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INDUSTRY AND DEVELOPMENT

GLOBAL REPORT 1989/90

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna, 1989

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Preface

In 1988, world industry grew at a faster rate than in 1987. This upward trend had been foreseen in *Global Report 1988/89* even though the prevailing opinion at the time was that the economy would slow down. That acceleration, although welcome, was unevenly distributed among the various regions, and the developing economies grew at a slower rate than the developed economies. Indeed, current signs clearly point to a slow-down in 1989 and little movement in 1990. Fears of inflation may well lead to an even more severe recession unless care is taken to move the global economy forward in an internationally co-ordinated fashion.

To that end, the United Nations system is drawing up a new international development strategy for the coming decade, the Fourth United Nations Development Decade. In the 1980s, the Third Development Decade, economic performance in all regions was disappointing. Despite a continued upswing for six years, growth performance was moderate compared to the 1950s and the 1960s. The universal optimism of the mid-1970s when the Lima target was adopted seems a far cry from today. By 1988, developing countries had attained a share of only 13.8 per cent in world industrial output, and, if current policies continue, they will probably only achieve a share of 17 per cent by 2000.

Given this failure to achieve economic targets, many people are advocating the relegation of industrial development from its place as the primary objective of international co-operation. Indeed, some people maintain that economic development has failed to fulfil its promise of enhanced individual freedom and improved quality of life for the masses in developing countries. Whereas mistakes have been made in the name of economic development and industrialization, it cannot be claimed that Europe fared much better. Even today, after more than a century of growth, abolition of poverty still ranks high on the agenda of developed countries. It would come as no surprise, therefore, were the new international development strategy to emphasize the qualitative and quantitative aspects of economic development and focus on the "human dimension" of development as its overall theme. This will serve as a reminder that industrialization offers a means of achieving other social and economic goals, while human resource development in the form of expanded primary education, improved health care, shelter, sanitation and food, along with improved development strategies that ensure expanded employment opportunities, represents both the basic objective and a means of achieving those goals.

The human condition in the South is in disarray. This is not attributable to over-industrialization, but to the low and slow growth in recent years. This holds especially true of those regions that are victims of high real interest rates, mounting debt service charges and reverse flows of capital from the South to the North. In addition to being inadequate to achieving the modest target set for the end of the century, industrial growth is also very unevenly distributed throughout the South.

As I embark on my second term of office, I am doubly conscious that UNIDO has the challenging task of proposing bold but practical solutions to the urgent needs of the next development decade. Ever since its first issue in 1985, the Global Report has studied the need for a more effective strategy for South-South co-operation. In *Global Report 1989/90*, a strategy for South-South co-operation is outlined. In designing this strategy, UNIDO has drawn on world industry's experience of markets. The globalization of industry and the emergence of an international division of labour with the dispersal and integration of manufacturing provide lessons for the burgeoning industrial economies of the South. As they pool their markets and co-ordinate their production capacities by outsourcing components and parts, the economies in the South, especially those with weak industries, can seize valuable opportunities for technological learning and acquiring manufacturing know-how. In keeping with normal practice in UNIDO, this strategy has been drawn up on the basis of a detailed and concrete examination of facts. I trust it will be found useful in furthering industrialization and moving us more firmly towards the Lima target.

DOMINGO L. SIAZON, Jr.

Director-General

ان الانسان في الجنوب في حالة من الفوضى . ولايعزى هذا الى الإفراط في التصنيع بل الى انخفاض درجة النمو وبطئه في الجنوب في السنوات الأخيرة . ويصدق هذا بصفة خاصة على المناطق التي تعاني من ارتفاع أسعار الفائدة الحقيقية ، وتصاعد أعباء خدمة الديون ، واتجاه تدفق رؤوس الأموال المعكوس من الجنوب الى الشمال . واذا كان النمو الصناعي غير كاف لبلوغ الهدف المتواضع المقرر تحقيقه في نهاية القرن ، فانه أيضا ، بالاضافة الى ذلك ، موزع توزيعا غير متكافئ للغاية في الجنوب .

إني أدرك تماما ، وأنا في مستهل فترتي الثانية في منصبي ، أن على اليونيدو مهمة صعبة هي اقتراح حلول جريئة ، ولكن عملية ، للاحتياجات الملحة التي يتصدى لها عقد التنمية الثالث . وقد تناول التقرير العالمي ، منذ صدور عدده الأول في عام ١٩٨٥ ، الحاجة الى استراتيجية أكثر فعالية للتعاون فيما بين بلدان الجنوب . ويحتوي التقرير العالمي ١٩٩٠/٨٩ على الخطوط الرئيسية لاستراتيجية للتعاون فيما بين بلدان الجنوب . وقد استفادت اليونيدو ، لدى صياغة هذه الاستراتيجية ، من خبرة الصناعة العالمية في مجال الأسواق . ذلك ان الانتشار العالمي للصناعة وظهور تقسيم دولي للعمل مع تشتت التصنيع وتكامله يشكّلان معينا من العبر التي يمكن أن تستفيد منها الاقتصادات الصناعية الناشئة في بلدان الجنوب . وبإمكان اقتصادات بلدان الجنوب ، وخاصة الاقتصادات ذات الصناعات الضعيفة ، وهي بصدد تجميع أسواقها وتنسيق قدراتها الانتاجية بالحصول على المكونات وأجزاء المنتجات من مصادر خارجية ، أن تنتهز فرصا قيمة لتعلّم التكنولوجيا واكتساب الدراية التصنيعية . وعملا بما درج عليه العمل عادة في اليونيدو ، أعدت هذه الاستراتيجية على أساس فحص الوقائع بصورة تفصيلية وملموسة . واني لواثق من انه ستثبت فائدته في تعزيز التصنيع والسير بنا قدما بثبات نحو تحقيق هدف ليما .

دومينغو ل. سيازون ، الابن

المدير العام

تصدير

نمت الصناعة العالمية في عام ١٩٨٨ بمعدل أسرع مما فعلت في عام ١٩٨٧ . وقد كان هذا الاتجاه الصعودي متوقعا في التقرير العالمي ١٩٨٩/٨٨ ، برغم أن الرأي السائد آنذاك كان أن عجلة الاقتصاد ستبطئ في سيرها . ومع أن هذا الإسراع موضع ترحيب ، فانه كان موزعا توزيعا غير متكافئ بين المناطق المختلفة ، فنمت الاقتصادات النامية بمعدل أبطأ من معدل نمو الاقتصادات المتطورة . بل ان البوادر الراهنة تشير بوضوح الى إبطاء سير عجلة الاقتصاد في عام ١٩٨٩ والى حركة طفيفة فيها في عام ١٩٩٠ . ومن الممكن جدا أن تفضي المخاوف من التضخم الى كساد أشد وطأة مالم يول الاهتمام لدفع الاقتصاد العالمي الى الأمام بصورة منسقة على الصعيد الدولي .

وتوخيا لهذه الغاية تقوم منظومة الأمم المتحدة بصياغة استراتيجية انمائية دولية جديدة للعقد القادم ، عقد الأمم المتحدة الانمائي الرابع . لقد كان الأداء الاقتصادي في كل المناطق مخيبا للآمال أثناء العقد الانمائي الثالث في الثمانينات . وبرغم اطّراد تصاعد النمو على مدى ست سنوات ، كان معدله معتدلا بالقياس الى الخمسينات والستينات . ويبدو البون شاسعا بين التفاول العالمي الذي كان سائدا في منتصف السبعينات عند اعتماد هدف ليما والحالة اليوم . فبحلول عام ١٩٨٨ بلغت حصة البلدان النامية ١٣٫٨ في المائة فقط من الانتاج الصناعي العالمي ، واذا استمرت السياسات الراهنة سائدة فالمرجح أنها لن تنتج إلا حصة قدرها ١٧ في المائة منه في عام ٢٠٠٠ .

وإزاء هذا الفشل في بلوغ الأهداف الاقتصادية ، يدعو الكثيرون الى إزاحة التنمية الصناعية من مكانتها بوصفها الهدف الأساسي للتعاون الدولي . بل ان البعض يقولون ان التنمية الاقتصادية لم تف بما وعدت به من تعزيز حرية الفرد وتحسين نوعية الحياة بالنسبة لجماهير البلدان النامية . وفي حين حدثت أخطاء باسم التنمية الاقتصادية والتصنيع،لايمكن الإدعاء بأن أوروبا كانت أحسن حالا بكثير . فحتى اليوم ، بعد أكثر من قرن من النمو ، مازال القضاء على الفقر من أهم النقاط في جدول أعمال البلدان المتقدمة النمو . ولذا لن يثير الدهشة أن تبرز الاستراتيجية الانمائية الدولية الجديدة الجانبين النوعي والكمي للتنمية الاقتصادية وتركز على " البعد الانساني " للتنمية بوصفه مدار بحثها الشامل . وسيكون هذا بمثابة تذكرة بأن التصنيع يهيئ وسيلة لتحقيق أهداف اجتماعية واقتصادية أخرى ، في حين أن تنمية الموارد البشرية في صورة التوسع في التعليم الابتدائي وتحسين الرعاية الصحية والمأوى والمرافق الصحية والغذاء ، الى جانب تحسين الاستراتيجيات الانمائية التي تكفل توسيع فرص العمالة ، تمثل الهدف الأساسي ووسيلة لبلوغ تلك الغايات في آن معا .

前 言

1988年世界工业发展速度超过了1987年。《1988/89年全球报告》已预见到这一上升趋势，尽管当时大多数人认为，经济发展速度会减慢。虽然这种发展是喜人的，但在各个地区却并不平衡。发展中国家经济的发展速度低于发达国家经济的发展速度。而且，目前的迹象已清楚表明，1989年的发展速度将会减慢，1990年也不会有什么进展。对通货膨胀的恐惧很可能导致更严重的经济衰退，除非采取谨慎措施，使全球经济以一种国际协调的方式向前发展。

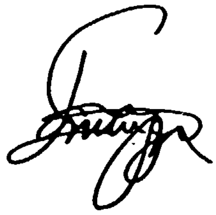
为此目的，联合国系统正在为未来的十年制定新的国际发展战略，即联合国第四个发展十年。在八十年代这一第三个发展十年中，各个地区的经济情况都是令人失望的。尽管经济连续六年向上发展，但与五十年代和六十年代相比，增长情况平平。七十年代中期利马目标通过时显示出的普遍乐观已成为遥远的过去。1988年，发展中国家在世界工业生产中所占的比重仅为13.8%，而且，如果目前的政策持续下去，到2000年时也许也只能达到17%。

由于未能达到经济目标，许多人现在主张把工业发展从其作为国际合作的主要目标的地位降级。而且，有些人还认为，经济发展未能实现其所作出的使发展中国家的广大民众增加个人自由和改善生活质量的承诺。经济发展和工业化虽然有些失误，但并不能说欧洲的情况就好得多。即使在经历了一个多世纪的增长之后的今天，消除贫困仍然是发达国家议程上的主要问题。因此，如果新的国际发展战略强调经济发展的质量和数量因素并着重以发展的"人的方面"作为其总的主题，这是不足为奇的。这可以提醒人们，工业化提供了一个实现其他社会和经济目标的手段，而以初级教育的扩大、医疗保健、住房、卫生和粮食状况改善的形式体现的人力资源的发展，再加上确保就业机会增加的发展战略的改进则既是基本的目标，也是实现这些目标的手段。

南方的人民的情况很糟。这并不能归咎于过分的工业化，而应归咎于近几年的低速和慢速增长。那些遭受实际高利率、不断上升的偿债费用和资本从南向北的反向流动打击的地区的情况尤其如此。除了未能充分实现为本世纪末所制定的并不宏伟的目标外，工业发展的速度在整个南方也十分不均匀。

在我开始我的第二个任期的时刻，我更加清楚地认识到工发组织肩负着富有挑战性的任务，这就是为下一个十年的迫切需要提出大胆而实际的解决办法。《全球报告》自从出版第一期以来就对需要为南南合作制定一个更有效的战略的问题进行着研究。《1989/90年全球报告》概述了一项南南合作战略。工发组织在制定这一战略时汲取了世界工业的市场经验。工业的全球化、国际分工的出现以及制造业的分散和联合的过程，为南方新兴的工业经济提供了教训。南方的经济、特别是工业力量较弱的经济如果能将其市场集中起来，并通过相互提供组件

和零部件协调其生产能力，就可以得到种种学习技术和获得制造方面的专门知识的宝贵机会。 根据工发组织的通常做法，这一战略是在对事实的详尽而具体的分析研究的基础上制定的。 我相信，人们将会看到，这一战略在推进工业化并使我们更坚定地向利马目标迈进方面是大有裨益的。



总　干　事

小多明哥·L·夏松

Préface

En 1988, l'industrie mondiale a progressé plus vite qu'en 1987, comme on le prévoyait dans la livraison de 1988/89 du rapport *Industrie et développement dans le monde*, alors que l'opinion générale à l'époque était qu'il y aurait ralentissement de l'économie. Cette accélération, dont il faut se féliciter, a malheureusement été répartie inégalement entre les diverses régions, et les économies des pays en développement ont crû plus lentement que celles des pays développés. En fait, certains indices montrent clairement un ralentissement en 1989 et un quasi-immobilisme en 1990. La crainte de l'inflation risque de provoquer une récession encore plus grave, à moins qu'on ne veille à faire progresser l'économie mondiale de façon coordonnée à l'échelon international.

A cette fin, le système des Nations Unies établit une nouvelle stratégie internationale de développement pour la décennie à venir, qui sera la quatrième Décennie des Nations Unies pour le développement. Depuis le début de la troisième décennie pour le développement en 1980, les résultats obtenus dans toutes les régions sur le plan économique ont été décevants. Bien qu'il y ait eu progression constante pendant six ans, la croissance a été modérée par rapport à celle des années 50 et 60. L'optimisme universel qui régnait en 1975, lorsque l'objectif de Lima a été adopté, semble bien loin aujourd'hui. En 1988, la part des pays en développement dans la production industrielle mondiale n'atteignait encore que 13,8 % et si les politiques actuelles se poursuivent, elle ne sera passée qu'à 17 % d'ici à l'an 2000.

Etant donné que les objectifs économiques n'ont pas été atteints, nombreux sont ceux qui préconisent de ne plus faire du développement industriel le principal objectif de la coopération internationale. En fait, certains soutiennent que le développement économique n'a pas tenu ses promesses et n'a pas signifié une liberté individuelle accrue et une qualité de vie améliorée pour les masses des pays en développement. Si des erreurs ont été commises au nom du développement économique et de l'industrialisation, on ne peut pas dire que la situation de l'Europe soit bien meilleure. Même aujourd'hui, après plus d'un siècle de croissance, l'abolition de la pauvreté est encore en bonne place à l'ordre du jour des pays développés. Nul ne serait donc surpris si la nouvelle stratégie internationale du développement mettait l'accent sur les aspects qualitatif et quantitatif du développement économique et avait pour thème général la dimension humaine du développement. Cela contribue à nous rappeler que l'industrialisation permet d'atteindre d'autres buts sociaux et économiques tandis que la mise en valeur des ressources humaines que représentent un enseignement primaire élargi, de meilleurs soins de santé et conditions de logement, une meilleure hygiène et une meilleure alimentation, ainsi que des stratégies de développement mieux conçues qui assurent des possibilités d'emploi plus nombreuses, représente à la fois l'objectif de base et le moyen d'atteindre ces buts.

La condition humaine dans l'hémisphère Sud n'est guère brillante. Cela n'est pas imputable à un excès d'industrialisation mais à la croissance faible et lente de ces dernières années, surtout dans les régions qui souffrent de taux d'intérêt réels élevés, d'un service de la dette de plus en plus lourd et du renvoi des capitaux du Sud vers le Nord. Outre qu'elle est insuffisante pour atteindre l'objectif modeste fixé pour la fin du siècle, la croissance industrielle est très inégalement répartie dans le Sud.

Alors que j'entame mon deuxième mandat, je ne suis que trop conscient de la difficulté de la tâche devant laquelle est placée l'ONUDI et qui consiste à proposer des solutions hardies mais pratiques aux besoins urgents de la prochaine décennie du développement. Dès sa première livraison en 1985, le *Rapport* a traité la question de la stratégie de coopération Sud-Sud plus efficace qui est nécessaire. La livraison de 1989/90 présente une stratégie de coopération Sud-Sud. Pour la mettre au point, l'ONUDI a fait appel à l'expérience des marchés de l'industrie mondiale. Il faut que les économies industrielles du Sud qui commencent à prendre leur essor tirent une leçon de la mondialisation de l'industrie et de l'apparition d'une division internationale du travail, avec la dispersion et l'intégration des activités manufacturières. Fusionner leurs marchés et coordonner leurs capacités de production en achetant à l'extérieur des composants et des pièces détachées permettra, en effet, aux économies du Sud, surtout à celles ayant des industries faibles, d'apprendre de nouvelles techniques et d'acquérir le savoir-faire nécessaire pour leurs industries manufacturières. Selon sa coutume, l'ONUDI a établi cette stratégie en se fondant sur un examen détaillé et concret des faits. Je suis sûr que cette stratégie aidera à promouvoir l'industrialisation et à nous faire progresser fermement vers l'objectif adopté à Lima.

Le Directeur général,

DOMINGO L. SIAZON Jr

Предисловие

В 1988 году темпы роста мирового промышленного производства были более высокими, чем в 1987 году. Такая тенденция к повышению прогнозировалась в „Глобальном докладе за 1988—1989 годы", хотя в тот момент господствовало мнение, что темпы роста экономики снизятся. Хотя такое ускорение является положительным явлением, оно неравномерно для различных регионов: рост в развивающихся странах отставал от роста в развитых странах. Кроме того, последние признаки четко указывают на замедление темпов в 1989 году и незначительное увеличение в 1990 году. Опасения в отношении усиления инфляции могут привести к еще большему спаду, если не будут приняты меры, которые обеспечат согласованное в международном масштабе продвижение глобальной экономики вперед.

С этой целью система Организации Объединенных Наций разрабатывает новую международную стратегию развития на предстоящее десятилетие — четвертое Десятилетие развития Организации Объединенных Наций. В 80-х годах, в период третьего Десятилетия развития, показатели развития экономики во всех регионах были разочаровывающими. Несмотря на непрерывный подъем в течение шести лет динамика роста была умеренной по сравнению с 50-ми и 60-ми годами. Всеобщий оптимизм 70-х годов, когда были приняты Лимские целевые показатели, отнюдь не разделяется в настоящее время. К 1988 году развивающиеся страны смогли увеличить свою долю в мировом промышленном производстве лишь до 13,8 процента, и если нынешняя политика будет проводиться и впредь, то к 2000 году эта доля, вероятно, достигнет лишь 17 процентов.

Ввиду недостижения намеченных экономических показателей многие выступают за то, чтобы отказаться от промышленного развития как основной цели международного сотрудничества. Так, некоторые утверждают, что экономическое развитие не обеспечило обещанное расширение свободы личности и не повысило качество жизни масс населения развивающихся стран. Хотя в процессе экономического развития и индустриализации, возможно, были допущены ошибки, нельзя утверждать, что в Европе состояние дел оказалось намного лучшим. Даже сегодня, после более чем столетия роста, ликвидация бедности по-прежнему является одной из актуальных проблем развитых стран. Неудивительно поэтому если в новой международной стратегии развития основное внимание будет уделено количественным и качественным аспектам экономического развития, а его общей темой станут в первую очередь „человеческие аспекты" развития. Это должно напомнить, что индустриализация обеспечивает средства для достижения других социально-экономических целей, в то время как развитие людских ресурсов в виде расширения начального образования, совершенствования здравоохранения, обеспечения жильем, санитарно-гигиеническими услугами и продовольствием, а также более эффективные стратегии развития, гарантирующие создание новых рабочих мест, представляют собой одновременно основную цель и средство для достижения этих целей.

Условия жизни людей в странах Юга весьма неблагоприятны. Это вызвано не сверхиндустриализацией, а низким и медленным ростом в последние годы. Это в первую очередь справедливо для тех регионов, которые стали жертвами высоких реальных процентных ставок, растущих выплат для покрытия задолженности и обратного потока капитала с Юга на Север. Помимо того, что промышленный рост оказался недостаточным для достижения скромных целей, поставленных до конца столетия, его распределение в странах Юга было к тому же исключительно неравномерным.

Приступая к исполнению своих полномочий в течение второго срока пребывания на своем посту, я как никогда ранее осознаю, что перед ЮНИДО стоит ответственная задача предложить смелые и одновременно реалистичные решения актуальных проблем следующего десятилетия развития. Еще с момента подготовки в 1985 году первого „Глобального доклада", в нем рассматривалась необходимость более эффективной стратегии сотрудничества Юг-Юг. В „Глобальном докладе за 1989—1990 годы" излагается стратегия сотрудничества Юг-Юг. При разработке такой стратегии ЮНИДО опиралась на опыт функционирования мировых промышленных рынков. Глобализация промышленности и возникновение международного разделения труда, предусматривающего рассредоточение и интеграцию обрабатывающих производств, дает уроки для динамично развивающихся индустриальных стран Юга. В результате объединения ими своих рынков и координации своих производственных потенциалов на основе использования внешних источников комплектующих частей и изделий страны Юга, прежде всего страны со слаборазвитой промышленностью, могли бы использовать ценные возможности для получения научно-технических знаний и приобретения ноу-хау в обрабатывающей промышленности. В соответствии с обычной практикой ЮНИДО эта стратегия была разработана на основе детального и конкретного рассмотрения фактов. Я уверен, что она окажется полезной для содействия индустриализации и более реального приближения нас к целевым заданиям, которые были поставлены в Лиме.

ДОМИНГО Л. СИАЗОН, МЛ.,
Генеральный директор

Prefacio

En 1988, la industria mundial creció más rápidamente que en 1987. Esta tendencia positiva había sido prevista en el *Informe Mundial 1988/1989* aunque la opinión predominante en esos momentos indicaba que el ritmo de la expansión económica decrecería. Esa aceleración, por otra parte bien venida, se distribuyó desigualmente entre las diversas regiones, y las economías en desarrollo crecieron más lentamente que las desarrolladas. En realidad, actualmente los indicios sugieren de manera clara un crecimiento más lento en 1989 y escasos cambios en 1990. Los temores de inflación pueden muy bien conducir a una recesión aun más severa, a menos que se ponga cuidado en hacer adelantar la economía mundial de manera internacionalmente coordinada.

Con ese fin, el sistema de las Naciones Unidas está redactando una nueva estrategia internacional del desarrollo para el próximo decenio, el Cuarto Decenio de las Naciones Unidas para el Desarrollo. En los años 80, Tercer Decenio para el Desarrollo, el desempeño de la economía fue decepcionante en todas las regiones. A pesar de un ascenso continuo durante seis años, el crecimiento conseguido fue moderado en comparación con los años 50 y 60. El optimismo universal a mediados de los años 70, cuando se adoptó la meta de Lima, parece algo muy lejano desde la perspectiva de hoy. Para 1988, los países en desarrollo habían alcanzado una participación de sólo el 13,8% en el producto industrial mundial y, si siguen aplicándose las actuales políticas, probablemente sólo alcanzarán una participación del 17% para el año 2000.

Dado este fracaso en lograr las metas económicas, muchos abogan actualmente porque se relegue el desarrollo industrial de su posición como objetivo primordial de la cooperación internacional. Algunos, incluso, sostienen que el desarrollo económico no ha podido cumplir su promesa de una mayor libertad individual y una mejor calidad de vida para las masas de los países en desarrollo. Aunque se han cometido errores en nombre del desarrollo económico y la industrialización, no puede alegarse que a Europa le haya ido mucho mejor. Incluso hoy en día, después de más de un siglo de crecimiento, la abolición de la pobreza continúa ocupando un lugar bien alto en la lista de tareas de los países desarrollados. No sorprenderá, pues, que la nueva estrategia internacional del desarrollo haga hincapié en los aspectos cualitativos y cuantitativos del desarrollo económico y se centre en la "dimensión humana" del desarrollo como tema global. Ello servirá como recordatorio de que la industrialización constituye un medio para conseguir otros objetivos sociales y económicos, mientras que el perfeccionamiento de los recursos humanos en forma de una educación primaria extendida y el mejoramiento de la atención sanitaria, la vivienda, las instalaciones sanitarias y la alimentación, junto con estrategias de desarrollo perfeccionadas que aseguren mayores oportunidades de empleo, representa el objetivo básico y el medio para alcanzar esas metas.

La situación humana en el Sur está desquiciada. No cabe atribuirlo a la hiperindustrialización, sino al escaso y lento crecimiento en los últimos años. Esto es especialmente cierto en las regiones que son víctimas de elevados tipos reales de interés, crecientes cargas de servicio de la deuda y corrientes inversas de capital del Sur al Norte. Además de insuficiente para alcanzar el modesto objetivo fijado para fines del siglo, el crecimiento industrial está muy desigualmente distribuido en todo el Sur.

Al iniciar mi segundo mandato, soy doblemente consciente de que la ONUDI se enfrenta con la difícil tarea de proponer soluciones audaces pero prácticas a las urgentes necesidades del próximo decenio de desarrollo. Ya desde su primera entrega en 1985, el *Informe Mundial* ha estudiado la necesidad de una estrategia más eficaz para la cooperación Sur-Sur. En el *Informe Mundial 1989/1990*, se esboza una estrategia para esa cooperación. Al elaborarla, la ONUDI ha echado mano de la experiencia de la industria en los mercados. Esta mundialización de la industria y el surgimiento de una división del trabajo internacional con la dispersión e integración de la manufactura ofrecen enseñanzas a las economías industriales del Sur en fase de crecimiento. A medida que ponen en común sus mercados y coordinan sus capacidades de producción intercambiando componentes y repuestos, las economías del Sur, especialmente las industrialmente débiles, pueden aprovechar valiosas oportunidades de aprendizaje tecnológico y adquisición de *know-how* industrial. Conforme con la práctica normal de la ONUDI, esta estrategia se ha trazado sobre la base de un examen detallado y concreto de los hechos. Confío en que resultará útil para fomentar la industrialización y hacernos avanzar más firmemente hacia la meta de Lima.

DOMINGO L. SIAZON, Jr.

Director General

CONTENTS

PART ONE

PART TWO

Tables

PART ONE

Page

PART TWO

Chapter IV

Page

Figures

PART ONE

Chapter I

Chapter II

Chapter III

Page

PART TWO

Chapter IV

Boxes

EXPLANATORY NOTES

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

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

A slash (1980/1981) indicates a crop year or a financial year.

References to ISIC codes are accompanied by a descriptive title (for example, ISIC 323: "Manufacture of leather and products of leather, leather substitutes and fur, except footwear and wearing apparel"). Considerations of space, however, may require 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.

