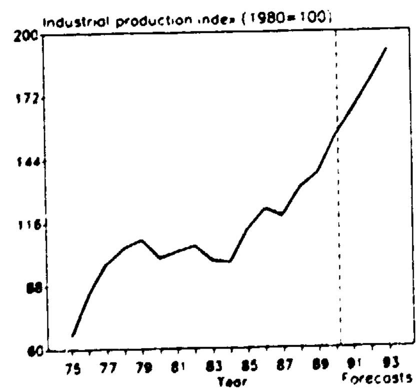


	1980	1985	1990
GDP: (na.c) (millions of 1980-dollars)	4133	5303	6262
Per capita (1980-dollars) (na.c)	279	329	363
Manufacturing share (%) (na) (current prices)	18.2	16.6	
MANUFACTURING:			
Value added (na.c) (millions of 1980-dollars)	785	978	1243
Industrial production index	100	113	153
Value added (millions of dollars)	307	628 /e	929 /e
Gross output (millions of dollars)	1129	1815	2220 /e
Employment (thousands)	163	211	251 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	73	65 /e	58 /e
Wages and salaries (%)	7	6	7 /e
Operating surplus (%)	20	28 /e	35 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	6934	8599	8836 /e
Value added / worker	1887	2973 /e	3699 /e
Average wage	486	529	642 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	8.29 /e	12.14 /e	8.65 /e
as a percentage of average θ in 1970-1975	123 /e	181 /e	129 /e
MVA growth rate / θ	1.31	1.92	0.46
Degree of specialization	20.4	29.9	25.9
-VALUE ADDED: (millions of dollars)			
311 Food products	28	180 /e	250 /e
313 Beverages	8	34 /e	75 /e
314 Tobacco products	63	151 /e	150 /e
321 Textiles	27	49 /e	80 /e
322 Wearing apparel	12	33 /e	101 /e
323 Leather and fur products	1	2 /e	1 /e
324 Footwear	2	4 /e	22 /e
331 Wood and wood products	5	8 /e	7 /e
332 Furniture and fixtures	1	2 /e	1 /e
341 Paper and paper products	8	12 /e	23 /e
342 Printing and publishing	4	8 /e	11 /e
351 Industrial chemicals	6	4 /e	3 /e
352 Other chemical products	12	18 /e	25 /e
353 Petroleum refineries	55	23 /e	11 /e
354 Miscellaneous petroleum and coal products	-	- /e	- /e
355 Rubber products	14	30 /e	39 /e
356 Plastic products	4	4 /e	5 /e
361 Pottery, china and earthenware	4	6 /e	17 /e
362 Glass and glass products	2	2 /e	4 /e
369 Other non-metal mineral products	21	28 /e	34 /e
371 Iron and steel	3	2 /e	5 /e
372 Non-ferrous metals	2	1 /e	2 /e
381 Metal products	7	9 /e	14 /e
382 Non-electrical machinery	4	6 /e	15 /e
383 Electrical machinery	10	5 /e	11 /e
384 Transport equipment	4	2 /e	10 /e
385 Professional and scientific equipment	1	- /e	- /e
390 Other manufacturing industries	1	5 /e	14 /e

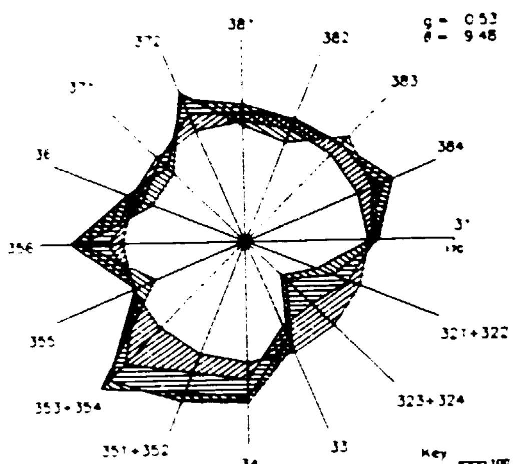
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

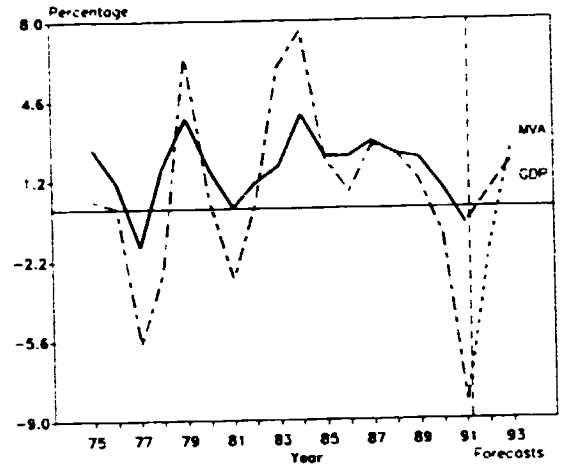






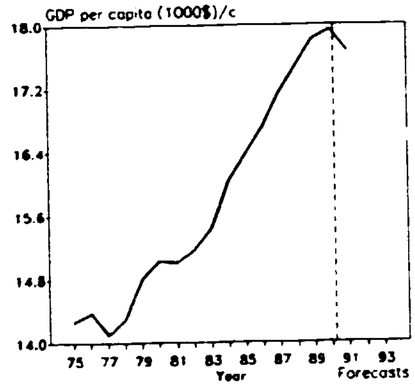
SWEDEN

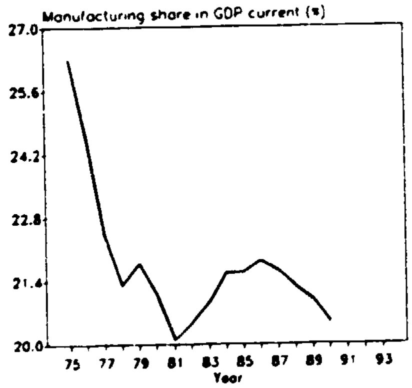


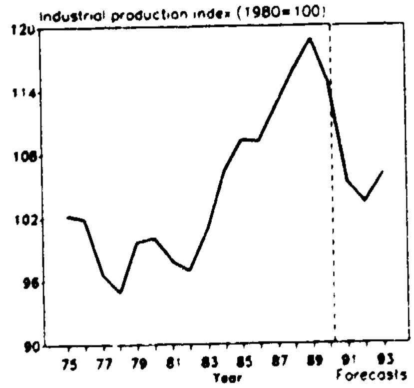


	1980	1985	1990
GDP: na.c (millions of 1980-dollars)	124883	136691	151433
Per capita (1980-dollars) /na.c	15026	16368	17932
Manufacturing share (%) na (current prices)	21 1	21 6	20 5 /e
MANUFACTURING:			
Value added na.c (millions of 1980-dollars)	29605	33494	35472
Industrial production index	100	109	115
Value added (millions of dollars)	30905	24486	54393
Gross output (millions of dollars)	73194	59391	122317
Employment (thousands)	853	769	726
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	58	59	56
Wages and salaries (%)	18	15	15 /e
Operating surplus (%)	24	26	30 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	85808	77252	168594
Value added / worker	36231	31850	74972
Average wage	15835	11676	25098 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	3 84	4 04	2 93
as a percentage of average θ in 1970-1975	74	78	57
MVA growth rate / θ	-0 45	0 37	0 60
Degree of specialization	15 4	16 1	15 7
-VALUE ADDED: (millions of dollars)			
311 Food products	2719	2107	4241
313 Beverages	338	250	668
314 Tobacco products	104	108	239
321 Textiles	534	379	664
322 Wearing apparel	274	157	261
323 Leather and fur products	54	40	52
324 Footwear	61	24	27
331 Wood and wood products	2102	1154	3033 /e
332 Furniture and fixtures	452	285	644 /e
341 Paper and paper products	2596	2230	5418
342 Printing and publishing	1842	1517	3464
351 Industrial chemicals	986	841	2259 /e
352 Other chemical products	1246	1090	2521 /e
353 Petroleum refineries	359	396	928
354 Miscellaneous petroleum and coal products	137	122	269 /e
355 Rubber products	314	225	465 /e
356 Plastic products	402	334	866 /e
361 Pottery, china and earthenware	87	71	120 /e
362 Glass and glass products	175	124	309
369 Other non-metal mineral products	801	510	1229
371 Iron and steel	1650	1185	2192
372 Non-ferrous metals	390	331	758
381 Metal products	2598	2048	4465
382 Non-electrical machinery	3936	3185	6439
383 Electrical machinery	2570	2132	4316
384 Transport equipment	3652	3153	7188
385 Professional and scientific equipment	371	400	1173 /e
390 Other manufacturing industries	154	87	188 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

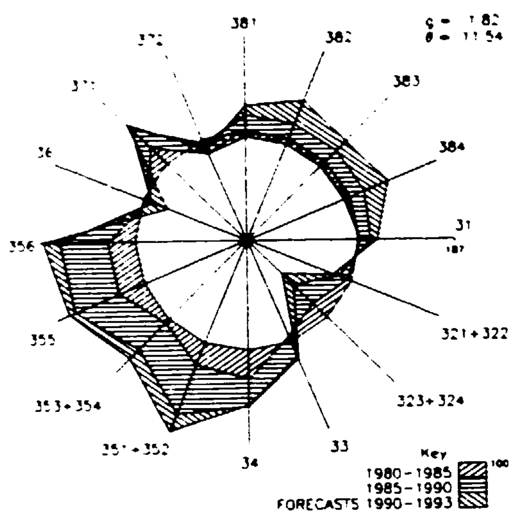




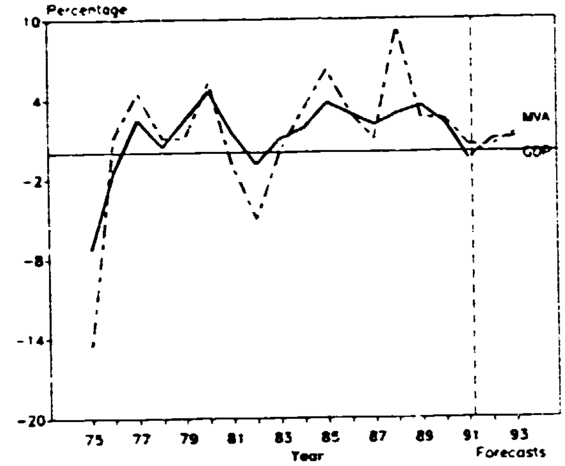


SWITZERLAND

Industrial structural change (index of value added: 1980=100)



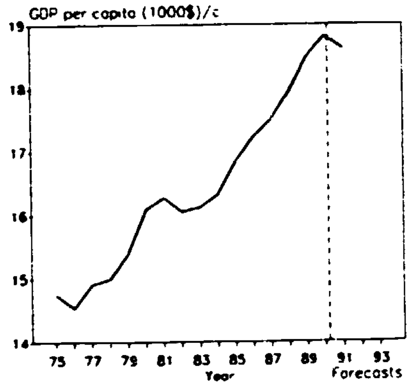
Annual growth rates of GDP and MVA (Constant 1980 prices)



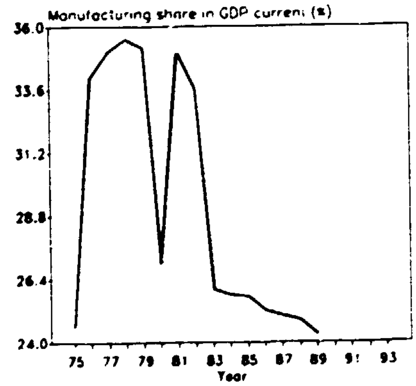
	1980	1985	1990
GDP: (na.c) (millions of 1980-dollars)	101629	108881	124382
Per capita (1980-dollars) (na.c)	16081	16826	18800
Manufacturing share (%) (na) (current prices)	27 0 /e	25 7	
MANUFACTURING:			
Value added (na.c) (millions of 1980-dollars)	35071	36123	43137
Industrial production index	100	100	116
Value added (millions of dollars)	27450	23504	58051
Gross output (millions of dollars)			
Employment (thousands)	686	656	677
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)			
Wages and salaries (%)			
Operating surplus (%)			
-PRODUCTIVITY: (dollars)			
Gross output / worker			
Value added / worker	40026	35808	85691
Average wage			
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	3 58 /e	2 63 /e	2 30 /e
as a percentage of average θ in 1970-1975	66 /e	48 /e	42 /e
MVA growth rate / θ	1 08	0 05	1 51
Degree of specialization	11 6	11 7	12 7
-VALUE ADDED: (millions of dollars)			
311 Food products	2905	2584 /e	5981 /e
313 Beverages	499	455 /e	1005 /e
314 Tobacco products	292	157 /e	312 /e
321 Textiles	972	878	1722
322 Wearing apparel	864	633	1140
323 Leather and fur products	124	61 /e	95 /e
324 Footwear	324	255	372
331 Wood and wood products	1079	873 /e	2245 /e
332 Furniture and fixtures	707	572 /e	1472 /e
341 Paper and paper products	624	558	1405
342 Printing and publishing	1471	1703	4222
351 Industrial chemicals	1530	1660 /e	4157 /e
352 Other chemical products	1332	1330 /e	4515 /e
353 Petroleum refineries	585	522 /e	1520 /e
354 Miscellaneous petroleum and coal products	95	85 /e	160 /e
355 Rubber products	226	240 /e	674 /e
356 Plastic products	625	665 /e	1870 /e
361 Pottery, china and earthenware	137	148 /e	274 /e
362 Glass and glass products	187	203 /e	376 /e
369 Other non-metal mineral products	651	433 /e	941 /e
371 Iron and steel	455	468 /e	1172 /e
372 Non-ferrous metals	584	428 /e	999 /e
381 Metal products	1922	1545 /e	3909 /e
382 Non-electrical machinery	3777	3037 /e	7683 /e
383 Electrical machinery	2860	2300 /e	5819 /e
384 Transport equipment	508	408 /e	1033 /e
385 Professional and scientific equipment	1977	1217 /e	2787 /e
390 Other manufacturing industries	138	85	193

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

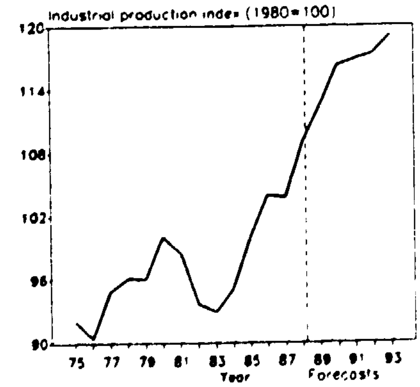
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

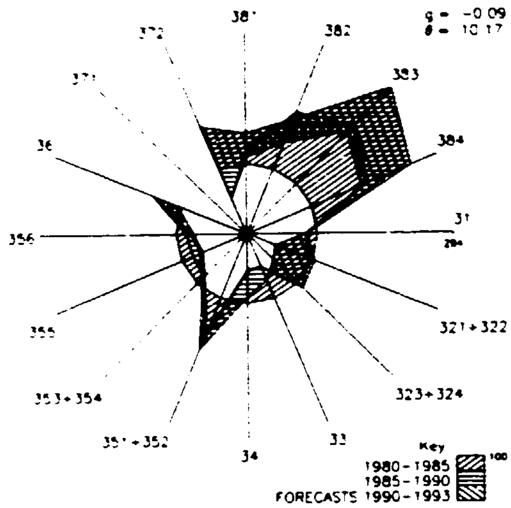


Industrial production index (1980=100)

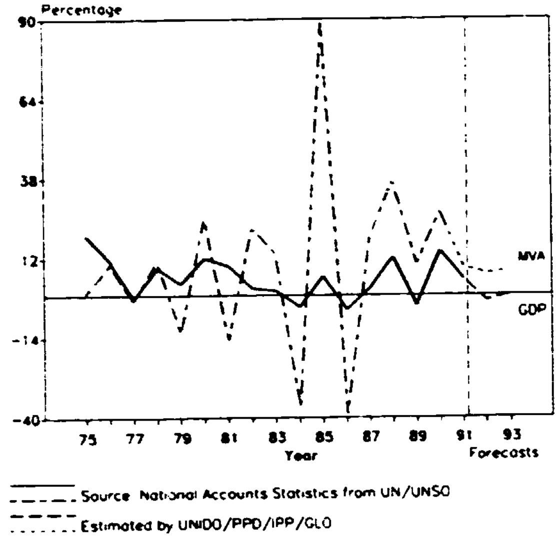


SYRIAN ARAB REPUBLIC

Industrial structural change
(index of value added 1980=100)



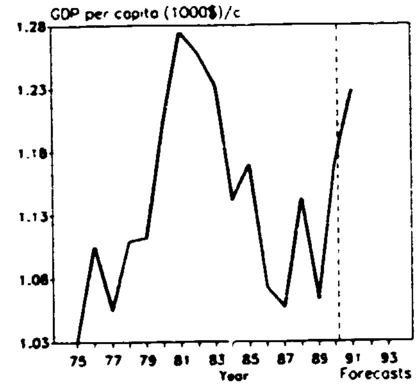
Annual growth rates of GDP and MVA
(Constant 1980 prices)