The term "trillion" signifies a thousand billion.

For information on member countries comprising a region (e.g., North Africa and Western Asia), see the statistical annex.

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:

ASEAN	Association of South-East Asian Nations
ASIC	application-specific integrated circuits
CAD	computer-aided design
CAE	computer-aided engineering
CAM	computer-aided manufacturing
CBI	Caribbean Basin Initiative
CMEA	Council for Mutual Economic Assistance
CMOS	complementary metal-oxide semiconductor
CNC	computer numerical control
DRAM	dynamic random access memory
EEC	European Economic Community
ECU	European currency unit
EDI	electronic data interchange
ESCAP	Economic and Social Commission for Asia and the Pacific
GCC	Gulf Co-operation Council
GDP	gross domestic product
GNP	gross national product
IMF	International Monetary Fund
ISDN	integrated systems digital networks
ISIC	International Standard Industrial Classification of all Economic Activities
LAB	linear alkyl benzene
MITI	Ministry of International Trade and Industry
MOS	metal-oxide semiconductor
MVA	manufacturing value added
NIC	newly industrializing country
NC	numerical control
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of Petroleum Exporting Countries
R + D	research and development
SITC	Standard Industrial Trade Classification
SRAM	Static random access memory
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
VANS	value-added network services

This report is based on information available as of March 1989.

Introduction: the structure of this *Report*

In 1989 the United Nations is undertaking a system-wide effort to establish a new international development strategy for the coming decade 1991-2000. There was a time when the mere mention of the year 2000 was a source of hope and excitement for developing countries. In part one, chapter I, after introducing UNIDO's forecasts for 1989-90 in a summary form, takes a sobre look at the prospect of achieving the Lima target of increasing the developing countries' share of world industrial production to 25 per cent by the year 2000. As a global issue, chapter I deals with the problem of excess international competition which is undermining investment productivity in developed countries. UNIDO finds that structural adjustments, if excessive, would lead to wasteful competition. In this regard, many African countries stand accused of harbouring structural rigidities and not adjusting promptly enough to the changing external environment. Chapter I provides some contrary empirical evidence and discusses the incongruousness of a market-oriented solution in the current context of Africa's development.

In chapter II, UNIDO assesses the current economic situation and provides short-term forecasts for each of the 11 major regions. Given the prospect of another bout of low growth for world industry as a whole, the interregional differences in growth performance are likely to be accentuated in the coming years. The problem is not of a regional nature. The world industrial economy is impeded by twin imbalances: one financial, the other technostructural—each feeding the other. Many regions are contemplating self-preserving strategies with sophisticated import restrictions and interest rate adjustments. The global external debt problem, however, looms larger than what the international community can resolve through marginal adjustments in the real sector. In 1989 UNIDO benefited enormously from the discussions held at the annual regional forecasting workshop which took place at Beijing in March 1989, jointly hosted by the Chinese State Planning Commission and UNIDO. That workshop was attended by a UNIDO panel of experts drawn from 10 regional economic research institutes (see acknowledgements). The preliminary forecasts prepared by UNIDO were commented upon by each of the regional representatives, on a country-by-country basis, with a candid assessment of the state of affairs in the relevant countries.

The prospects for the year 2000 outlined in chapter I assume the present mix of policies. It is obvious that the world industrial economy cannot afford to take the placid view that this is the best that can be done. Policies are, therefore, needed to alter and relax the constraints on global development. UNIDO has been arguing for multilateral growth-enhancing policies as well as for an international financial regime that permits an uninterrupted and rapid pace of industrialization. However, even with such policies, the problem of spreading industrial growth to all countries of the developing world remains.

It is in this context that *Global Report 1989/90*, dealt with in chapter III, focuses on the special theme of South-South co-operation. In returning to that theme, which was taken up in the first *Global Report*, UNIDO has the uneven distribution of industry within the South as much in mind as that between the North and the South. Drawing on the experience of the emerging international division of labour, a strategy of South-South co-operation is outlined which aims at the dispersal of production of parts and components based on the complementarities of the productive capacities of different countries in the South and the pooling of their markets. Such a South-South industrial complementation scheme may help not only to accelerate the pace of industrial growth, but also to spread industrial development more evenly among developing countries. Moreover, such a strategy is in the spirit of the Lima target and may even hasten its achievement.

In part two, chapter IV provides surveys and reviews of 13 selected industries on the basis of contributions from editors of professional trade journals (see acknowledgements). Included among the nine comprehensive surveys are three high-technology industries, namely machine tools (ISIC 3823), semiconductors (ISIC 383228) and telecommunications equipment (ISIC 3832), which are of crucial importance to the development of the capital goods industry. These are followed by surveys of aluminium (ISIC 372022-372034), man-made fibres (ISIC 351), agro-chemicals (ISIC 351216), and plastics (ISIC 3513) which constitute important intermediate inputs industries. Finally, two consumer goods industries, wearing apparel (ISIC 322) and soap and detergents (ISIC 3523) are added. The four relatively brief review articles cover iron and steel (ISIC 371), footwear (ISIC 324), newsprint (ISIC 341) and brewing (ISIC 3133).

A statistical annex is included as in previous *Global Reports*. This annex, which has proved to be a valuable tool for policy-makers, covers 161 countries and gives the latest available information in the UNIDO data bank.

PART ONE

I. World industrial development: a perspective to the year 2000

A. The world economy: an immediate outlook

In the *Global Report 1988/89* UNIDO again went against the consensus of forecasters with a generally optimistic forecast of continued robust expansion of the world economy. In general that optimism has been borne out by the preliminary performance figures for 1988 (see table I.1). In fact, even UNIDO's optimistic assessment turns out to have underestimated the extent of the expansion in most parts of the world. For developed countries UNIDO forecast a growth of 3.5 per cent, while actual performance was 4.1 per cent. However, on the basis of an assumed strong performance in developed countries, UNIDO somewhat overestimated growth in developing countries, excluding China. UNIDO's forecast was 4.4 per cent, while actual performance was only 4 per cent. UNIDO's forecasts for Tropical Africa exactly matched actual performance, and for South-East Asia the forecast of 7.7 per cent nearly matched actual performance of 7.8 per cent. While UNIDO forecasts for China, at 8.3 per cent, and the Indian Subcontinent, at 5.8 per cent, were on the optimistic side, the extraordinary growth rates actually recorded were even higher, at 11.2 and 8.5 per cent, respectively. The main reason for the difference between UNIDO's forecast and actual performance in the developing countries was the very poor growth registered in the Latin American and Caribbean region. For that region UNIDO forecast a growth of 3.6 per cent, while actual growth was a mere 1.3 per cent. UNIDO underestimated the difficulties that the region faced in resolving the debt crisis and re-establishing growth conditions. In the projections for 1989-1990, UNIDO has been more pessimistic for both Latin America and Tropical Africa, reflecting slow progress on the debt issue, on which progress is necessary before growth conditions can be re-established in those two regions.

Growth in the developed economies was spurred by increases in both investment and international trade. Particularly noteworthy is the 30 per cent increase in exports of United States manufactured goods as it reaped the benefits of increased competitiveness resulting from the restructuring of manufacturing facilities and the devaluation of the dollar. During the first six months of 1988, world exports of manufactures increased by 10 per cent, prompted in part by the surge in investment. Several developing countries, particularly in Asia, shared in the surge in manufactures as well as in exports generally.

It is not surprising that as growth accelerated inflation once again emerged as a potential problem. Capacity utilization rates climbed and unemployment fell in industrialized countries in 1988, even though unemployment rates remain high in some of the Group-of-Seven countries. Following the steep recession of 1981-1982 the rate of inflation had been steadily declining, but in 1988 that trend was reversed. For the Group-of-Seven countries, inflation in 1988 was 2.9 per cent, up slightly from 2.8 per cent in 1987 though still lower than the 1986 rate of 3.2 per cent.* In response, the monetary authorities have begun to tighten the reins, most sharply in the United States, where the management of aggregate demand has fallen entirely to the Federal Reserve Board as a consequence of the failure of Congress and the Administration to agree on policies to curb the federal deficit. Thus, as a result of international interest rate differentials, the dollar appreciated significantly during the first six months of 1989. All three effects of the tightening of monetary policy, namely slower growth, higher interest rates and the appreciation of the dollar, will have an adverse impact on developing countries, particularly the highly indebted countries. One hopeful sign, however, came in early June as United States banks cut their prime lending rate, raising hopes that United States interest rates may have peaked. Generally moderate wage demands combined with sharply improved labour productivity provide encouragement that inflation can be contained without a sharp drop in economic growth. Labour productivity was up by 2.5 per cent in the countries of the Organisation for Economic Co-operation and Development (OECD) in 1988, and the higher levels of investment over the past two years should help to maintain that trend at least through 1989.

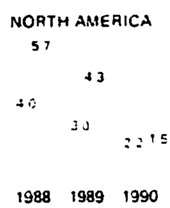
UNIDO's GDP and manufacturing-value-added (MVA) growth rate projections for 1989 and 1990 for individual countries as well as for groups of countries are shown in table I.1 and figure I.1. A discussion of country details and regional data is presented in chapter II.

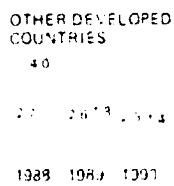
UNIDO's forecast for the year 1989 has changed slightly from the forecast presented in *Global Report 1988/89*. The two-year 1989-1990 forecast is for the world growth rate in GDP to fall from 4.4 per cent in 1988 to 3.4 per cent in 1989, then further to 3.3 per cent in 1990. Growth in developed countries in 1989

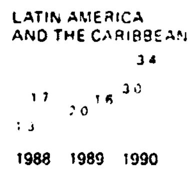
*Measured in terms of gross domestic product (GDP) deflators.

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

Regions, countries and areas	GDP growth rates (percentage) 1988	1989	1990	MVA growth rates (percentage) 1988	1989	1990
World	4 4	3 4	3 3	5 2	4 6	3 5
Developing countries excluding China	4 0	3 6	4 1	5 2	5 8	6 1
Developed countries	4 1	3 3	2 9	5 2	4 4	3 3
China	11 2	5 0	6 0			
North America	4 0	3 0	2 2	5 7	4 3	1 5
Bermuda	2 4	1 0	1 1	3 8	3 4	3 3
Canada	4 0	3 0	2 8	5 9	1 4	1 4
United States	4 0	3 0	2 1	5 7	4 5	1 5
Western Europe	3 4	3 1	2 9	3 8	3 8	2 9
Austria	4 2	3 0	2 5	4 2	3 0	2 3
Belgium	4 1	3 0	2 5	4 3	3 4	2 3
Denmark	0 1	1 5	1 6	1 0	0 6	1 6
Finland	4 8	2 7	2 9	4 3	4 2	2 9
France	3 3	3 1	2 8	5 3	3 2	2 7
Germany, Fed. Rep. of	3 5	3 1	2 9	2 8	4 8	2 6
Greece	3 5	2 5	2 3	5 1	3 1	2 0
Iceland	3 7	1 0	1 2	3 3	3 0	0 0
Ireland	1 6	3 2	4 1	11 6	6 1	4 6
Israel	1 1	1 1	1 2	3 1	2 7	0 6
Italy	3 8	3 5	3 0	4 7	4 5	3 6
Luxembourg	4 0	3 1	2 5	11 8	3 7	2 4
Malta	6 0	6 6	6 5	6 8	6 1	5 0
Netherlands	2 5	2 9	2 8	0 2	3 0	2 6
Norway	1 5	3 0	2 5	5 8	1 5	1 6
Portugal	6 7	5 7	3 7	5 5	5 4	3 4
Spain	5 1	5 0	4 5	3 7	5 7	6 2
Sweden	2 0	2 1	2 0	1 7	2 1	2 1
Switzerland	3 0	2 2	2 3	6 7	2 4	2 1
United Kingdom	3 8	3 1	2 9	4 0	2 5	2 2
Yugoslavia	1 0	1 0	1 0	0 0	2 3	2 3
Centrally planned Europe including USSR	4 1	3 1	3 3	3 9	3 6	3 8
Albania	5 3	6 2	5 7	5 9	6 6	6 8
Bulgaria	6 2	3 7	3 0			
Czechoslovakia	2 5	2 3	2 3	2 7	2 4	2 5
German Dem. Rep.	3 0	4 0	4 4	4 4	5 0	5 3
Hungary	0 5	2 1	3 2	0 9	2 8	4 0
Poland	4 5	3 0	4 0	5 6	3 7	4 9
Romania	3 2	1 1	1 0	5 3	3 4	2 2
USSR	4 1	3 0	3 2	3 7	3 3	3 5
Japan	6 5	5 0	4 8	9 4	7 1	6 5
Other developed countries	2 7	2 6	2 5	4 0	1 8	1 4
Australia	2 9	3 0	2 7	3 8	1 7	0 8
New Zealand	0 2	2 6	2 1	0 4	3 4	2 7
South Africa	3 0	1 6	2 0	6 1	1 6	2 2
Latin America and the Caribbean	1 3	2 0	3 0	1 7	1 6	3 4
Argentina	1 5	0 6	2 5	0 3	3 3	3 2
Bahamas	3 0	1 5	4 6			
Barbados	2 3	3 1	1 6	6 2	3 6	2 2
Belize	2 6	3 0	3 4	2 8	2 0	2 3
Bolivia	2 8	0 5	1 9	2 1	1 2	0 7
Brazil	0 3	1 5	3 5	2 5	0 0	2 7
Chile	6 5	4 8	4 0	7 8	4 3	3 6
Colombia	4 1	2 1	4 1	3 7	0 3	3 9
Costa Rica	3 8	3 0	2 9	4 9	3 8	3 7
Cuba	9 0	5 6	4 8	11 7	6 4	5 5
Dominican Republic	3 0	5 9	7 0	1 8	5 4	6 9
Ecuador	7 9	3 8	5 4	11 5	3 5	6 6
El Salvador	1 9	0 6	0 1	2 0	0 4	0 4
French Guiana	1 0	1 4	0 8	3 7	3 1	2 7
Guadeloupe	0 2	1 1	1 9	0 4	0 3	1 2
Guatemala	3 5	4 4	4 2	4 1	4 9	4 5
Guyana	2 0	0 2	0 5	1 1	0 8	1 4
Haiti*	0 6	0 1	1 0	2 6	1 6	0 5
Honduras	4 0	2 5	3 0	3 8	2 3	2 9
Jamaica	3 2	0 8	1 8	2 6	0 5	2 1
Martinique	3 0	2 0	4 0	3 8	3 6	3 3
Mexico	1 0	1 3	1 9	4 0	2 4	3 1
Montserrat	5 6	2 1	3 9	9 2	5 2	7 3
Netherlands Antilles	4 6	3 5	5 0	4 3	3 9	3 9
Nicaragua	8 0	1 1	1 0	5 5	0 6	2 5
Panama	22 0	0 4	2 8	10 3	0 1	1 4
Paraguay	6 2	5 6	5 8	4 4	5 0	4 8
Peru	8 9	2 4	1 4	2 9	7 2	2 4
Puerto Rico	4 3	6 0	2 9	5 7	9 5	5 3
Suriname	0 8	1 9	1 4	4 2	5 0	4 7
Trinidad and Tobago	4 0	1 7	1 9	3 2	0 1	1 7
Uruguay	0 5	3 0	3 5	1 0	3 4	3 3
Venezuela	4 2	3 8	2 9	4 9	4 9	4 2
Tropical Africa (Sub-Sahara)	2 4	2 7	3 2	3 8	4 6	5 3
Benin*	2 0	1 0	2 0	1 9	3 4	0 1
Botswana*	1 3	8 0	8 5			
Burkina Faso*	3 9	3 1	5 0	2 6	2 9	3 3
Burundi*	0 7	6 1	5 2	4 5	3 7	3 8
Cameroon	9 3	1 0	1 5	0 5	8 3	8 7
Cape Verde*	11 7	6 0	6 5			
Central African Rep.*	2 0	1 1	2 0	0 4	0 5	0 5
Chad*	1 8	1 2	3 9	3 1	2 7	4 6
Comoros*	1 3	3 5	4 1	0 9	2 6	3 8
Congo	3 0	3 2	4 0	6 4	0 6	4 2







growth for 1988 and projections for 1989 and 1990

Regions, countries and areas	GDP growth rates (percentage)			MVA growth rates (percentage)		
	1988	1989	1990	1988	1989	1990
Côte d'Ivoire	3.2	2.2	2.3	5.4	1.4	1.3
Djibouti*	0.2	0.8	1.6	2.0	2.2	2.4
Equatorial Guinea*	7.1	4.0	4.1	9.7	4.9	8.6
Ethiopia*	2.7	3.0	2.8	5.8	4.6	4.6
Gabon	3.0	2.0	1.3			
Gambia*	5.4	2.0	2.3	2.8	5.7	5.4
Ghana	6.0	4.0	4.8	14.6	9.1	11.3
Guinea*	4.5	2.6	1.0	0.0	0.6	1.3
Guinea-Bissau*	4.0	0.5	3.8	0.5	1.1	0.7
Kenya	6.2	4.0	6.1	10.2	7.1	10.0
Lesotho*	8.4	3.0	6.2			
Liberia	1.5	0.1	0.5	0.5	1.4	1.9
Madagascar	3.1	2.3	3.2	0.1	0.1	0.0
Malawi*	3.8	4.3	6.0	3.1	0.7	2.9
Mali*	7.0	2.0	4.0	3.4	6.9	5.4
Mauritania*	4.0	1.5	4.0	5.3	4.3	4.3
Mauritius	6.7	3.0	4.0	10.9	7.0	7.5
Mozambique*	8.0	1.2	1.5	12.6	1.9	2.4
Namibia	2.0	1.5	2.4			
Niger*	7.5	1.0	4.7	3.0	3.3	2.3
Nigeria	4.0	2.9	3.3	6.8	5.5	6.0
Reunion	6.0	3.0	3.6	2.8	3.4	3.3
Rwanda*	1.8	2.9	4.0			
Sao Tome and Principe*	3.4	0.8	1.3	2.8	0.8	1.2
Senegal	4.0	2.0	3.9	0.8	4.8	2.6
Seychelles	5.6	2.0	1.9	10.3	8.4	8.3
Sierra Leone*	5.6	1.0	1.2	6.1	0.1	1.8
Somalia*	2.3	1.1	3.7			
Swaziland	3.7	4.0	2.8	3.6	3.6	3.3
Togo*	3.9	2.6	1.4	1.0	0.5	0.0
Uganda*	5.0	3.5	3.5	7.2	4.4	4.0
United Republic of Tanzania*	3.5	2.4	2.9	1.6	5.7	0.0
Zaire	2.7	3.7	2.9	1.4	2.4	1.7
Zambia	3.2	1.0	2.6	4.7	2.1	4.0
Zimbabwe	0.6	3.5	3.4	4.9	4.0	4.0
North Africa	1.5	2.3	2.6	4.4	4.8	5.2
Algeria	2.7	2.1	2.1	5.7	6.1	5.9
Egypt	2.2	3.3	4.4	4.2	3.9	4.6
Libyan Arab Jamahiriya	3.6	1.5	1.0	6.7	10.4	9.9
Morocco	8.0	3.1	4.7	3.8	2.8	3.1
Sudan*	5.0	0.2	2.0	1.9	2.6	0.7
Tunisia	1.0	3.0	3.4	3.0	6.0	6.6

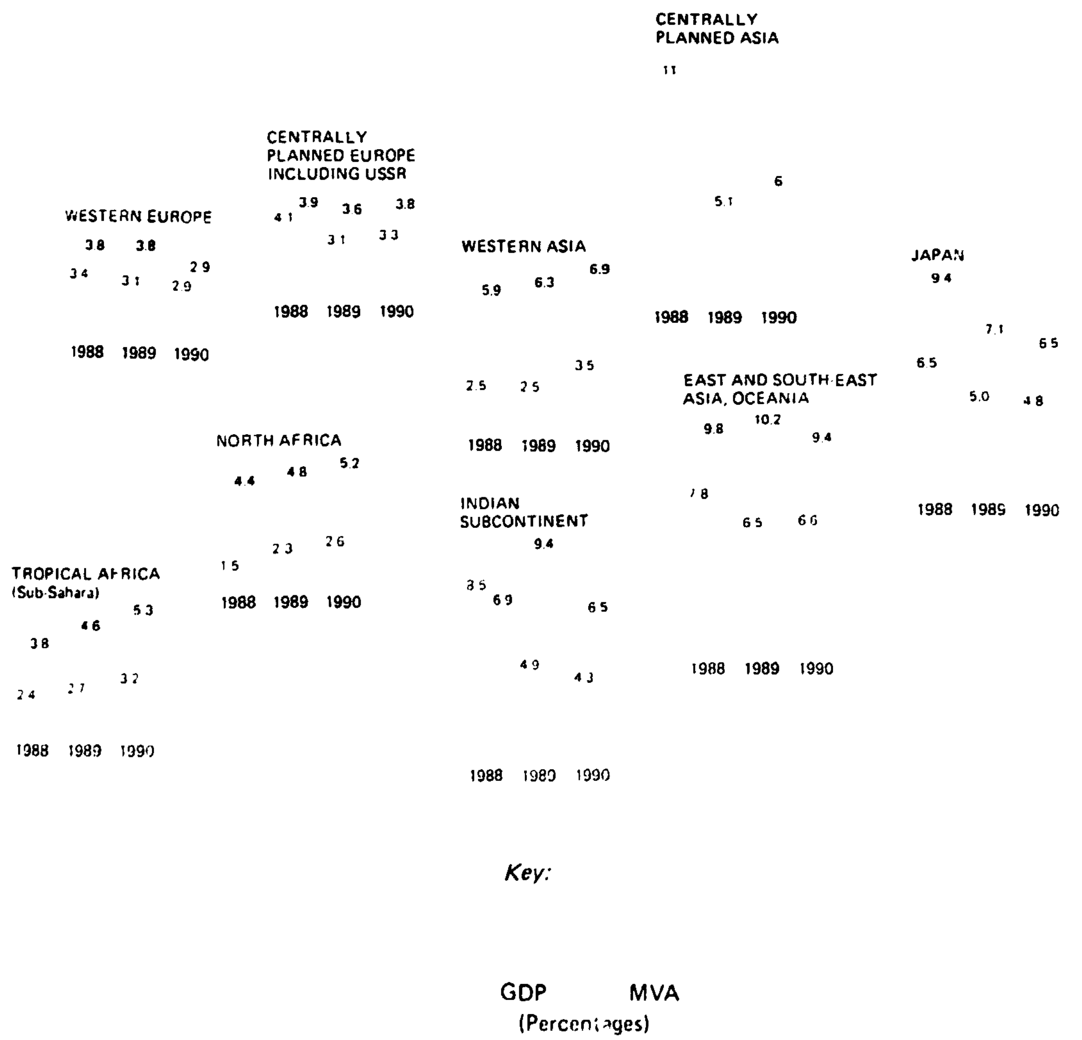


Table I.1. Regional and country estimates of GDP and MVA growth for 1988 and projections for 1989 and 1990 *(continued)*

Regions, countries and areas	GDP growth rates (percentage) 1988	1989	1990	MVA growth rates (percentage) 1988	1989	1990
Western Asia	2.5	2.5	3.5	5.9	6.3	6.9
Cyprus	7.0	3.8	4.8	7.5	3.7	5.6
Democratic Yemen*	5.1	2.0	4.0	4.5	4.6	4.5
Iran (Islamic Rep. of)	2.0	0.7	3.0	3.4	5.6	7.5
Iraq	3.3	2.0	2.2	4.2	5.1	4.6
Jordan	1.5	1.0	3.1	2.8	2.8	-0.6
Kuwait	3.0	1.2	2.0	2.1	2.1	2.1
Oman	0.0	4.2	4.7	..	..	..
Qatar	1.5	1.1	3.5	8.5	8.4	9.0
Saudi Arabia	7.4	3.1	3.6	7.0	4.9	5.2
Syrian Arab Republic	1.5	2.3	2.8	..	..	..
Turkey	5.1	5.1	5.2	6.7	6.7	6.9
United Arab Emirates	1.2	1.0	2.2	5.9	11.8	10.7
Yemen*	4.0	4.0	4.0	8.5	8.3	8.3
Indian Subcontinent	8.5	4.9	4.3	6.9	9.4	6.5
Afghanistan*	2.6	1.7	0.9	..	..	..
Bangladesh*	2.6	4.3	2.7	-3.0	..	..
Bhutan*	8.0	8.2	8.4	0.5	10.3	3.5
India	10.0	5.1	4.4	7.2	10.3	6.5
Myanmar, Union of*	3.0	-3.4	-3.9	-0.9	-4.0	-4.5
Nepal*	7.2	1.2	4.2	2.9	-1.7	8.6
Pakistan	5.8	6.2	6.2	7.6	7.5	7.7
Sri Lanka	3.3	3.4	4.4	8.5	5.4	4.9
East and South-East Asia, Oceania	7.8	6.5	6.6	9.8	10.2	9.4
Brunei Darussalam	1.7	2.5	3.0	-1.4	-0.3	0.3
Fiji	2.0	5.0	3.0	9.2	9.2	4.5
French Polynesia	4.0	3.9	3.6	5.5	5.8	5.5
Hong Kong	7.5	5.0	5.1	6.4	2.7	2.3
Indonesia	4.1	4.5	5.1	8.0	8.6	9.7
Malaysia	8.1	7.5	7.5	10.8	10.2	10.2
New Caledonia	0.0	0.3	1.0	3.3	2.3	1.1
Papua New Guinea	4.1	4.0	3.5	8.3	7.8	7.5
Philippines	6.7	7.5	7.0	10.4	10.1	9.2
Republic of Korea	11.0	7.6	7.5	13.7	14.4	11.2
Samoa*	1.5	1.3	4.0			
Singapore	11.0	7.7	6.0	21.3	9.1	5.6
Taiwan Province	6.8	6.5	7.6	4.1	6.8	9.0
Thailand	10.5	8.1	7.0	11.8	12.6	9.9
Tonga	7.7	7.5	7.0	31.2	17.6	4.3
Tuvalu*						
Vanuatu*	6.9	4.5	2.8	28.3	22.4	26.8
Centrally planned Asia	11.0	5.1	6.0			
China	11.2	5.0	6.0			
Democratic People's Republic of Korea	10.2	8.0	7.0			
Lao People's Democratic Republic*	7.2	6.5	5.5			
Mongolia	8.5	5.4	5.7	12.1	10.4	7.7
Viet Nam	3.6	4.3	3.4			

*Least developed country

Table I.2. Share of industrial output of developing countries in world total in 1975, projected shares for 1989 and 1990, and growth rates, 1975-1990

(Percentage)