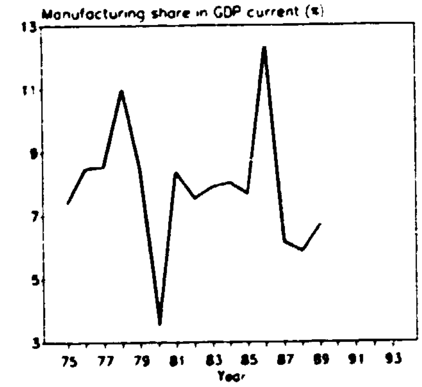
	1980	1985	1990
GDP: na.c millions of 1980-dollars	10593	12231	14649
Per capita (1980-dollars) na.c	1204	1169	1169
Manufacturing share (%) (na) (current prices)	3 6	7 7	
MANUFACTURING:			
Value added (na.c millions of 1980-dollars)	377	529	732
Industrial production index	100	147	152
Value added (millions of dollars)	1256	1435	2126 /e
Gross output (millions of dollars)	3362	5914	8679 /e
Employment (thousands)	195	182 /e	138 /e
-PROFITABILITY: in percent of gross output			
Intermediate input (%)	63	76	75 /e
Wages and salaries (%)	10 /e	8 /e	6 /e
Operating surplus (%)	27 /e	16 /e	19 /e
-PRODUCTIVITY: dollars			
Gross output / worker	17278	32511 /e	62869 /e
Value added / worker	6452	7892 /e	15403 /e
Average wage	1788 /e	2738 /e	3761 /e
-STRUCTURAL INDICES:			
Structural change θ 5-year average in degrees	6 56	12 60	7 20 /e
as a percentage of average θ in 1970-1975	142	273	156 /e
MVA growth rate / θ	1 17	-0 17	0 18
Degree of specialization	20 0	14 7	19 4
-VALUE ADDED: millions of dollars			
311 Food products	214	235	328 /e
313 Beverages	37	42	59 /e
314 Tobacco products	146	163	228 /e
321 Textiles	273	154	477 /e
322 Wearing apparel	14	9	27 /e
323 Leather and fur products	26	19	54 /e
324 Footwear	43	28	84 /e
331 Wood and wood products	29	27	27 /e
332 Furniture and fixtures	74	69	70 /e
341 Paper and paper products	6	8	6 /e
342 Printing and publishing	14	16	14 /e
351 Industrial chemicals	3	7	8 /e
352 Other chemical products	31	73	90 /e
353 Petroleum refineries	100	112	157 /e
354 Miscellaneous petroleum and coal products	4	4	5 /e
355 Rubber products	15	16	18 /e
356 Plastic products	13	14	17 /e
361 Pottery, china and earthenware	7	13	13 /e
362 Glass and glass products	13	24	26 /e
369 Other non-metal mineral products	72	135	143 /e
371 Iron and steel	-	-	- /e
372 Non-ferrous metals	13	28	13 /e
381 Metal products	53	100	109 /e
382 Non-electrical machinery	18	42	47 /e
383 Electrical machinery	16	62	62 /e
384 Transport equipment	3	11	11 /e
385 Professional and scientific equipment	-	-	- /e
390 Other manufacturing industries	19	23	30 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

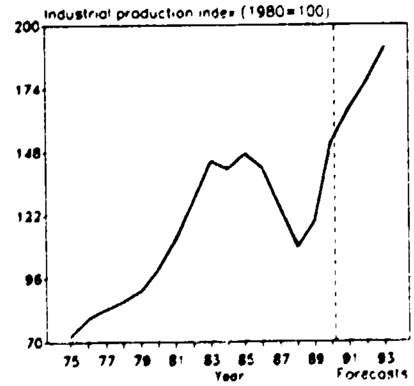
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

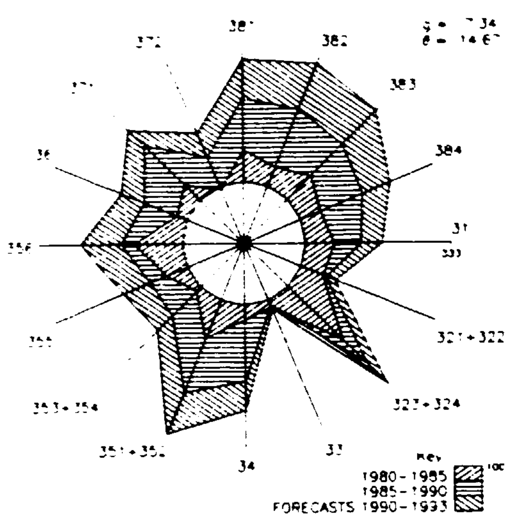


Industrial production index (1980=100)

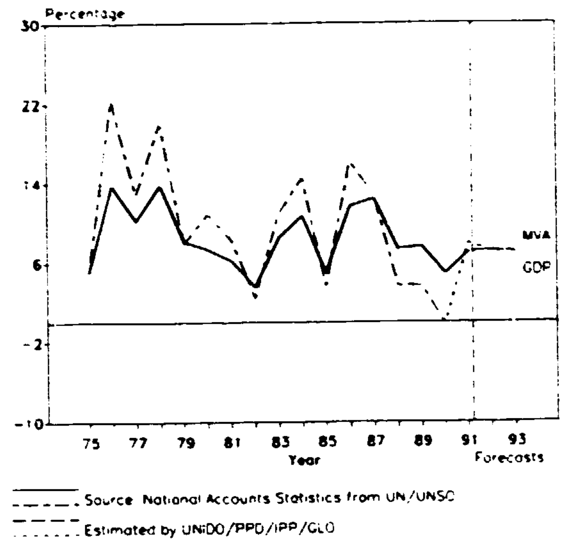


TAIWAN PROVINCE

Industrial structural change (index of value added: 1980=100)

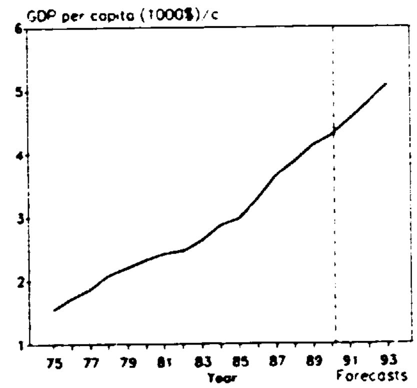


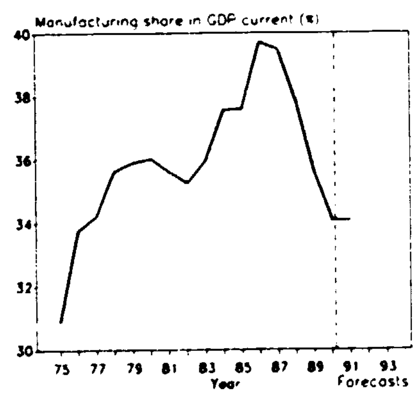
Annual growth rates of GDP and MVA (Constant 1980 prices)

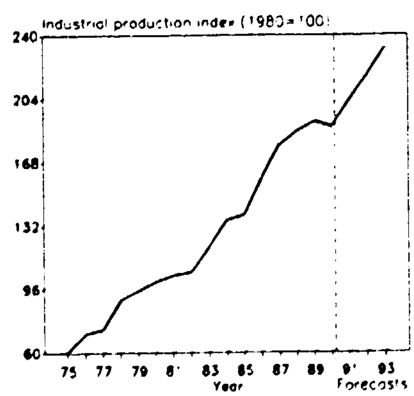


	1980	1985	1990
GDP (real, millions of 1980-dollars)	41384	57275	86947
Per capita (1980-dollars, real)	2324	2974	4277
Manufacturing share (%) (real) (current prices)	36.0	37.6	34.1
MANUFACTURING:			
Value added (real, millions of 1980-dollars)	14907	21734	30484
Industrial production index	100	138	188
Value added (millions of dollars)	14907	23557	55424
Gross output (millions of dollars)	55343	69508	144592
Employment (thousands)	1997	2459	2260
-PROFITABILITY (in percent of gross output)			
Intermediate input (%)	73	66	62
Wages and salaries (%)	10	14	16
Operating surplus (%)	17	20	22
-PRODUCTIVITY (dollars)			
Gross output / worker	27719	28267	63975
Value added / worker	7466	9580	24523
Average wage	2678	3862	10168
-STRUCTURAL INDICES			
Structural change θ (5-year average in degrees)	5.14	3.18	4.42
as a percentage of average θ in 1970-1975	73	45	63
MVA growth rate / θ	2.83	2.37	1.72
Degree of specialization	11.0	11.8	11.4
-VALUE ADDED (millions of dollars)			
311 Food products	1542	2541	5090
313 Beverages	173	313	922
314 Tobacco products	123	125	303
321 Textiles	1885	2687	4680
322 Wearing apparel	337	720	1139
323 Leather and fur products	176	431	889
324 Footwear	46	119	236
331 Wood and wood products	316	394	547
332 Furniture and fixtures	119	146	325
341 Paper and paper products	424	647	1950
342 Printing and publishing	263	294	860
351 Industrial chemicals	622	1125	2820
352 Other chemical products	502	941	2544
353 Petroleum refineries	719	946	2460
354 Miscellaneous petroleum and coal products	157	116	192
355 Rubber products	223	336	672
356 Plastic products	917	1793	3312
361 Pottery, china and earthenware	158	229	576
362 Glass and glass products	85	120	291
369 Other non-metal mineral products	439	535	1290
371 Iron and steel	828	1242	3392
372 Non-ferrous metals	139	146	385
381 Metal products	637	1069	2741
382 Non electrical machinery	475	703	2041
383 Electrical machinery	1676	2865	6945
384 Transport equipment	766	1135	2894
385 Professional and scientific equipment	129	234	609
390 Other manufacturing industries	1028	1604	5320

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

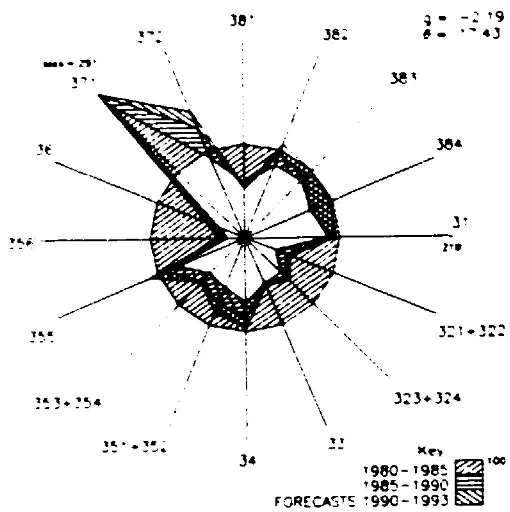




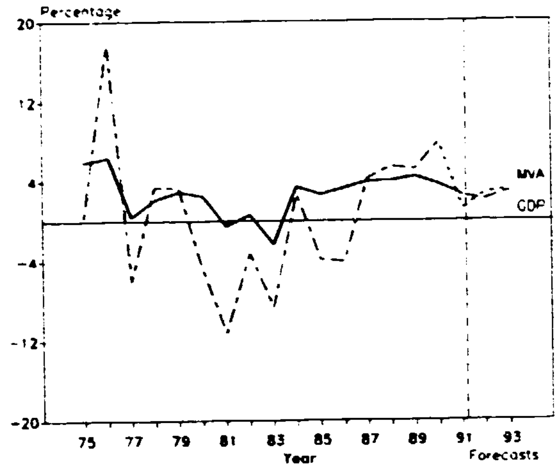


TANZANIA, UNITED REPUBLIC OF

Industrial structure change
Index of value added 1980=100



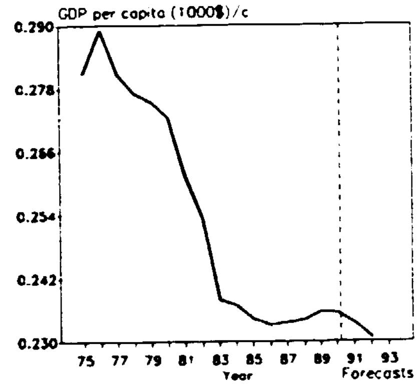
Annual growth rates of GDP and MVA
(Constant 1980 prices)

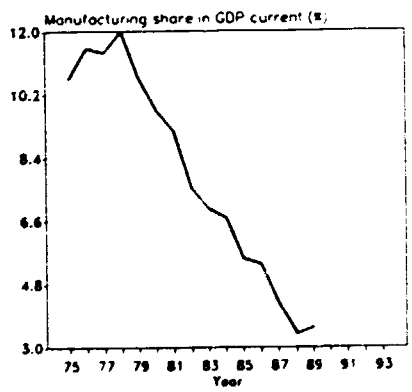


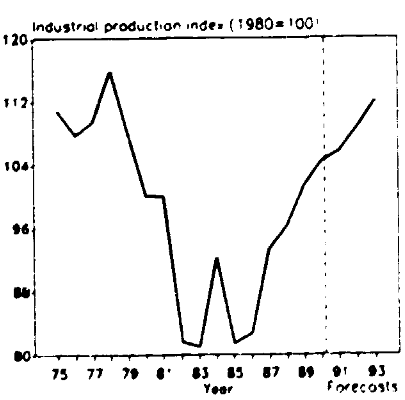
Source National Accounts Statistics from UN/UNSO
Estimated by UNIDO/PPD/IPP/GLO

	1980	1985	1990
GDP (n.a.c. millions of 1980-dollars)	5138	5327	6426
Per capita (1980-dollars) (n.a.c.)	272	234	235
Manufacturing share (%) (na) (current prices)	9 7	5 5	
MANUFACTURING:			
Value added (n.a.c. millions of 1980-dollars)	562	435	519
Industrial production index	100	81	104
Value added (millions of dollars)	361	278	104 .e
Gross output (millions of dollars)	1266	1145	428 /e
Employment (thousands)	101	94	121 .e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	71	76	76 .e
Wages and salaries (%)	9	9	9 .e
Operating surplus (%)	19	16	15 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	12537	12217	3541 /e
Value added / worker	3577	2970	861 /e
Average wage	1174	1041	319 /e
-STRUCTURAL INDICES.			
Structural change θ (5-year average in degrees)	5 71 /e	9 82	2 83 .e
as a percentage of average θ in 1970-1975	85 /e	147	42 /e
MVA growth rate / θ	1 39	-1 00	0 99
Degree of specialization	17 0	14 7	14 8
-VALUE ADDED: (millions of dollars)			
311 Food products	58	58	20 /e
313 Beverages	14	21	6 /e
314 Tobacco products	12	16	6 /e
321 Textiles	25	43	19 e
322 Wearing apparel	10	4	2 /e
323 Leather and fur products	7	4	1 /e
324 Footwear	8	6	3 .e
331 Wood and wood products	7	6	2 /e
332 Furniture and fixtures	6	3	1 e
341 Paper and paper products	8	7	3 e
342 Printing and publishing	14	12	5 e
351 Industrial chemicals	11	9	4 e
352 Other chemical products	10	7	3 /e
353 Petroleum refineries	15	10	4 .e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	11	11	4 e
356 Plastic products	8	2	1 e
361 Pottery, china and earthenware		-	. e
362 Glass and glass products	.	-	- /e
369 Other non-metal mineral products	11	4	2 e
371 Iron and steel	2 e	6 .e	3 .e
372 Non-ferrous metals	4 e	4 /e	2 /e
381 Metal products	20	15	5 e
382 Non-electrical machinery	3	4	1 e
383 Electrical machinery	6	6	2 e
384 Transport equipment	19	19	6 e
385 Professional and scientific equipment		-	- e
390 Other manufacturing industries	2	2	1 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

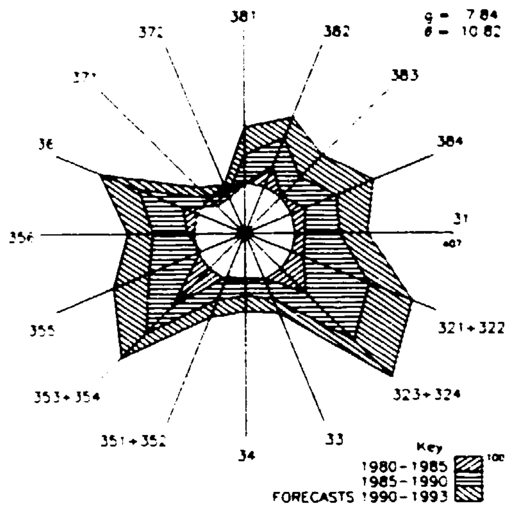




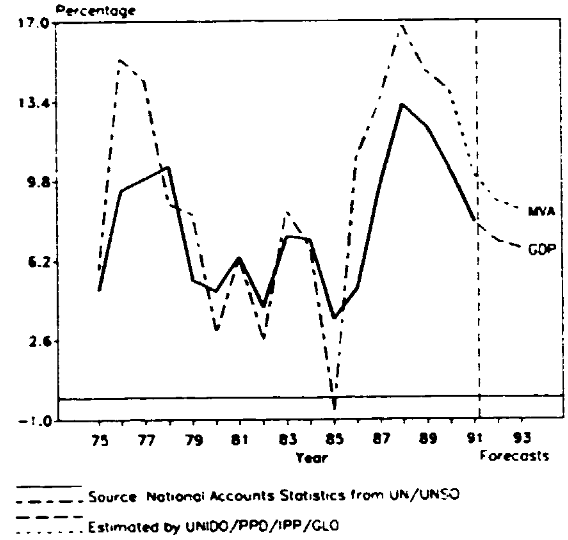


THAILAND

Industrial structural change (index of value added 1980=100)



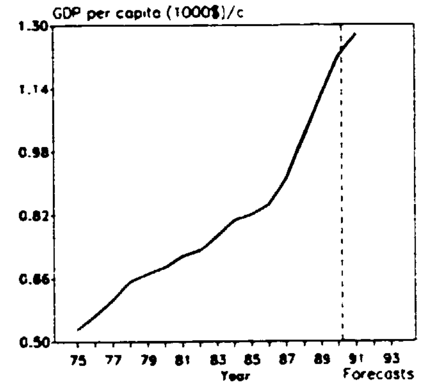
Annual growth rates of GDP and MVA (Constant 1980 prices)