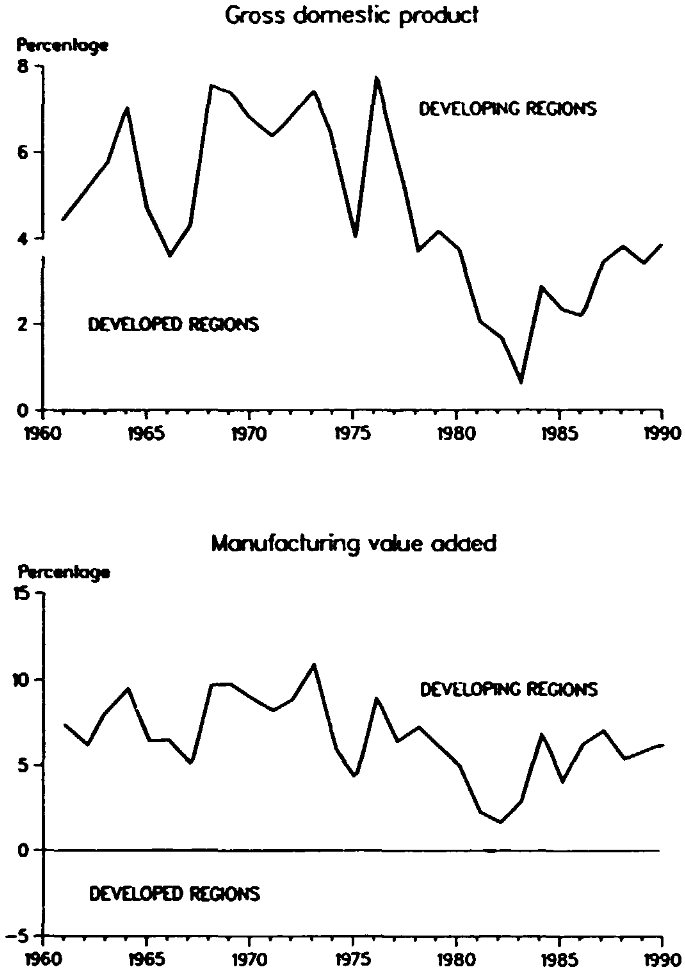
Branch of industry	Share of developing countries in world total 1975	Projected 1989	Projected 1990	Average annual growth rates: Developed countries 1975-1985	Developed countries 1985-1990	Developing countries 1975-1985	Developing countries 1985-1990
3 Manufacturing	11.3	13.9	14.2	3.0	3.6	4.3	6.4
311 Food manufacturing	16.1	19.6	19.9	2.5	3.2	4.6	4.3
313 Beverages	15.2	22.2	22.7	1.4	1.6	4.4	5.9
314 Tobacco manufactures	33.4	38.9	39.9	0.8	1.3	3.1	2.4
321 Textiles	21.0	24.0	24.6	1.2	2.0	2.1	4.4
322 Wearing apparel	13.0	17.9	18.5	1.2	1.4	3.2	5.2
323 Leather and fur products	15.2	17.7	18.0	0.4	1.3	1.3	3.7
324 Footwear, excl. rubber/plastic	15.6	19.7	20.1	0.8	0.3	2.4	3.2
331 Wood and cork products	11.2	13.0	13.4	1.5	3.7	3.6	3.7
332 Furniture and fixtures	7.7	7.7	7.8	2.1	4.4	2.6	3.6
341 Paper and paper products	9.0	11.7	12.1	3.5	4.3	5.7	7.0
342 Printing and publishing	9.5	8.0	8.1	3.2	4.6	2.0	3.5
351 Industrial chemicals	9.0	14.8	15.4	3.7	4.2	7.7	9.0
352 Other chemical products	16.9	20.3	20.7	4.0	4.0	5.1	7.0
353 Petroleum refineries	24.5	39.1	39.7	0.0	0.7	4.6	6.1
354 Miscellaneous petroleum/coal products	7.9	15.1	15.7	1.4	0.3	6.5	5.5
355 Rubber products	14.1	18.5	19.1	2.5	2.4	4.1	6.6
356 Plastic products n.e.c.	12.6	14.2	14.3	5.8	6.0	6.8	7.4
361 Pottery, china and earthenware	11.5	13.3	13.5	1.9	2.4	2.9	4.3
362 Glass and glass products	13.0	13.8	14.1	2.9	3.6	2.7	5.9
369 Other non-metallic mineral products	13.9	21.2	22.0	1.3	3.0	5.4	6.3
371 Iron and steel	8.4	14.5	15.2	0.5	1.3	4.5	7.1
372 Non-ferrous metals	8.8	11.3	11.7	2.4	2.9	5.0	4.6
381 Metal products, excl. machinery	8.5	12.5	12.7	2.2	3.1	4.8	7.2
382 Non-electrical machinery	4.4	4.3	4.3	4.5	4.5	2.9	7.2
383 Electrical machinery	6.9	10.3	11.1	6.2	5.2	7.5	14.0
384 Transport equipment	7.3	8.0	8.2	2.9	3.9	2.6	7.5
385 Professional and scientific goods	2.8	5.5	5.8	4.1	4.1	8.2	11.9
390 Other manufactures	12.9	19.7	20.2	3.7	4.4	7.3	8.5

Sources: UNIDO data base; estimates and forecasts by UNIDO/PPD/IPP/GLO.

All calculations are based on constant 1980 U.S. dollar figures.

Figures are derived from 129 sample countries: 34 developed and 95 developing.

Figure I.1. Growth rates of GDP and MVA in developed and developing regions, 1961-1990



Sources United Nations National Accounts Statistics, United Nations Industrial Statistics and forecasts by UNIDO/PPD/IPP/GLO

will be down from 4.1 to 3.3 per cent, largely in response to deflationary measures which have been implemented to contain inflation. This deflationary trend is expected to continue through 1990, resulting in a further decline to 2.9 per cent. Japan will be down from 6.5 per cent in 1988 to 5 per cent in 1989 and 4.8 per cent in 1990. North America will grow at 3 per cent in 1989 and 2.2 per cent in 1990, down from 4 per cent in 1988. In Western Europe growth will fall to 3.1 per cent in 1989 and 2.9 per cent in 1990, against 3.4 per cent in 1988.

However, there have been no new developments to alter the general view presented in *Global Report 1988/89*, which presumes that the slow-down will not develop into a recession. None the less, the possibility of a recession developing during late 1989 or 1990 cannot be completely ruled out. Factors which have led some forecasters to predict a recession are the gradual re-emergence of inflation, the debt crisis, and the persistent twin deficits in the federal budget and the balance of trade of the United States. A recession scenario was discussed in detail in *Global Report 1988/89* as part of an analysis of the effects of economic performance in the United States economy on the economies of the rest of the world.

The UNIDO forecast for developing countries, excluding China, is for GDP growth in 1989 of 3.6 per cent, with some improvement to 4.1 per cent in 1990. For Latin America and sub-Saharan Africa the growth rates in 1989 are forecast to be 2 per cent and 2.7 per cent respectively, which implies a continuing slide in per capita incomes in the two regions for 1989. In 1990 growth in the two regions will be slightly higher, allowing for a modest increase in per capita incomes. If there were convincing evidence of concerted global action to assist the countries in those two regions in coping with their debt burden, the forecast would be more optimistic. In general, the countries that have performed well in the two regions during 1988 are expected to maintain their momentum over the next two years, but the number of good performances will not be much increased.

In South-East Asia GDP growth will be reduced from the 1988 level as the rate of growth of exports falls off. However, growth in the region as a whole is expected to continue strong at 6.5 per cent in 1989 and 6.6 per cent in 1990. The Indian Subcontinent will also experience some decline in growth rates, at 4.9 per cent in 1989 and 4.3 per cent in 1990. India is forecast to grow at 5.1 per cent in 1989, down sharply from its rapid growth of 10 per cent in 1988, but still much better than the 4.4 per cent of 1987. A further fall to 4.4 per cent is forecast for 1990. Without a significant recovery in oil prices, which is considered unlikely in the next two years, growth in Western Asia is likely to remain little changed from 1988 levels at 2.5 per cent in 1989 and 3.5 per cent in 1990.

How profoundly economic growth in China will be affected by the events of June 1989 is difficult to predict, but international reaction in the immediate aftermath seems to indicate that growth rates will be sharply down from their 1987 to 1988 levels. While the Government has announced a desire to maintain its outward looking posture, it remains to be seen how the international business and financial community will respond. Given the uncertain situation there, UNIDO is forecasting growth of 5 per cent for 1989 with some recovery in 1990 to 6 per cent. Growth rates in 1987 and 1988 were 10.5 and 11.2 per cent, respectively.

World MVA growth in 1988 is estimated to be 5.2 per cent, up from 4 per cent in 1987. The only other year since 1976 in which world MVA growth has exceeded 5 per cent was 1984, when it grew at the rate of 6.4 per cent. The fastest-growing industries were miscellaneous petroleum and coal products, at 7.8 per cent, electrical machinery, at 7.2 per cent, and plastic products at 6.6 per cent. The rate of growth in MVA was estimated to have been the same for developed and developing countries, thus no progress was made by developing countries in increasing their share of world MVA. The estimated share for 1988 is 13.8 per cent.

In 1988 substantial gains occurred in the share of world MVA in Asian developing countries as well as in Japan. Declines were registered in the Latin America and Caribbean region. Western Europe, sub-Saharan Africa and North America maintained approximately their same shares. The Latin American and Caribbean region recorded MVA growth of only 1.7 per cent for 1988, as MVA in Brazil declined by 2.5 per cent and Argentina registered a bare 0.3 per cent increase. Tropical Africa did somewhat better at 3.8 per cent. The debt crisis, particularly in Argentina and Brazil, is in a large measure responsible for the poor performance, as producers struggle to maintain operations in the face of deteriorating infrastructure, including power supplies and transport facilities, and difficulties in obtaining inputs and keeping machinery in operation.

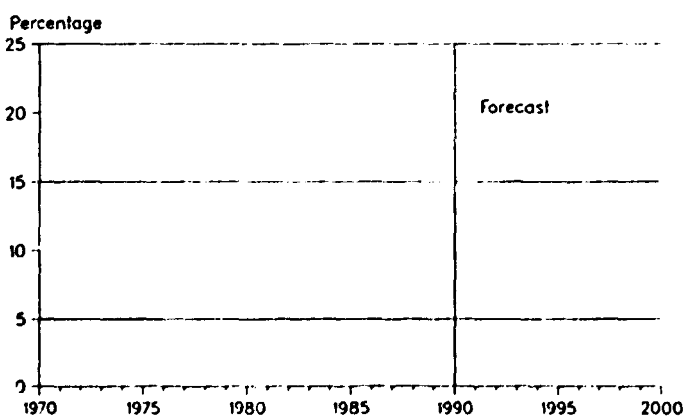
For 1989 and 1990 UNIDO is forecasting that developing countries as a whole will increase their share of world MVA (see figure I.2). In 1989, MVA growth rates for developing and developed countries will be 5.8 per cent and 4.4 per cent, respectively. In 1990 the growth rate for developing countries will increase further to 6.1 per cent, while that for the developed countries decreases to 3.3 per cent. The developing countries of Asia are expected again to make the strongest gains, and in general developing countries in all regions except Latin America are expected to have faster MVA growth than the 3.3 per cent rate forecast for developed countries.

B. Prospects for the year 2000

As the 1980s draw to a close there is a growing urge to take a longer look ahead across the last decade of the century to the year 2000. The United Nations has decided to call this decade the Fourth United Nations Development Decade. This has led to a conscious effect on the part of the various United Nations agencies to take a medium-term perspective for the years 1991-2000 about the prospects for growth in the world economy.

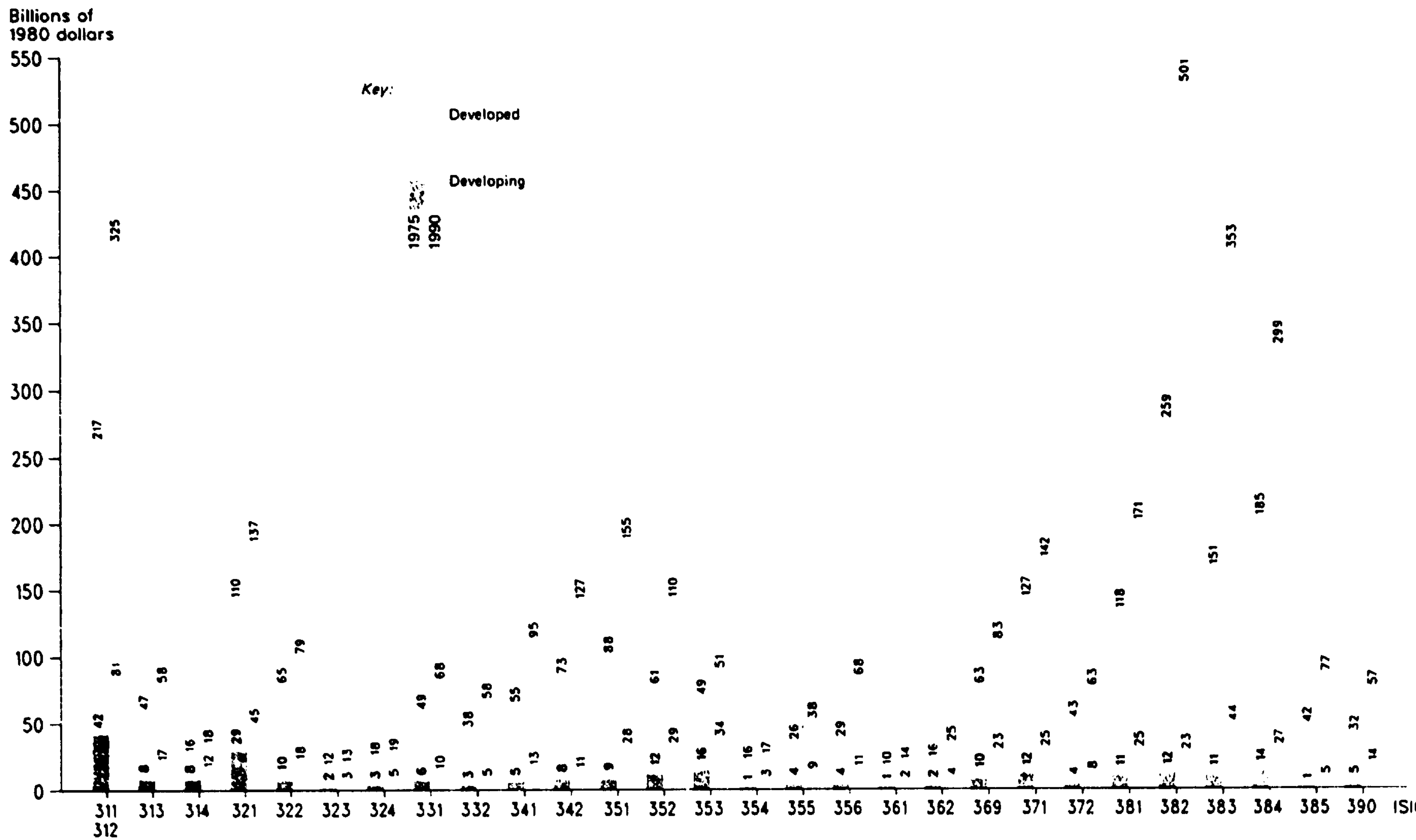
UNIDO expects that during 1989-1990 the share of developing countries will increase across all industries except non-electrical machinery (ISIC 382), in which the share is forecast to remain constant. Overall the developing countries' share of world MVA is forecast to increase faster during 1989-1990 than it has over the 1975-1989 period (see table I.2 and figure I.3). The

Figure I.2 Manufacturing share of developing countries in world industrial output, 1970-1990 and 2000



Source: United Nations Industrial Statistics and forecasts by UNIDO PPD IPP GLO

Figure I.3. Manufacturing value added of North and South, 1975 and 1990



Source: United Nations Industrial Statistics and forecasts by UNIDO/PPD/IPP/GLO

Table I.3. Agency baseline projections of long-term GDP growth, 1991-2000
(Percentage)

Region or economic grouping	DIESA	Economic Commission for Europe	UNCTAD [a]	World Bank [a/b] Baseline	World Bank [a/b] Low	International Monetary Fund [c]
<u>World</u>	3.3	3.2	3.1	3.3 [c]	2.8 [c]	3.7
Developed market economies	2.7	2.8 [d]	2.6	2.9	2.4	3.1
Centrally planned economies of Europe	3.9	4.0	3.9	..	..	..
<u>Developing countries</u> [e]	4.1	3.6 [c]	3.4	5.1	4.3	5.0
North Africa	4.6	..	1.4 [f]	4.[illegible] [g]	3.5 [g]	3.5 [h]
Sub-Saharan Africa	3.3	..	..	4.0	3.6	..
Latin America	3.2	..	3.5	4.3	3.4	4.2 [i]
West Asia	4.3	..	4.4	..	..	..
South-East Asia	4.1	..	..	6.2 [d]	5.3 [d]	6.6 [j]
Mediterranean	2.8	..	..	..	..	..
China	6.7	..	6.3 [k]	..	..	..

<u>Sources</u>: Administrative Committee on Co-ordination, Task Force on Long-Term Development Objectives, Inter-Agency Technical Working Group, "Report of the Inter-Agency Technical Working Group on its fourteenth session", April 1989; for projections of the Department for International Economic and Social Affairs (DIESA): "Overall socio-economic perspective of the world economy to the year 2000" (A/43/554), table 4; for projections of the Economic Commission for Europe: "Overall economic perspective to the year 2000" (ECE/EC.AD/32); for UNCTAD projections: "Statistical tables relating to long-term economic trends in the 1990s", paper submitted to the fourteenth session of the Inter-Agency Technical Working Group; for IMF projections: <u>World Economic Outlook</u> (International Monetary Fund, Washington, D.C., April 1989); for World Bank projections: "Statistical tables relating to the short-term outlook and long-term economic trends in the 1990s", paper submitted to the fourteenth session of the Inter-Agency Technical Working Group.

a/ Preliminary and subject to revision.
b/ For 1989-2000, market economies only.
c/ Medium-term technical baseline, average for 1991-1994.
d/ Derived by DIESA from more detailed ECE data in the original source.
e/ Including high-income oil exporters (except in World Bank and IMF projections) and China (except in DIESA and UNCTAD projections).
f/ All developing Africa.
g/ Includes Western Asia and European developing countries and Pakistan.
h/ All African capital-importing countries.
i/ Western Hemisphere capital importing countries.
j/ Asian capital-importing countries.
k/ Asian countries with centrally planned economies.

largest increases are forecast to occur in professional and scientific goods (ISIC 385), iron and steel (371), industrial chemicals (351), miscellaneous petroleum and coal products (354), other non-metallic mineral products (369) and non-ferrous metals (372). In addition to non-electrical machinery, where no gain is expected during 1989-1990, the other industries at the bottom end of the scale, in terms of the rate at which developing countries' shares will increase, are plastic products not elsewhere classified (n.e.c.) (356), printing and publishing (342), furniture and fixtures (332) and pottery, china and earthenware (361).

UNIDO is forecasting that over the 1985-1990 period, MVA in developing countries will grow at an average annual rate of 6.4 per cent, which is up significantly from its average growth of 4.3 per cent during the 1975-1985 period. The rate will also be up slightly for developed countries at 3.6 per cent for the second half of the decade, against 3 per cent for the earlier period. The fastest-growing industries in developing countries are expected to be electrical machinery (ISIC 383), professional and scientific goods (385), industrial chemicals (351), other manufactures (390), transport equipment (384), plastic products n.e.c. (356), non-electrical machinery (382), metal products excluding machinery (381), iron and steel (371) and other chemical products (352). All of them are forecast to show a growth rate of 7 per cent or higher for the 1985-1990 period. Except for iron and steel and metal products excluding machinery, those industries are also among the fastest growing sectors in the developed countries. Iron and steel runs ahead of only three industries, namely petroleum refineries (353), footwear excluding rubber or plastic (324) and miscellaneous petroleum and coal products (354).

The slower growing industries in developing countries during the 1985-1990 period are expected to be tobacco manufactures (314), footwear excluding rubber

Table I.4. UNIDO forecast of long-term growth of GDP and MVA, regional shares, and per capita GDP, 1990-2000
(Percentage)

Region or economic grouping	Average annual growth rate 1990-2000 GDP	MVA	Share of world MVA 1990	2000	GDP 1990	2000	Per capita GDP (1980 dollars) 1990	2000
World	3.5	4.0	100.0	100.0	100.0	100.0	2 917	3 406
Developed market economies	3.0	3.4	63.8	60.1	67.2	64.3	12 313	15 440
Centrally planned economies of Europe and the USSR	3.9	4.5	22.0	22.9	10.8	11.3	4 099	5 512
Developing market economies	4.5	6.0	14.2	17.0	17.2	19.0	946	1 161
Regions								
North Africa	4.6	6.1	0.5	0.6	1.1	1.3	1 238	1 521
Tropical Africa	3.5	4.8	0.5	0.5	1.3	1.3	439	459
Latin America and the Caribbean	4.0	4.2	5.7	5.8	5.7	5.9	1 958	2 301
Western Asia	4.5	7.3	1.4	2.0	2.9	3.2	2 462	2 888
Indian Subcontinent	4.4	6.1	1.6	2.0	2.5	2.8	330	407
South-East Asia	5.5	7.5	4.5	6.1	3.7	4.5	1 433	2 036
China	5.0	..	..	..	4.7	5.5	591	805

Source: UNIDO data base.

or plastic (324), printing and publishing (342), furniture and fixtures (332), leather and fur products (323) and wood and cork products (331), all of which are forecast to grow at less than 4 per cent. In developed countries those same industries, with the exceptions of printing and publishing (342) and furniture and fixtures (332), are also among the slower-growing industries. Growth rates of 4.4 per cent for furniture and fixtures and 4.3 per cent for printing and publishing in fact place these two industries among the fastest-growing in developed countries.

Table I.3 shows a comparison of the GDP projections for the coming decade of various organizations and bodies within the United Nations system. The forecasts generally indicate more rapid economic growth in the coming decade than has occurred in the 1980s, but none of the agencies see a return to the growth rates of the 1960s and 1970s. For developing countries, only the International Monetary Fund (IMF) and the World Bank foresee GDP growth in the 5 per cent range, and this only holds for the more optimistic scenario of the World Bank. From a regional perspective there is agreement among the forecasts on the question of where rapid growth or slow growth are likely to occur. The pattern of the 1980s is continued, with Asia showing rapid progress and sub-Saharan Africa and heavily indebted Latin America forecast to grow slowly. UNIDO has made a synthesis of the estimates to provide a forecast to be used in computing its own estimate of MVA in the year 2000. The UNIDO forecast, as shown in table I.4, is a little more optimistic than the forecasts of the other agencies, since it is based on more optimistic assumptions about the resolution of the debt crisis and the outcome of the Uruguay round of trade negotiations.

According to UNIDO calculations, developing countries, excluding China, will by the year 2000 be producing 17 per cent of world MVA against 14.2 per cent in 1990 (table I.4). The most substantial gains would come in Western Asia, the Indian Subcontinent and South-East Asia. Sub-Saharan Africa and Latin America show little or no increase in their shares of world MVA. On the basis of a preliminary analysis, UNIDO expects the share of developing countries in world MVA to continue to increase in petroleum refining (ISIC 353), rubber products (355), electrical machinery (383) and transportation equipment (384). Some decline in their shares in the food (311), textile (321) and wearing apparel (322) industries is likely.

The UNIDO forecasts, optimistic though they are relative to those of the other organizations or bodies in the United Nations system, therefore clearly show that the Lima target of a share of 25 per cent of world industrial production for developing countries by the year 2000 will remain an elusive goal.

C. The Lima target and the new international development strategy

There was a time when the mere mention of the year 2000 conjured up hopes and excitement for the future of developing countries. In 1975 the Second General Conference of UNIDO, meeting at Lima, Peru, adopted the Lima Declaration and Plan of Action on Industrial Development and Co-operation, by which the world community agreed to assist and encourage developing countries in their efforts to achieve at least a 25 per cent share of world manufacturing output by the year 2000. That the Lima target was subsequently endorsed by the United

Nations General Assembly attests to the optimistic mood at that time, but the minimal progress towards that target so far underlies the basic reality of the world today. The share in world industrial output for developing countries, excluding China, reached 13.8 per cent in 1988.

However, instead of taking such a result as a sign of the ultimate failure of the Lima Plan of Action, it should perhaps be viewed as an indication of the outstanding task yet to be completed before the target date of the year 2000. As reviewed elsewhere in this *Global Report*, the actual progress made by developing countries is much more substantial than the one indicated by a mere aggregate picture. The fact that many developed countries have started taking industrial competition from developing countries seriously is a testimony to the success of industrialization efforts made in developing countries so far. What is most unfortunate, however, is that the industrialization process has not taken place always in a hospitable global economic climate nor has it brought about a uniformly successful result to all developing countries. Having worked very hard to diversify away from primary products and to launch themselves on a path of industrialization, many of the African countries are on the verge of returning to the status of peripheral providers of raw materials. In that regard, shifting its priorities to African industrial rehabilitation has been one of the pressing tasks of UNIDO for the past several years.

As for the Latin American countries, the so-called debt crisis of 1981 represented a historic turning point. By borrowing too much and too fast, and then being saddled with high interest rates, many Latin American developing countries found themselves unable to service their debts on time. International credit flows to those countries, in general, were brought to an abrupt halt, forcing them to undertake a radical cut in imports, a general tightening of the economy, especially in basic public services, and the imposition of penalties on industries that do not produce export goods. Needless to say, forcing Latin America to industrialize strictly on the basis of short-term balance-of-payments considerations is obviously neither sustainable nor desirable from a global point of view.

The Lima Plan of Action, although framed in terms of regional share targets, assumed parallel growth in developed and developing countries and a smoothly functioning global economic system to accommodate such growth. However, the global economy has for some time been fraught with problems. In many respects, the world has become a less kind and gentle place to live in. The "high technology" of today is still powerless to combat droughts and other natural disasters that all too frequently accompany mass starvation. Violent civil unrest is not only becoming common, but is taken as an almost inevitable aspect of atoning for past economic excesses. Modern-day economic liberalism has been credited with many instances of economic revitalization (including those in the sub-Saharan African countries, according to a recent World Bank report). Unfortunately, however, it also seems to have had the effect of blurring the traditional divide between technostructural and macro-economic problems underlying the world economy as a whole. While the need to adopt new technology and to adapt the economy to its consequences cannot be gainsaid, the costs of doing so are often exacerbated if the global macro-economic framework is not helpful. The external debt of many developing countries has reached an unprecedented proportion relative to their ability to repay. The flow of international financial resources is increasingly distorted, and even acting in a negative manner, making developing countries finance the developed, rather than the other way around. In the midst of all these problems, stable economic growth seems ready to desert the world once again, thereby exacerbating the old problems and creating new ones. Are the economic problems besetting every country today only temporary difficulties of their own making, or are they symptoms of a fundamental systemic flaw in the global economy?