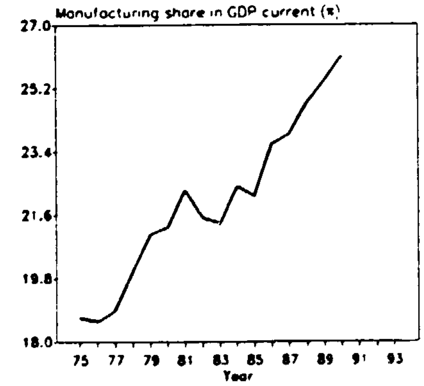
	1980	1985	1990
GDP: (na.c (millions of 1980-dollars)	32160	42323	68100
Per capita (1980-dollars) /na.c	688	820	1221
Manufacturing share (%) /na (current prices)	21 3	22 1	26 1 /e
MANUFACTURING:			
Value added (na.c (millions of 1980-dollars)	6834	8567	16411
Industrial production index	100	117	212
Value added (millions of dollars)	9156 /e	10584 /e	23725 /e
Gross output (millions of dollars)	28156 /e	29388	72307
Employment (thousands)	1549 /e	1730 /e	2359 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	67 /e	64 /e	68 /e
Wages and salaries (%)	8 /e	9	7 /e
Operating surplus (%)	25 /e	27 /e	25 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	18180 /e	16984 /e	31131 /e
Value added / worker	5912 /e	6117 /e	10059 /e
Average wage	1401 /e	1517 /e	2216 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	6 40 /e	3 57 /e	2 65 /e
as a percentage of average θ in 1970-1975	102 /e	57 /e	42 /e
MVA growth rate / θ	1 32	1 08	4 10
Degree of specialization	15 7	16 2	18 0
-VALUE ADDED: (millions of dollars)			
311 Food products	2039 /e	2274	5034 /e
313 Beverages	682 /e	786	1490 /e
314 Tobacco products	375 /e	470	883 /e
321 Textiles	1118 /e	1044	2684
322 Wearing apparel	591 /e	1025	3107
323 Leather and fur products	38 /e	85	216 /e
324 Footwear	47 /e	54	113 /e
331 Wood and wood products	244 /e	180	342 /e
332 Furniture and fixtures	132 /e	173	347 /e
341 Paper and paper products	213 /e	120	164 /e
342 Printing and publishing	110 /e	161	355 /e
351 Industrial chemicals	94 /e	63	104 /e
352 Other chemical products	245 /e	238	515 /e
353 Petroleum refineries	191	405 /e	725
354 Miscellaneous petroleum and coal products	35 /e	35 /e	79 /e
355 Rubber products	301 /e	272 /e	797 /e
356 Plastic products	108 /e	116 /e	253 /e
361 Pottery, china and earthenware	33 /e	42 /e	97 /e
362 Glass and glass products	97 /e	122 /e	282 /e
369 Other non-metal mineral products	212 /e	268 /e	618 /e
371 Iron and steel	312 /e	230 /e	396 /e
372 Non-ferrous metals	138 /e	102 /e	151 /e
381 Metal products	230 /e	217 /e	458 /e
382 Non-electrical machinery	158 /e	217 /e	416 /e
383 Electrical machinery	319 /e	315 /e	642 /e
384 Transport equipment	661 /e	820 /e	1673 /e
385 Professional and scientific equipment	20 /e	34 /e	68 /e
390 Other manufacturing industries	412 /e	716 /e	1715 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

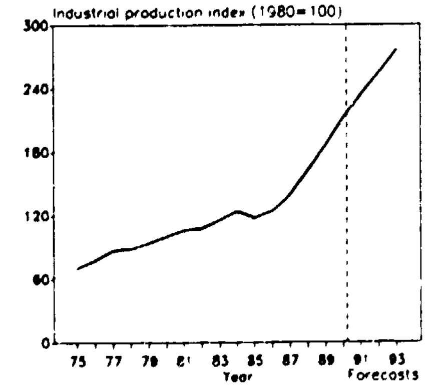
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

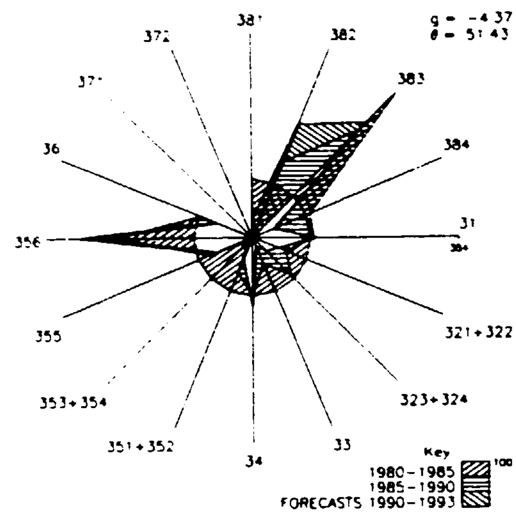


Industrial production index (1980=100)

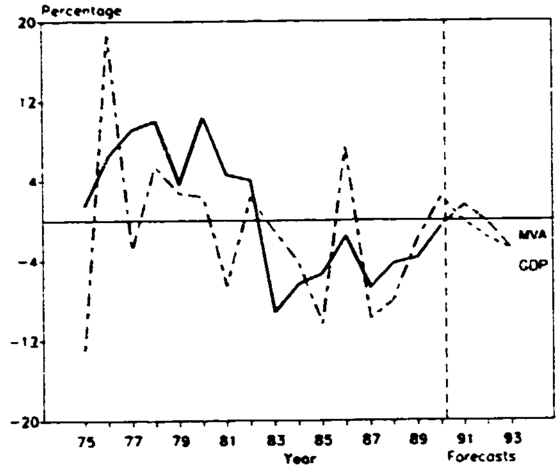


TRINIDAD AND TOBAGO

Industrial structural change
(index of value added 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)

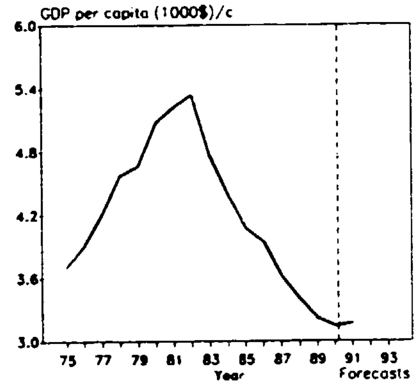


Source National Accounts Statistics from UN/UNSO
Estimated by UNIDO/PPD/IPP/GLO

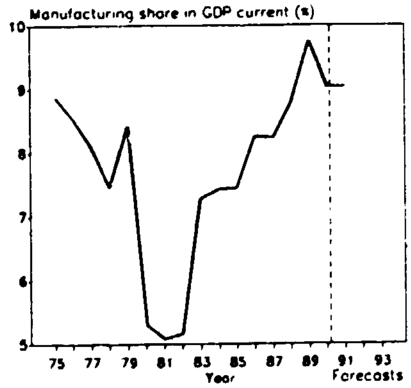
	1980	1985	1990
GDP: na.c (millions of 1980-dollars)	5486	4803	4036
Per capita (1980-dollars) /na.c	5070	4074	3143
Manufacturing share (%) /na (current prices)	5 3	7 4	9 0
MANUFACTURING:			
Value added (na.c (millions of 1980-dollars)	490	398	355
Industrial production index	100	86	104
Value added (millions of dollars)	492	387	471 /e
Gross output (millions of dollars)	1604 /e	1765	1747 /e
Employment (thousands)	44	34	31 /e
-PROFITABILITY: in percent of gross output			
Intermediate input (%)	69 /e	78	73 /e
Wages and salaries (%)	15 /e	18 /e	17 /e
Operating surplus (%)	15 /e	4 /e	10 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	36214 /e	52667	56574 /e
Value added / worker	11099	11544	15252 /e
Average wage	5543 /e	9488 /e	9457 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2 62 /e	20 14	7 25 /e
as a percentage of average θ in 1970-1975	111 /e	856	308 /e
MVA growth rate / θ	0 74	-0 52	-0 12
Degree of specialization	28 3	18 0	20 3
-VALUE ADDED: millions of dollars)			
311 Food products	67	95	131 /e
313 Beverages	27	34	42 /e
314 Tobacco products	14	35	33 /e
321 Textiles	1	2	2 /e
322 Wearing apparel	16	13	13 /e
323 Leather and fur products	-	-	- /e
324 Footwear	4	5	2 /e
331 Wood and wood products	6	4	4 /e
332 Furniture and fixtures	9	7	1 /e
341 Paper and paper products	9	14	26 /e
342 Printing and publishing	13	19	22 /e
351 Industrial chemicals	5	6	3 /e
352 Other chemical products	12	10	9 /e
353 Petroleum refineries	190 /e	17 /e	38 /e
354 Miscellaneous petroleum and coal products	2 /e	- /e	- /e
355 Rubber products	9	10	10 /e
356 Plastic products	2	8	12 /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	3	4	3 /e
369 Other non-metal mineral products	23	31	27 /e
371 Iron and steel	-	-	- /e
372 Non-ferrous metals	-	-	- /e
381 Metal products	26	11	17 /e
382 Non-electrical machinery	13	-	33 /e
383 Electrical machinery	3	13	13 /e
384 Transport equipment	28	43	21 /e
385 Professional and scientific equipment	-	-	- /e
390 Other manufacturing industries	8	6	7 /e

For sources, footnotes and comments see 'Technical notes' at the beginning of this Annex

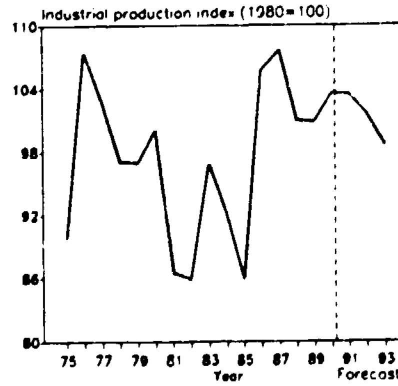
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

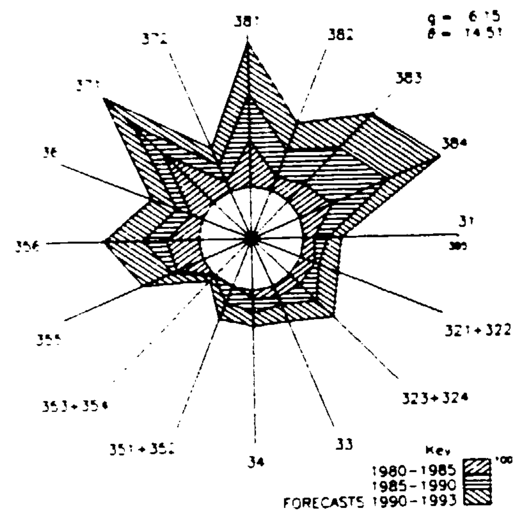


Industrial production index (1980=100)

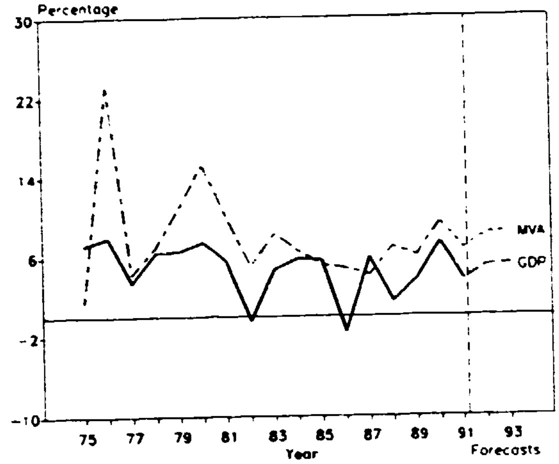


TUNISIA

Industrial structure change
(index of value added, 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)

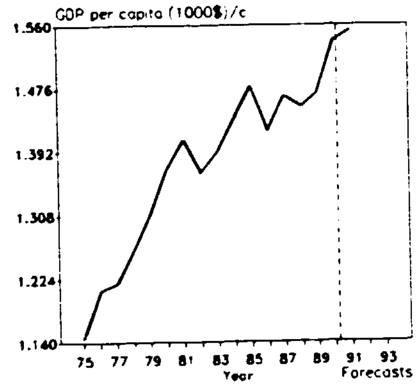


——— Source: National Accounts Statistics from UN/UNSO
- - - - Estimated by UNIDO/PPD/IPP/GLO

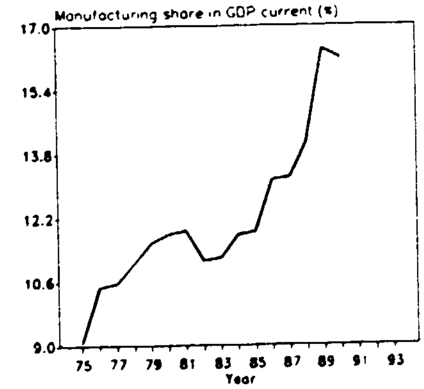
	1980	1985	1990
GDP: (na.c. millions of 1980-dollars)	8742	10733	12607
Per capita (1980-dollars) (na.c)	1369	1478	1539
Manufacturing share (%) (na.) (current prices)	11 8	11 8	16 2 /e
MANUFACTURING:			
Value added (na.c. millions of 1980-dollars)	1191	1668	2254
Industrial production index	100	125	133
Value added (millions of dollars)	939	948 /e	1605 /e
Gross output (millions of dollars)	3579	3449 /e	5559 /e
Employment (thousands)	125	165 /e	212 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	74	73 /e	71 /e
Wages and salaries (%)	12	13 /e	15 /e
Operating surplus (%)	14	14 /e	14 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	28737	20888 /e	26178 /e
Value added / worker	7542	5744 /e	7559 /e
Average wage	3499	2817 /e	3837 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	9 45 /e	3 81 /e	1 86 /e
as a percentage of average θ in 1970-1975	84 /e	34 /e	17 /e
MVA growth rate / θ	1 58	1 49	2 79
Degree of specialization	13 9	13 7	13 8
-VALUE ADDED: (millions of dollars)			
311 Food products	96	78 /e	119 /e
313 Beverages	49	54 /e	92 /e
314 Tobacco products	22	22 /e	36 /e
321 Textiles	55	60 /e	84 /e
322 Wearing apparel	92	86 /e	121 /e
323 Leather and fur products	6	6 /e	10 /e
324 Footwear	21	21 /e	38 /e
331 Wood and wood products	12	12 /e	21 /e
332 Furniture and fixtures	13	12 /e	15 /e
341 Paper and paper products	24	21 /e	33 /e
342 Printing and publishing	17	16 /e	25 /e
351 Industrial chemicals	42 /e	26 /e	46 /e
352 Other chemical products	96 /e	77 /e	139 /e
353 Petroleum refineries	13	10 /e	14 /e
354 Miscellaneous petroleum and coal products	-	- /e	- /e
355 Rubber products	8	10 /e	14 /e
356 Plastic products	18	22 /e	38 /e
361 Pottery, china and earthenware	11	9 /e	14 /e
362 Glass and glass products	7	6 /e	11 /e
369 Other non-metal mineral products	156	149 /e	245 /e
371 Iron and steel	45	81 /e	143 /e
372 Non-ferrous metals	8	7 /e	12 /e
381 Metal products	53	77 /e	150 /e
382 Non-electrical machinery	2	2 /e	4 /e
383 Electrical machinery	35	38 /e	84 /e
384 Transport equipment	30	38 /e	85 /e
385 Professional and scientific equipment	1	1 /e	2 /e
390 Other manufacturing industries	5	6 /e	9 /e

For sources, footnotes and comments see 'Technical notes' at the beginning of this Annex

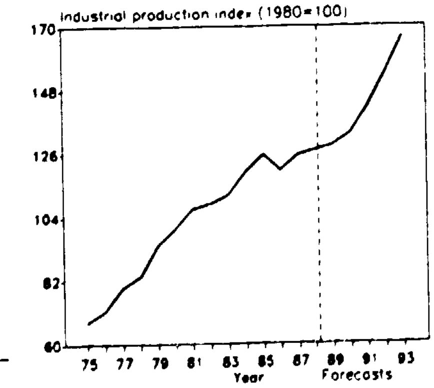
GDP per capita (1000$)/c



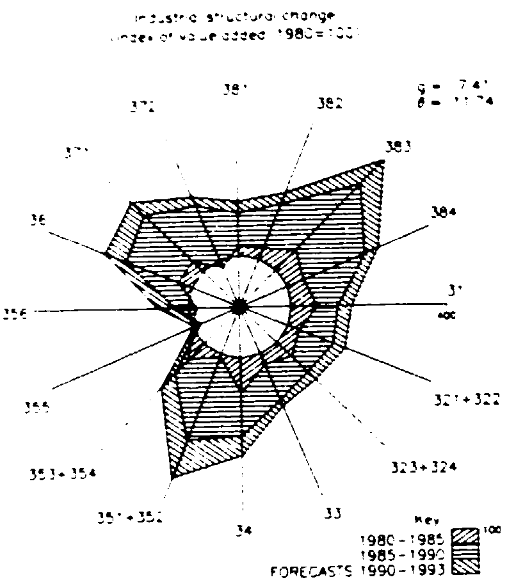
Manufacturing share in GDP current (%)

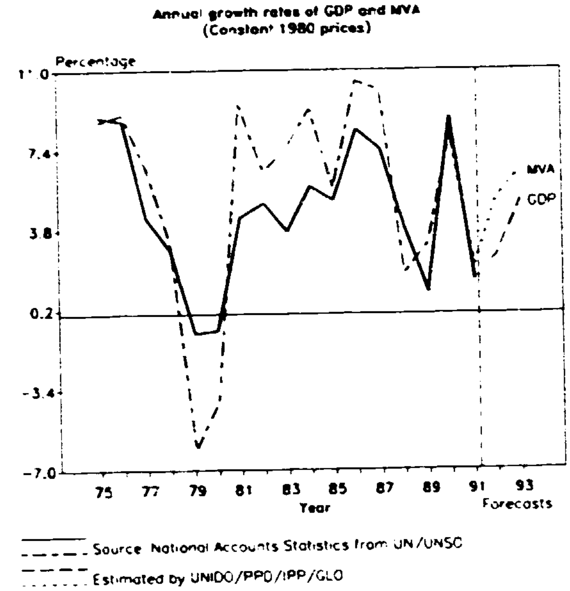


Industrial production index (1980=100)