In the meantime, tempers are rising with increasingly explicit threats of retaliation among the industrialized trading partners, as though trade has suddenly become more injurious than beneficial. The realization, during the 1940s, that some economic problems afflicting individual countries may be interrelated brought the world community to establish international organizations to resolve problems multilaterally. On the eve of the final decade of the twentieth century, the most immediate challenge to the world economy might again be that of containing the growing spectre of unilateralism and bilateralism among countries acting either individually or in groups. The increasing fragmentation of the global economy is, to a certain extent, mirrored in the apparent ineffectiveness of the existing international organizations. In this regard, saving multilateralism through an enhancement of the reputation of the United Nations system suggests itself as one of the many challenges facing the world economic community during the coming decade.

Some of the economic challenges facing the world have already been addressed in previous UNIDO *Global Reports*, including the problems of external debts, terms of trade, protectionism, exchange and interest rate alignments, direct investment, technology transfers and others, in the context of the need for a harmonized global industrialization. In *Global Report 1989/90*, attention is drawn to another dimension of the existing challenges. The accelerating pace of structural change taking place in both developed and developing countries seems to be creating frictions and undermining industrial productivity, sometimes shaking the very foundation of the institutional framework for development in many developing countries. In the following section, the relationship between structural change and the changing level of investment productivity in advanced industrial countries observed in the past three decades is first examined, and then the structural adjustment crisis being experienced in developing countries, in particular sub-Saharan Africa, will be reviewed.

D. A basic economic challenge: the world economy on a lowered growth path

The Lima target was originally postulated on the basis of stable growth of GDP and industrial expansion in the OECD countries in the range of 3.7 to 4 per cent per annum. Without the assurance of such stable growth in developed countries, the existing link between developed and developing countries can become detrimental to the latter, as recent events tend to show [1]. However, an analysis of industrial expansion in the OECD countries throughout the past four decades shows a perceptive decline in growth of manufacturing value added (MVA) since 1974, from a 5.5 per cent yearly average between 1949 and 1974 to only a 2.1 per cent average since then. Many economists have noticed this, and have made frequent references to the so-called Kondratieff long waves. According to the eminent economic historian, Joseph Schumpeter, innovations, including territorial expansion and improvements in marketing and management as well as technological change, are among the important factors underlying the Kondratieff long waves. The palpitation of the clustering of major innovations is such that, according to Schumpeter, writing in 1935, the world had experienced three industrial revolutions. The question is: Did the world have another industrial revolution since that time without being aware of it?

A Schumpeterian extrapolation would certainly refer to the period between 1960 and 1973 as the peak of another industrial revolution. Not only was there the so-called electronics revolution, which brought out a host of new products that changed people's life-style drastically, but the computer industry was expanding at an annual compound rate of 22 per cent, instilling fears among middle management of their jobs' becoming obsolete. Although this did not happen (white-collar work expanded), optimization through project evaluation and review techniques (PERT) and dynamic simulations became, ostensibly, standard management tool kits. In a way, even the territorial expansion which characterized the two previous industrial revolutions, according to Schumpeter, did take place. By and large, it was only during the latter half of the 1960s that the newly decolonized, developing countries were rediscovered by the international financial community for their industrial potential. From a handful in number in the 1960s, by 1970, 59 developing countries had managed to expand their industrial bases enough to reach or exceed the critical turning-point for a self-sustainable industrialization process (taken as a 10 per cent MVA share of GDP). By 1985, the number of developing countries in that group increased by just one. However, it is a well-known fact that sustained investment demand in those developing countries during the late 1960s, and especially after the 1973 recession, played a crucial role in maintaining the growth performance of the OECD countries.

The purpose here is neither to defend Schumpeter, nor Kondratieff. One should explore a bit more into some of the puzzling features of the current state of world economic affairs. If the world economy continues to grow only at a crawling pace, as indeed has been the case for the past 15 years, then why has inflation everywhere become such a great and recurrent concern as to arrest growth in every instance and to strain international economic relationships all the time? One answer could be that some countries make it a big problem by drumming up fears of inflation and pre-empting growth. That sounds like a self-fulfilling prophecy situation of low growth with non-negligible inflation. Although the thesis has some merit [2], there must be more to the problem.

Lack of investment? Until very recently, the overheating of the United States economy was attributed to the prolonged underinvestment in that country which caused productivity to decline, thus undermining its international competitive power. In fact, it is surprising to find that the ratio of gross capital formation to GDP in the United States, today, is almost the same as it was in 1970—that is, around 18 per cent of GDP, although the United States savings rate dropped from 18.4 per cent of GDP in 1960 to 13.9 per cent by 1987. In some other developed countries, however, the investment ratio has been on a declining trend. For example, Japan used to plough back 35.5 per cent of its GDP as capital investment until as late as 1970. The ratio in Japan is currently 28.9 per cent, while that of the Federal Republic of Germany, which was 25.5 per cent in 1970, dropped to 19.4 per cent in 1987. Still, taking all developed countries together, the combined gross capital formation effort has become only slightly less than it was some 20 years ago. Their combined ratio of investment to GDP was 21.5 per cent in 1970, and 20.7 per cent in 1987.

World-wide, that small loss was made up by investments in developing countries. In 1970, both developed and developing countries combined, excluding China, produced $2.5 trillion (in current dollar prices) worth of goods and services. The combined gross investment world-wide in that year amounted to more than $527 billion, or 21 per cent of the combined GDP. In 1987, the world, again excluding China, produced $13.4 trillion worth of goods and services and invested $2.7 trillion—exactly 21 per cent of combined GDP. In other words, the world-wide savings and investment ratio has remained the same (at the 21 per cent level) in the past 20 years.

Deterioration in the quality of capital goods? A numerically controlled machine tool—one combined with a microprocessor and process control software—is claimed to be able to improve production by 160 per cent. On top of this, if one uses computer-aided design (CAD) and computer-aided manufacturing (CAM), the plant-wide production triples. Moreover, with a mainframe computer, a "just-in-time" inventory control system can be instituted which would save warehousing costs entirely. Although such claims are never taken too seriously, in 1988 the computer and computer-related industry sold $230 billion worth of hardware, and they have been selling computers for the past 40 years. Has the quality of those computers deteriorated? Today, one memory chip has the capacity of one megabyte compared to 16 kilobytes only 20 years ago. The memory access speed is only 9 nanoseconds (one billionth of a second) and is expected to drop to 2 nanoseconds some time in 1989. Tools, today, not only come equipped with their own intelligence, but are made with better materials and design. There is no question, therefore, that the quality of physical capital has not just improved, but improved tremendously. It should be noted that the related software components, which are human-capital-intensive and do not so much enjoy the economies of scale as do physical capital goods, are of ever-increasing importance. In calculating the productivity of capital, using an output capital ratio, the inclusion or exclusion of human capital makes a great deal of difference. If human capital is included among the capital inputs, there is low productivity but the result is reversed if it is excluded. That aspect will be discussed later.

Could the pace of technological progress have slowed down? This cannot be true. Developments in new materials, in genetics engineering, in telecommunications and information technology will beat the impact of the steam engine at any time. The OECD countries have been spending some 2 per cent of their GDP in research and development, and the share is increasing rather than decreasing. Nevertheless, there seems still a long way to go until research and development efforts give rise to yet another clustering of "major innovations" of the kind which Schumpeter saw characterizing the upswing phases of the long waves.

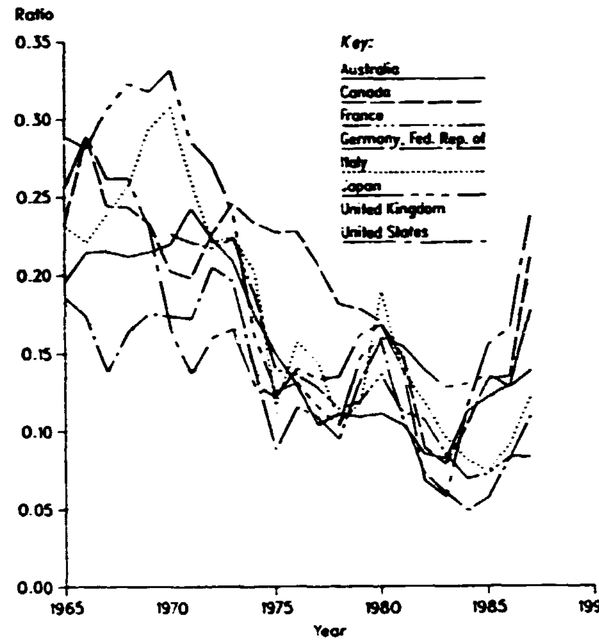
Has the world run out of strategic raw materials? The year 1988 turned out to be the best year for the basic metals industry since 1979. The average stock-consumption ratio dropped to 50 per cent (that is, a half year's supply in stock). This boom in the basic metal industry, however, occurred mainly because the years of poor prices and resultant closures of uneconomic operations left the industry unprepared to increase its capacity in the short run. According to the UNIDO survey, both mining capacity and primary refining capacity are sufficient to supply world demand in the foreseeable future. What about oil? Although UNIDO predicts a shortage by around 1996, if not before, the Organization of Petroleum Exporting Countries (OPEC) has been unable to improve oil prices to $18 per barrel. The current oil price of about $16.8 per barrel is still lower than the 1973 level in real price terms. Thus, viewed from a longer-term perspective, the world has not suffered from a shortage of materials. On the contrary, an over-supply has been the problem, and that includes the production of food as well. Unfortunately, sub-Saharan Africa has little capacity to tap the excess supply in the global food market.

The classical "Malthusian trap"—so much expounded by the Club of Rome only a decade ago—has now been replaced by a new concern about "our common future"—in particular "the greenhouse effect" arising from the current dependence on fossil fuels. Apart from the growing concern about the relationship between energy technology and the global ecology, the current economic scene is characterized by every country trying to export rather than import and accusing other countries of dumping, rather than hoarding materials and products. In the global context, the current trend of economic slow-down does not seem to stem from an excess aggregate demand. In fact, the world has a depressed aggregate demand partly because it has been transferring the effective demand from "high-propensity-to-consume countries" such as those of Latin America to "high-propensity-to-save countries" such as Japan and the Federal Republic of Germany. And once the United States starts saving, total world demand will plunge, unless new effective demand is created elsewhere through some income transfer mechanism.

E. Productivity of investment and industrial restructuring

There are many ways to measure changes in the productivity of a country, but for the purpose of the present analysis, the growth in GDP is compared with investment, expressing productivity in a simple ratio—the percentage increase in GDP resulting from every 1 per cent GDP invested in capital formation. This ratio is akin to the "capital coefficient" in the orthodox Harrod-Domar growth equation or to the inverse of the so-called incremental capital-output ratio. Since investment requires some gestation period, a five-year moving average is used to calculate this national investment productivity measure. The actual values calculated for selected developed countries are shown in figure I.4.

Figure I.4. Ratio of GDP growth to capital formation share in selected developed countries



Sources: UNIDO data base, International Financial Statistics
Note: Ratios are five-year moving averages

Despite differences in the experiences of the various countries, the overall pattern is quite striking. In the 1960s the ratio is high and often rising. It reaches a peak in 1970 after which it declines steadily, reaching a trough in the recession of the early 1980s. There is, however, a clear sign of a revival since then and the ratio is again rising. But around this "duck back" shape, there are interesting variations.

In the United States, the ratio achieved the highest value of 0.28 (that is, investment equivalent to 1 per cent of GDP produced 0.28 per cent of extra GDP) in 1966. Since then, national investment productivity or the capital coefficient steadily declined, hovering around 0.13 in the 1970s and hitting bottom with 0.08 in 1983. From then on, it recovered to show a value of 0.16 in 1986 and a sudden jump to 0.22 in 1987.

In the past, Japan's growth performance has been extraordinary, as reflected by its national investment-productivity ratio. When Japan was consistently maintaining double-digit growth figures during the 1960s, the figure stood near the remarkable level of 0.38. Since 1972, however, the growth rate and with it the capital coefficient have perceptibly and continuously been dropping. The lowest point was reached in 1978, when each 1 per cent investment of GDP brought only 0.10 per cent GDP growth in return. Since then, it recovered to around 0.13 during the 1983-1987 period. In 1988, it is expected to have increased to no more than 0.14.

Is it true that investment productivity in Japan has fallen below that of the United States? Incredible as it may seem, that has been the case continuously since 1982, and was so occasionally between 1972 and 1982. In other words, since 1972, Japan's relatively high growth has been the result of higher rates of investment, rather than due to higher productivity of capital. As will be seen later, this applies to the Federal Republic of Germany as well.

The capital coefficient of Japan plunged practically overnight during 1974 and 1975 because of a massive restructuring in the manufacturing sector. The quadrupling oil price hit the world and Japan especially hard. The initial response by Japan's industry was to invest money in replacing old equipment to make factories more energy-efficient. How expensive that effort was can be gauged from the following: in 1973, Japan spent 36.4 per cent of GDP on capital formation—the highest ever ratio in recent history. The capital coefficient, however, dropped to 0.24—the lowest rate ever up to that year. But the real crunch came soon after, when the continued effort to retool and re-equip industry in 1974 and 1975 forced Japan to invest, respectively, 34.8 per cent and 32.5 per cent of its income in those two years, with the consequence of investment productivity declining to 0.16, and further to 0.13. But consider what happened in the manufacturing sector, which contributed roughly 26 per cent of Japan's GDP at that time. In 1974, Japan's manufacturing sector, as a whole, invested 14.2 per cent of its gross income, but obtained a negative 3.8 per cent return in the form of aggregate income growth. In 1975, the return was a negative 9.9 per cent, while investment was equivalent to 21.9 per cent of total manufacturing value added in that year.

Once it was realized in Japan that the energy crisis was not only permanent but world-wide, another wholesale structural change had to take place—this time to explore, and if possible to satisfy, the changed structure of world demand. Thus, during the period from 1975 to 1980, 19 out of the 28 industrial sectors in Japan contracted their shares of MVA, led by the petroleum refining and automobile industries. On the other hand, the glass and glass products industry and the electronic machinery sector led the expansion. Surprisingly, the scale of restructuring undertaken by the Japanese manufacturing sector in that particular period was much greater than the one in the previous period—in fact almost twice as great. The UNIDO index measuring structural change experienced by the Japanese economy between 1970 and 1975 shows a figure equivalent to 8.7 per cent of the total output value.* The figure for 1975-1980, however, has reached the value of 15.6 per cent. In the meantime, the capital coefficient dropped to unprecedented levels—0.13 in 1976, 0.12 in 1977, 0.10 in 1978 and 0.15 in 1979.

The story of Japan's industrial restructuring does not stop here. In the early 1980s, the oil price started collapsing, which presaged another massive income redistribution world-wide, and further changes in the world-wide demand pattern. Thus, between 1980 and 1985, the share of electronic machinery in total industry increased by 57 per cent and that of non-electrical machinery by 11 per cent. With the exception of the automobile industry, which managed to increase its share slightly, all other 25 industrial sectors have been forced to contract their original shares in the economy. This switch-over was bigger than the one between 1970 and 1975, and amounted to a 23.7 per cent structural change between 1980 and 1985. And, after the massive revaluation of the yen, the structural change index reached 20.4 in 1986 and 20.7 in 1987.

An industry-wide restructuring also took place in the United States after the first oil crisis, but surprisingly without any major upheaval in the economy. The structural change index for the United States between 1970 and 1975 was a mere 6 per cent. By 1980, however, the index went up to 8.1 per cent and continued to climb, reaching 8.3 per cent by 1985. The fact that these figures are extremely low in comparison with those of other countries simply reflects the relative size of the United States economy *vis-à-vis* others. It was, indeed, the relative size of the United States economy that enabled it to absorb and accommodate the enormous onslaught of imports from Japan and the so-called newly industrializing coun-

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*In this *Global Report*, unless stated otherwise, structural changes are measured by the compositional changes in output that have taken place between two specified periods in the manufacturing sector as a whole, which, in turn, consists of 28 International Standard Industrial Classification (ISIC) industries. The compositional changes are, however, measured with the value-added contents of different industry outputs instead of taking the values of total output at face value.

Productivity weighted by labour $= P = \frac{Y}{L} \left(= \sum_i \frac{Y_i}{L_i} \cdot \frac{L_i}{L}\right)$

with $Y = \sum_i Y_i$ and $L = \sum_i L_i$

Productivity weighted by output $= P_0^t = \sum_i \frac{Y_i^t}{L_i^t} \cdot \frac{Y_i^t}{Y^t}$

Change in productivity due to structural change $= P_0 - P_{t+5}$ $P_t =$

$$\sum_i \frac{Y_i^t}{L_i^t} \cdot \frac{Y_i^{t+5}}{Y^{t+5}} - P_0^t$$

Specifically, the UNIDO "structural change index" is derived by calculating the differences between the actual output values (measured by the value-added contents only) observed in a given year for each of the 28 ISIC industries and the respective output values that would have been achieved if all sectors had expanded (or contracted) with the same rate as the average for the manufacturing sector as a whole. The total sum of differences so obtained thus indicates the extent to which the current output composition underwent changes during a given period, and in this *Global Report* that sum is expressed as a percentage of the total manufacturing output (value-added) of the end year of observation. This means that the UNIDO structural change index will have a bigger value if the period of observation becomes five years instead of one year, unless yearly changes in the meantime cancel themselves out. This means that structural changes occurring at the intrasectoral level are not fully reflected.

tries* (NICs) during those periods without serious structural strains. In 1970, even before the oil crisis, the United States economy suddenly lost steam, and its growth rate dipped for two years, allowing the economy to adjust and realign itself, but pushing down the aggregate capital coefficient to 0.17 from the previous average of 0.27. Structural changes that took place after the oil crisis brought the investment productivity figure down to about 0.12 or 0.13. After regaining strength during 1975-1980, that figure plunged further to about 0.07 or 0.08 during the 1981-1982 recession, when a wholesale restructuring took place. But a basic structural change occurred in 1978, when the United States import share of GDP became 10 per cent, which it has remained ever since.

Among other developed countries, Australia had a relatively high investment coefficient until 1971, when the terms of trade on its agricultural exports started deteriorating. The capital coefficient was 0.24 in 1971, but has declined steadily to 0.09 in 1982-1983. The recovery of its strength since then has been slow. Canada was one of those fortunate countries where national investment productivity did not suffer during the oil crises. Canada, as was the case with most developed countries, registered the highest productivity figure during the late 1960s, in the range of 0.22 to 0.24. The decline in the coefficient in the early 1970s was arrested in 1972 and received a boost in 1973-1974, Canada being an oil supplier. Since 1976, however, the capital coefficient has taken a turn for the worse, dropping to 0.08 in 1983 and recovering only to 0.13 by 1986.

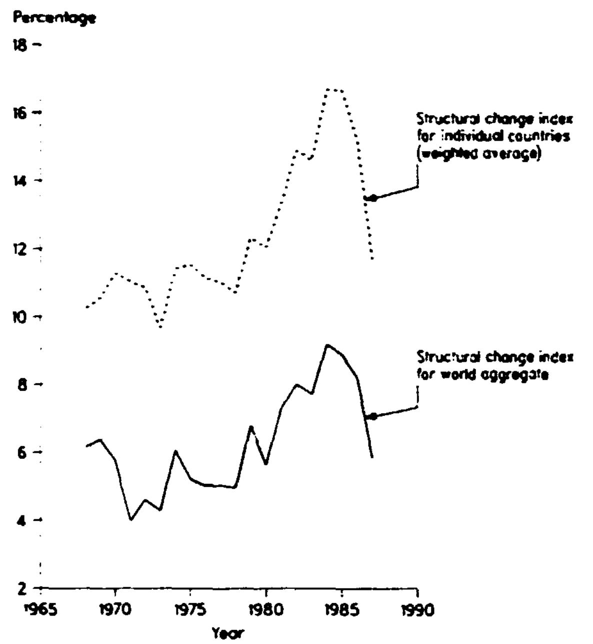
In Europe, the vaunted economy of the Federal Republic of Germany was also showing signs of not having a proper aggregate return on its aggregate investment. One of the most surprising facts is that, since 1960, the Federal Republic of Germany has had, on the average, a much lower capital coefficient than that of the United States and Japan. A similar phenomenon has been observed in most of the European economies, and was once generally known as "Eurosclerosis". The capital coefficient of the Federal Republic of Germany, which was in the 0.17-0.19 range most of the time prior to 1974, has come down to 0.05-0.08 in recent years, up to but excluding 1987. The productivity decline in the United Kingdom was almost continuous from 1965 to 1984, with the initial figure of 0.18 dropping to 0.04 during the 1980-1984 period. Except for a brief recovery during 1973-1974, due to North Sea oil, the United Kingdom's capital coefficients of 0.11 in 1985 and 0.16 in 1986 represent tremendous improvements. Both France and Italy had relatively high capital productivity ratios until 1974—France often exceeding 0.27 and Italy gyrating between 0.20 and 0.32. Both countries, however, experienced a decline in their productivity, reaching the 0.05 figure in 1984 and further dropping to 0.04 in 1985. Since then, both have recovered, but only marginally.

*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.

F. International competition and the cost of structural adjustment

Between 19' · 1985, world-wide production of manufactured g ·s underwent only a 8.8 per cent structural change, defined as the combined value of additional output by expanding industries and the value of output lost by contracting industries. It so happened, however, that the structural change undertaken by individual countries amounted to 16.7 per cent of their total manufacturing output on the average; that is, twice as much as the global aggregates suggest (see figure I.5). Such a large discrepancy

Figure I.5. Structural change in the world and in individual countries



Source: UNIDO data base.
Note: Structural change indices are based on five year intervals.

occurs because expansions and contractions in one country are partly offset by obverse output changes and investment decisions in other countries. The economic meaning of the discrepancy is left open for discussion, possibly because the decisions underlying the discrepancy are largely unco-ordinated, a circumstance which can result in a tremendous waste of investment resources in aggregate terms.

Suppose there were as many independent firms in a country as unco-ordinated and competing national economies in the world, then the 17 per cent structural change undertaken by a country during 1980-1985 could mean that the individual firms within that country, again on an average, expanded or contracted their production by more than 34 per cent. In the meantime, the number of firms swells because of new entrants or decreases due to bankruptcies and plant closures. In any case, it is not hard to imagine the extensiveness of duplicative investment decisions among individual companies in the absence of an industry-wide agreement. Collusion and cartelization are indeed dreadful words. They reduce competition and, therefore, supposedly reduce the efficiency of an industry and of the economy as a whole. However, the figures indicating how much unco-ordinated efforts among the countries lead to duplicative competitive investment efforts in the world as a whole should be kept in mind.

For instance, is it any wonder that the average cost of financing increases beyond the average rate of return on investment when the same investment is duplicated four times over the world? If real interest rates were to become higher than the rate of return on investment, not just on marginal investment projects, but on the average basis for all investments in the world, global debt would certainly have to expand, rather than contract.

According to UNIDO's estimate, the total outstanding official external debt of developed and developing countries combined reached \$2.7 trillion in 1988. The then current Eurodollar rate of interest ranged between 8.7 per cent and 9.7 per cent. Even after discounting for the current United States inflation rate of 5.3 per cent, the real interest rate exceeded the world-wide average capital coefficient or investment productivity, which was 3 per cent in 1988. One can, of course, find profitable investment opportunities even in debtor countries, but not \$2.7 trillion worth, which coincidently happened to be the same amount that was invested by the world as a whole in 1988, receiving a 3 per cent real return. This means that external debt can perhaps be shifted from country to country, but the absolute amount will keep increasing. This, in turn, means that trade and investment will be increasingly determined by the relative creditworthiness of countries rather than by comparative advantage.

It is often said that the international financial system, with an introspective logic of its own, has become ever more remote from reflecting genuine economic needs. How else could one explain that a country practically sitting on a lake of oil cannot borrow \$10 million, while one businessman can raise \$2.5 billion simply by issuing "junk bonds"? What is frightening is not that such strange things could happen, but the fact that such a deal makes perfect sense in this world.

The traditional theory of international trade is based on comparative advantage. The thought that trade expands to compensate for the comparative disadvantages inherent to a country now seems to be misplaced, and with it the notion of finding harmony in international trade. In the past, the world has benefited from cheaper import prices for constantly improving products because of increasingly competitive international trade. International trade, however, has come, to an important degree, to be driven by both economies of scale and economies of scope rather than comparative advantages alone. In other words, a country can prevail over others simply by investing more in plants, keeping ahead of other countries in research, and developing an ability to manage diversified lines of business. Proposals in the United States for the Government to fund national efforts to develop high-definition television sets, to form collaborative research groups to work on superconductivity applications and to assist private sector work in areas of advanced technology such as X-ray lithography and optoelectronics show the scope of investment required even before products are developed. The real indication that Governments in developed countries are seriously thinking about economies of scale can be gleaned, for example, from movements toward a much less stringent application of the traditional anti-trust laws, and from the single market concept of Europe.

Competition, however, begets competition, and more often than not the competitive edge that one country establishes against others, through massive research and investment efforts, soon shifts to any other country which, in the meantime, can afford an even more intensive research and investment effort. For example, after forcing the United States memory chip-makers to close their plants in 1986, Japanese firms came to account for 95 per cent of the world's supply of 1 megabyte DRAMs in 1988. The equipment to produce memory chips is expensive (\$300 million for one fabrication plant). Thus, fixed overhead costs run up to 75 per cent of total costs, as currently prevalent in Japan. In the case of 256 kilobyte DRAM, a doubling of output reduced costs by 30 per cent, and in the case of 1 megabyte DRAM, by 20 per cent. Japan beat the United States with the price advantage obtained through the mass-production of chips. The situation has, however, almost reversed itself in less than two years. Currently, the Japanese price of 2,000 yen per chip gave the United States makers more than a fighting chance, especially with the drastically devalued dollar. The United States semi-conductor industry already has four declared new entrants. Would competitive rivalry stop here? In 1989, Japan's big ten semiconductor manufacturers announced new investment plans totalling \$5 billion—all scheduled for 1989 alone. The irony is, of course, that this competitive expansion is taking place when world-wide demand for chips is expected to slacken, and the double irony is that those who are investing are aware of this. While winners see an opportunity here for further "globalization" of their production, losers tend to call this situation "excessive" competition—a concept which neo-classical economists snub as mere illusion.

Many developed countries are therefore turning against international competition. Protectionism, under other names, is now widespread. It is called fair trade, anti-dumping, promotion of local content or voluntary export restraints. In the meantime, international competition is acquiring new dimensions, such as public subsidies, research consortia, recession cartels, intellectual properties, single markets and other restrictive forms of economic integration.

Would this retreat to protectionism save developed countries from a continuous drop in their productivity? The answer seems to be a negative one so far. The following three examples illustrate the point. First, increasing trade friction between the United States and Japan forced Japan to shift production bases to the United States in increasing amounts. For example, the Japanese had to invest in the United States in order to produce 2.2 million automobiles it had been exporting. Japanese automobile parts and component producers are following suit. Needless to say, the new capacity is in addition to what already exists in the United States and Japan. Second, the toughening stand by the European Economic Community (EEC) on the local content provision is forcing Japan to upgrade its "screw-driver-assembly" type of plants to increase their local content from 40 to 80 per cent. It appears that Japan now has to invest some $300 million to install what is known as a "diffusion process"—the etching of circuits on to blank silicon wafers in its memory chips factory in Europe. In that case, what will become of the existing plant capacity in Japan? Third, it is now apparent that the United States, Japan and the EEC will each develop its own competing system of high-definition television. The development of a United States high-definition television industry, it is claimed, could result in employment for 232,000 workers and contribute at least $22.8 billion to the United States GNP. No doubt similar figures can be found for the EEC and Japan. This, however, is not the net addition to total employment. Parallel with the creation of new employment will be the destruction of jobs in the existing television industry. To this we have to add those of the companies in the new industry in these three competitors who will lose out due to duplicate investments.

G. Dilemma for late comers

Large economies of scale mean that, for newcomers or late comers—that is, developing countries—the initial investment required to build an export-oriented industry often becomes prohibitively expensive, not to mention the risk involved in building production capacity ahead of demand. But the world will continue to face newcomers and "pre-emptive investments" by them. When Japan started seriously considering automobile exports in 1960, its production capacity for both passenger and commercial vehicles combined amounted to less than 500,000 units per year (less than 3 per cent of world-wide capacity). Export ambition brought the Japanese capacity to 2 million units by 1965. Japan managed to export only 195,000 vehicles in that year. Continuous investment brought the capacity to 6 million units by 1970 and Japan sold 1,087,000 units abroad that year. Exports took off only after the first oil crisis: 2 million units in 1973, 3 million in 1976; 4 million in 1977; and 6 million in 1980. The present production capacity of 12 million units, however, is only twice the 1970 capacity, showing the extent of slow-down in the capacity build-up in anticipation of export demand.

Building production capacity ahead, in anticipation of export demand, is risky, but often necessary. The above-mentioned case of the automobile industry of Japan is one of the success stories associated with the emergence of Japan as the most internationally competitive producer in many industrial product lines. Despite World Bank objections, the Republic of Korea went ahead and built a steel complex in the face of a world wide glut and excess capacity in steel, and eventually became a successful steel exporter. Likewise, Nigeria is hoping to complete its Ajaokuta integrated steel mill project which will give the country an expanded steel production capacity of 2.3 million tonnes a year which, according to the World Bank, is almost five times the projected domestic demand. It took Chile five years of patience and investment before it started exporting agro-food products all over the world.

Efforts to build large excess capacity ahead of demand entail enormous risks, especially for developing countries. First, anticipated demand may never materialize, such as, for example, the car manufacturing projects in Malaysia and Thailand, the iron and steel project in Trinidad and Tobago and sugar alcohol production in Brazil. Second, a country's foreign exchange may run out before the project is completed, as was the case with the Ajaokuta steel project and the textile and cement industries in Nigeria, the sugar mill in Sudan, food-processing plants in Cameroon and Congo, an edible oil production plant in Mozambique and agricultural tool and implements manufacturing in the United Republic of Tanzania. Third, once completed, a full-scale operation may be forestalled because of lagging investments in infrastructure, as was the case with the missing deep sea ports for the Delta steel mill in Nigeria and the Shanghai mill in China, the frequent power shortage for jute and carpet industries in India and for glass bottle manufacturing in China, and the lack of effective transportation systems for rice milling in Chad and agro-industries in Zambia.

The list of such investment misadventures committed by developing countries abound, especially during the cheap money era of the 1970s. However, the main question should not be why or how these mistakes were made, but what to do with them now? Nowadays, one often hears of countries going through "restructuring" or "structural adjustments" rather than growth-oriented structural changes. International lending agencies make "structural adjustment loans" to economically distressed developing countries. Even in the developed countries, investments are often carried out in the name of structural adjustment. And there is *perestroika*, or restructuring, in some centrally planned economies. Implicit in all this is the perception that restructuring is required in order to survive the harsh economic realities of international competition. Every country's perception is now more on survival than on progress. Adam Smith, long ago, pointed out that survival and progress are not necessarily a contradiction in terms: Progress means that some industries will prosper while others will fail. However, in international competition, weak and slow countries cannot disappear, and they are not allowed to declare bankruptcy. They are just "encouraged" to become more competitive internationally and in as short a time as possible. Earning foreign exchange has become a paramount consideration for almost all countries. Thus, competing to secure increased global market shares for traditional export goods or to develop new export products has become the driving force for structural changes. Indeed, according to our survey, "industrial structural changes" in 30 developed countries remained quite moderate until 1974. However, developed countries, as a whole, seem to have been subjected to an almost continuous change ever since in spite of stagnating manufacturing activities. Major "structural changes" took place for three years in succession (in 1973, 1974 and 1975) immediately after the first oil shock. After a brief interlude, extensive industry-wide changes returned with un-

Figure I.6. Structural change and growth performance in manufacturing, developed countries

Source: UNIDO data base.

Figure I.7. Structural change and growth performance in manufacturing, developing countries

Source: UNIDO data base.

expected regularity and severity—in 1980, 1982 and 1984 and probably again in 1987.

Genuine structural change, however, requires more than a yearly change in output composition. Therefore, figures I.6 and I.7 show the structural change indices, computed on the basis of output compositional changes, in developed and developing countries over a longer (five-year) time span, but ignoring changes that took place in in-between years. Figure I.6, which depicts the situation in developed countries, as a whole, shows the quickening pace of structural change against the deteriorating growth performance since 1974 and up to 1984. For some reason (protectionism, lags?), the pace of structural change has slowed down considerably since 1984, and with it, the growth performance seems to have improved. Figure I.7 shows the situation in developing countries, where major structural changes seem to have taken place before the 1980s. There are strong indications that developing countries have for some time been at the receiving end of world-wide structural change instead of generating their own through the internal dynamics of industrialization.

All that could be concluded from this observation is that the developed countries, as a whole, have become adept at coping with economic change. What cannot be concluded, is that this adaptive dynamism has led those countries to anywhere near to recovering lost productivity of investment. Indeed, evidence indicates the contrary—the constant structural change has undermined overall productivity of investment. This somewhat unexpected and almost heretical conclusion receives some credence if one realizes that the structural changes undertaken in the developed countries in the past 15 years or so were, by and large, either involuntary or of the adjustment-through-rationalization type, such as after the oil shock, during economic recessions, or under beggar-thy-neighbour pressure to expand exports abroad (or to defend home turfs aggressively).

Thus, while the pace of structural change in developed countries has been accelerating, that of international trade has been decelerating. A review of the world economy shows that world trade expanded at an annual growth rate of 8 per cent in the 1950s and 1960s. During the 1970s, annual rates slowed down to between 4 and 5 per cent. In the 1980s, with the exception of 1988, the average rate has dropped to just under 3 per cent. In the meantime, economic growth rates in almost every country participating in international trade has shown a general and substantial decline despite a continuous effort to restructure the economy and readjust to a changing external environment. In view of such statistics, it may be wondered whether the particular brand of international competition which the global economy is imposing on itself is conducive to growth and development.

The basic nature of international trade is changing for another reason as well. Nowadays, the wage content of most industrial products is said to be less than 20 per cent. The remaining 80 per cent is usually associated with costs of management, marketing and financing. This means that the cost advantages obtained through automation in the classical sense of the term or through the use of cheaper labour cannot exceed 20 per cent of the product value. The implication for developing countries is therefore ominous. Their advantage in labour cost no longer counts, and it appears that their advantage in natural resources counts even less. One consequence is that world-wide investment in physical capital is diminishing. For instance, the Federal Republic of Germany spent less on machine tools in 1988 ($3.84 billion) than in the previous year, although manufacturing investment in 1988 was the highest since 1985. Again in 1988, the long-awaited investment boom occurred in the United States, but United States manufacturers installed less machine tools in 1988 ($3.85 billion) than in 1987 ($3.97 billion). This simply confirms that software, rather than hardware, counts. But the real problem arises when the world neglects long-term physical investments. With the current market rate of interest, any project promising normal returns five years hence makes little sense, especially under rapidly and constantly changing international comparative advantages. This also means that the flow of investment funds to developing countries becomes scanty, despite the fact that they need developmental investments which ought not be exclusively short-term and commercially oriented. The economies of the sub-Saharan African countries seem to have been particularly hurt by the dwindling flow of long-term investment capital.

II. Adjustment through deindustrialization in sub-Saharan Africa : some empirical evidence

Many developing countries, especially those of sub-Saharan Africa, are being criticized for not taking prompt action to redeploy resources from declining to expanding industries. If an economy can direct its resources to produce the right goods in the right proportions, productivity of its resources will, in general, be enhanced. Many have an implicit faith in the working of market forces for this job, while others favour some form of government intervention. All, however, admit that an economic system—any economic system—can make mistakes from time to time. But, are some developing countries mistake-prone? For nearly a decade, international development agencies have been urging developing countries—especially those with high external debts and those in the sub-Saharan African region—to adopt policy reforms in favour of increased efficiency in the allocation of scarce resources to strengthen their external competitiveness. For example, between 1980 and 1987, 51 countries received either structural or sectoral adjustment loans from the World Bank, totalling $15 billion in 121 separate incidences. Almost half the number—but not the amount—of loans for adjustment went to sub-Saharan Africa. All the adjustment loans essentially had the same broad objectives—to support policies to improve economic incentive structures, and to strengthen institutional capacities to bring about necessary structural adjustment to cope with a changing external environment. As has been pointed out, however, the external environment seems to be changing not only frequently but also with a special ferocity, allowing these countries little time to adjust or to reap the benefits of whatever adjustments have been achieved. Some measures need to be taken, therefore, to contain external impacts in order to control the pace of adjustment and to provide a semblance of stability required for long-term structural change. In that context, what sort of institutional arrangement would be required to tackle the job in developing countries with an extremely fragile and limited industrial base still remains an open question.

A recent report [3], prepared jointly by the World Bank and the United Nations Development Programme, argues that, rather than external factors, domestic difficulties, including structural rigidities and institutional weaknesses as well as poor policies, have limited the ability of sub-Saharan Africa to adjust their economies to the adverse changes which have occurred since the good years of the late 1970s and early 1980s, and this, in turn, could have contributed to the current economic crisis.

Thus, structural rigidity and resulting price distortions, especially in the agricultural sector, have become the main focus of the reform in sub-Saharan African countries initiated by the World Bank. UNIDO is particularly concerned with the success of those African countries in handling structural changes in the manufacturing sector. In that context, it should be kept in mind that the most crucial structural change required in sub-Saharan African countries is the one which brings about a minimum level of industrialization in those countries. In most of them, a genuine industrialization process has either yet to take hold or is still in a nascent stage. On the other hand, industrialization is not only desirable *per se*, but is frequently the chosen road for economic development in many of those countries. Under the circumstances, evaluating their economic performances with the marginal rules of resource allocation advocated by the neo-classical school of economists would be woefully inadequate, since those rules take the economic environment facing each country in each slice of time as given, and do not prescribe a process of change. The UNIDO analysis none the less starts by quantifying the potential productivity losses in those countries within the narrow confine of static allocative efficiency —in order to grasp first their relative economic significance.

Although much is heard about the poor performance of the agricultural sector in sub-Saharan countries, the situation in their manufacturing sector seems to be much worse. While the sub-Saharan countries, as a whole, maintained a slightly positive productivity growth per worker in agriculture in recent years, the manufacturing sector experienced an absolute diminution in output per worker of approximately 28 per cent between 1970 and 1985 in real terms. Some countries saw their labour productivity declining by more than 50 per cent (Benin, Central African Republic, Ghana, Somalia, Togo, United Republic of Tanzania and Zaire). Thus, the average manufacturing output (value added) per worker for the whole of sub-Saharan Africa, which was $11,255 in 1970, dropped to $8,673 in 1985 (all in 1980 dollar prices) (see figure I.8).

Between 1970 and 1975, the output per worker in the manufacturing sector declined in 16 countries—Seychelles, Togo, Central African Republic and Somalia suffering the largest losses of more than 40 per cent. Between 1975 and 1980, the number of countries experiencing negative productivity growth increased to 17, led by Zaire (−80 per cent), Ghana (−69 per cent) and Gabon (−58 per cent). Finally, during the 1980-1985 period, the number of countries suffering from a declining manufacturing productivity jumped to 20, led by such countries as the United

Figure I.8. Value added per worker in manufacturing and changes due to structural adjustment in Tropical African countries, 1970-1985

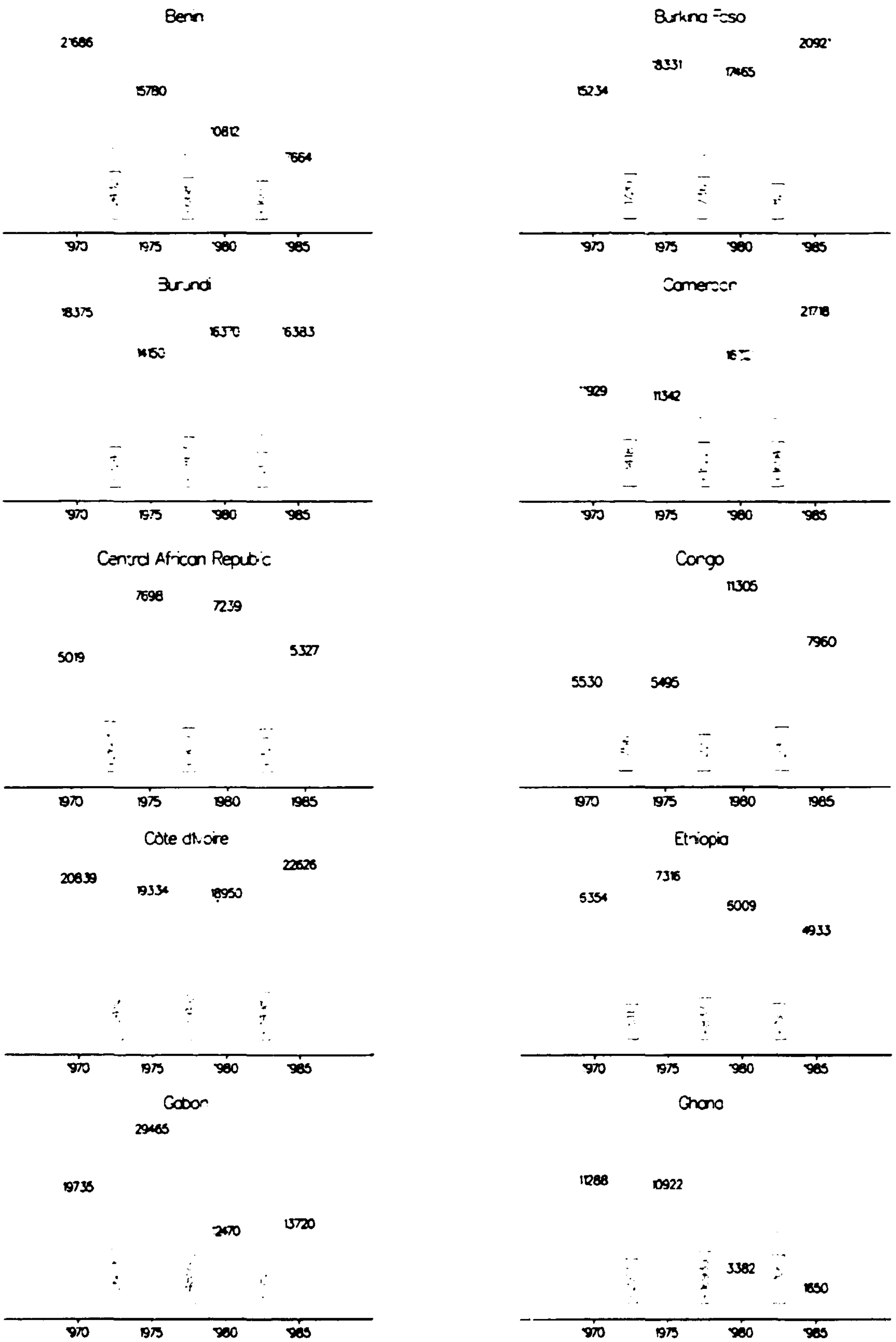


Figure I.8 *(continued)*

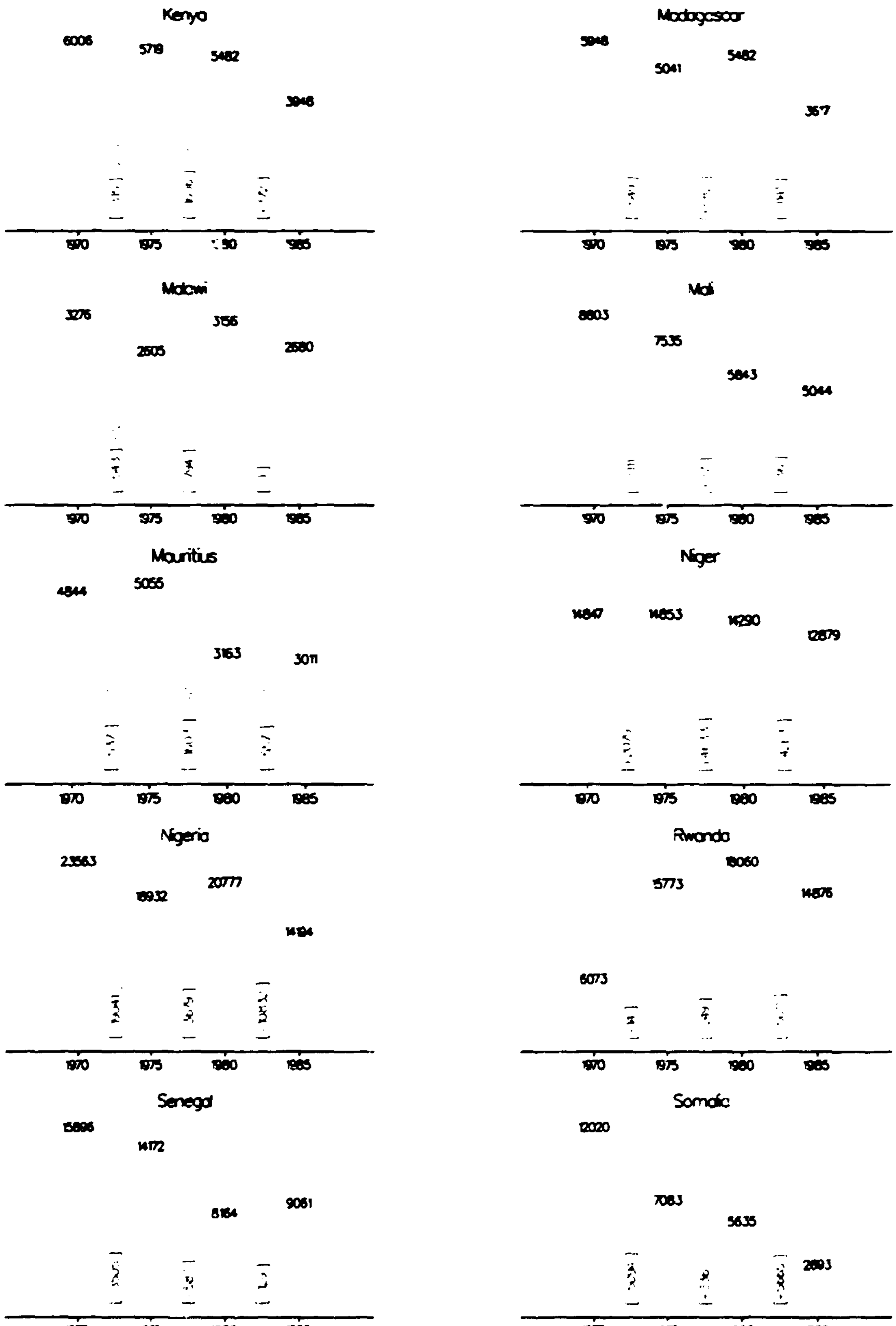
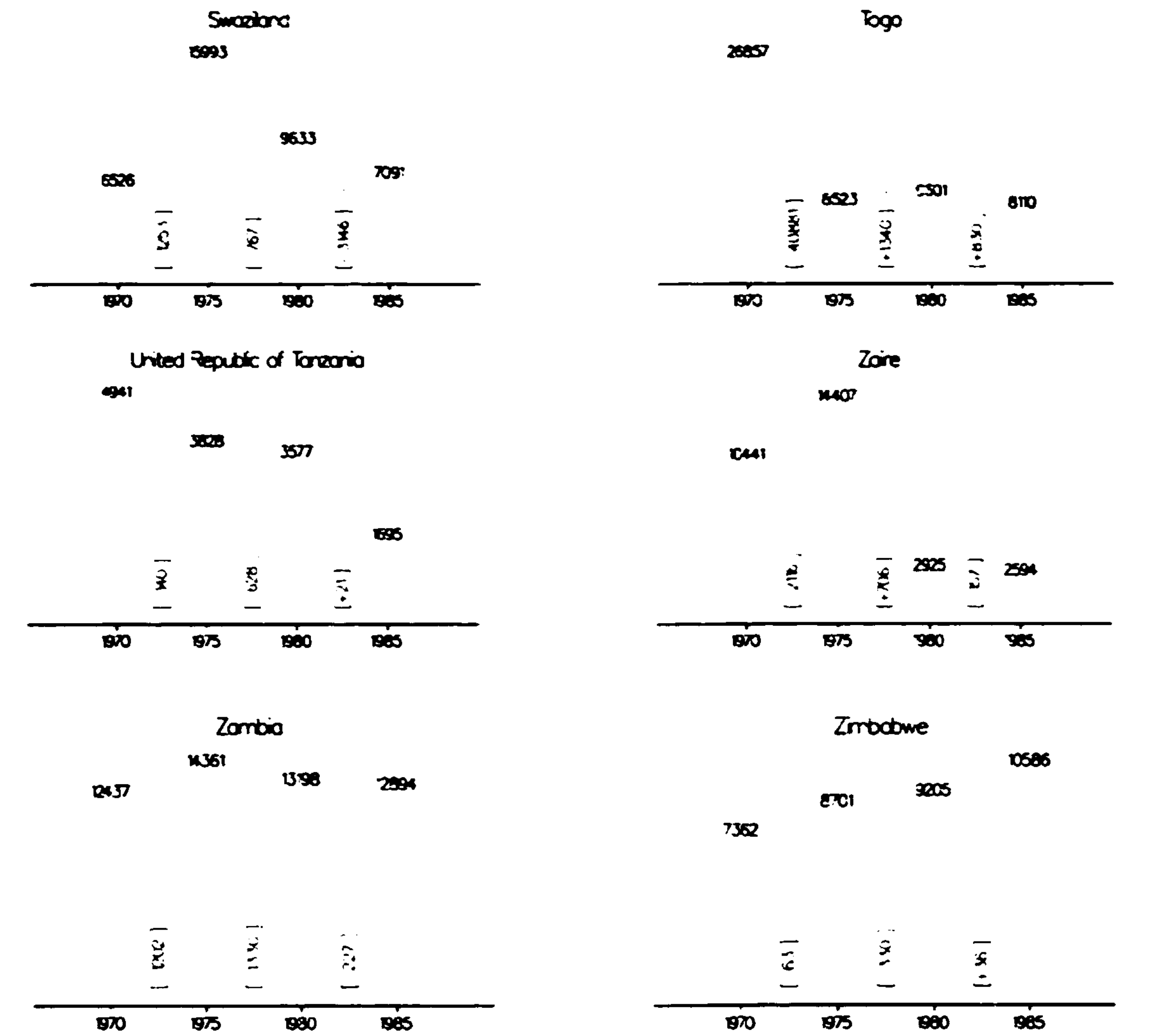


Figure I.8 (continued)



Source UNIDO data base
Note All figures are in 1980 constant dollars

Key: Value added per worker in given year

Increase or decrease in value added per worker due to change in output composition

Structural change index

Republic of Tanzania, Ghana, Somalia, Nigeria and Congo.

What made workers in those countries suddenly less productive in such a drastic way? The period between 1980 and 1985 represents a specially painful period for the sub-Saharan countries. Both GDP and MVA per capita declined absolutely for the region as a whole. The collapsing export markets and increasing debt service made foreign exchange extremely scarce. This, in turn, forced many new industrial plants, ranging from plastics to automobile assembly, to curtail production because of shortages in imported inputs, equipment and spare parts. A large number of traditional manufacturing facilities were also forced into idleness with the withdrawal of government subsidies and other supports as an austerity measure. Thus, capacity-utilization rates dropped drastically in most countries, often to between 20 and 30 per cent. Under the circumstances, a drop in output per worker is not a totally unexpected outcome, assuming that countries did not adjust their employment levels promptly.

An important concern in this context is whether or not that trend implies that the industry-wide structural adjustment process has taken a perverse turn, shifting workers from more productive to less productive industries, and producing relatively more goods that are deemed less worthy by the consuming public. Incidences of an economy getting caught in such a quandary because of an unanticipated shift in demand are quite frequent. It appears that such a phenomenon took place in Japan during the 1970-1975 and 1980-1985 periods. It even happened in the United States between 1980 and 1985. In fact, only Belgium and Ireland seem to have avoided making such a mistake among developed countries (including centrally planned economies) and, surprisingly, Mexico, among developing countries.

However, an industry-wide loss of output per worker may mean, alternatively, a relative increase in the output share of labour-intensive (hence low average labour productivity) industries at the expense of capital-intensive (high average labour productivity) industries. Should that prove the case, then the issue will not so much be one of structural maladjustment as one of the fragility of the fledgling modern industries (or simply deindustrialization) in the region.

Of the 27 sub-Saharan countries surveyed, 21 countries seem to have experienced structural adjustment during 1970 to 1975 which cost each country at least 10 per cent in terms of output per worker. Especially in Gabon and Togo, the estimated output losses were enormous, and the loss estimates for Côte d'Ivoire and Nigeria were equivalent to more than 30 per cent of their respective output per worker figures for 1970. Apparently the situation improved between 1975 and 1980. There were only 14 sub-Saharan countries suffering from signs of deindustrialization during that period, of which 13 were repeaters from the previous period with one newcomer, Rwanda. Among the repeaters, the situation worsened in Côte d'Ivoire, Kenya, Malawi, Mauritius, United Republic of Tanzania and Zimbabwe. The number of countries caught in the adjustment through deindustrialization between 1980 and 1985 became 15, including three of those eight that showed positive results in the previous period. The list also includes newcomers such as Burundi and Niger* (see figure I.8).