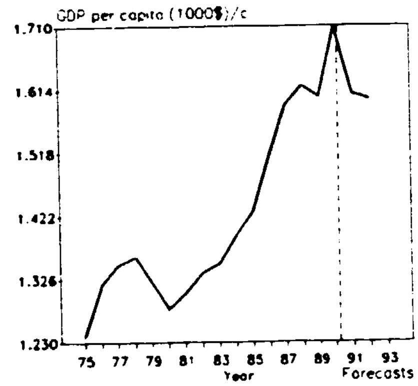
TURKEY

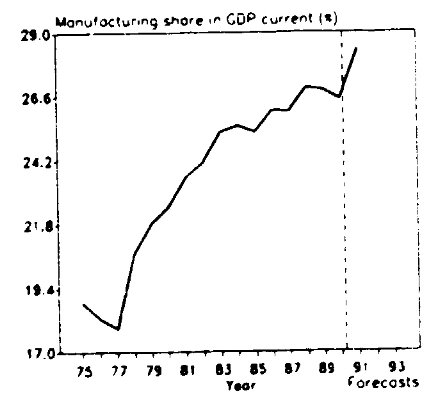


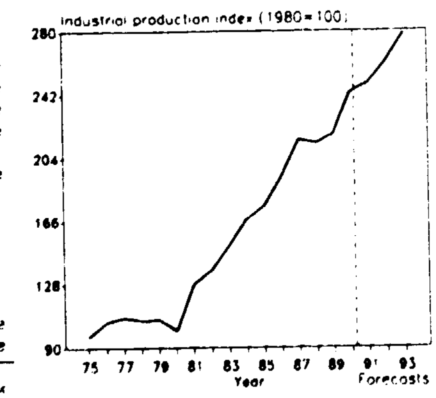


	1980	1985	1990	
GDP (n.a.c., millions of 1980-dollars)	56918	71874	95433	
Per capita (1980-dollars, n.a.c.)	1281	1428	1707	
Manufacturing share (%, n.a., current prices)	22 4	25 2	26 5	e
MANUFACTURING:				
Value added (n.a.c., millions of 1980-dollars)	13033	18836	25981	
Industrial production index	100	174	243	
Value added (millions of dollars)	10837	10449	29709	
Gross output (millions of dollars)	29413	32471	78666	
Employment (thousands)	787	844	976	
-PROFITABILITY (in percent of gross output)				
Intermediate input (%)	63	68	62	
Wages and salaries (%)	11	7	5	e
Operating surplus (%)	26	25	32	e
-PRODUCTIVITY (dollars)				
Gross output / worker	37374	38478	80794	
Value added / worker	13770	12382	30435	
Average wage	4231	2618	4236	e
-STRUCTURAL INDICES:				
Structural change θ (5-year average in degrees)	14 36	11 89	11 76	
as a percentage of average θ in 1970-1975	155	129	127	
MVA growth rate / θ	0 38	0 54	0 95	
Degree of specialization	14 3	13 8	12 3	
-VALUE ADDED (millions of dollars)				
311 Food products	1185	973	2416	
313 Beverages	335	331	870	
314 Tobacco products	467	877	1472	
321 Textiles	1535	1289	3247	
322 Wearing apparel	60	146	662	
323 Leather and fur products	25	37	69	
324 Footwear	33	22	53	
331 Wood and wood products	118	64	248	e
332 Furniture and fixtures	16	55	36	e
341 Paper and paper products	205	241	612	
342 Printing and publishing	97	133	347	
351 Industrial chemicals	719	457	2430	
352 Other chemical products	387	394	1470	
353 Petroleum refineries	1352	1514	3086	
354 Miscellaneous petroleum and coal products	222	152	517	e
355 Rubber products	201	151	210	e
356 Plastic products	125	76	198	e
361 Pottery, china and earthenware	93	102	333	e
362 Glass and glass products	110	167	610	
369 Other non-metal mineral products	535	428	1278	e
371 Iron and steel	783	734	2535	
372 Non-ferrous metals	292	181	788	
381 Metal products	395	344	914	
382 Non-electrical machinery	506	456	1376	
383 Electrical machinery	463	531	1956	
384 Transport equipment	541	534	1797	
385 Professional and scientific equipment	8	9	51	e
390 Other manufacturing industries	28	49	67	e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

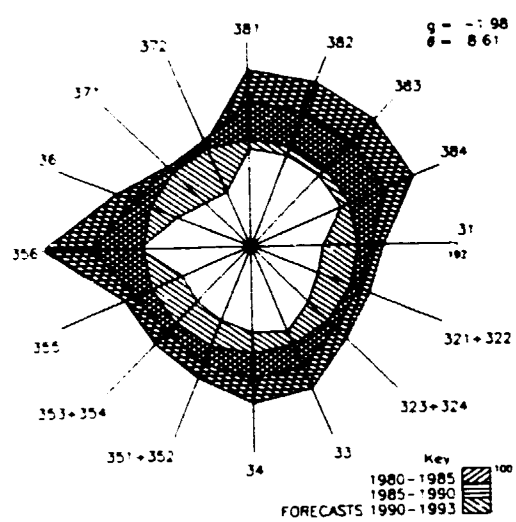




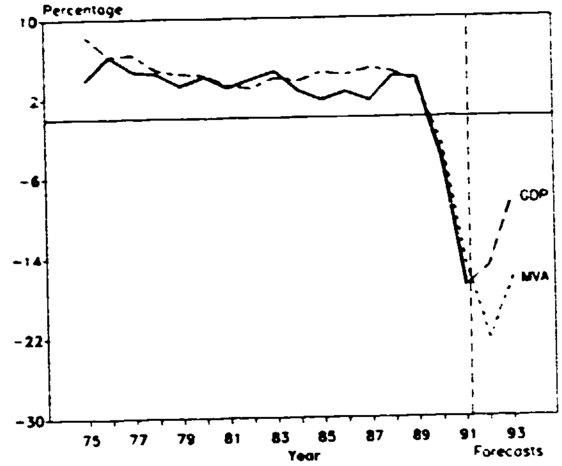


UNION OF SOVIET SOCIALIST REPUBLICS, FORMER

Industrial structural change
(index of value added 1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)

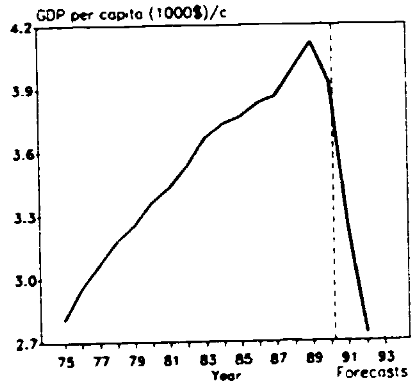


Source National Accounts Statistics from UN/UNSO

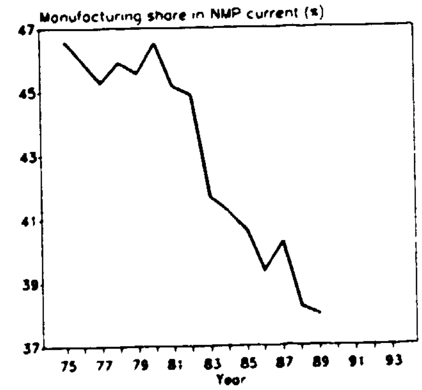
Estimated by UNIDO/PPD/IPP/GLO

	1980	1985	1990
GDP: /na.c (millions of 1980-dollars)	892879	1044668	1132755
Per capita (1980-dollars) /na.c	3362	3764	3923
Manufacturing share (%) /na (current prices)	46 5	40 6	
MANUFACTURING:			
Value added /na.c (millions of 1980-dollars)	404805	485530	561028
Industrial production index	100	120	139
Value added (millions of 1980-dollars)	362425	436247	502639
Gross output (millions of dollars)	834090	867603	564562 /e
Employment (thousands)	31464	32794	30608 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)			
Wages and salaries (%)			
Operating surplus (%)			
-PRODUCTIVITY: (dollars)			
Gross output / worker	26509	26456	18445 /e
Value added / worker /c	11519	13303	16422 /e
Average wage	3247	3002	2134 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	1 77	1 21	0 78
as a percentage of average θ in 1970-1975	93	64	41
MVA growth rate / θ	2 51	3 11	3 70
Degree of specialization	18 1	18.9	19 7
-VALUE ADDED: (millions of 1980-dollars)			
311 Food products	66053	75960	85868
313 Beverages	10336	9303	8786
314 Tobacco products	2032	2856	2398
321 Textiles	32553	34506	37435
322 Wearing apparel	19633	21792	24345
323 Leather and fur products	2443	2345	2345
324 Footwear	3892	4593	5488
331 Wood and wood products	4932	5771	6412
332 Furniture and fixtures	3457	4459	5669
341 Paper and paper products	2784	3424	4065
342 Printing and publishing	2613	3214 /e	3815 /e
351 Industrial chemicals	14704	17939	19703
352 Other chemical products	7584	8419	9632
353 Petroleum refineries	5490	6093	6972
354 Miscellaneous petroleum and coal products	11003	12214	13974
355 Rubber products	4154	4861	5276
356 Plastic products	1546	2273	2969
361 Pottery, china and earthenware	2014	2457	3001
362 Glass and glass products	1204	1517	1914
369 Other non-metal mineral products	13769	15696	17761
371 Iron and steel	14418	15283	15427 /e
372 Non-ferrous metals	7716	8333	8025 /e
381 Metal products	7130	9625	11764
382 Non-electrical machinery	79367	107146	130956
383 Electrical machinery	9105	12292	15023
384 Transport equipment	11574	15625	19097
385 Professional and scientific equipment	9711	13110	16024
390 Other manufacturing industries	11210	15133 /e	18496 /e

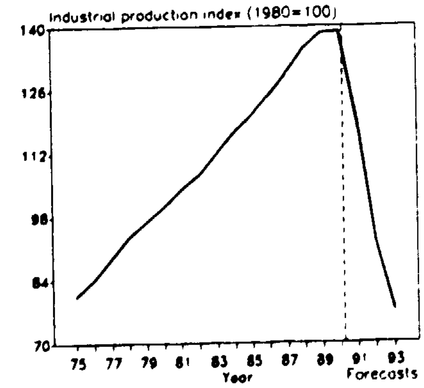
GDP per capita (1000$)/c



Manufacturing share in NMP current (%)



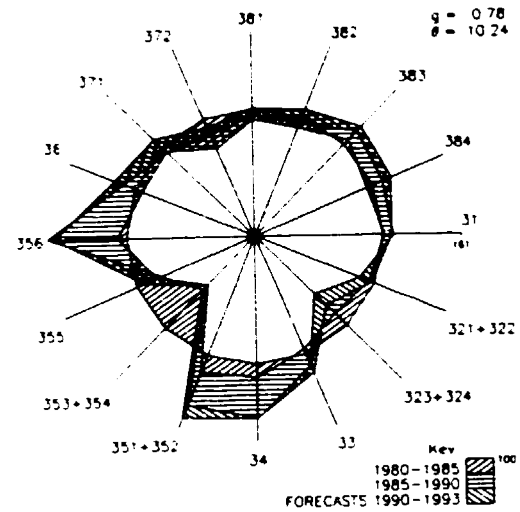
Industrial production index (1980=100)



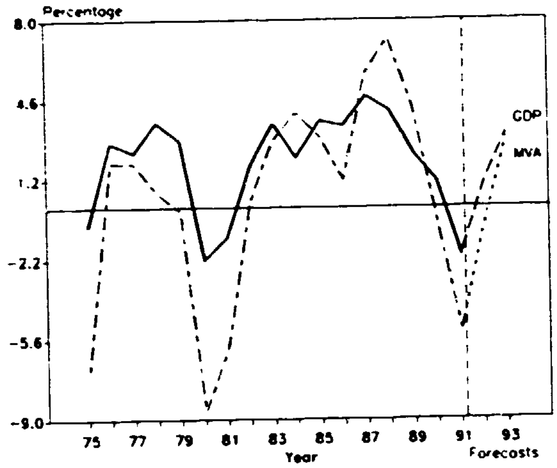
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND

Industrial structural change
(index of value added 1980=100)

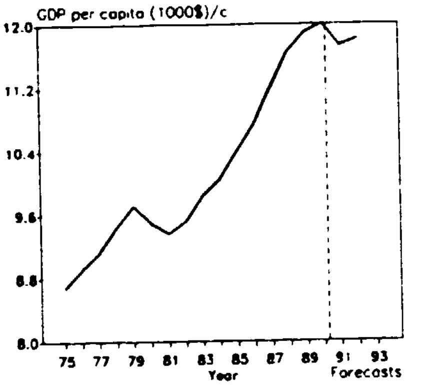


Annual growth rates of GDP and MVA
(Constant 1980 prices)



Source National Accounts Statistics from UN/UNSO
Estimated by UNIDO/PPD/IPP/GLO

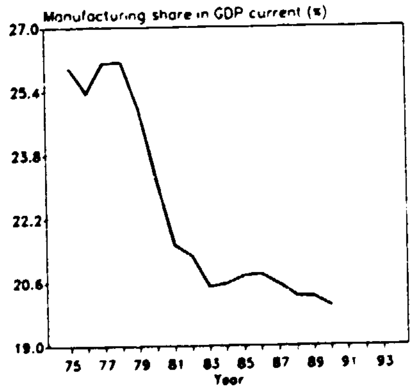
GDP per capita (1000$)/c



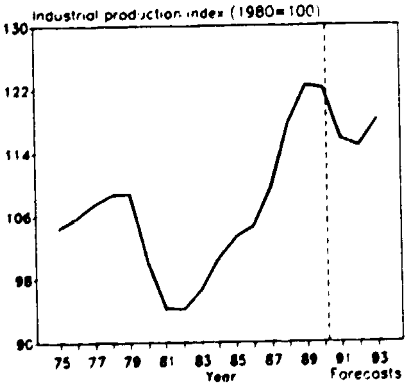
	1980	1985	1990
GDP: (na.c millions of 1980-dollars)	536588	590748	689088
Per capita (1980-dollars) /na.c	9493	10398	11999
Manufacturing share (%) /na (current prices)	23 1	20 8	20 0 /e
MANUFACTURING:			
Value added (na.c millions of 1980-dollars)	143281	148726	176537
Industrial production index	100	103	122
Value added (millions of dollars)	163790	124409	269971
Gross output (millions of dollars)	400929	306225	609483
Employment (thousands)	6462	4932	4804
-PROFITABILITY (in percent of gross output)			
Intermediate input (%)	59	59	56
Wages and salaries (%)	20	18	17 /e
Operating surplus (%)	21	23	27 /e
-PRODUCTIVITY (dollars)			
Gross output / worker	62044	62089	126882 /e
Value added / worker	25347	25225	56203 /e
Average wage	12371	10916	21760 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	3 83	2 57	1 90
as a percentage of average θ in 1970-1975	109	73	54
MVA growth rate / θ	-0 20	-0 15	1 71
Degree of specialization	11 1	11 9	12 3
-VALUE ADDED: (millions of dollars)			
311 Food products	14744	12179	24344
313 Beverages	5419	3554	7339
314 Tobacco products	1814	1479	2264
321 Textiles	5419	3917	7414
322 Wearing apparel	3395	2633	4988
323 Leather and fur products	558	363	523
324 Footwear	1093	752	1326
331 Wood and wood products	2349	1556	3688 /e
332 Furniture and fixtures	2558	2101	4510 /e
341 Paper and paper products	4860	3800	9020
342 Printing and publishing	9814	8807	20928
351 Industrial chemicals	8233	7328	16561 /e
352 Other chemical products	7512	6641	15644 /e
353 Petroleum refineries	4512	1712	3172
354 Miscellaneous petroleum and coal products	721	428	865 /e
355 Rubber products	2349	1505	3161 /e
356 Plastic products	3698	3087	8298 /e
361 Pottery, china and earthenware	977	765	1525 /e
362 Glass and glass products	1442	960	2375
369 Other non-metal mineral products	5698	4215	9806
371 Iron and steel	5860	4345	9202
372 Non-ferrous metals	2581	1505	3450
381 Metal products	10140	7211	14611
382 Non-electrical machinery	21326	15110	32800
383 Electrical machinery	15209	12399	26094
384 Transport equipment	17512	12944	29314
385 Professional and scientific equipment	2209	1803	3830 /e
390 Other manufacturing industries	1791	1310	2918 /e

For sources, footnotes and comments see 'Technical notes' at the beginning of this Annex

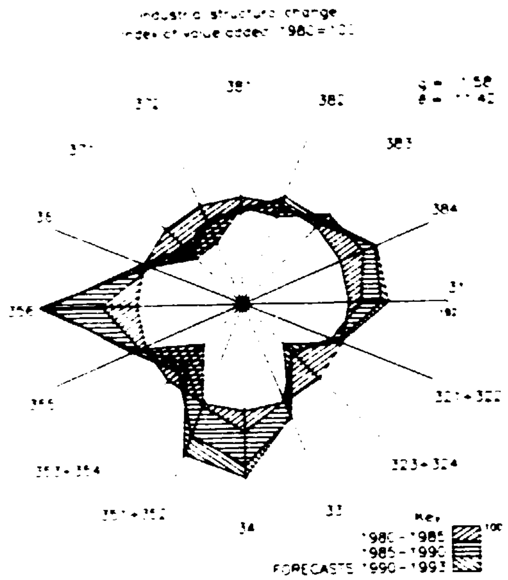
Manufacturing share in GDP current (%)

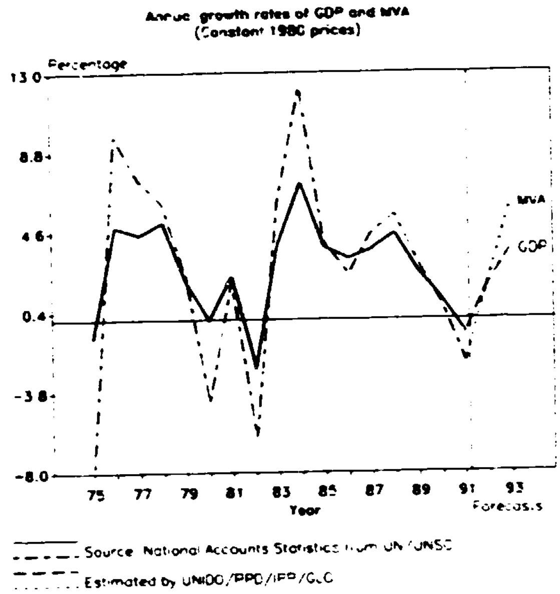


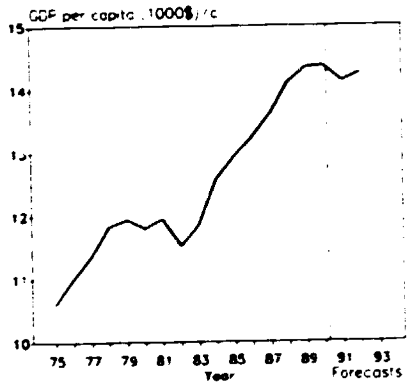
Industrial production index (1980=100)