Statistics show the scope of structural changes imposed on the sub-Saharan countries in the manufacturing sector to be usually two to three times as great as the average size in developed countries. The extreme case is Togo, which had a structural change index of 102 per cent of its total output between 1970 and 1975, dropping to 46 per cent between 1975 and 1980, but moving back up to 53 per cent between 1980 and 1985. Somalia underwent 84 per cent structural change in the initial period, 62 per cent in the second period, and 74 per cent in the final period. Nigeria, the largest economy in sub-Saharan Africa, experienced 63 per cent between 1975 and 1980 and 60 per cent between 1980 and 1985. In fact, of the 27 sub-Saharan countries subjected to the UNIDO statistical analysis, 15 underwent a 30 per cent or more structural change between 1970 and 1975; and 14 experienced a similar extent of structural change between 1980 and 1985. There are, however, exceptions. Structural change seems practically absent in the Seychelles, averaging only 3 per cent before completely disappearing in the 1980s. Both Burkina Faso and Côte d'Ivoire seem to have enjoyed a relatively steady rate of structural change within the 14 to 22 per cent range throughout.

The African data suggest that the structural adjustment problem is not only prevalent, but a recurrent problem in sub-Saharan countries. However, even when the problem is common, the cause often varies. Recently, UNIDO completed a series of country studies examining the rehabilitation aspects of African industry [4], which helps to throw some light on the differing adjustment processes undertaken by the sub-Saharan countries in the face of rapidly changing external conditions. Two contrasting cases are described below.

The one country that does not appear to have lost productivity through the misallocation of resources is the Central African Republic, which apparently managed not just better, but consistently better, than any other in sub-Saharan Africa in selecting the expansion and contraction of the right industries. In a small country with a very limited manufacturing base, such as the Central African Republic, an economy-wide structural change often means merely one or two plants opening or closing down. In that regard, up to 1975, more than one third of manufacturing output and almost two thirds of manufacturing employment in the country were in the textiles and clothing industry. As a traditional industry, textiles and clothing still commands very low output per worker in the Central African Republic (as in many other countries). In 1980, the textile and clothing industry's share of output and employment dropped to less than 12 per cent and 25 per cent respectively after financial difficulties forced the closure of one plant which had been producing 1.4 million metres of cloth a year until 1979. However, in the meantime, new industrial enterprises producing products commanding higher outputs per worker such as car and truck assembly plants (Citroen and Peugeot), breweries (Mocat and Castel), and a soft drink bottling plant went into operation.

Again, a cigarette factory which began production in 1977 (with a capacity of 50 million cigarettes a year) created new employment in the tobacco industry for more than 100 workers. The gross output per worker figure in the tobacco industry was $10,209 in 1975, which compares extremely well against the 1,458 figure in textiles for that year. The country's food-processing industry, which consists largely of a few oil mills processing ground-nuts, cotton seed and sesame, a flour mill and an abattoir, increased employment from 476 in 1975 to 663 in 1985; the gross output per worker figures in the food industry were $10,294 in 1975, $8,292 in 1980 and $11,463 in 1985, which again compare favourably against, for instance, the wood products industry, which had been losing employment steadily, and had an output per worker figure of less than $8,000 in 1975 and only $3,031 in 1985.

The manufacturing sector of the Central African Republic, which was quite sizeable relative to the country's economic status in 1970 (15 per cent MVA

*The loss of productivity associated with structural change in this context was calculated by multiplying the output (or labour) composition vector of a given year by a set of output-labour coefficients observed in the starting year for different industrial branches which were held unchanged during the period considered share in GDP in 1970), has contracted year after year until 1983 at an annual rate exceeding 10 per cent. The total MVA figure, which stood at $94 million in 1970 (in 1980 constant prices), had dropped by 1986 to a level of $21 million. Today, the value-added contribution from the textiles and clothing industry seems to have completely disappeared. The wood and wood products industry, which generated $70 million a year in value added in the early 1970s, was allowed to contract to the current size of $5 million a year. The indigenous furniture industry, which contributed $0.4 million in value added up to the mid-1970s has barely survived with no growth since then. Whatever the country had by way of electrical machinery, cars and truck assembly and industrial and other chemical processing activities has either ceased operation or is operating at a nominal level. Today, the entire Central African Republic's manufacturing sector consists practically of three industries: food-processing (42 per cent of total MVA in the country), beverages (21 per cent) and tobacco manufacturing (35 per cent).

In 1983, serious attempts were made at economic recovery with financial and other forms of support from bilateral donors and international agencies. Indeed, despite a serious drought, the economy showed signs of expanding again in 1983 with a 3 per cent output growth in manufacturing that year, followed by a spectacular growth of 25 per cent and 12 per cent in 1984 and 1985, before relapsing in 1986 with a negative growth of 30 per cent. Was that recovery due to a structural reform which removed structural rigidities? The danger of attributing the economic recovery to any structural reform in the Central African Republic is, however, quite obvious. The point remains that structural fragilities rather than rigidities seem to have been the greatest of the problems encountered by the country in its relatively short history of industrialization.

Until the recession of 1981-1984, manufacturing was the most dynamic sector in Côte d'Ivoire's fast growing economy. Manufacturing gross output almost doubled between 1970 and 1975 and added another two thirds by 1980. Since then, growth has slowed, but remained positive—certainly well above and ahead of its neighbours within the West African community. Côte d'Ivoire's dynamic performance, however, seems to have been based on something other than the ability to redeploy resources from declining to expanding sectors promptly and continuously.

Côte d'Ivoire's manufacturing is heavily dependent on the processing of cocoa (of which it is the world's largest producer), coffee (of which it is the world's third largest producer) and sugar. The unprecedentedly high prices of cocoa, coffee and sugar in the mid-1970s attracted European money to open and expand export-oriented processing plants in the country. The entire food-processing industry in Côte d'Ivoire is, therefore, practically built around 16 coffee-processing plants (with a combined capacity of 325,000 tonnes a year), four cocoa processing plants (with a combined capacity of 110,000 tonnes a year), and six sugar complexes (with a capacity of 2 million tonnes a year). There are also numerous palm-oil processing mills with a capacity of 1.2 million palm clusters a year.

Given the importance of the food-processing industry in Côte d'Ivoire's manufacturing sector, it is not surprising to find a rigid synchronized timing between the output behaviours of both the food-processing industry and the overall manufacturing sector. For example, on three occasions the food-processing industry has shown a negative annual output growth (in 1974, 1979 and 1981), the entire manufacturing sector suffered a similar fate. What is surprising, however, is the fact that Côte d'Ivoire's food-processing industries, so vulnerable to crop cycles and unpredictable world markets, has suffered only on those three occasions in the past two decades, each time with a relatively minor setback in output and employment. The industry is, however, still growing, albeit at a slower pace.

This stable performance in the food-processing industry, and thus for the whole manufacturing sector, is largely due to the active role of the Government. Côte d'Ivoire's manufacturing industry is dominated by publicly owned enterprises. The Government holds over 50 per cent of the registered capital of all large enterprises, many of which are joint ventures between the Government and foreign partners. In adverse situations, this semi-public nature prevents enterprises from reducing employment and cutting their output levels. Indeed, since 1970, the employment figure in food-processing in Côte d'Ivoire has shown, with one interruption in 1983, a continuous increase from less than 6,000 (18 per cent of total manufacturing employment) in 1970 to more than 20,000 (36 per cent of manufacturing employment) in 1986.

It is apparent that Côte d'Ivoire has, in the past, invested too much in the processing of cocoa, coffee and sugar. The European taste for African coffee seems to be changing, and the world-wide oversupply situation for cocoa forced the International Cocoa Organization to stop its price support when its buffer stock reached the limit of 250,000 tonnes in 1988. World sugar prices, which deteriorated even before all six mills were completed, currently stand at only half the local production costs. Yet it took Côte d'Ivoire some time before the plans for six new sugar complexes were scrapped and two old ones were closed down (in 1983-1984). Current domestic demand of some 80,000 tonnes of raw sugar could be met by one or two mills.

This means that a diversification of its industrial base, especially the export industries, would help Côte d'Ivoire's economy greatly. Such an attempt has been made. The Government has encouraged industries producing canned pineapple, tomato, mango, tuna fish and animal feed. The country is still nurturing hopes of becoming a major regional oil-refining centre by processing oil imported from Angola, Nigeria and Zaire. Planned new investments include one textile factory, one dairy, one more refinery for processing imported crude oil for the regional market, one sugar packing industry, three plants for industrial alcohol, and a complex producing ammonia from offshore gas reserves. There are also plans to rehabilitate one of the palm-oil processing plants.

The existing structure of industry in Côte d'Ivoire represents the heritage of strong government initiatives and high public subsidies. Given the vagaries of global macro-economic trends and price fluctuations in international commodity markets, the role chosen by the Government to provide a buffer against the alternating fortunes of its industry is understandable and possibly legitimate. That such a paternalistic policy has an economic rationality as well has long been argued among development economists. The answer depends very much on the impact which the policy has had on the evolving industrial and technological capabilities of the country's industry. The legitimacy of government leadership in a fledgling stage of industry stems from a judicious integration of industrial policy with technology policy, which in turn calls for a judicious blending of public and private entrepreneurships as well as an appropriate balance between the resources devoted to building up critical "nodes" for the transfer and development of modern industrial technology, on the one hand, and the resources devoted to facilitate ever-wider participation of the local population in the process of industrial development, including the progressive upgrading of informal-sector activities, on the other.

I. Adjustment towards rebuilding a more resilient base for industrialization

Countries with small industrial bases frequently harbour national ambitions to become industrialized, and Governments often take more than a detached stand and interfere or even displace individual business decisions to promote industrialization. In fact, in the past, they were often told that economic calculations, based strictly on short-term commercial profitability, are usually insufficient as well as inappropriate, and industrial projects should be appraised in terms of their long-term "social benefits". In this respect, there is growing confusion over what structural reform should be in the context of the least developed countries in Africa. Those countries are struggling to establish a base for viable and sustainable industrialization, which cannot be brought about by investment projects in marginal doses alone, nor by projects that prove commercially attractive from the outset. Shielding domestic industries against foreign competition and nurturing them under an artificial price structure with high tariffs and unrealistic exchange rates have been the norm for developing countries throughout the ages. The choice of the sub-Saharan African countries for reform, especially at this juncture of their economic development, therefore raises certain questions. In particular, are they too protective for their own good?

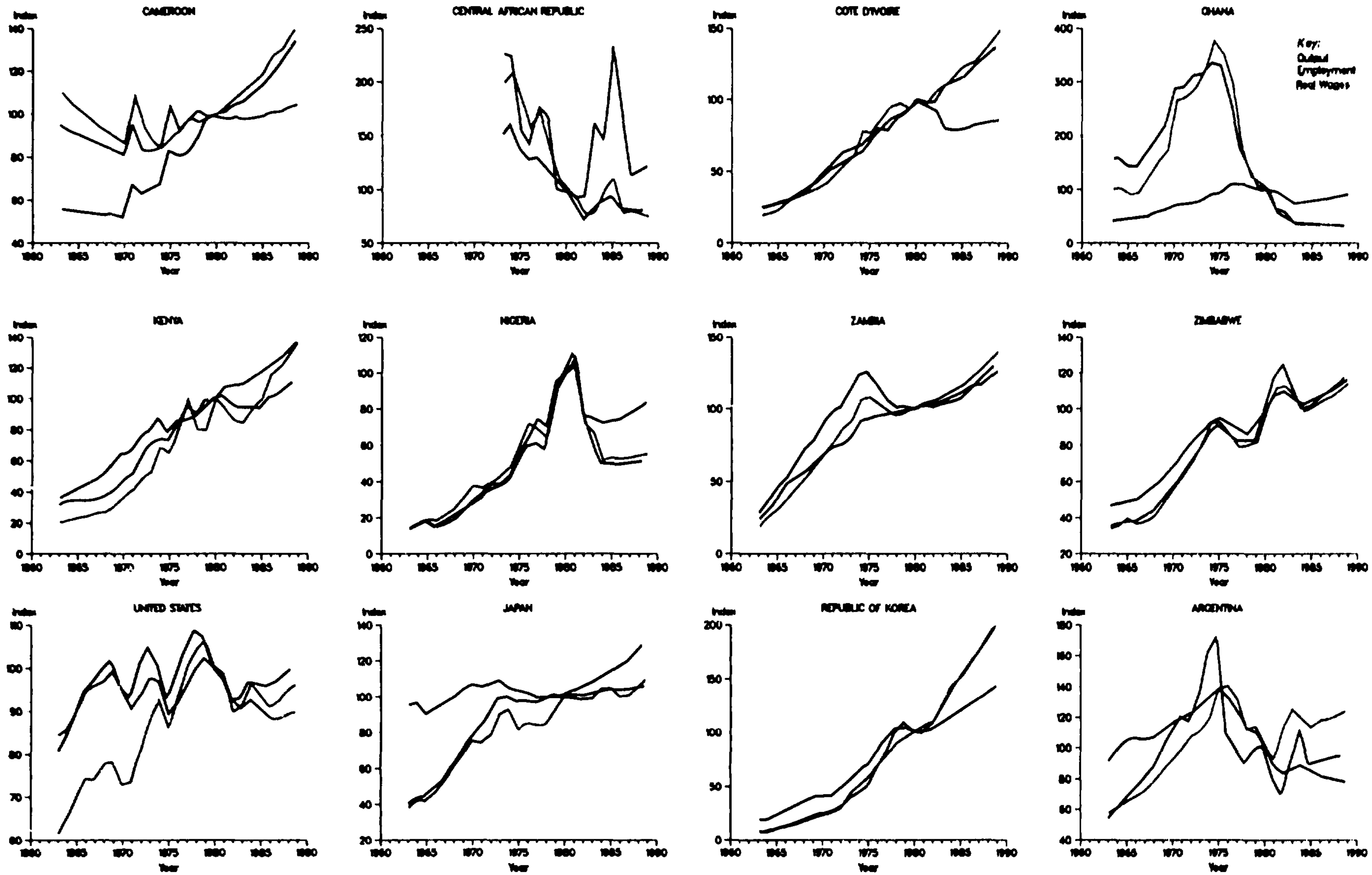
It is argued that the reluctance to allow real wages to fall is responsible for the failure of many countries to achieve economic growth. But that contention is seldom borne out by the historical record, as may be seen by an examination of data on output, employment and real wages for eight selected African economies as well as for the United States, Japan, the Republic of Korea and Argentina (see figure I.9). There is little evidence of a fixity of real wages. Ghana and Nigeria have allowed their real wages and output to move up and down together while maintaining employment. The Central African Republic has had a flexible (that is, declining) real wage, but has still suffered excessive fluctuations in employment while its output has declined. Japan has maintained nearly constant employment for over 30 years while letting the real wage move up with output. In the United States, however, employment and real wages have moved together rather than against each other, as the argument for real wage flexibility requires. Looking at the overall pattern, it is hard to argue either that a fall in the real wage rate is associated with a rise in employment, or that the sub-Saharan African countries have less variation in their real wages than do the non-African countries in our sample.

A review of the historical record, however, offers little help to orienting the future course of industrialization for sub-Saharan African countries. It has been suggested that improved market access is an important condition for their export-oriented industrialization. However, freer access to markets alone does not guarantee industrialization. Indeed, the principal disappointing feature has been the poor export performance of sub-Saharan African countries throughout the whole period. Furthermore, the relative importance of the EEC as a market for Africa's manufactured exports and source for manufactured imports has declined, despite the fact that trade concessions for industrial goods are particularly liberal under the Lomé Convention.

It is argued that the rules of origin under the Lomé Convention have been too stringent and require African countries to add on an unreasonably large proportion of processing before they can benefit from the preferences. Those rules are designed to prevent countries other than African, Caribbean or Pacific developing countries from using Lomé Convention beneficiaries as transit bases for their manufactured exports to the EEC. Studies show, however, that most of the manufactured exports from the so-called Asian tigers (Hong Kong, Republic of Korea, Singapore and Taiwan Province) started with a value-added level of only 20 per cent, which is just half of the Lomé specification. This was understandable given the paucity of natural resource-based industries in those Asian countries, as well as their willingness to exploit their only comparative advantage; namely, cheap well-trained labour. Input materials to those Asian countries were initially imported from developed countries, often in a semi-finished form, with the final assembly segment performed in the country before being re-exported. Their domestic value-added contents, however, increased gradually through a stage-by-stage import substitution of intermediate inputs, which in turn provided strong linkage effects for other industries not directly connected to export effort.

There are several reasons why the final assembly and re-export route to development might not be realized by the sub-Saharan African countries. The first and foremost reason is that whatever good will the EEC has displayed jointly towards those African countries so far, it has not extended to them an invitation to join the European Single Market. This means the African countries cannot, and should not, expect the rules of origin to change drastically. The second reason is that perhaps the African countries have already missed their opportunities. As pointed out in previous *Global Reports*, the world has somehow grown out of demanding inexpensive mass-produced consumer goods. The above-mentioned four Asian tigers have already had to change their strategies, and are now aiming at up-market export products catering to specialized clienteles. The places vacated

Figure I.9. Measuring structural rigidities: output, employment and real wages in selected countries, 1960-1990



Source: UNIDO data base
Note: Index 1960 = 100.

by these four, however, have been already taken up by other Asian and some Latin American countries. The third reason is that today, whatever industrial bases the sub-Saharan African countries once had have become seriously weakened after prolonged disinvestment. Currently, investment in infrastructure has gone beyond the means of normal government finance, and the essential improvements in telecommunication and transportation networks are all being delayed.

For the time being, the final-stage assembly types of export-processing industry may still find the sub-Saharan African countries generally less attractive compared, for example, to some North African countries, even in purely logistic terms. In order to earn more foreign exchange, therefore, sub-Saharan African countries have very little option except to take another hard look at the possibility of further processing of local resources before they are exported. Processing of mineral ores, refining of non-ferrous metals, processing of fishery and other marine products, primary and secondary processing of timber and the manufacture of cocoa butter, instead of dehusked cocoa, could do the job of strengthening both forward and backward linkages as well as any final-stage processing industry.

Most of Africa's mining and agricultural products are exported after only rudimentary processing. Liberia, Zambia and Côte d'Ivoire are good examples. Although Liberia is a major producer of natural rubber, the rubber-processing industry is almost non-existent. Zambia's economy is dominated by copper exports, but the non-ferrous metals industry has not developed. Only a small part of Côte d'Ivoire's cocoa and coffee crops undergoes any form of processing (beyond drying and dehusking) before shipping. Much of sub-Saharan Africa's wood is exported in the form of logs, or at best, sawn timber. Not only are investments in downstream manufacturing absent, but many downstream industries rely on raw materials imported from abroad. For example, the aluminium industry in Cameroon and the steel industry in Nigeria import bauxite and iron ore in spite of large domestic deposits. The obvious reason for this inability to exploit the potential for creating intersectoral and interindustrial linkages, is that, in most cases, such investments do not appear commercially viable, given the current state of development of the indigenous managerial and entrepreneurial resources and technological skills in those countries.

In this regard, a recent UNIDO study makes oblique, but highly pertinent, observations on the structural reforms being carried out in sub-Saharan African countries. In many of the sub-Saharan African countries where structural adjustment programmes have been carried out, the liberalization of the markets (devaluation, removal of tariffs and quotas etc.) has drastically altered the "profitability" of industries. Although it is suggested that investible resources do exist for bankable projects, few such projects have been forthcoming (hence the paradox of under-utilization of bilateral and multilateral development assistance funds for industry in sub-Saharan Africa) [5].

A significant improvement in the investment climate should occur only as the economy moves on to a sounder economic footing, but this could take time, and for some economies it may never occur without some intervention. A pressing question in the minds of many observers, both within and outside the area, is the following: if intervention is to have any chance of promoting industrialization in sub-Saharan African countries, why wait until the industrial bases, which they have so far built up at such great expense, are allowed to disappear?

In most of the region, foreign direct investment has become zero or negative, and even external assistance funds earmarked for industrial development has been declining. For example, the share of the European Development Fund (EDF) allocated to the manufacturing sector in sub-Saharan African countries became less than 1 per cent of total. At the end of 1987, sub-Saharan African debt stood at $120 billion. Unlike Asia, the share of debt incurred by the manufacturing sector in sub-Saharan countries is quite modest, and exceeds 20 per cent only in four countries, and in no instance does it go beyond 50 per cent. Industry, however, seems to have taken more than its share of the debt crisis. It has curtailed essential intermediate input imports, thereby being forced into a woeful state of capacity under-utilization. The flow of funds to industry is stagnating to the extent that even the financing of urgently required repair and maintenance of industrial plants is practically non-existent.

Partly to relieve the dearth of foreign exchange, which is currently paralysing African industries, many African countries were advised to devalue their local currencies. A spate of devaluations in 1985 and 1986 halted the tendency to pursue a policy of serious overvaluation which existed in Africa between 1978 and 1984. Although this, in a way, marks a return to more realistic exchange rate parities, whether currency devaluation would indeed assist African industries in increasing their export volumes is a question left largely unanswered. However, given the price-inelastic nature of traditional African exports, devaluation is most likely to bring about an immediate deterioration in Africa's terms of trade, and thus a lowering of real income which has largely sustained African industrialization in the past.

Studies have shown that the principal source of manufacturing growth in Africa since the late 1960s has been the growth of domestic demand. For instance, in Zimbabwe, domestic demand provided 61 per cent of the total sources of growth for manufacturing between 1965 to 1979, while export growth accounted for 9 per cent and import substitution 30 per cent. Since 1980, the contribution of export growth has declined to less that 3 per cent. Similarly, in Kenya, the growth of domestic demand accounted for more than two thirds of manufacturing output growth between 1964 to 1984. Import substitution added another 25 per cent, while export growth contributed only 5 per cent to total growth of manufacturing output.

Needless to say, the existing structure of industry in many sub-Saharan African countries is the product of highly protected trade regimes of the past. Again taking the case of Kenya, a study [6] concludes that a substantial proportion of growth in manufacturing was the result of an increase in the average scheduled tariff rates by 100 per cent between 1974 and 1984, as

UNIDO's response to the debt crisis

The UNIDO General Conference, in resolution 11 adopted at its second session held in 1987, called upon the Director-General to propose measures in the technical assistance programme of UNIDO that would enable developing countries to alleviate the negative effects of external debt on industrial development.

UNIDO's major response to the debt problem has been to stress industrial rehabilitation and mobilization of financial resources for industrial development among its priority problem areas. Both themes are pursued in the broader context of industrial restructuring in developing countries in the face of a changing international economic environment and emerging technological changes. Moreover, these themes are closely interwoven with other major priority considerations, such as economic co-operation among developing countries, which promises to be a source of dynamism for international trade and investment, as well as human resource development and the promotion of small- and medium-scale industries, both of which emphasize the necessity of building a broader and more resilient basis for industrialization in developing countries. The debt issue, of necessity, leads to a selective geographical focus for UNIDO operations in Africa and Latin America.

It must be stressed that UNIDO is not a multilateral financial institution, nor any other type of finance institution. It is an international agency focused on industry, its main activity being the provision of technical assistance, although even in this narrow area its resources are meagre. In 1988, UNIDO delivered technical assistance amounting to some $120 million, so that given the magnitude of the debt issue, UNIDO's financial input is but a drop in the ocean. A drop in the ocean certainly in purely financial terms, but not negligible in terms of the expected quality improvements in industry and the catalytic impact those improvements can have in helping countries cope with the crisis through promoting their industrial recovery. Of UNIDO's total provision of technical assistance to developing countries, approximately 80 per cent, funded primarily by UNDP, may be considered to have a direct or an indirect bearing on requirements for industrial restructuring and rehabilitation at various levels of policy, planning and industrial support services. Such technical assistance tends to stress the strengthening of domestic technical service institutions in their capabilities for solving industry- and enterprise-specific problems as well as bringing about technical solutions to urgent technical problems of limited scope. Other technical assistance projects respond to the needs envisaged by particular recipients and financing parties dealing with the revamping and revitalization of specific industrial operations at the micro-economic and micro-industrial levels.*

Under its constitutional mandates UNIDO aims, *inter alia*, at the objective of promoting a common perception of important issues of industrial development in developing countries and suggesting the directions for concerted action at both national and international level. In 1987, UNIDO addressed debt issues in considering the prospects for renewed financial flow, the changing structure of international investment and production and the plight of primary product producers faced with the increasing software content in manufacturing. The specific impact on industrial investment and output of external economic shocks was traced through the transmission of these shocks on the current account, capital flows and manufacturing investment. The experience of Nigeria, Peru, the Philippines and Sri Lanka with respect to the import squeeze and the fall in capital formation resulting from external economic shocks was considered.** In 1988 the debt issue was examined through an analysis of the continuing reverse flow of capital from developing countries as well as changes in commodity prices and their impact on commodity-exporting developing countries.*** Future *Global Reports* will address a decision of the Industrial Development Board calling for a study of the effects of external debt and debt servicing on industrial development of developing countries and a resolution of the General Assembly regarding international economic co-operation, in particular the revitalization of economic growth and development of developing countries.

*For details of UNIDO's technical assistance activities that contribute to an alleviation of the debt problem, see the Annual Reports of UNIDO for 1987 (IDB.4/10) and 1988 (IDB.5/10).

**Global Report 1987 (UNIDO publication, Sales No. E.87.II.B.2).

***See [2].

well as lower duties on intermediate goods combined with easier access to import licensing for intermediates. The study also remarks that this encouraged import-intensive manufacturing industries which are now suffering from the current macro-economic crisis. The point remains, however, that the exchange rate realignment coupled with trade liberalization does not allow sub-Saharan African countries, at least at the present stage of industrialization, to produce intermediate inputs themselves, nor does it make sense to ask those countries to find a new and more appropriate technology to produce the items by themselves.

The current economic problems facing individual countries are somehow all related, but have a different basis. The unfortunate thing about the least developed countries, especially in sub-Saharan Africa, is that commercially profitable investment opportunities are often to be created, rather than found. The creation of profitable investment opportunities, however, requires initial investments in seemingly unprofitable projects. This inevitably entails government participation in one form or another. Contrary to the popular myth, favourable credit and foreign exchange rationing and high tariff and non-tariff protection accorded to their nascent industries started off the industrialization processes in the Republic of Korea and Taiwan Province. The basic wisdom involved is not even totally alien to developed market economies, where industries to be nurtured and protected are often singled out as "strategic industries".