UNITED STATES OF AMERICA

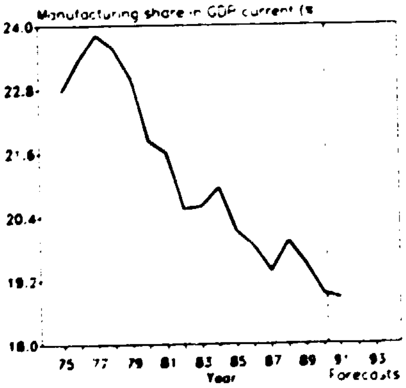


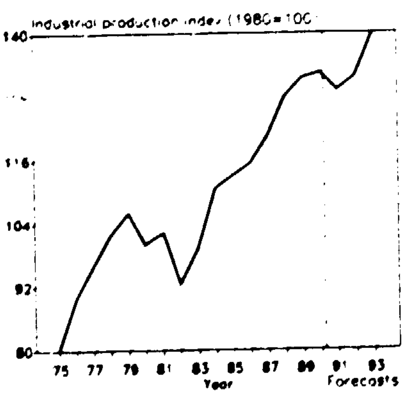




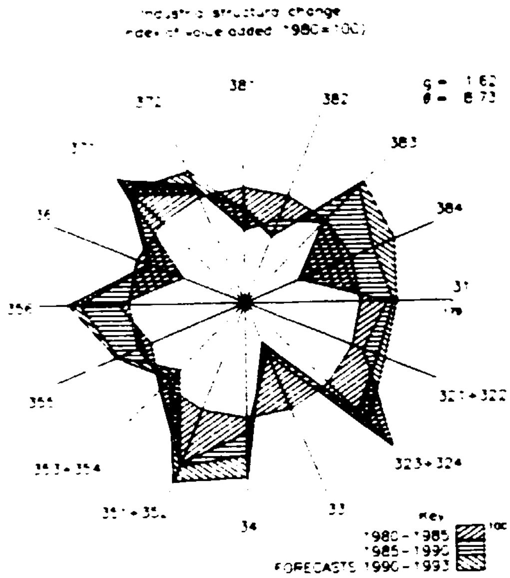
	1980	1985	1990	
GDP (real) millions of 1980-dollars	2638470	3095560	3581479	
Per capita (1980-dollars) (real)	11304	12937	14361	
Manufacturing share (%) (real) (current prices)	21.8	20.1	18.9	e
MANUFACTURING				
Value added (real) millions of 1980-dollars	596630	706584	826970	
Industrial production index	100	113	132	
Value added (millions of dollars)	769899	996380	1369065	
Gross output (millions of dollars)	1857094	2267000	2919047	
Employment (thousands)	19210	17422	17269	
-PROFITABILITY (in percent of gross output)				
Intermediate input	59	56	53	
Wages and salaries	17	17	16	e
Operating surplus	24	27	31	e
-PRODUCTIVITY (dollars)				
Gross output / worker	96673	130123	169035	
Value added / worker	40078	57191	79279	
Average wage	16406	22683	25999	e
-STRUCTURAL INDICES				
Structural change θ 5-year average in degrees	2.91	3.35	3.15	
as a percentage of average θ in 1970-1975	84	96	90	
MVA growth rate / θ	1.45	0.10	1.03	
Degree of specialization	11.3	13.5	12.4	
-VALUE ADDED (millions of dollars)				
311 Food products	63460	87960	117915	
313 Beverages	11810	16160	22377	
314 Tobacco products	5160	11890	19503	
321 Textiles	23030	26910	36524	
322 Wearing apparel	19780	22150	24918	
323 Leather and fur products	1850	1570	2287	
324 Footwear	2950	2470	2331	
331 Wood and wood products	12970	15390	22025	e
332 Furniture and fixtures	9840	13250	17612	e
341 Paper and paper products	29790	40330	62359	
342 Printing and publishing	44390	73050	105036	
351 Industrial chemicals	38920	43360	71855	e
352 Other chemical products	35530	54280	76066	e
353 Petroleum refineries	23010	13890	28282	e
354 Miscellaneous petroleum and coal products	2670	3450	5422	e
355 Rubber products	8030	10970	13806	e
356 Plastic products	14540	24740	40380	e
361 Pottery, china and earthenware	1210	1300	1752	e
362 Glass and glass products	5470	7660	10439	e
369 Other non-metal mineral products	16300	19880	24565	e
371 Iron and steel	30780	24070	34780	
372 Non-ferrous metals	14340	11440	18308	
381 Metal products	53180	61810	71929	
382 Non-electrical machinery	102760	115550	159804	
383 Electrical machinery	74850	111220	117567	
384 Transport equipment	81280	128230	164895	
385 Professional and scientific equipment	27940	40280	77388	e
390 Other manufacturing industries	12060	13060	18937	e

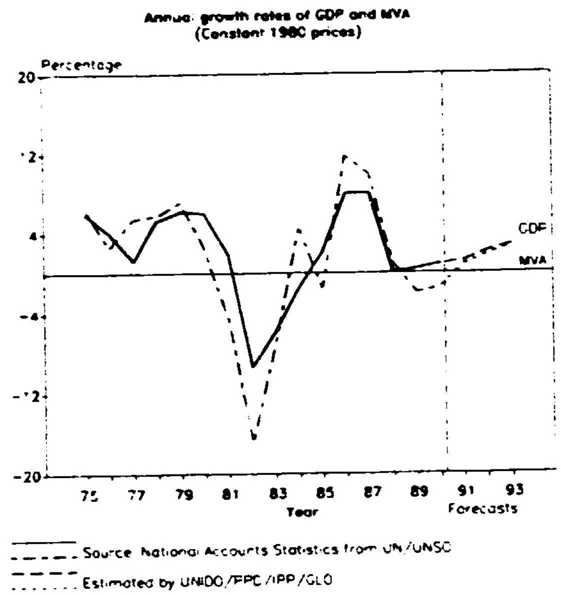
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex





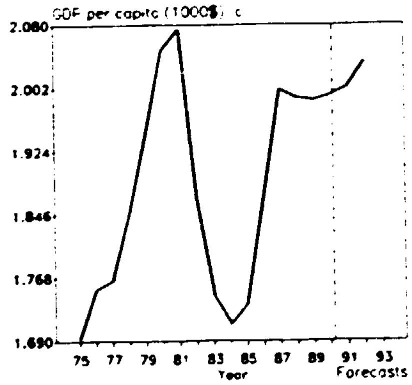
URUGUAY

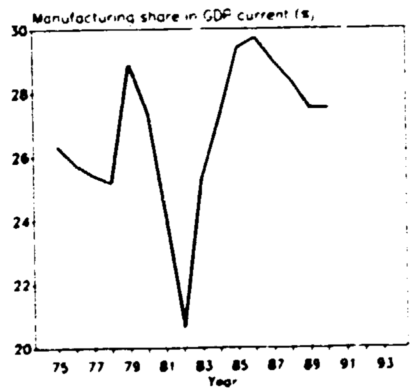


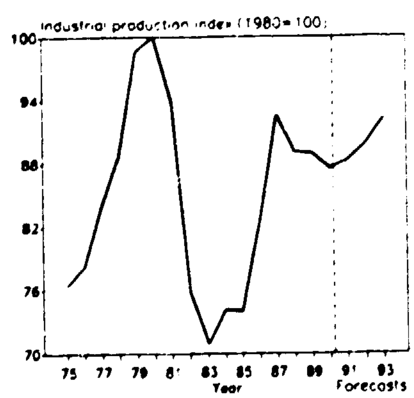


	1980	1985	1990
GDP (real, millions of 1980-dollars)	5970	5220	6166
Per capita (1980-dollars) (real)	2049	1735	1993
Manufacturing share (%) (real) (current prices)	27.3	29.4	27.5 e
MANUFACTURING			
Value added (real) (millions of 1980-dollars)	1546	1173	1404
Industrial production index	100	74	88
Value added (millions of dollars)	1286	1344	2246 e
Gross output (millions of dollars)	3302	3189	5107 e
Employment (thousands)	160	123	122 e
-PROFITABILITY (in percent of gross output)			
Intermediate input	61	58	56 e
Wages and salaries	13 e	9	11 e
Operating surplus	26 e	33	33 e
-PRODUCTIVITY (dollars)			
Gross output / worker	20615	26012	41736 e
Value added / worker	8028	10965	18353 e
Average wage	2625 e	2448	4519 e
-STRUCTURAL INDICES			
Structural change θ (5-year average in degrees)	12.10	14.61	4.94 e
as a percentage of average θ in 1970-1975	123	149	50 e
MVA growth rate / θ	-0.08	0.14	0.31
Degree of specialization	13.9	18.7	16.2
-VALUE ADDED (millions of dollars)			
311 Food products	165	266	407 e
313 Beverages	104	92	178 e
314 Tobacco products	90	68	107 e
321 Textiles	109	137	247 e
322 Wearing apparel	59	43	65 e
323 Leather and fur products	31	76	33 e
324 Footwear	18	8	17 e
331 Wood and wood products	14 e	8	10 e
332 Furniture and fixtures	7 e	2	4 e
341 Paper and paper products	30	47	82 e
342 Printing and publishing	37	27	51 e
351 Industrial chemicals	20	26	49 e
352 Other chemical products	75	112	169 e
353 Petroleum refineries	192	194	234 e
354 Miscellaneous petroleum and coal products	2	4	5 e
355 Rubber products	40	34	72 e
356 Plastic products	24	25	51 e
361 Pottery, china and earthenware	13	7	20 e
362 Glass and glass products	14	7	34 e
369 Other non-metal mineral products	41	24	37 e
371 Iron and steel	10	14	19 e
372 Non-ferrous metals	3	3	5 e
381 Metal products	53 e	32	66 e
382 Non-electrical machinery	16 e	12	15 e
383 Electrical machinery	33	31	71 e
384 Transport equipment	78	38	141 e
385 Professional and scientific equipment	1	1	2 e
390 Other manufacturing industries	8	6	7 e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

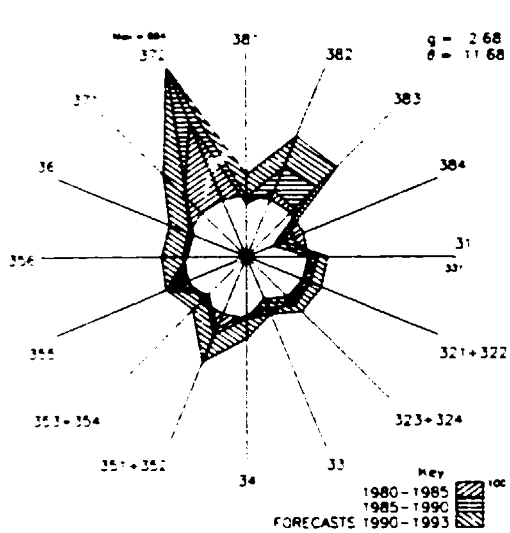




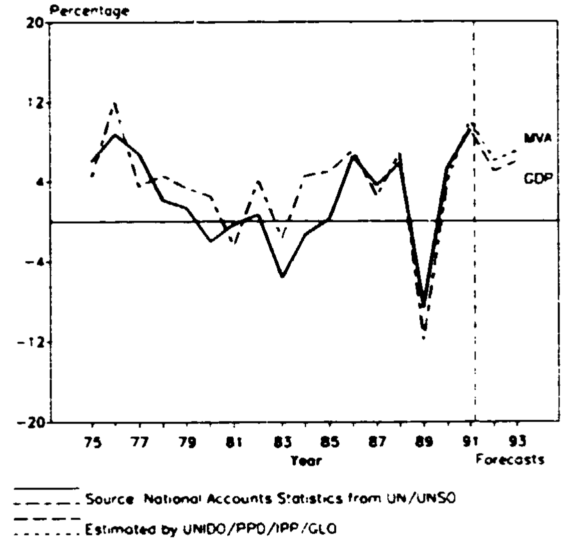


VENEZUELA

Industrial structural change
(index of value added 1980=100)



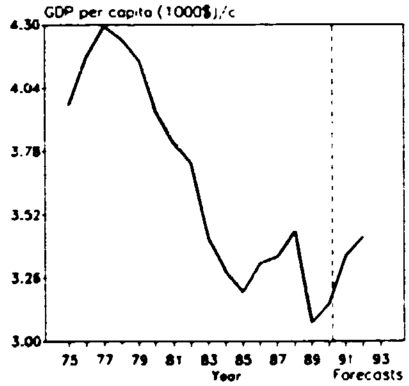
Annual growth rates of GDP and MVA
(Constant 1980 prices)



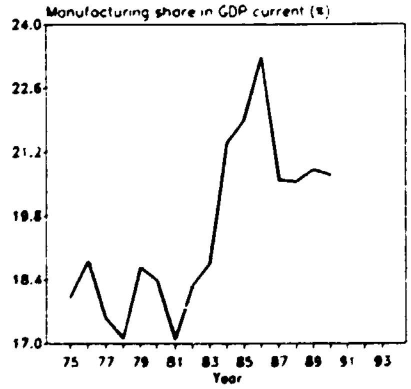
	1980	1985	1990
GDP (n.a.c., millions of 1980-dollars)	59213	55446	62315
Per capita (1980-dollars, n.a.c.)	3941	3202	3154
Manufacturing share (%, n.a., current prices)	13.4	21.9	20.7 /e
MANUFACTURING:			
Value added (n.a.c., millions of 1980-dollars)	9843	10777	11604
Industrial production index	100	160	531
Value added (millions of dollars)	14172 /e	14071	11164 /e
Gross output (millions of dollars)	29407 /e	30305	24191 /e
Employment (thousands)	477 /e	426	489 /e
-PROFITABILITY (in percent of gross output)			
Intermediate input (%)	52 /e	54	54 /e
Wages and salaries (%)	13 /e	12	10 /e
Operating surplus (%)	35 /e	35	37 /e
-PRODUCTIVITY (dollars)			
Gross output / worker	61640 /e	71155	49506 /e
Value added / worker	29705 /e	33038	22847 /e
Average wage	7932 /e	8436	4746 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	7.50 /e	10.25	13.58 /e
as a percentage of average θ in 1970-1975	70 /e	96	127 /e
MVA growth rate / θ	1.18	0.07	0.07
Degree of specialization	20.6	17.3	17.8
-VALUE ADDED (millions of dollars)			
311 Food products	1410 /e	1597	1151 /e
313 Beverages	992 /e	836	625 /e
314 Tobacco products	331 /e	597	288 /e
321 Textiles	483 /e	505	388 /e
322 Wearing apparel	330 /e	359	204 /e
323 Leather and fur products	55 /e	58	39 /e
324 Footwear	147 /e	158	99 /e
331 Wood and wood products	88 /e	80	58 /e
332 Furniture and fixtures	167 /e	142	81 /e
341 Paper and paper products	355 /e	357	285 /e
342 Printing and publishing	364 /e	299	245 /e
351 Industrial chemicals	275 /e	498	462 /e
352 Other chemical products	881 /e	890	696 /e
353 Petroleum refineries	4417 /e	3634	2929 /e
354 Miscellaneous petroleum and coal products	24 /e	30	20 /e
355 Rubber products	141 /e	188	111 /e
356 Plastic products	379 /e	348	276 /e
361 Pottery, china and earthenware	44 /e	39	32 /e
362 Glass and glass products	136 /e	132	109 /e
369 Other non-metal mineral products	441 /e	378	312 /e
371 Iron and steel	632 /e	855	628 /e
372 Non-ferrous metals	198 /e	447	778 /e
381 Metal products	601 /e	503	434 /e
382 Non-electrical machinery	217 /e	241	252 /e
383 Electrical machinery	291 /e	307	343 /e
384 Transport equipment	652 /e	486	219 /e
385 Professional and scientific equipment	34 /e	26	37 /e
390 Other manufacturing industries	88 /e	81	65 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

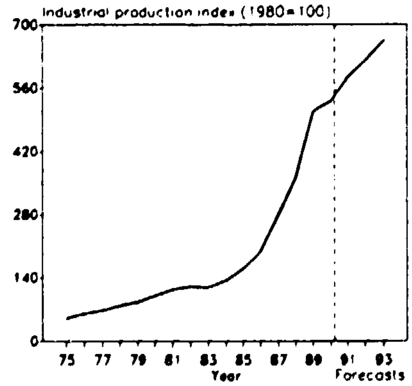
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

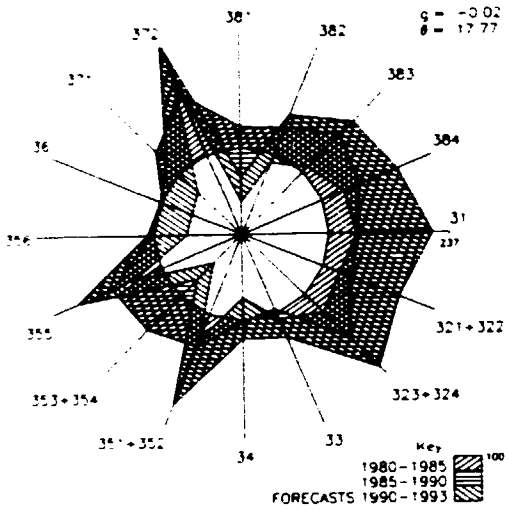


Industrial production index (1980=100)

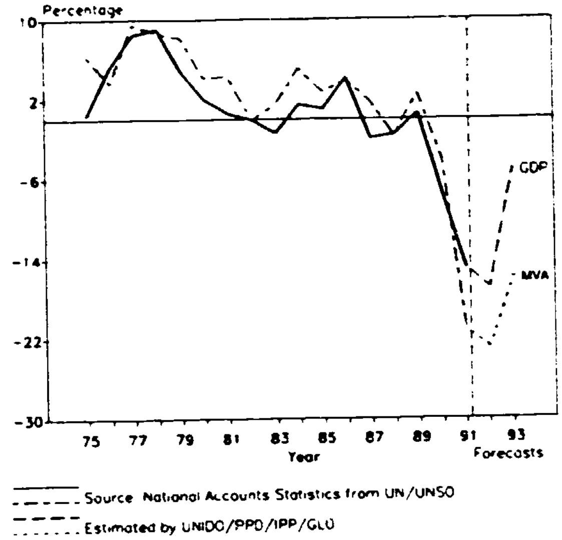


YUGOSLAVIA, FORMER

Industrial structural change
index of value added (1980=100)



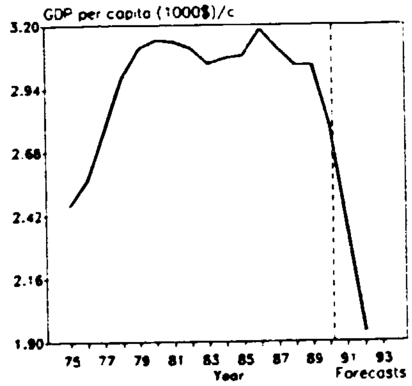
Annual growth rates of GDP and MVA
(Constant 1980 prices)



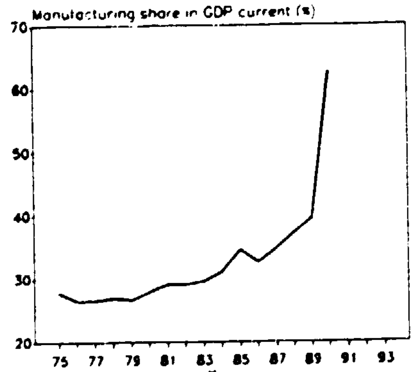
	1980	1985	1990
GDP: (n.a.c. millions of 1980-dollars)	69970	71070	66383
Per capita (1980-dollars) (n.a.c.)	3137	3073	2787
Manufacturing share (%) (n.a.) (current prices)	27 9	34 5	62 5 /e
MANUFACTURING:			
Value added (n.a.c.) (millions of 1980-dollars)	21429	24455	24974
Industrial production index	100	116	108
Value added (millions of dollars)	21750	17171	27660 /e
Gross output (millions of dollars)	72629	57020	63032 /e
Employment (thousands)	2106	2467	2542 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	70	70	56 /e
Wages and salaries (%)	10	9	12 /e
Operating surplus (%)	20	21	32 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	34486	23113	24793 /e
Value added / worker	10328	6960	10880 /e
Average wage	3546	2024	2970 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	5 08	4 66	5 48 /e
as a percentage of average θ in 1970-1975	72	66	78 /e
MVA growth rate / θ	1 13	1 20	0 77
Degree of specialization	8 8	9 0	10 4
-VALUE ADDED: (millions of dollars)			
311 Food products	1897	1458	3542 /e
313 Beverages	458	353	599 /e
314 Tobacco products	184	221	313 /e
321 Textiles	1759	1428	2662 /e
322 Wearing apparel	903	718	1471 /e
323 Leather and fur products	226	231	346 /e
324 Footwear	482	503	902 /e
331 Wood and wood products	977	530	718 /e
332 Furniture and fixtures	730	438	1064 /e
341 Paper and paper products	529	394	686 /e
342 Printing and publishing	876	462	680 /e
351 Industrial chemicals	694	631	1012 /e
352 Other chemical products	681	525	1314 /e
353 Petroleum refineries	454	415	234 /e
354 Miscellaneous petroleum and coal products	101	101	91 /e
355 Rubber products	276	269	456 /e
356 Plastic products	413	258	357 /e
361 Pottery, china and earthenware	128	72	145 /e
362 Glass and glass products	163	113	209 /e
369 Other non-metal mineral products	906	513	607 /e
371 Iron and steel	1221	1000	1175 /e
372 Non-ferrous metals	480	509	917 /e
381 Metal products	2105	1577	1134 /e
382 Non-electrical machinery	1828	1463	2179 /e
383 Electrical machinery	1600	1544	2342 /e
384 Transport equipment	1441	1263	2240 /e
385 Professional and scientific equipment	101	93	146 /e
390 Other manufacturing industries	134	88	115 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

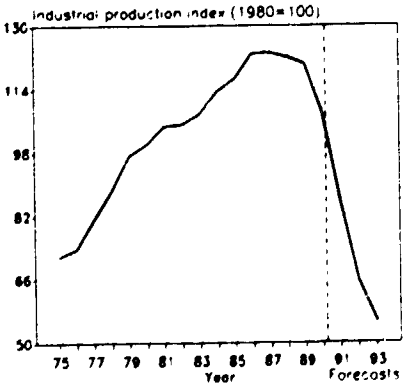
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

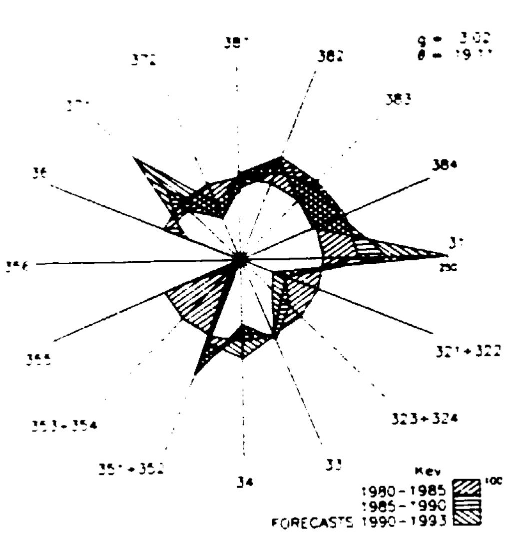


Industrial production index (1980=100)

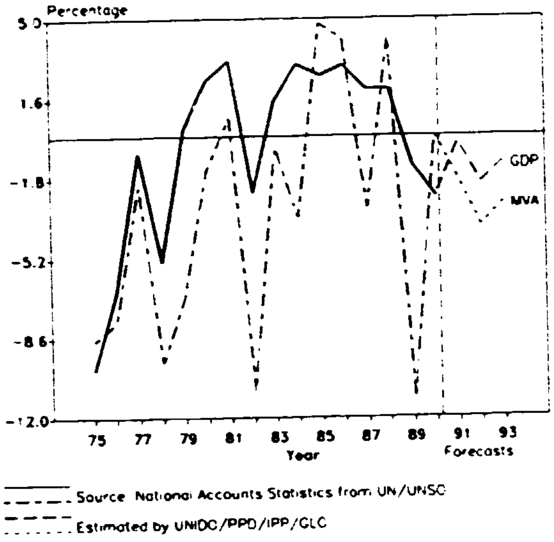


ZAIRE

Industrial structure change
(index of value added 1980=100)



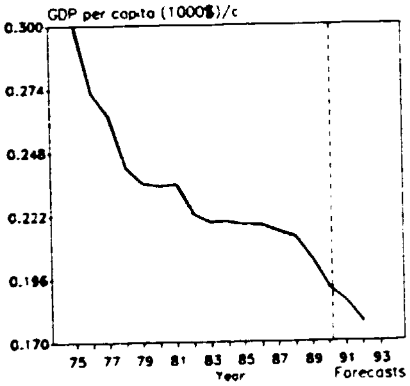
Annual growth rates of GDP and MVA
(Constant 1980 prices)



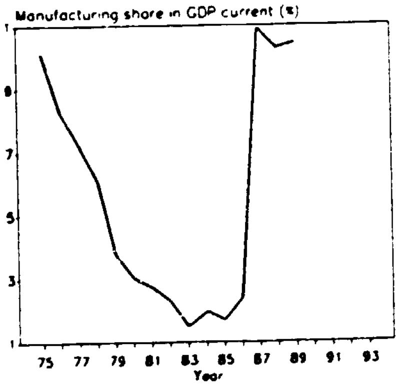
	1980	1985	1990
GDP: (na.c millions of 1980-dollars)	6137	6630	6831
Per capita (1980-dollars) (na.c)	234	218	192
Manufacturing share (%) (na current prices)	3 0	1 7	
MANUFACTURING:			
Value added (na.c millions of 1980-dollars	184	166	155
Industrial production index	100	117	110
Value added (millions of dollars)	170	66 e	94 /e
Gross output (millions of dollars)			
Employment (thousands)	50 e	51 /e	51 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)			
Wages and salaries (%)			
Operating surplus (%)			
-PRODUCTIVITY: (dollars)			
Gross output / worker			
Value added / worker	3377 e	1304 /e	1843 /e
Average wage	4728 e	1635 e	2132 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	6 76 e	8 05 /e	3 39 /e
as a percentage of average θ in 1970-1975	90 e	107 /e	45 /e
MVA growth rate (θ)	-1 54	0 32	0 48
Degree of specialization	16 8	23 8	26 9
-VALUE ADDED: (millions of dollars)			
311 Food products	20	4 /e	7 /e
313 Beverages	35	21 e	31 e
314 Tobacco products	9	7 /e	14 /e
321 Textiles	10	2 /e	3 e
322 Wearing apparel	7	1 e	2 e
323 Leather and fur products	-	- /e	1 /e
324 Footwear	8	2 /e	2 /e
331 Wood and wood products	4	1 e	1 e
332 Furniture and fixtures	1	1 /e	1 e
341 Paper and paper products	-	- e	- /e
342 Printing and publishing	2	1 e	1 /e
351 Industrial chemicals	12	6 e	8 e
352 Other chemical products	-	- e	- /e
353 Petroleum refineries	14	1 /e	1 e
354 Miscellaneous petroleum and coal products	-	- /e	- /e
355 Rubber products	-	- /e	- /e
356 Plastic products	-	- /e	- /e
361 Pottery, china and earthenware	-	- /e	- /e
362 Glass and glass products	1	- /e	- /e
363 Other non-metal mineral products	4	1 /e	1 /e
371 Iron and steel	4	1 /e	2 /e
372 Non-ferrous metals	2	- /e	1 /e
381 Metal products	5	2 e	2 /e
382 Non-electrical machinery	5	2 e	3 /e
383 Electrical machinery	3	1 e	2 /e
384 Transport equipment	5	3 /e	3 /e
385 Professional and scientific equipment	-	- e	- /e
390 Other manufacturing industries	15	7 /e	9 e

For sources, footnotes and comments see Technical notes at the beginning of this Annex

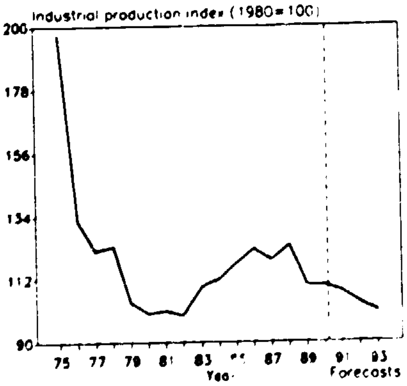
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

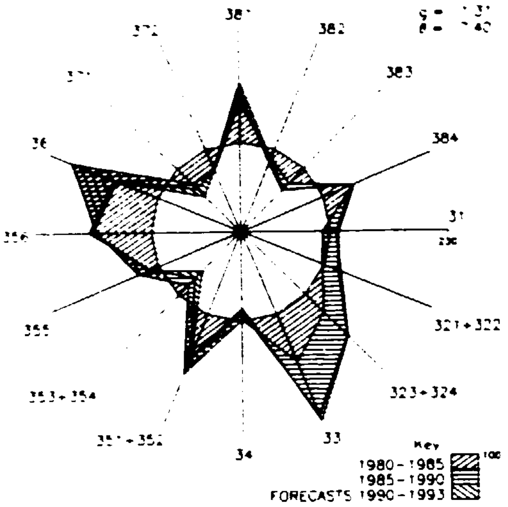


Industrial production index (1980=100)

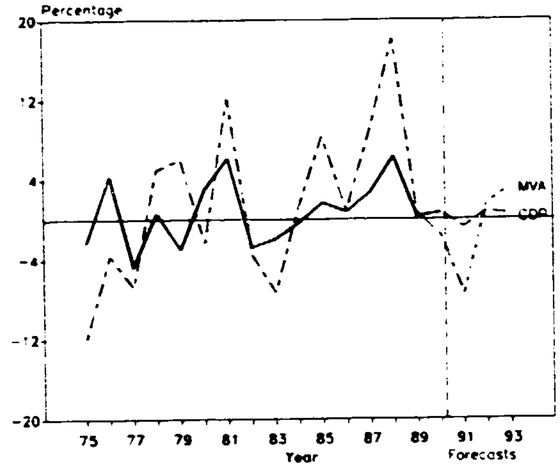


ZAMBIA

Industrial structural change
Index of value added (1980=100)



Annual growth rates of GDP and MVA
(Constant 1980 prices)



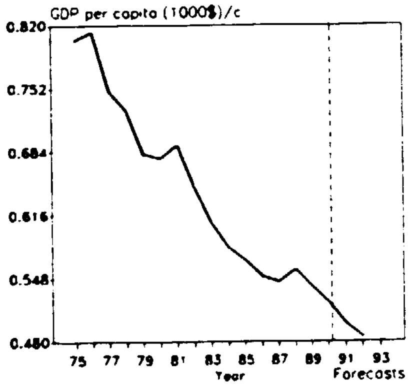
Source National Accounts Statistics from UN/UNSO

Estimated by UNIDO/PPD/IPP/GLO

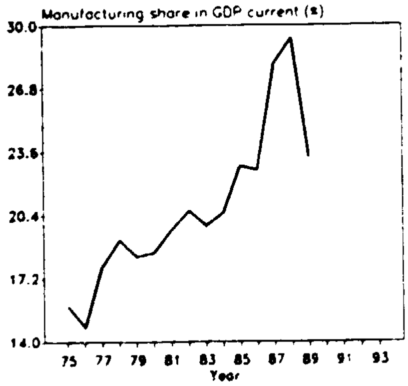
	1980	1985	1990
GDP (n.a.c., millions of 1980-dollars)	3883	3978	4409
Per capita (1980-dollars) (n.a.c.)	677	568	522
Manufacturing share (%) (n.a., current prices)	18 5	22 9	
MANUFACTURING:			
Value added (n.a.c., millions of 1980-dollars)	745	819	1052
Industrial production index	100	106	115
Value added (millions of dollars)	780	575 /e	1074 e
Gross output (millions of dollars)	1671	1378 /e	2761 /e
Employment (thousands)	59	62 /e	61 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	53	58 /e	61 /e
Wages and salaries (%)	11	11 /e	10 /e
Operating surplus (%)	35	30 /e	28 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	28286	22254 /e	45033 /e
Value added / worker	13199	9280 /e	17518 /e
Average wage	3245	2542 /e	4721 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	3 31 /e	5 05 /e	5 00 /e
as a percentage of average θ in 1970-1975	55 /e	84 /e	83 /e
MVA growth rate / θ	0 17	0 52	0 59
Degree of specialization	17 9	15 4	16 9
-VALUE ADDED (millions of dollars)			
311 Food products	92	62 /e	35 /e
313 Beverages	193	104 /e	223 /e
314 Tobacco products	58	39 /e	106 /e
321 Textiles	51	32 /e	69 /e
322 Wearing apparel	34	23 /e	44 /e
323 Leather and fur products	4	3 /e	6 /e
324 Footwear	15	13 /e	29 /e
331 Wood and wood products	8	11 /e	28 /e
332 Furniture and fixtures	12	10 /e	23 /e
341 Paper and paper products	15	8 /e	11 /e
342 Printing and publishing	17	13 /e	22 /e
351 Industrial chemicals	22	26 /e	41 /e
352 Other chemical products	47	51 /e	80 /e
353 Petroleum refineries	9	5 /e	7 /e
354 Miscellaneous petroleum and coal products	3	2 /e	3 /e
355 Rubber products	20	16 /e	25 /e
356 Plastic products	7	7 /e	13 /e
361 Pottery, china and earthenware	1	1 /e	1 /e
362 Glass and glass products	3	3 /e	4 /e
369 Other non-metal mineral products	33	45 /e	59 /e
371 Iron and steel	10	5 /e	8 /e
372 Non-ferrous metals	2	1 /e	2 /e
381 Metal products	50	47 /e	94 /e
382 Non-electrical machinery	18	11 /e	18 /e
383 Electrical machinery	26	13 /e	20 /e
384 Transport equipment	28	24 /e	43 /e
385 Professional and scientific equipment	-	- /e	- /e
390 Other manufacturing industries	2	1 /e	1 /e

For sources, footnotes and comments see 'Technical notes' at the beginning of this Annex

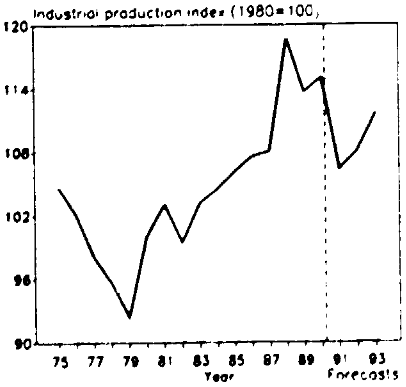
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)

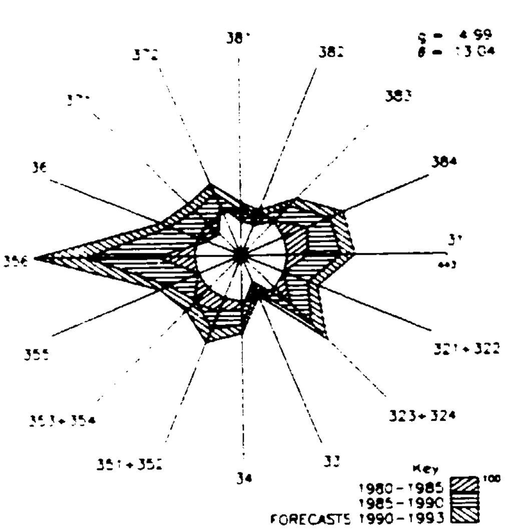


Industrial production index (1980=100)

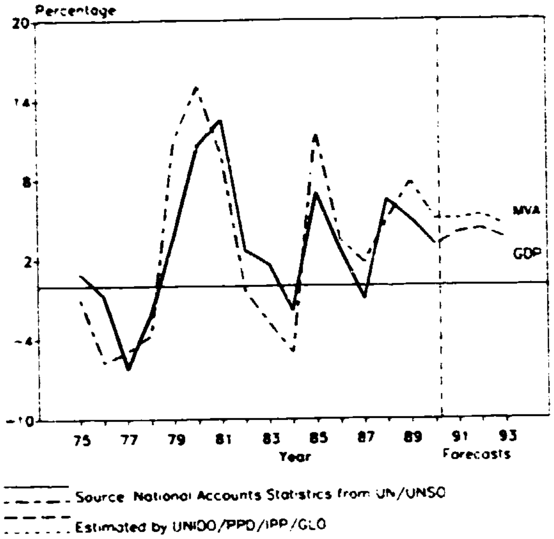


ZIMBABWE

Industrial structural change
(index of value added: 1980=100)