There are many reasons why industrial development is not proceeding as hoped in the sub-Saharan African countries. Many industrial projects in those countries were ill-conceived and apparently mismanaged. There seems, therefore, to be a general consensus that the basic institutional framework in sub-Saharan Africa should be changed.

Unfortunately, the recent emphasis given to institutional reform seems to be diverting the world's attention away from the real needs of the countries concerned. Those needs include immediate debt relief and an increased flow of finance in order to allow them enough time to bring about the necessary improvements without destroying what they have built up so far in terms not only of physical capital, but also of basic institutional assets for industrial development, including basic education, training, technical research, information, finance, extension and other public service systems geared to enhancement of productive efficiency.

II. Industrial growth performance, policy issues and prospects in 10 major regions of the world

The decade of the 1980s has seen growing global financial imbalances amid economic turbulence such as the 1981-1982 recession, roller-coaster interest rates and commodity prices, including that of oil, and the stock market crash of October 1987. The world industrial economy recorded a low MVA growth of only 2.6 per cent annually between 1980 and 1987. That performance compares with a 5.9 per cent MVA growth rate for the 1960s and 3.6 per cent for the 1970s.

The low growth experienced by world industry as a whole accentuated interregional differences (see table II.1). During the 1980-1987 period, MVA in Western Europe grew by 0.9 per cent as contrasted to 3.6 per cent in Eastern Europe and the Union of Soviet Socialist Republics (USSR). However, the latter figure is misleading because of the resource-intensive (inefficient) nature of industry in the region (see section D for an explanation). In developing regions, a 1.8 per cent MVA growth for Latin America and Tropical Africa contrasts with a 9.8 per cent MVA growth for South-East Asia. The following sections provide some explanation for the differences in growth performance by region. On the whole, developing regions grew twice as fast as developed regions. But still the distribution of manufacturing output is grossly unbalanced: 25 per cent of the world population residing in developed regions are enjoying approximately 82 per cent of manufactured output (in 1987). That situation could worsen unless the global imbalances are corrected.

The world industrial economy is hampered by twin imbalances: one financial, the other technostructural. To a certain extent, the second contributes to the first—a point which has received less attention than it deserves, although an awareness of its importance has recently emerged.

The financial imbalance, or growing debt, was initially thought of as curable if the currencies of debtor countries were devalued and if the creditor

Table II.1. Distribution of MVA (1980 and 1987) and population (1987) by major regions of the world

Country, region or economic grouping	MVA[a] (billions of 1980 dollars) 1980	1987	Growth, 1980-1987 (annual average)	Distribution (percentage) 1980	1987	Change	Population[b] 1987 (millions)	Percentage
World	2 771	3 305	2.6	100.0	100.0		4 882	100.0
Developed region	2 437	2 852	2.2	88.0	86.2	-1.8	1 221	25.0
North America	605	729	2.7	21.8	22.0	0.2	269	5.5
Western Europe	921	979	0.9	33.2	29.6	-3.6	383	7.8
Eastern Europe and USSR	577	740	3.6	20.8	22.4	1.7	394	8.1
Japan	285	350	3.0	10.3	10.6	0.3	122	2.5
Other[c]	49	50	0.5	1.8	1.5	-0.3	52	1.1
Developing region	333	456	4.5	12.0	13.8	1.8	2 593	53.1
Latin America	177	201	1.8	6.4	6.1	-0.3	419	8.6
Tropical Africa	14	16	1.8	0.5	0.5	0.0	413	8.5
North Africa, Western Asia	43	61	5.2	1.6	1.9	0.3	295	6.0
Indian Subcontinent	31	48	6.3	1.1	1.4	0.3	1 094	22.4
South-East Asia	67	129	9.8	2.4	3.9	1.5	371	7.6
China	..	..	..	..	..	..	1 069	21.9

Source: UNIDO statistical data bank, (129 countries) Industrial Statistics.

a/ Excludes China.

b/ Includes China and sample countries.

c/ Australia, New Zealand and South Africa.

countries grew faster and imported more from debtor countries. But the actual experience during the past few years has belied such an expectation.

The external debt position of Latin America and Tropical Africa as well as that of the United States shows little sign of improvement, while the trade surpluses of Japan, the Federal Republic of Germany and the Asian NICs (newly industrializing economies) continue to add to their ballooning external assets.

Policy-makers have lately begun to realize that the financial imbalances reflect, in a significant way, the differences in industrial competitiveness arising from the technostructural gaps between trading partners. The gaps refer to the varying speeds of innovation for increasing competitiveness and changes in output composition conforming to a changing demand structure. Now policy-makers are toying with the idea that some form of regionalism could help increase industrial competitiveness as well as bargaining power. Such an approach is thought to provide a means of winning in global competitiveness and thereby arresting growing financial imbalances.

Thus, the EEC has been preparing to remove all internal trade barriers between its member countries by 1992; North America has equipped itself with the United States Omnibus Trade and Competitiveness Act of 1988 coupled with the United States-Canada Free Trade Agreement; and Japan has been pushing for an informal Asia-Pacific economic alliance. Those new arrangements are emerging to shape the world industrial economy during the 1990s.

Such a regional approach carries with it, however, a potential danger of degenerating into born-again protectionism through the formation of trade blocs. In the process, Latin America and Tropical Africa could be left out in the cold with little prospect of reducing their burden of indebtedness. This chapter examines some salient developments, policy changes and controversies which have arisen, or may arise, within and between major regions of the world. Emphasis is given to reviewing supply-side factors such as structural upgrading of the industrial base, foreign direct investment, technology policies, and the process of opening up the economy as a way of enhancing industrial competitiveness.

A. North America

In the next couple of years, the region's industrial growth is expected to slow down somewhat from a cyclical peak reached in 1988. Late in 1988 a tighter monetary policy was adopted by the United States Federal Reserve Board to bring about a slower growth and to combat inflationary pressures which accompanied the peak growth performance of that year. Though a slow-down looks desirable, there was always a danger that a continuous rise in interest rates could lead to overkill, adding to forces already apparent, such as a slower growth in investment spending and export demand expected in 1989. Further, higher interest rates can, if combined with increasing protectionism, effectively discourage industrial restructuring through new investment necessary to maintain the long-run competitiveness of industry in the region. The heightened awareness of global competition (especially that coming from Japan) led policy-makers to enact the Omnibus Trade and Competitiveness Act of 1988 and the United States-Canada Free Trade Agreement. How those laws would be implemented to regain competitiveness remains to be seen.

Boosted by export and investment activities in the manufacturing sector, the economy of the region looks set to achieve moderate growth in 1989 at 3.0 per cent of GDP and 4.3 per cent of MVA. This represents a slow-down from a growth rate of 4 per cent in GDP and 5.7 per cent in MVA estimated for 1988. Figure II.1 shows relative longer-term changes in the industrial structure of North America.

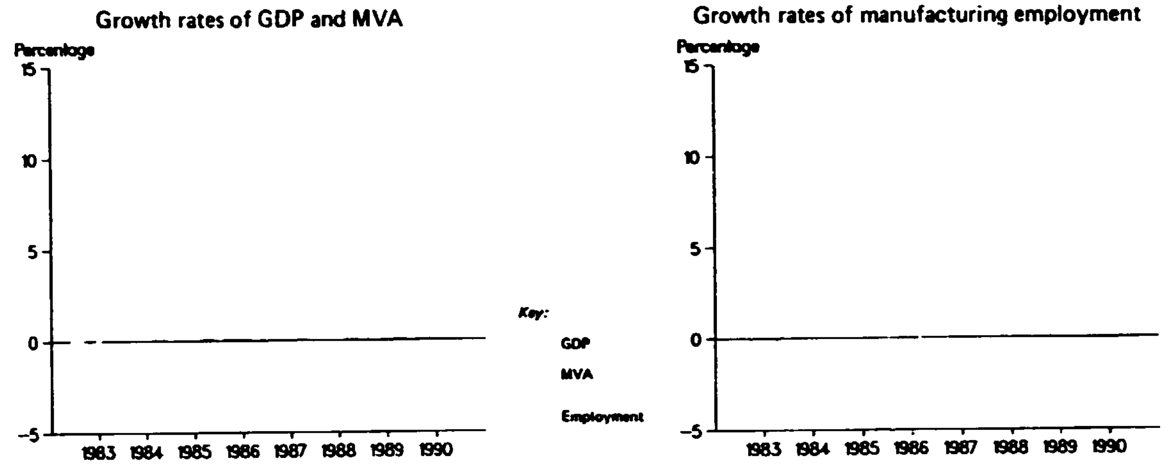
Despite unfavourable factors such as the stock market crash, the collapse of farm output and the weight of the twin deficits, the industry of the region not only survived but thrived in 1988. The cheaper dollar plus a boom in Japan and a recovery in Europe brought a jump in United States exports, particularly of manufactured goods (there was a 30 per cent increase in value terms). Robust consumer demand also stimulated investment in plant and equipment, which provided a means for the industry in the region to improve on efficiency and competitiveness. Such capital spending in the United States surged by 11.6 per cent (real terms) in 1988, a four-year high. Meanwhile, real consumer spending, which accounts for two thirds of GDP, grew by a sturdy 3.8 per cent.

The United States economy thus had a high growth rate during 1988 (4 per cent), high levels of capacity utilization by the end of 1988 (84.5 per cent for all manufacturing and over 90 per cent in primary metals and paper) and a 14-year low for the rate of unemployment (5.4 per cent). Inflationary pressures were beginning to build up and threatened to bring the seven-year boom to an end with a hard landing. The news during 1989 has been mixed, however. The revised data for gross national product (GNP) in the first quarter of 1989 showed that the economy grew at 4.3 per cent rather than the previously estimated 5.5 per cent. While the fears of inflation are still strong, there was a clear enough signal in the economic data for the Federal Reserve Board to cut the federal funds rate by one half of a percentage point in June 1989.

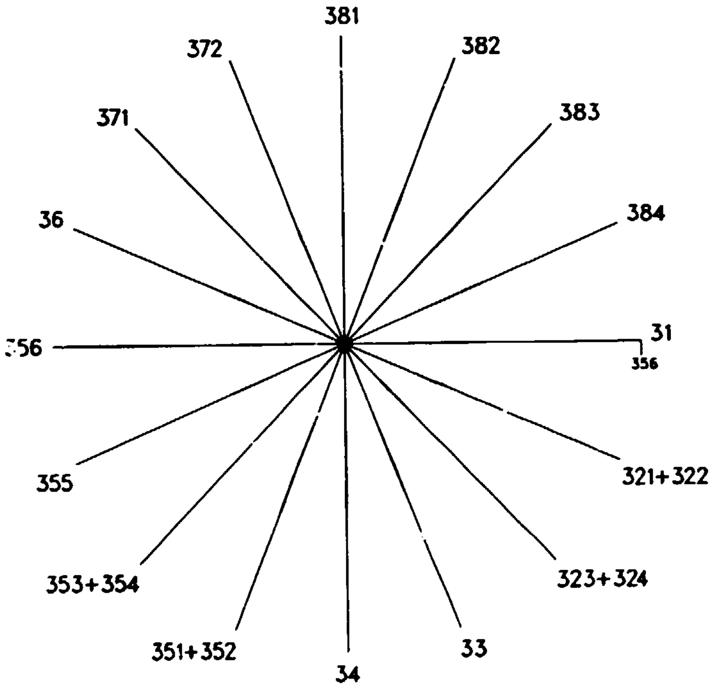
The immediate prospect thus remains that of a precarious balance between an economy growing slower at around 3 per cent, which can keep inflation in check with monetary policy engineering a soft landing, and a lurch into a recession if the psychology of inflationary expectations forces the Federal Reserve to reverse its policy and raise interest rates sharply again. In this respect, the strong showing of the dollar in the first half of 1989 has added to the uncertainty. If it were to prove merely a bubble, then the prospect for United States export competitiveness will improve, if not, it may strengthen the prospect of a hard landing later in the year. But over a slightly longer period, it is export competitiveness which will determine the course of the United States economy.

A comparison of the United States and Japan illustrates the importance of maintaining competitiveness through continued investment. The average age of United States equipment is 17 years, as compared with 10 years for Japan; and since 1975, average investment per worker has amounted to

Figure II.1. Growth rates of GDP, MVA and manufacturing employment, 1983-1990, and industrial structural change, 1975-1990: North America



Industrial structural change
(Index of value added: 1975 = 100)



g =	3.46
θ =	10.97

Key:

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)

Constant prices of 1980

g = Average annual growth rate, 1975–1990 (percentage)

θ = Index of structural change, 1975–1990

1985–1990 forecast

1980–1985

1975–1980

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

$2,600 in the United States, against $6,500 in Japan (in 1975 constant dollars) (for other elements of competitiveness, see table II.2.). Continued high-level Japanese investment provided a vehicle to double the growth of manufacturing labour productivity in Japan over that of the United States during the 1979-1986 period.

The real challenge faced by the industry in the region seems to be whether competitiveness and capacity can be raised continuously to fight inflationary pressures and trade deficits without sacrificing growth. Fortunately, in 1988 investment activities surged by 11.8 per cent, and capital spending helped to improve efficiency and competitiveness in many industrial branches. It seems desirable to make policy efforts to encourage similar investments in 1989 and beyond.

Machine tool orders soared by 66 per cent to $3.5 billion in 1988.* Order backlogs are expected to register a high growth rate in 1989, though at a somewhat slower pace than in 1988 because of fears of possible overcapacity. Automation and reorganization of production appear to be providing the main driving force for the brisk demand, and many machine-tool-makers report the adoption of just-in-time inventory systems.

The steel industry in the United States gives another example of rapid modernization for efficiency through new investment. Between 1982 and 1986 the industry slashed its old capacity by 27 per cent and spent $11 billion to raise productivity. But still only 60 per cent of steel produced in the United States makes use of efficient, continuous casters compared with 95 per cent in Japan. Major United States steel-makers plan to invest over $2 billion for modernization in 1989—a 23 per cent increase over 1988.

The new investments would help make United States steel-makers more competitive, particularly against their Japanese counterparts. This process, however, would be accompanied by a new development that has occurred in international business co-operation in recent years. Steel producers in the United States and Japan, once traditional rivals, are now partners in joint ventures designed to manufacture better steel at lower costs. The LTV Corporation of the United States and Sumitomo Metal Industries Ltd. are building a second steel-coating plant in the United States, using a new electro-galvanizing technology developed in Japan. Aramco Inc. and Kawasaki Steel Corporation are working together to produce better carbon steel. Virtually all major steel producers in Japan have entered into some sort of joint venture agreement with their United States counterparts, sharing new technologies, market access and profits.*

The United States automobile industry faces intense competition from Japan and, lately, at the low end of the market, the Republic of Korea. Survival requires drastic measures to make United States car-makers efficient and competitive. Thus, cost-cutting activities have been going on in all phases of car model design, production and marketing. Ironically, the increasing presence of Japanese car-makers in the United States has spurred the imitation of Japanese practices designed to attain greater efficiency, such as the following: just-in-time components supply management; establishing a long-term contractual relationship with components suppliers in return for technology co-operation ensuring quality control; improving the employer-employee relationship to create worker loyalty to the company or a sense of partnership; introducing quality control circles in the assembly lines; simultaneous group-oriented designing of car models, discarding the traditional, sequential relay of blueprints from design engineering department to production engineering department to production assemblies and to marketing; and rapid shift of component sourcing towards Hong Kong, the Republic of Korea, Singapore and Taiwan Province. Though it is difficult to quantify the benefits, these new practices appear to be paying off. Thus, General Motors, for instance, has reported cost savings of $3.7 billion in 1987 and $4 billion in 1988.

But the overcapacity problem still remains. Japanese cars produced in the United States together with imports from Japan accounted for about one quarter

*Japanese competition through imports has been blocked since January 1987, when a voluntary export restraint agreement took effect for bilateral trade in machine tools such as computer-controlled machining centres and numerically controlled lathes. In 1988, the Japanese share of United States machine tool orders fell by 11 percentage points to 17 per cent.

*This new approach can be attributed, at least in part, to the voluntary export restraints on steel exports from Japan to the United States.

Table II.2. Indicators of industrial competitiveness, United States and Japan

Item	United States	Japan
Working stock and inventory	Up to 9 months	Under 2 months
Time from order to shipment a/	5-6 months	1-2 months
Quality defects and reworking b/	8-10 per cent	1 per cent or less
Average age of equipment	17 years	10 years
Annual investment per worker c/	2 600	6 500
Change since 1975	+25 per cent	+90 per cent

Source: United States Bureau of Labour Statistics and Japan Economic Institute, as quoted by Business Week, 6 June 1988, p.48.

a/ Machine tool industry.
b/ Electronics industry.
c/ In 1975 dollars.

of total United States car sales in 1988. Japanese plants in the United States are rapidly coming on stream, with a projected output of 2.5 million cars by the early 1990s. More plant closings are expected, along with further competition in cost-cutting, computer-aided design, robotization of assembly lines, new fancy models and energy-mileage efficiency.

The efficiency-creating aspects of such competition may be commendable, but the effect of voluntary export restraints on Japanese cars has produced the paradoxical result of overcapacity in the United States.

With regard to long-term prospects, industrial competitiveness is the key element determining future growth of the industry in the region. Greater investment does not necessarily lead to greater competitiveness. The latter derives from the effectiveness with which the investment in physical and human capital introduces new technology and restructures industrial composition. It should be noted that in Japan the share of engineering-intensive output* has been steadily increasing over the past two decades (that is, from about 25 per cent in the mid-1960s to about 55 per cent in the mid-1980s). By contrast, in the United States the share of engineering-intensive output remained at 40 to 47 per cent during the same period. The engineering-intensive sector is where the United States is experiencing serious competition from Japan. Structural changes in Japan, meanwhile, reflect its continu us efforts to shift from so-called smoke-stack industries, particularly those producing intermediate goods, towards high-technology industry based on information processing and telecommunications. Over 80 per cent of United States imports from Japan originate from engineering-intensive sectors.

* This includes metal products (ISIC 381), non-electrical machinery (ISIC 382), electrical machinery (ISIC 383), transport equipment (ISIC 384) and professional and scientific equipment (ISIC 385).

The Japanese challenge comes also from ensuring a supply of trained engineers to meet with the needs of industrial restructuring. For instance, the number of college graduates or recipients of higher degrees in electrical and electronic engineering almost doubled in Japan during the 1969-1979 period (from approximately 11,800 to 21,400). In the United States the number slightly declined from 16,300 to 16,100 during the same period. In the area of research and development a recent study has revealed an interesting contrast between Japan and the United States. Edwin Mansfield has collected information on technology including the sources of R + D projects (or the initiators of project ideas) from a random sample of 65 United States and 35 Japanese firms in the chemical, electrical equipment, machinery, motor vehicle, instruments and metals industries (see table II.3). His analysis led him to conclude:

(a) About one third of the R + D projects of Japanese firms are based on suggestions from their production personnel and customers, whereas only about one sixth of United States projects stem from those sources;

(b) The greater importance of customers as sources of R + D projects in Japan stems from the very close relations between firms and their customers;

(c) Applied R + D in Japan has yielded a higher return than in the United States;

(d) The Japanese advantage has been largely confined to applied R + D aimed at the adaptation and improvement of existing technology (instead of basic research).

In response to the challenge from Japan and mounting trade deficits, the United States recently launched a variety of measures. Among others, the enactment of the Omnibus Trade and Competitiveness

Table II.3. Sources of R+D projects of 100 firms in Japan and the United States, 1985

Industry and Country a/	Percentage of R+D projects suggested by: R+D	Marketing	Production	Customers
Total				
Japan	47	18	15	15
United States	58	21	9	9
Chemicals				
Japan	49	23	15	3
United States	45	25	14	8
Electrical equipment				
Japan	47	21	5	27
United States	90	17	1	1
Machinery				
Japan	44	22	11	20
United States	56	21	4	18
Automobiles, instruments and metals				
Japan	48	8	26	13
United States	51	25	12	11

Source: Reproduced from Edwin Mansfield, "Industrial R&D in Japan and the United States: a comparative study", American Economic Review, vol. 78, No. 2 (May 1988), p. 227.

a/ The sample sizes are as follows: all industries combined, 100; chemicals, 26; electrical equipment, 20; machinery, 26; and automobiles, instruments and metals, 28.

Act of 1988 stands out as a comprehensive package of measures. Though designed to help restore the competitiveness of United States exporters and to end unfair practices, the trade act could also be used to restrict trade—through the protection of domestic industry.

Section 301 of the trade act can be invoked to help United States companies gain access to overseas markets. If an investigation finds foreign competition unjustifiable, unreasonable or discriminatory, the United States trade representative can retaliate according to a strict timetable, though in a discretionary manner, in choosing a specific retaliatory measure. Such an approach is complemented by provisions intended to deal with trading partners who tend to create "excessive and unwarranted" trade surpluses. The target country would be asked to negotiate and open its market to United States goods and services in an effort to reduce its trade surpluses with the United States. Otherwise, the United States could retaliate by limiting access to its own market, for instance.

The 1988 trade act also provides for a set of export promotion measures, including the following: expansion of funds granted to support studies of possible United States export markets, particularly for small businesses; relaxation of licensing requirements for goods and technologies under the Cocom agreements relating to the export of strategic goods; incentives for the export of telecommunications equipment, particularly to Japan and countries of Western Europe.*

It remains to be seen how those measures will be interpreted and implemented. The law can be used either positively to increase trade or negatively to decrease it. Unpredictable reactions of United States trade partners provide an additional element of uncertainty.

A review of current developments—notably in United States trade policy—suggests that exclusive reliance on a low-dollar policy has reached the limits of its usefulness as a means of helping to regain competitiveness in United States industry, to restore the trade balance and to promote growth based on productivity and efficiency. The limitation arises from the differences in competitiveness between the United States and Japan, which are rooted in technostructural differences. The latter are reflected in the approach to savings, investment behaviour, speed of innovation in product design and industrial processes, and customer-orientated strategies focused on speedy delivery and product quality. Price, though important, is only one of many sources of competitiveness.

The Japanese challenge is thus broadly based. To meet that challenge and to adapt to changes in global demand structure, the United States will find it necessary to consume less and save more, to pay greater attention to technology applications, and to redirect investment resources to human as well as physical capital formation.**

*To be added to these measures is the recent relaxation of the anti-trust laws to enable United States enterprises to form research-oriented consortia, particularly for defence-related industries. Under the new ruling, over 120 consortia, involving over 1,000 firms, have already been born.

**For an analysis of these issues see [7], pp. 299-307, and [8], pp. 313-316.

B. Japan

The high speed of industrial restructuring in Japan has enabled it to turn the recessionary impact of the high yen into an opportunity to grow faster than any other industrial country. The year 1988 saw a turn-around of the economy from export-led to domestic-demand-oriented growth supported by new investment by Japanese industries at home and abroad. The new capacity to produce and compete is expected to allow the high level of growth to continue at approximately 5 per cent in 1989 and 1990 (see figure II.2), though the uncertainty of potential world financial market instability clouds this outlook. Meanwhile, Japanese investment abroad is creating mixed responses in the host countries. The domestic restructuring scene will first be reviewed, followed by the international aspects.

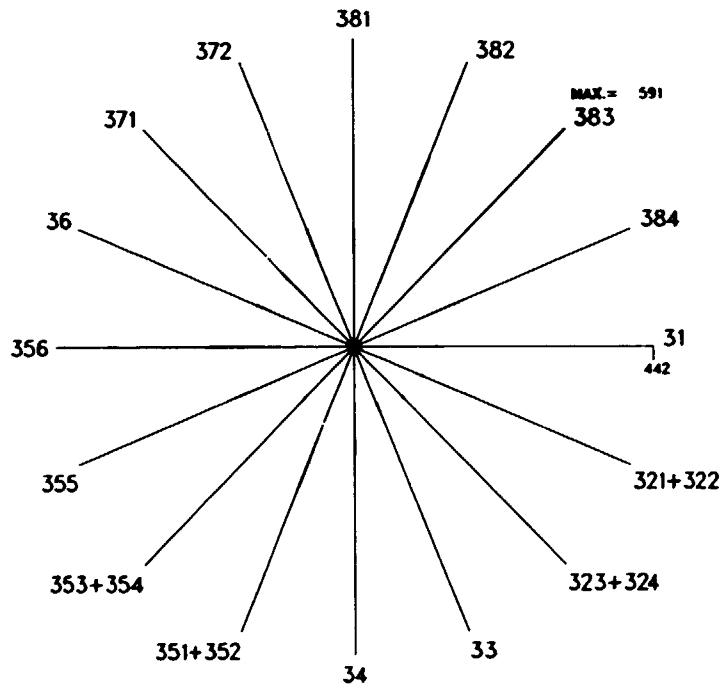
Behind the rapid recovery from negative industrial growth in 1986 to near double-digit growth in 1988 lie both demand and supply factors. Factors on the demand side include a relaxed money supply coupled with a 6-trillion-yen fiscal package to boost domestic demand. The latter measure was intended to help mitigate the effects of decreasing export demand resulting from the falling value of the dollar. Factors on the supply side include the declining price of raw materials and intermediate inputs imported from abroad. But the most dynamic element in the adjustment process appears to be new investment, which is accelerating product and technology innovation. That element is designed, on the one hand, to push aggregate demand through equipment expenditures and, on the other, to upgrade supply capacity and productivity. Aggregate investment in plant and equipment is estimated to have jumped by 16 per cent during 1988, up from 10 per cent in the previous year. Investment growth is expected to slow down to 10 per cent in 1989.

An important reason for the spurt in investment stems from the introduction of high technology, particularly micro-electronics, across major branches of industry. Factories, under pressure to rationalize as a result of the high value of the yen, have resorted increasingly to automated production systems by combining industrial robots, numerically controlled machines and flexible production process technology. Office automation added to the spurt in investment, creating instant-information networks linking subsidiary companies abroad and domestic and foreign market sales agents. Such investments aim at integrating and controlling, under one computer system, multidimensional activities such as receiving orders from customers, product design, production of output, factory shipments and sales at home and abroad.

Another important reason for the investment boom comes indirectly from the high value of the yen. The Economic Planning Agency of Japan estimates the benefit of the high yen at 29 trillion yen or $215 billion in savings on the cost of imported raw materials and cheaper manufactured goods. The consumers' share amounts to 14 trillion yen, through lower prices of the goods and services they buy, and the producers' share, 15 trillion yen, through production cost savings. The latter contributed to the increased profitability of industry and its ability to finance structural change.