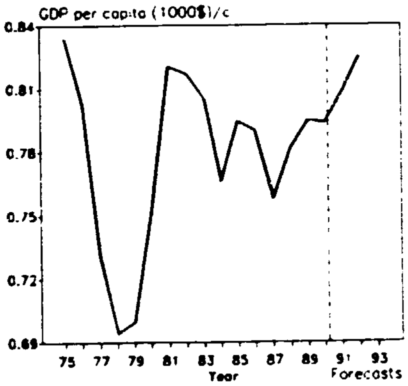
Annual growth rates of GDP and MVA
(Constant 1980 prices)



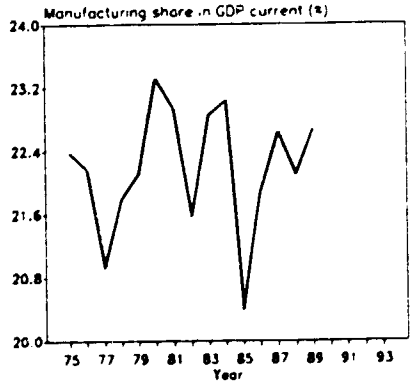
	1980	1985	1990
GDP: (na.c. millions of 1980-dollars)	5351	6586	7704
Per capita (1980-dollars) (na.c.	751	794	794
Manufacturing share (%) (na.) (current prices)	23.3	20.4	
MANUFACTURING:			
Value added (na.c. millions of 1980-dollars)	1331	1497	1872
Industrial production index	100	112	137
Value added (millions of dollars)	1480 /e	1278 /e	2324 /e
Gross output (millions of dollars)	3579	3020	4948 /e
Employment (thousands)	161	163	198 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	67	61	53 /e
Wages and salaries (%)	13	13	13 /e
Operating surplus (%)	19	26	34 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	22265	18472	25021 /e
Value added / worker	9333	9752	16216 /e
Average wage	3848	3241	4103 /e
-STRUCTURAL INDICES:			
Structural change θ (5-year average in degrees)	2.77	7.00	4.21 /e
as a percentage of average θ in 1970-1975	151	381	229 /e
MVA growth rate / θ	1.81	1.35	2.04
Degree of specialization	11.9	6.3	9.2
-VALUE ADDED: (millions of dollars)			
311 Food products	193	130	252 /e
313 Beverages	92	189	348 /e
314 Tobacco products	55	72	103 /e
321 Textiles			
322 Wearing apparel			
323 Leather and fur products			
324 Footwear			
331 Wood and wood products			
332 Furniture and fixtures			
341 Paper and paper products			
342 Printing and publishing			
351 Industrial chemicals			
352 Other chemical products			
353 Petroleum refineries			
354 Miscellaneous petroleum and coal products			
355 Rubber products			
356 Plastic products			
361 Pottery, china and earthenware			
362 Glass and glass products			
369 Other non-metal mineral products			
371 Iron and steel			
372 Non-ferrous metals			
381 Metal products			
382 Non-electrical machinery			
383 Electrical machinery			
384 Transport equipment			
385 Professional and scientific equipment			
390 Other manufacturing industries			

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

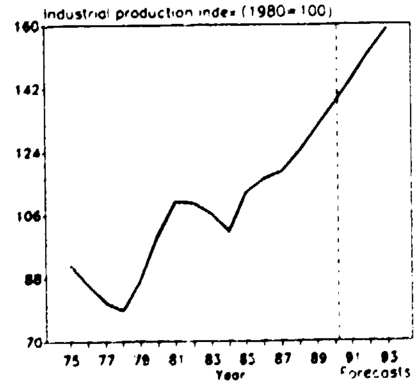
GDP per capita (1000$)/c



Manufacturing share in GDP current (%)



Industrial production index (1980=100)



AFGHANISTAN	1980	1985	1989	1990	1991
GDP: (na,c) (in million 1980-dollars)	3852	4450	4041	3942	4139
Growth rate (%) (na,c)	-3.72	3.53	-7.10	-2.45	5.00
Per capita (in 1980-dollars) (na,c)	239.8	306.5	257.3	246.2	252.2 /e
MVA: (na,c) (in million 1980-dollars)	272	258	258	240	235 /e
Growth rate (%) (na,c)	-6.06	0.63	-5.96	-7.02	-2.13 /e
Manufacturing share (%) /na,current prices					

ALBANIA	1980	1985	1989	1990	1991
GDP: (na,c) (in million 1980-dollars)	2373	2711	3070	3070	2640 /e
Growth rate (%) (na,c)	6.29	1.48	2.04	-0.01	-14.00 /e
Per capita (in 1980-dollars) /na,c	888.1	914.9	962.5	944.9	796.5 /e
MVA: (na,c) (in million 1980-dollars)	912	1111	1304	1350	810 /e
Growth rate (%) (na,c)	6.08	1.57	5.63	3.50	-40.00 /e
Manufacturing share (%) /na,current prices					

BAHAMAS	1980	1985	1989	1990	1991
GDP: (na,c) (in million 1980-dollars)	1320	1709	1977	2036	2021 /e
Growth rate (%) /na,c	-3.77	13.51	4.00	3.00	-0.77 /e
Per capita (in 1980-dollars) /na,c	6255.0	7335.6	7908.0	8016.9	7831.9 /e
MVA: (na,c) (in million 1980-dollars)					
Growth rate (%) (na,c)					
Manufacturing share (%) /na,current prices					

BAHRAIN	1980	1985	1989	1990	1991
GDP: (na,c) (in million 1980-dollars)	3072	2902	3293	3385	3336 /e
Growth rate (%) (na,c)	0.24	-3.94	2.50	2.80	-1.44 /e
Per capita (in 1980-dollars) /na,c	8827.2	6748.1	6599.4	6535.3	6197.6 /e
MVA: (na,c) (in million 1980-dollars)	498	457	747	820	847 /e
Growth rate (%) /na,c	-3.38	-16.13	2.48	9.66	3.31 /e
Manufacturing share (%) /na,current prices	16.2	10.0	18.3		

BELIZE	1980	1985	1989	1990	1991
GDP: (na,c) (in million 1980-dollars)	171	183	248	278	296 /e
Growth rate (%) /na,c	4.39	2.25	5.70	12.20	6.27 /e
Per capita (in 1980-dollars) /na,c	1172.6	1093.2	1348.8	1481.2	1582.4 /e
MVA: (na,c) (in million 1980-dollars)	22	21	25	27	29 /e
Growth rate (%) /na,c	14.91	0.89	8.07	6.58	6.44 /e
Manufacturing share (%) /na,current prices	14.6	9.7	9.4		

BENIN	1980	1985	1989	1990	1991
GDP: /na,c (in million 1980-dollars)	1163	1225	1227	1268	1242 /e
Growth rate (%) /na,c	10.16	-2.47	-1.40	3.30	-2.07 /e
Per capita (in 1980-dollars) /na,c	336.1	307.3	273.3	274.0	260.1 /e
MVA: (na,c) (in million 1980-dollars)	78	129	86	91	91 /e
Growth rate (%) /na,c	-3.47	1.34	-5.09	5.83	0.51 /e
Manufacturing share (%) /na,current prices	11.5	7.5	8.8		

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

BERMUDA	1980	1985	1989	1990	1991
GDP (na.c) in million 1980-dollars	752	752	820	838	865 e
Growth rate (%) (na.c)	2.51	5.57	1.33	2.23	3.24 /e
Per capita (in 1980-dollars) (na.c)	13678.2	13190.0	14137.9	14453.5	14921.7 /e
MVA (na.c) in million 1980-dollars	101	98	107	109	112 /e
Growth rate (%) (na.c)	4.68	3.02	1.30	1.94	2.66 /e
Manufacturing share (%) (na,current prices)					

BHUTAN	1980	1985	1989	1990	1991
GDP (na.c) in million 1980-dollars	142	196	274	286	308 /e
Growth rate (%) (na.c)	17.63	3.69	3.81	4.40	8.00 /e
Per capita (in 1980-dollars) (na.c)	113.6	144.1	184.4	188.5	199.6 /e
MVA (na.c) in million 1980-dollars	5	10	19	21	22 /e
Growth rate (%) (na.c)	-0.79	12.20	36.02	8.78	4.00 /e
Manufacturing share (%) (na,current prices)	3.2	5.4	5.6		

BRUNEI DARUSSALAM	1980	1985	1989	1990	1991
GDP (na.c) in million 1980-dollars	4848	4115	3822	3778	3659 /e
Growth rate (%) (na.c)	-7.00	0.73	2.50	-1.15	-3.14 /e
Per capita (in 1980-dollars) (na.c)	26063.3	18287.7	14813.5	14150.1	13178.5 /e
MVA (na.c) in million 1980-dollars	573	339	367	367	356 /e
Growth rate (%) (na.c)	-8.35	-5.42	2.49	0.09	-3.03 /e
Manufacturing share (%) (na,current prices)	11.8	10.1	9.3		

CAPE VERDE	1980	1985	1989	1990	1991
GDP (na.c) in million 1980-dollars	142	196	245	254	271 e
Growth rate (%) (na.c)	3.32	8.63	5.50	4.00	6.40 e
Per capita (in 1980-dollars) (na.c)	490.5	604.5	681.2	691.2	718.2 e
MVA (na.c) in million 1980-dollars	8	12	15	15	
Growth rate (%) (na.c)	7.15	31.06	7.90	4.98	
Manufacturing share (%) (na,current prices)	4.5	5.5	5.9		

CHAD	1980	1985	1989	1990	1991
GDP (na.c) in million 1980-dollars	1005	804	979	952	978 /e
Growth rate (%) (na.c)	-7.40	6.86	4.70	-2.70	2.70 /e
Per capita (in 1980 dollars) (na.c)	224.5	160.2	176.7	167.8	168.0 /e
MVA (na.c) in million 1980-dollars	92	69	85	83	86 /e
Growth rate (%) (na.c)	-12.00	5.39	7.10	-1.90	2.93 /e
Manufacturing share (%) (na,current prices)	10.6	11.6	12.2	9.8	

COMOROS	1980	1985	1989	1990	1991
GDP (na.c) in million 1980-dollars	139	170	192	198	200 /e
Growth rate (%) (na.c)	7.27	2.71	3.00	3.00	1.27 /e
Per capita (in 1980-dollars) (na.c)	353.5	367.6	361.1	359.1	374.5 /e
MVA (na.c) in million 1980-dollars	5	6	8	8	8 /e
Growth rate (%) (na.c)	5.78	3.52	4.11	3.88	2.69 /e
Manufacturing share (%) (na,current prices)	3.8	3.7	3.8		

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

DJIBOUTI	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	339	357	389	397	410 /e
Growth rate (%) (na.c	4.72	0.85	1.00	2.00	3.15 /e
Per capita (in 1980-dollars) (na.c	1116.3	1004.4	978.5	971.2	962.5 /e
MVA (na.c) (in million 1980-dollars)	34	36	41	43	45 /e
Growth rate (%) (na.c	2.98	0.49	11.49	5.10	4.38 /e
Manufacturing share (%) /na,current prices	8.4	8.3			

EQUATORIAL GUINEA	1980	1985	1989	1990	1991
GDP: (na.c) (in million 1980-dollars)	43	49	52	54	56 /e
Growth rate (%) /na.c	-9.14	7.31	-2.76	3.14	5.26 /e
Per capita (in 1980-dollars) (na.c	198.9	157.2	150.5	151.3	124.4 /e
MVA: (na.c) (in million 1980-dollars)	0	0	0	0	0 /e
Growth rate (%) /na.c	-9.33	4.27	1.76	3.90	0.43 /e
Manufacturing share (%) /na,current prices		1.8	1.3		

FRENCH GUIANA	1980	1985	1989	1990	1991
GDP: (na.c) (in million 1980-dollars)	183	189	194	197	196 /e
Growth rate (%) /na.c	0.00	-0.35	0.57	1.63	-0.55 /e
Per capita (in 1980-dollars) /na.c	2649.6	2280.0	2041.5	2011.3	1960.3 /e
MVA: (na.c) (in million 1980-dollars)	11	10	11	11	12 /e
Growth rate (%) /na.c	4.68	3.02	1.30	0.05	2.11 /e
Manufacturing share (%) /na,current prices					

FRENCH POLYNESIA	1980	1985	1989	1990	1991
GDP: (na.c) (in million 1980-dollars)	1260	1767	2165	2276	2285 /e
Growth rate (%) /na.c	-2.93	5.35	3.00	5.11	0.40 /e
Per capita (in 1980-dollars) /na.c	8458.8	10042.5	10826.1	11048.2	12418.7 /e
MVA: (na.c) (in million 1980-dollars)	83	127	171	183	189 /e
Growth rate (%) /na.c	1.77	-1.09	7.62	7.12	3.49 /e
Manufacturing share (%) /na,current prices	6.6	8.3			

GUADELOUPE	1980	1985	1989	1990	1991
GDP: (na.c) (in million 1980-dollars)	1387	1412	1765	1873	1873 /e
Growth rate (%) /na.c	-4.66	-0.76	4.50	6.09	0.03 /e
Per capita (in 1980-dollars) /na.c	4240.7	4226.4	5176.1	5459.2	5541.9 /e
MVA: (na.c) (in million 1980-dollars)	92	105	112	114	113 /e
Growth rate (%) /na.c	1.21	3.14	1.35	1.56	-0.92 /e
Manufacturing share (%) /na,current prices					

GUINEA	1980	1985	1989	1990	1991
GDP: (na.c) (in million 1980-dollars)	1897	1807	2106	2190	2267
Growth rate (%) /na.c	5.60	3.89	4.11	4.00	3.50
Per capita (in 1980-dollars) /na.c	425.1	362.2	376.9	381.0	410.9 /e
MVA: (na.c) (in million 1980-dollars)	60	76	66	68	70 /e
Growth rate (%) /na.c	2.70	33.33	3.87	2.90	2.93 /e
Manufacturing share (%) /na,current prices	2.9	2.0			

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

GUINEA-BISSAU	1980	1985	1989	1990	1991
GDP: /na.c (in million 1980-dollars)	154	171	211	218	221 /e
Growth rate (%) /na.c	-4.19	-2.30	5.00	3.04	1.44 /e
Per capita (in 1980-dollars) /na.c	193.6	195.7	223.7	225.9	222.0 /e
MVA: /na.c (in million 1980-dollars)	3	3	2	2	2 /e
Growth rate (%) /na.c	-5.10	-5.96	4.23	1.23	-0.28 /e
Manufacturing share (%) /na,current prices	1.6	1.6			

GUYANA	1980	1985	1989	1990	1991
GDP: /na.c (in million 1980-dollars)	591	494	464	436	462
Growth rate (%) /na.c	1.66	1.02	-3.50	-6.21	6.00
Per capita (in 1980-dollars) /na.c	778.2	624.3	584.8	547.8	573.8 /e
MVA: /na.c (in million 1980-dollars)	64	45	38	33	33 /e
Growth rate (%) /na.c	0.76	-3.13	-10.91	-11.99	-0.74 /e
Manufacturing share (%) /na,current prices	10.7	11.6	13.5		

HAITI	1980	1985	1989	1990	1991
GDP: /na.c (in million 1980-dollars)	1437	1365	1405	1394	1383
Growth rate (%) /na.c	7.34	0.26	0.87	-0.76	-0.81
Per capita (in 1980-dollars) /na.c	267.5	231.8	220.1	214.1	209.2 /e
MVA: /na.c (in million 1980-dollars)	274	228	221	220	215 /e
Growth rate (%) /na.c	14.68	-2.89	0.90	-0.51	-2.43 /e
Manufacturing share (%) /na,current prices	18.3	16.0			

KOREA, DEMOCRATIC PEOPLE'S REPUBLIC	1980	1985	1989	1990	1991
GDP: /na.c (in million 1980-dollars)	12730	20368	25205	26618	28026 /e
Growth rate (%) /na.c	9.89	9.59	5.88	5.60	5.29 /e
Per capita (in 1980-dollars) /na.c	697.2	1024.1	1179.6	1223.5	1257.8 /e
MVA: /na.c (in million 1980-dollars)					
Growth rate (%) /na.c					
Manufacturing share (%) /na,current prices					

LAO PEOPLE'S DEMOCRATIC REPUBLIC	1980	1985	1989	1990	1991
GDP: /na.c (in million 1980-dollars)	462	661	828	903	959 /e
Growth rate (%) /na.c	1.70	9.83	6.50	9.10	6.15 /e
Per capita (in 1980-dollars) /na.c	144.1	183.8	206.0	218.5	230.3 /e
MVA: /na.c (in million 1980-dollars)	23	29	31	34	38 /e
Growth rate (%) /na.c	7.94	1.99	4.83	9.70	11.99 /e
Manufacturing share (%) /na,current prices					

LESOTHO	1980	1985	1989	1990	1991
GDP: /na.c (in million 1980-dollars)	368	397	469	525	553 /e
Growth rate (%) /na.c	8.63	3.24	2.09	7.25	5.39 /e
Per capita (in 1980-dollars) /na.c	274.6	257.9	283.7	295.7	297.7 /e
MVA: /na.c (in million 1980-dollars)	24	42	70	77	
Growth rate (%) /na.c	16.00	4.05	8.01	9.98	
Manufacturing share (%) /na,current prices	5.6	9.0			

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

LIBERIA	1980	1985	1989	1990	1991
GDP (na.c, in million 1980 dollars)	[illegible]	989	1044	1023	1055 e
Growth rate (na.c)	-6.29	[illegible]	2.30	-1.99	3.24 e
Per capita (in 1980 dollars) (na.c)	488.3	450.[illegible]	418.4	397.4	369.3 e
MVA (na.c, in million 1980 dollars)	88	109	121	118	125 e
Growth rate (na.c)	[illegible]	[illegible]	2.94	-2.9[illegible]	5.93 e
Manufacturing share (%) (na, current prices)	8.4	6.[illegible]	[illegible]6		