Figure II.2. Growth rates of GDP, MVA and manufacturing employment, 1983-1990, and industrial structural change, 1975-1990: Japan

Industrial structural change
(Index of value added: 1975 = 100)



g =	5.00
θ =	31.55

Key:

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)

Constant prices of 1980

g = Average annual growth rate, 1975–1990 (percentage)

θ = Index of structural change, 1975–1990

1985–1990 forecast
1980–1985
1975–1980

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

The rationalization through company-level restructuring as well as other cost-cutting efforts has enabled Japanese industry continuously to lower the break-even point with respect to the rising value of the yen. Table II.4 shows that in the case of non-electrical machinery, for instance, the figure approximately halved from 204 yen per dollar in 1985 to 101 yen in 1988. Other industries, such as electrical machinery, tranportation equipment and precision instruments have achieved similar changes. Many enterprises are also reportedly preparing up for the contingency of 100 yen or even 80 yen per dollar.

Thus the conventional notion that an abrupt appreciation of the yen would have a recessionary impact turned out to be unfounded, largely because of the ability of industry in Japan to restructure quickly compared with other countries. The experience of particular industries, for instance textiles and clothing, steel, electronics and precision equipment, supports the above view.

As in other developed countries, the textile and clothing industry in Japan confronts competition from developing countries, particularly NICs. The recent appreciation of the yen has intensified the competitive position of NICs in the industry. But the Japanese industry has fortunately been diversifying itself into non-textile fields, moving up into higher value-added segments (fashion materials) and shifting the lower segments offshore through joint ventures. A salient example is provided by Asahi Chemical, which has diminished its dependence on textiles from 75 per cent of its revenues in 1965 to 20 per cent in 1988. The non-textile fields include textile machinery, dyestuffs, up-stream petrochemical plants and equipment for producing man-made fibres, base materials for video and audio tapes, monosodium glutamate (food seasoning) and even genetically engineered drugs.

An important element for the survival of Japanese textiles companies is their investment in Asia and elsewhere through joint ventures. Total investment by those companies in Asia is estimated at $1.2 billion so far. Joint ventures were initially set up for exports to the United States and European markets, but since 1985 Japan itself began providing a market for them. A small step was thus made towards reducing the embarrassing trade surpluses.

Similarly, restructuring is observable in the steel industry (although going offshore is not as evident as in the textile and clothing industry). The big-five steel-makers—Kawasaki, Kobe, Nippon, NKK and Sumitomo Metal—lost 400 billion yen ($2.5 billion) in fiscal year 1986, with a 7 per cent reduction in output combined with increased imports. They responded to those bleak conditions by adopting measures to diversify into non-steel activities and to cut costs through greater automation. The diversification measures include plans to become involved in high-technology projects and a scheme to convert the old steel plant sites into leisure complexes with health clubs, restaurants, entertainment facilities, condominiums and rental apartments. For example, Nippon Steel formed a subsidiary, Nippon Steel Information and Communication Systems, with 2,100 employees and 2.2 billion yen in capital to develop manufacturing computer systems and to provide company financing. Meanwhile, the big-five steel-makers are retraining steelworkers released under rationalization as they redeploy into the new business ventures. None is being dismissed.

The Japanese automobile industry has taken a somewhat different route to restructuring by going massively abroad, closer to the consumer market. The industry's exports fell for two consecutive years to 6.3 million units in 1987, a 4.5 per cent drop from 1986. However, domestic sales, with a 5.4 per cent increase, more than compensated for the export losses in 1987. Thus 1986 losses for major car-makers have reversed to fat profits in 1987. Regarding more permanent export prospects as unfavourable owing to both import restrictions and the high value of the yen, the car-makers began forming alliances with United States producers several years ago (for example, Mazda-Ford, Mitsubishi-Chrysler and General Motors-Isuzu), mainly to acquire marketing clout through joint ventures. A similar mode of co-operation was also used to cut production costs of automobile parts in developing countries and areas (for example, Philippines, Republic of Korea, Taiwan Province and Thailand). The global grid plan of car-making promises to remain as a major strategic tool for the Japanese industry to react speedily against potential shocks from any source (such as exchange rates, interest

Table II.4. Break-even points in Japanese industry with respect to changes in the yen-dollar exchange rate
(Yen)

Industry or type of average	April to September 1985	April to September 1986	April to September 1987	October 1987 to March 1988
Non-electrical machinery	204	148	127	101
Electrical machinery	203	148	126	109
Transportation equipment	216	155	133	118
Precision instruments	216	155	137	120
Weighted average	210	152	131	114
Actual exchange rate (period average)	245	163	145	132

Source: Estimates by Fuji Bank, Ltd., Japan.

rates, oil prices and protectionism). It is quite likely that a further appreciation of the yen will make imports into Japan of Japanese cars produced in the United States a profitable business.

The electronics industry of Japan has experienced perhaps the fastest pace of restructuring spurred by the high yen value since mid-1985. For instance, in the case of radio cassette players, imports rose to 48 per cent of total sales in 1987 from 15 per cent in the previous year. Imports are mostly from Asian suppliers. In contrast, Japan's exports of consumer electronics products fell by 25 per cent in 1987. Those trends are expected to continue in the foreseeable future. To cope with the situation, Japanese companies are going abroad fast, particularly to other Asian countries where Japanese investment in electronics more than doubled to $4.9 billion during the year to March 1988. The aim is to decrease yen-denominated cost components and increase non-yen-denominated components. Matsushita, for example, wants to double its total production to 24 per cent abroad from the current level of 12 per cent in the next few years. Other companies such as Toshiba, Hitachi and Sanyo are following with more or less comparable strategies for overseas production.

The above account of four industries depicts the micro-economic aspects of industrial restructuring with two features, namely domestic diversification into new fields of production on the one hand, and investment abroad on the other. Table II.5 shows a summary of the diversification effect for all ISIC two-digit industries in Japan between 1984 and 1986 (fiscal years). It is worth noting that, within just two years, virtually all industries diversified into other areas of production (except food and transport equipment). Most of the changes involve new ventures rather than buying existing operations, partly as a means of redeploying the existing work-force. Those moves can also be seen as a means of speeding up the structural transformation of the economy in keeping with the goals outlined in the Maekawa Report [9].

In order to expedite industrial restructuring, the Ministry of International Trade and Industry (MITI) planned to introduce a "risk finance system" in 1989. For domestic-demand oriented venture investment, MITI will increase the loan guarantee fund for venture businesses up to 2 to 3 billion yen per new venture under the plan [10].

The international dimension of industrial restructuring appears to be swiftly expanding. Japan's foreign direct investment in manufacturing more than doubled from $3.8 billion in 1986 to $7.8 billion in 1987 (fiscal years). The cumulative sum of Japan's foreign direct investment in manufacturing has reached over $36 billion (as of 31 March 1988). The geographical and industry distribution is shown in table II.6. The bulk of foreign direct investment went to North America, with electrical machinery and transport equipment leading other industries. This seems to reflect rising protectionism (through voluntary export restraints) and the high yen value against the dollar. Asia ranks second with metals, chemicals and electrical machinery as the leading industries. As noted earlier, Japanese ventures in Asia play largely the role of parts suppliers to Japanese enterprises elsewhere.

Accompanying the surge of Japanese overseas direct investment is the new attitude on sharing technology developed in Japan. There are growing signs of a realization that technology-sharing between countries is important and beneficial, and new ways are being found to bring benefits to both technology-givers and technology-receivers. As noted in section A, traditional rival steel producers in the United States and Japan are becoming partners in joint ventures in steel production and the sharing of new technology, market access and profits, and such practices are spreading to

Table II.5. Share of base industry products in total sales[a/] 1984 and 1986 (Percentage in each fiscal year)

Base industry	Fiscal year 1984	Fiscal year 1986	1984-1986 change
Food products	96.8	97.0	0.2
Textiles	60.3	57.1	-3.2
Wood and wood products	72.8	68.8	-4.0
Pulp and paper	93.0	92.5	-0.5
Printing and publishing	100.0	88.3	-11.7
Chemicals	88.7	84.6	-4.1
Coal and petroleum products	99.7	99.2	-0.5
Rubber	89.6	88.5	-1.1
Non-metallic mineral products	76.4	71.4	-5.0
Steel	81.8	78.8	-3.2
Non-ferrous metals	67.7	60.8	-6.9
Fabricated metal products	90.9	90.0	-0.9
Non-electrical machinery	77.9	73.1	-4.8
Electrical machinery	95.3	83.6	-11.7
Transportation equipment	77.0	79.0	2.0
Precision equipment	45.1	37.6	-7.5
Other manufacturing	69.7	67.4	-2.3
Average	84.5	80.2	-4.3

Source: Japan Fair Trade Commission.
a/ Including products classified as in other countries.

Table II.6. Japan's foreign direct investment by industry and region as of 31 March 1988
(Millions of dollars)

Item	North America	Latin America	Asia	Middle East	Europe	Africa	Oceania	Total
Manufacturing sector	14 753	4 994	10 000	1 260	3 310	225	1 496	36 038
Food products	724	207	425	0	112	8	68	1 546
Textiles	397	428	1 231	4	245	39	9	2 353
Wood and paper products	952	200	212	-	2	0	128	1 495
Chemicals	1 499	562	1 585	1 124	347	19	111	5 247
Metals	1 650	1 764	2 064	59	276	127	364	6 304
Non-electrical machinery	1 716	361	778	11	365	1	53	3 284
Electrical machinery	4 451	366	1 562	13	704	7	53	7 155
Transport equipment	2 221	995	1 028	4	797	17	613	5 675
Other	1 142	112	1 115	45	462	7	98	2 980
Non-manufacturing sector	36 858	20 126	16 286	448	16 794	3 722	5 131	99 365
Agriculture and forestry	260	186	262	2	5	7	171	893
Fisheries	139	104	129	1	3	92	69	538
Mining	1 440	1 549	6 677	199	890	579	1 601	12 936
Construction	510	203	254	40	57	21	49	1 134
Trade and sales	9 727	1 397	1 482	19	3 374	7	800	16 807
Banking, finance, insurance	9 149	6 913	1 447	93	10 508	22	640	29 772
Services	3 164	826	3 173	4	540	664	655	9 026
Transportation	188	7 690	393	2	93	1 532	73	9 970
Real estate	10 130	55	846	-	268	-	658	11 958
Other	2 151	1 203	1 622	87	1 056	798	415	7 332
Branch offices	667	45	336	1 369	905	1	12	3 336
Real estate transactions a/	485	23	37	2	38	2	7	595
Total	52 763	25 189	26 658	3 079	21 047	3 951	6 647	139 334

Source: Ministry of Finance of Japan.
a/ Overseas real estate transactions have been excluded from Japan's foreign direct investment data since 1 December 1980.

Table II.7. Total Japanese investment abroad by sectors and industry, selected years and projection for 1993 and 2000

Sector or industry	Investment flow in selected years (millions of dollars)				Projection (percentage)		Annual average growth rates			
	1975	1980	1985	1986	1993	2000	1975-1986	1986-1993	1993-2000	1986-2000
Intermediate input	2 685	6 882	11 255	12 001	24 400	53 000	14.6	10.7	11.7	11.2
	(52.0)	(54.7)	(46.1)	(42.5)	(23.0)	(17.4)				
Textiles	1 016	1 637	2 083	2 146	3 300	6 000	7.0	6.3	8.9	7.6
	(19.7)	(13.0)	(8.5)	(7.6)	(3.1)	(2.0)				
Chemicals	887	2 626	3 982	4 337	9 600	21 000	25.4	12.0	11.8	11.9
	(17.2)	(20.9)	(16.3)	(15.4)	(9.1)	(6.9)				
Iron and other metals	782	2 619	5 190	5 518	11 500	26 000	19.4	11.1	12.4	11.7
	(15.1)	(20.8)	(21.3)	(19.6)	(10.8)	(8.6)				
Fabrication	1 290	3 452	9 091	11 532	65 000	205 000	22.0	28.0	17.8	22.8
	(25.0)	(27.5)	(37.3)	(40.9)	(61.3)	(67.4)				
Machinery	405	894	1 971	2 597	14 400	48 000	18.4	27.7	18.8	23.2
	(7.8)	(7.1)	(8.1)	(9.2)	(13.6)	(15.8)				
Electrical machinery	522	1 579	3 747	4 734	26 700	90 000	22.2	28.0	19.0	23.4
	(10.1)	(12.6)	(15.4)	(16.8)	(25.2)	(29.6)				
Transport equipment	363	979	3 373	4 201	23 900	67 000	24.9	28.2	15.9	21.9
	(7.0)	(7.8)	(13.8)	(14.9)	(22.5)	(22.0)				
Others	1 189	2 239	4 052	4 672	16 600	46 000	13.2	19.9	15.7	17.7
	(23.0)	(17.8)	(16.6)	(16.6)	(15.7)	(15.1)				
Total	5 164	12 573	24 400	28 206	106 000	304 000	16.7	20.8	16.2	18.5

Source: Japan Economic Research Centre.

Note: Figures in parentheses are percentage shares. Dollar figures are based on foreign direct investment registrations and Ministry of Finance data.

other industries. Similar arrangements for technology-sharing through joint ventures and other means are becoming one of the sources of Asian dynamism. Japan is transferring its technology and capital not only to Asian NICs, but also to Indonesia, Malaysia, Philippines and Thailand, to form joint ventures. Today, virtually all major producers of automobile, electrical and electronics products (both machines and consumer goods) have subsidiaries and joint ventures. Recently, even small- and medium-scale manufacturing enterprises have built large joint ventures in South-East Asia, and they trade among themselves as well as with others.

The trend of globalization of Japanese industry is expected to continue. The Japan Economic Research Centre forecasts that Japanese overseas production will increase to 7 per cent of Japan's manufacturing output by 1993 and 15.3 per cent by the year 2000 (compared with 3.3 per cent in 1986) (see [9]). The distribution of Japanese overseas investment underpinning the forecasts is shown in table II.7. It has led to soaring intra-regional trade based on increased productivity of labour and capital, and to a new division of labour in the form of intra-industry trade.

To sum up, the review of Japanese industry under the stress of the high yen value and of restructuring activities suggests that its international competitiveness will remain strong. Vigorous investment in high-technology areas, audacious and co-ordinated shedding of inefficient segments of each industry, going abroad in search of cost efficiency, company-level redeployment and retraining of workers all seem to prepare Japanese industry well to meet future shocks.

C. Western Europe

EEC progress toward the total removal of internal trade barriers by 1992 steadily continued during 1988 and stimulated investment and export demand to yield a high average EEC growth of 3.7 per cent. A similar high growth performance is expected to continue in 1989 and 1990, though at a somewhat slower pace of about 3 per cent each year (see table II.8 for a country breakdown). Having earned hefty profits in 1988, Western European enterprises appear ready to continue their factory modernization drive for greater efficiency and competitiveness (see table II.9 for growth of investment in 1988 and 1989 by country) in order to meet the enhanced competition anticipated in the coming years not only among themselves in the enlarged market, but also from Japanese and United States companies investing in the region. But rising interest rates, protectionist pressures at home and abroad and a slow-down in growth of the world economy expected in the next couple of years may counter the expansionary forces at work in the region (see figure II.3).

Table II.8. Growth rates of GDP forecast for 1989 and 1990 in EEC member countries

(Percentage)

Country	1989	1990
Belgium	2.75	3.0
Denmark	0.75	1.75
Germany, Federal Republic of	2.5	3.0
Greece	2.5	3.0
France	3.0	3.0
Ireland	3.25	2.75
Italy	3.25	3.5
Luxembourg	2.75	2.5
Netherlands	3.25	2.25
Portugal	4.0	4.0
Spain	4.25	3.75
United Kingdom	3.0	2.0
EEC average	3.0	3.0

Source: Commission of the European Communities.

The medium-term outlook, however, is uncertain, owing to unpredictable responses of the United States, Japan and other trade partners of the region towards the development of what might be a "Fortress Europe". Possible financial market instabilities add to the uncertain outlook.

A big surprise came from the growth performance of the Federal Republic of Germany, at 3.5 per cent in 1988 compared with 1.9 per cent in 1987. With a cheap deutsche mark against the United States dollar and the yen, exports of the Federal Republic of

Table II.9. Growth rates of investment expenditure, 1988 and forecast for 1989 and 1988 capacity utilization rate of industry in EEC member countries
(Percentage)

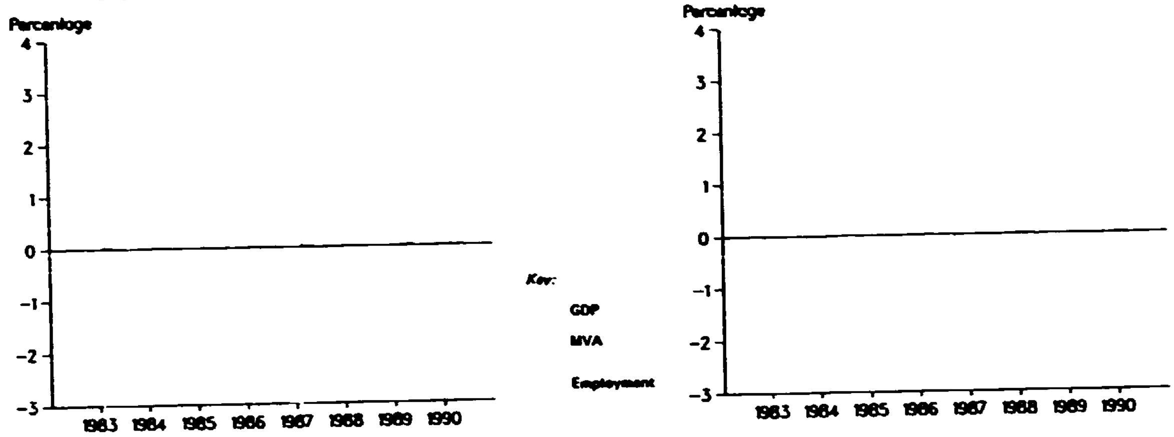
Country	Growth rates of investment		Capacity utilization rate
	1988	1989	1988
Belgium	7.3	2.7	79.1
Denmark	4.0	0.1	-
Germany, Federal Republic of	6.2	3.7	86.5
Greece	8.8	8.0	77.3
France	6.9	5.4	86.4
Ireland	0.4	3.6	76.5
Italy	4.9	3.8	79.0
Luxembourg	6.3	1.7	83.7
Netherlands	3.3	2.9	85.1
Portugal	12.8	11.0	-
Spain	13.0	10.0	-
United Kingdom	9.6	6.3	93.9
EEC average	7.1	5.2	85.9

Source: Commission of European Communities.

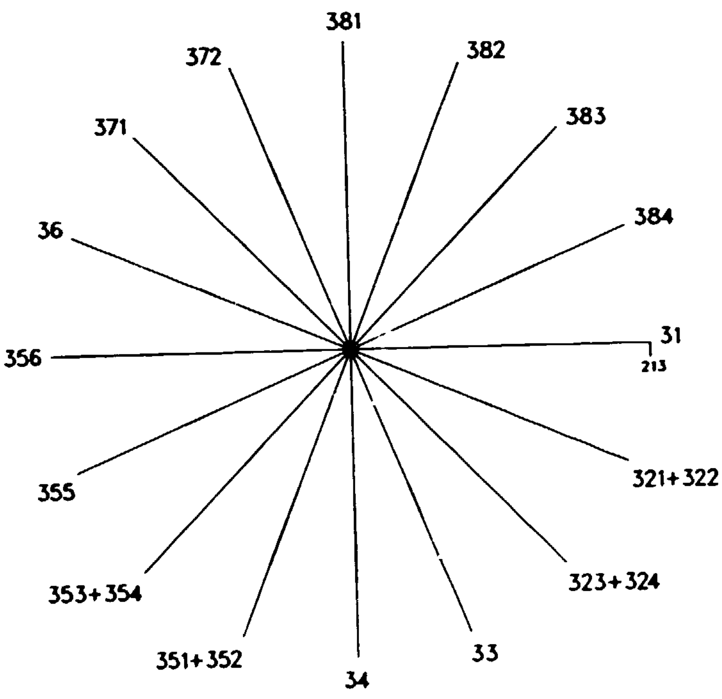
Figure II.3. Growth rates of GDP, MVA and manufacturing employment, 1983-1990, and industrial structural change, 1975-1990: Western Europe

Growth rates of GDP and MVA

Growth rates of manufacturing employment



Industrial structural change
(Index of value added: 1975 = 100)



g =	2.01
θ =	8.09

Key:

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)

Constant prices of 1980

g = Average annual growth rate, 1975–1990 (percentage)

θ = Index of structural change, 1975–1990

1985–1990 forecast

1980–1985

1975–1980

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

Germany to Japan jumped by 24.6 per cent in 1988, and to other EEC countries by 10.9 per cent, while exports to the United States declined by 8.4 per cent. The leading export items included non-ferrous metal products, steel products, chemicals, electrical machinery and general machinery. The composition (mainly capital goods) appears to reflect investment activities in the importing countries. The high level of export demand has also stimulated domestic investment in the Federal Republic of Germany. Expenditures on plant and equipment rose by 6.6 per cent in 1988 compared with 4 per cent in 1987, and such expenditures are expected to rise by over 7 per cent in 1989. This reflects a double-digit growth in profit earnings (15 per cent on average) of companies listed on the stock exchange of the Federal Republic of Germany and an 88.7 per cent capacity utilization ratio, the highest recorded since 1973, of factories in 1988.

The economy of the United Kingdom grew by 3.8 per cent in 1988, buttressed by a 12 per cent growth in investment and 6.5 per cent in consumer spending. But the high growth was accompanied by a 6.3 per cent rate of inflation indicating overheating and a need to slow down. Policy-makers responded by raising interest rates to 13 per cent to fight the possible wage-price spiral. That step is expected to cool consumption demand and perhaps investment expenditures as well. The economy is likely to grow by 3 per cent in both 1989 and 1990.

The economy of France, like that of the Federal Republic of Germany and the United Kingdom, achieved a high growth of 3.3 per cent in 1988 (up from 2.3 per cent the year earlier). Investment by enterprises and export demand led the economy with growth rates of 9.3 per cent and 7.8 per cent respectively. The lowered tax rate on corporate earnings in the 1987 and 1988, improved operating returns, heightened capacity utilization and EEC prospects for 1992 helped to stimulate investment activity in 1988.

The surge in exports from a low growth of 1.7 per cent in 1987 reflected the improved international environment as well as the boost to French competitiveness given by the continuing process of disinflation, deregulation, reduced subsidies and structural adjustments in industry. The economy is expected to grow in 1989 and 1990 at a somewhat slower rate of 3 per cent each year.

In spite of slower growth generally expected for the region, investment activities are likely to remain a major stimulus of growth for several reasons. The latter include encouragement given to investment by EEC Governments with a view to strengthening their own industries even before the target year of 1992, and no less important foreign direct investment from Japan, the United States and even Asian NICs, in an attempt to establish a niche to forestall difficulties in obtaining market access after the target year. Thus, several Governments are contemplating lower tax burdens on business. For instance, France has decided to reduce taxation on undistributed profit from 42 per cent to 39 per cent beginning from January 1989. The Federal Republic of Germany will reduce federal corporate income tax from 56 per cent to 50 per cent beginning from January 1990. Following suit, Denmark, Italy and the United Kingdom are also reviewing the possibility of reducing various taxes on business. Those measures will undoubtedly boost incentives for further investment.

Added to domestic investment will be a rapid inflow of foreign direct investment. United States companies invested $19.7 billion in 1988 on new plant and equipment in EEC countries, up 39 per cent from 1986 and reversing the trend of disinvestment in the early 1980s. As of 1987 total United States foreign direct investment stock in Western Europe stood at $149 billion, of which $67.5 billion was in manufacturing. Those figures are expected to increase further as even small- and medium-scale enterprises are joining industrial giants to invest in Western Europe. Compared to the presence of United States' foreign direct investment in the region, that of Japan appears rather small, amounting to $21 billion worth of total foreign direct investment stock as of March 1988. Of that amount, only $3.3 billion was in manufacturing, although its rapid growth in the past couple of years seems to have frightened the region's competitors (see table II.10 for a country distribution of Japanese foreign direct investment). Worth noting is that Luxembourg and the United Kingdom received more than one half of total Japanese foreign direct investment in Europe and that foreign direct investment in 1986 and 1987 contributed about one half of the cumulative total stock as of March 1988. Apparently, the country concentration reflects the hospitable economic environment for Japanese companies. Those trends are expected to continue at least in the short run, and to contribute to the region's growth through employment and income creation plus the efficiency-creating effects of competition.*

Notwithstanding the potential benefits as seen by its proponents, debates have erupted recently as to the quality of Japanese foreign direct investment. The critics have argued that Japanese companies bring with them Japanese machinery and intermediate inputs for assembly operations in the region. Hence the value-added content is rather minimal, while the competition might harm local manufacturers. Thus, the local content requirement arose as a policy issue among EEC member countries. For instance, France insisted that a car should have 80 per cent or more value added within the region. Otherwise the car should not be regarded as EEC-produced and should be subjected to the same quotas and tariffs as imported cars. The United Kingdom considered a demarcation line of about 60 per cent. Finally, negotiations led to a compromise of 70 per cent. The Japanese response was to argue that the poor quality of local components makes it difficult to produce a quality car corresponding to Japanese standards. The Japanese are therefore trying either to erect new parts-producing plants or to train European parts-makers by providing them with Japanese technology. The

*Some argue that "the influence of Japanese companies has prompted far-reaching changes in the United Kingdom since 1986 the adoption of just-in-time inventory control methods, heightened awareness of quality control, stronger relationships with component suppliers, and more co-operative workers-management relationships. After several years of Japanese presence in the country this influence is being deepened by Japanese-trained managers transferring to British companies" (see [10] p. 24)

Table II.10. Japanese direct investment in Europe, 1986, 1987a/ and 1951-1987 cumulative total
(Millions of dollars)

Country	1986			1987			1951-1987 cumulative total		
	Cases	Value	Percentage	Cases	Value	Percentage	Cases	Value	Percentage
United Kingdom	142	984	4.4	178	2 473	7.4	1 368	6 598	4.7
Luxembourg	16	1 092	4.9	18	1 764	5.3	117	4 072	2.9
Netherlands	60	651	2.9	71	829	2.5	425	3 166	2.3
Germany, Federal Republic of	59	210	0.9	50	403	1.2	867	1 955	1.4
France	52	152	0.7	99	330	1.0	841	1 300	0.9
Switzerland	7	91	0.4	22	224	0.7	242	977	0.7
Spain	15	86	0.4	24	283	0.8	187	883	0.6
Belgium	7	50	0.2	12	70	0.2	261	863	0.6
Ireland	4	72	0.3	5	58	0.2	167	1 390	0.3
Italy	18	23	0.1	26	59	0.2	182	262	0.2
USSR	1	1	0.0	1	1	0.0	8	195	0.1
Others	23	57	0.3	31	82	0.2	296	386	0.3
Total Europe	404	3 469	15.5	537	6 576	19.7	4