MALI	1980	1985	1989	1990	1991
GDP (na.c, in million 1980 dollars)	1629	1666	2198	2252	2263
Growth rate (na.c)	4.3[illegible]	[illegible]	9.8[illegible]	2.45	0.50
Per capita (in 1980 dollars) (na.c)	237.3	2[illegible].4	246.0	244.5	239.0 e
MVA (na.c, in million 1980 dollars)	[illegible]	116	115	121	122 e
Growth rate (na.c)	1.56	-0.47	10.05	5.15	0.75 e
Manufacturing share (%) (na, current prices)	4.3	[illegible]	7.6		

MARTINIQUE	1980	1985	1989	1990	1991
GDP (na.c, in million 1980 dollars)	1444	1797	2264	2403	2524 e
Growth rate (na.c)	2.80	4.50	5.92	6.10	5.07 e
Per capita (in 1980 dollars) (na.c)	4415.4	5413.0	6679.7	7045.6	7626.6 e
MVA (na.c, in million 1980 dollars)	78	86	94	96	98 e
Growth rate (na.c)	1.82	2.39	1.74	2.35	2.05 e
Manufacturing share (%) (na, current prices)	5.0				

MAURITANIA	1980	1985	1989	1990	1991
GDP (na.c, in million 1980 dollars)	829	874	984	1023	1049
Growth rate (na.c)	3.93	3.[illegible]	3.59	4.00	2.50
Per capita (in 1980 dollars) (na.c)	534.6	494.4	499.6	505.8	503.0 e
MVA (na.c, in million 1980 dollars)	46	[illegible]	90	95	101 e
Growth rate (na.c)	-1.38	7.8[illegible]	1.41	5.30	6.61 e
Manufacturing share (%) (na, current prices)	3.3	4.3			

MONGOLIA	1980	1985	1989	1990	1991
GDP (na.c, in million 1980 dollars)	1389	1911	2272	2374	1946 e
Growth rate (na.c)	3.43	6.51	3.14	4.47	-18.00 e
Per capita (in 1980 dollars) (na.c)	835.0	1000.3	1066.3	1083.9	863.5 e
MVA (na.c, in million 1980 dollars)	347	512	559	572	422 e
Growth rate (na.c)	8.03	3.13	3.91	2.20	-26.14 e
Manufacturing share (%) (na, current prices)					

MONTSERRAT	1980	1985	1989	1990	1991
GDP (na.c, in million 1980 dollars)	24	27	40	44	48 e
Growth rate (na.c)	10.22	4.73	9.12	11.06	8.47 e
Per capita (in 1980 dollars) (na.c)	2018.5	2241.1	3012.7	3412.5	3701.6 e
MVA (na.c, in million 1980 dollars)	1	2	2	2	3 e
Growth rate (na.c)	10.65	0.00	9.28	8.13	10.00 e
Manufacturing share (%) (na, current prices)	5.2	5.1			

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

MOZAMBIQUE	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	2407	1914	2238	2308	2328
Growth rate (%) (na.c)	2.46	-8.82	5.10	3.10	0.90
Per capita (in 1980-dollars) (na.c)	199.0	139.6	146.9	147.5	144.3 /e
MVA (na.c) (in million 1980-dollars)	759	334	416	434	453 /e
Growth rate (%) (na.c)	3.25	-11.98	5.00	4.40	4.33 /e
Manufacturing share (%) (na,current prices)	33.[illegible]	14.9			

MYANMAR	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	5851	7473	6887	7238	7636 /e
Growth rate (%) (na.c)	7.94	3.20	7.36	5.10	5.50 /e
Per capita (in 1980-dollars) (na.c)	173.0	199.1	168.7	173.7	179.4 /e
MVA (na.c) (in million 1980-dollars)	558	722	674	721	755 /e
Growth rate (%) (na.c)	7.46	2.14	12.40	7.00	4.73 /e
Manufacturing share (%) (na,current prices)	9.5	9.9	7.4		

NAMIBIA	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	2007	1871	2034	2156	2194 /e
Growth rate (%) (na.c)	0.18	0.00	0.20	6.00	1.74 /e
Per capita (in 1980-dollars) (na.c)	1535.6	1232.0	1178.6	1210.0	1133.1 /e
MVA (na.c) (in million 1980-dollars)	79	83	87	92	
Growth rate (%) (na.c)	-14.65	-3.54	3.64	5.91	
Manufacturing share (%) (na,current prices)	4.0	4.3			

NEPAL	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	1946	2471	2957	3016	3140
Growth rate (%) (na.c)	-2.32	6.15	2.30	2.00	4.10
Per capita (in 1980-dollars) (na.c)	131.0	146.1	158.2	157.4	159.8 /e
MVA (na.c) (in million 1980-dollars)	83	108	110	110	114 /e
Growth rate (%) (na.c)	-8.24	-9.86	-4.41	0.49	3.08 /e
Manufacturing share (%) (na,current prices)	4.0	4.5	5.5		

NETHERLANDS ANTILLES AND ARUBA	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	866	829	938	1003	1022 /e
Growth rate (%) (na.c)	4.06	-2.07	1.54	6.99	1.86 /e
Per capita (in 1980-dollars) (na.c)	4947.6	4555.5	5014.1	5336.2	5160.8 /e
MVA (na.c) (in million 1980-dollars)	75	73	80	81	83 /e
Growth rate (%) (na.c)	4.68	3.03	1.30	1.93	2.46 /e
Manufacturing share (%) (na,current prices)					

NEW CALEDONIA	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	1182	1172	1832	2075	2490 /e
Growth rate (%) (na.c)	-0.40	4.51	10.95	13.26	19.96 /e
Per capita (in 1980-dollars) (na.c)	8446.1	7663.3	11104.9	12353.2	14731.5 /e
MVA (na.c) (in million 1980-dollars)	68	70	81	84	84 /e
Growth rate (%) (na.c)	2.07	2.29	2.16	3.69	-0.91 /e
Manufacturing share (%) (na,current prices)	5.8	4.7			

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

NIGER	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	2538	2473	2567	2639	2660 /e
Growth rate (%) (na.c)	4.90	5.70	-3.51	2.80	0.78 /e
Per capita (in 1980-dollars) (na.c)	454.3	374.1	342.7	341.5	363.7 /e
MVA (na.c) (in million 1980-dollars)	99	106	101	103	104 /e
Growth rate (%) (na.c)	4.68	8.25	0.00	1.70	1.51 /e
Manufacturing share (%) (na,current prices)	3.7	7.1			

OMAN	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	5896	11343	13503	15407	16177 /e
Growth rate (%) (na.c)	12.15	8.89	7.96	14.10	5.00 /e
Per capita (in 1980-dollars) (na.c)	5991.6	9125.4	9325.0	10243.7	10593.9 /e
MVA (na.c) (in million 1980-dollars)	45	240	276	298	
Growth rate (%) (na.c)	19.05	20.39	-11.35	8.04	
Manufacturing share (%) (na,current prices)	0.8	2.4			

PAPUA NEW GUINEA	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	2549	2739	2963	2919	3190 /e
Growth rate (%) (na.c)	-1.91	4.31	-1.77	-1.50	9.30 /e
Per capita (in 1980-dollars) (na.c)	825.9	791.2	782.3	753.5	805.0 /e
MVA (na.c) (in million 1980-dollars)	252	279	303	309	331 /e
Growth rate (%) (na.c)	-3.02	2.80	11.61	1.82	7.24 /e
Manufacturing share (%) (na,current prices)	10.4	10.9			

PUERTO RICO	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	15956	18279	22085	22593	23028 /e
Growth rate (%) (na.c)	1.07	7.38	3.60	2.30	1.93 /e
Per capita (in 1980-dollars) (na.c)	4975.3	5567.8	6421.8	6492.1	6597.4 /e
MVA (na.c) (in million 1980-dollars)	5793	6552	7812	7971	8196 /e
Growth rate (%) (na.c)	1.04	2.69	4.09	2.04	2.82 /e
Manufacturing share (%) (na,current prices)	36.8	39.0	39.2		

QATAR	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	7838	6342	6862	7583	7848
Growth rate (%) (na.c)	7.10	-3.91	10.58	10.50	3.50
Per capita (in 1980-dollars) (na.c)	34077.6	21211.1	19385.3	20550.1	21740.7 /e
MVA (na.c) (in million 1980-dollars)	259	390	523	573	624 /e
Growth rate (%) (na.c)	11.20	3.64	10.59	9.54	8.79 /e
Manufacturing share (%) (na,current prices)	3.3	7.9			

REUNION	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	1999	2455	2892	3008	3123 /e
Growth rate (%) (na.c)	4.20	3.49	3.30	4.00	3.83 /e
Per capita (in 1980-dollars) (na.c)	3927.7	4488.9	4910.4	5013.2	5261.2 /e
MVA (na.c) (in million 1980-dollars)	206	236	265	289	302 /e
Growth rate (%) (na.c)	0.85	3.36	3.00	8.90	4.45 /e
Manufacturing share (%) (na,current prices)	9.9	8.4			

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

RWANDA	1980	1985	1989	1990	1991
GDP (nat.c.) in million 1980-dollars	1163	1347	1388	1365	1337 e
Growth rate (%) (nat.c.)	6.21	4.41	-4.68	-1.65	-2.00 e
Per capita (in 1980-dollars) (nat.c.)	225.2	220.7	198.4	188.6	179.0 e
MVA (nat.c.) in million 1980-dollars	164	210	252	242	
Growth rate (%) (nat.c.)	12.30	6.96	-1.82	-4.00	
Manufacturing share (%) (na,current prices)	15.3	13.7			

SAMOA	1980	1985	1989	1990	1991
GDP (nat.c.) in million 1980-dollars	112	109	111	106	103 e
Growth rate (%) (nat.c.)	3.00	6.04	1.29	-4.52	-2.32 e
Per capita (in 1980-dollars) (nat.c.)	718.4	568.2	660.0	626.5	
MVA (nat.c.) in million 1980-dollars	15	16	16	16	16 e
Growth rate (%) (nat.c.)	-5.08	10.22	1.34	-2.78	2.11 e
Manufacturing share (%) (na,current prices)	4.1	12.7			

SAO TOME AND PRINCIPE	1980	1985	1989	1990	1991
GDP (nat.c.) in million 1980-dollars	47	33	38	39	39 e
Growth rate (%) (nat.c.)	2.53	-5.01	2.49	3.81	0.60 e
Per capita (in 1980-dollars) (nat.c.)	497.2	311.0	320.5	324.5	318.4 e
MVA (nat.c.) in million 1980-dollars	4	3	4	4	4 e
Growth rate (%) (nat.c.)	0.00	-8.74	0.97	3.27	1.17 e
Manufacturing share (%) (na,current prices)	7.3	7.2			

SEYCHELLES	1980	1985	1989	1990	1991
GDP (nat.c.) in million 1980-dollars	147	156	177	187	190 e
Growth rate (%) (nat.c.)	-2.55	10.70	5.74	5.90	1.66 e
Per capita (in 1980-dollars) (nat.c.)	2302.4	2362.1	2561.1	2673.4	
MVA (nat.c.) in million 1980-dollars	12	13	18	20	21 e
Growth rate (%) (nat.c.)	16.21	3.44	3.42	5.81	8.21 e
Manufacturing share (%) (na,current prices)	7.4	9.7			

SIERRA LEONE	1980	1985	1989	1990	1991
GDP (nat.c.) in million 1980-dollars	758	828	862	898	916 e
Growth rate (%) (nat.c.)	3.00	3.53	4.30	4.10	2.05 e
Per capita (in 1980-dollars) (nat.c.)	232.1	226.0	213.2	216.5	215.5 e
MVA (nat.c.) in million 1980-dollars	57	56	47	48	49 e
Growth rate (%) (nat.c.)	5.57	-13.93	10.00	2.40	1.26 e
Manufacturing share (%) (na,current prices)	7.3	4.8			

SOMALIA	1980	1985	1989	1990	1991
GDP (nat.c.) in million 1980-dollars	2755	3536	4056	3947	3829 e
Growth rate (%) (nat.c.)	2.45	1.93	2.52	2.67	3.00 e
Per capita (in 1980-dollars) (nat.c.)	515.3	564.4	556.6	523.9	484.3 e
MVA (nat.c.) in million 1980-dollars	131	139	145	145	
Growth rate (%) (nat.c.)	3.17	1.55	5.19	0.00	
Manufacturing share (%) (na,current prices)	4.5	4.7			

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

SUDAN	1980	1985	1989	1990	1991
GDP (na.c) in million 1980-dollars	7807	8209	9363	8817	89[illegible] e
Growth rate (na.c)	-3.41	-6.28	7.39	-5.83	1.13 e
Per capita in 1980-dollars (na.c)	417.9	367.0	382.3	349.8	343.2 e
MVA (na.c) in million 1980-dollars	717	926	1053	1069	1075 e
Growth rate (na.c)	-7.69	4.53	0.17	1.46	0.53 e
Manufacturing share (%) (na,current prices)	8.6	8.9	7.5		

SURINAME	1980	1985	1989	1990	1991
GDP (na.c) in million 1980-dollars	891	879	934	911	928 e
Growth rate (na.c)	-8.57	2.02	4.98	-2.50	1.92 e
Per capita in 1980-dollars (na.c)	2522.9	2294.3	2256.5	2158.3	2288.1 e
MVA (na.c) in million 1980-dollars	165	132	127	122	120 e
Growth rate (na.c)	-10.52	6.45	3.86	-3.72	-1.73 e
Manufacturing share (%) (na,current prices)	15.7	11.8			

SWAZILAND	1980	1985	1989	1990	1991
GDP (na.c) in million 1980-dollars	543	637	799	836	863 e
Growth rate (na.c)	3.28	2.35	4.10	4.60	3.24 e
Per capita in 1980-dollars (na.c)	363.7	959.4	1048.4	1059.1	1051.4 e
MVA (na.c) in million 1980-dollars	119	138	185	199	211 e
Growth rate (na.c)	11.17	-1.28	-4.93	7.70	6.09 e
Manufacturing share (%) (na,current prices)	18.9	14.3			

TOGO	1980	1985	1989	1990	1991
GDP (na.c) in million 1980-dollars	1131	1056	1263	1317	1291 e
Growth rate (na.c)	-4.53	2.00	4.50	4.30	-2.00 e
Per capita in 1980-dollars (na.c)	432.2	348.8	369.0	373.3	361.8 e
MVA (na.c) in million 1980-dollars	98	97	110	113	111 e
Growth rate (na.c)	-3.19	3.28	2.10	2.79	-1.92 e
Manufacturing share (%) (na,current prices)	7.0	6.7			

TONGA	1980	1985	1989	1990	1991
GDP (na.c) in million 1980-dollars	60	90	39	100	104 e
Growth rate (na.c)	15.81	5.37	3.31	0.80	3.74 e
Per capita in 1980-dollars (na.c)	614.8	938.4	1044.2	1152.5	
MVA (na.c) in million 1980-dollars	4	4	4	5	5 e
Growth rate (na.c)	21.46	6.27	3.17	2.98	7.51 e
Manufacturing share (%) (na,current prices)	6.1	8.2			

TUVALU	1980	1985	1989	1990	1991
GDP (na.c) in million 1980-dollars	4				
Growth rate (na.c)					
Per capita in 1980-dollars (na.c)	525.0				
MVA (na.c) in million 1980-dollars					
Growth rate (na.c)					
Manufacturing share (%) (na,current prices)					

For sources, footnotes and comments see 'Technical notes' at the beginning of this Annex

UGANDA	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	2644	2787	3245	3430	3485 /e
Growth rate (%) (na.c)	-3.40	-5.50	6.56	5.70	1.60 /e
Per capita (in 1980-dollars) (na.c)	201.5	178.1	179.2	182.7	182.6 /e
MVA (na.c) (in million 1980-dollars)	109	110	177	200	206 /e
Growth rate (%) (na.c)	6.10	-9.80	18.53	13.45	2.78 /e
Manufacturing share (%) (na,current prices)	4.2	2.2	3.9	4.1	

UNITED ARAB EMIRATES	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	29629	27036	24637	27594	29663
Growth rate (%) (na.c)	26.42	-2.39	11.17	12.00	7.50
Per capita (in 1980-dollars) (na.c)	29162.0	20026.8	15925.8	17246.1	17836.1 /e
MVA (na.c) (in million 1980-dollars)	1114	2510	2156	2389	2630 /e
Growth rate (%) (na.c)	64.87	-2.20	3.95	10.81	10.10 /e
Manufacturing share (%) (na,current prices)	3.8	9.3			

VANUATU	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	113	171	177	185	191 /e
Growth rate (%) (na.c)	-11.46	1.18	4.50	4.70	3.38 /e
Per capita (in 1980-dollars) (na.c)	961.3	1248.2	1147.4	1163.5	1127.6 /e
MVA (na.c) (in million 1980-dollars)	3	7	11	12	13 /e
Growth rate (%) (na.c)	13.98	11.23	10.57	1.94	13.37 /e
Manufacturing share (%) (na,current prices)	4.2	3.8			

VIET NAM	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	5630	7791	9120	9338	9693 /e
Growth rate (%) (na.c)	-4.81	6.20	5.50	2.40	3.80 /e
Per capita (in 1980-dollars) (na.c)	104.8	130.1	139.8	140.1	141.1 /e
MVA (na.c) (in million 1980-dollars)					
Growth rate (%) (na.c)					
Manufacturing share (%) (na,current prices)					

YEMEN, NORTHERN PART	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	2779	3692	5087	5433	5868
Growth rate (%) (na.c)	6.04	10.31	4.30	6.80	8.00
Per capita (in 1980-dollars) (na.c)	437.1	484.4	574.4	590.8	619.5 /e
MVA (na.c) (in million 1980-dollars)	185	341	408	420	460 /e
Growth rate (%) (na.c)	7.70	1.45	3.19	2.99	9.51 /e
Manufacturing share (%) (na,current prices)	7.6	11.2			

YEMEN, SOUTHERN PART	1980	1985	1989	1990	1991
GDP (na.c) (in million 1980-dollars)	666	892	859	918	966 /e
Growth rate (%) (na.c)	14.78	-2.97	2.00	6.79	5.29 /e
Per capita (in 1980-dollars) (na.c)	359.0	417.2	355.9	368.6	352.2 /e
MVA (na.c) (in million 1980-dollars)	34	62	63	64	67 /e
Growth rate (%) (na.c)	-41.12	22.43	1.97	1.85	3.84 /e
Manufacturing share (%) (na,current prices)	5.3	7.6			

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex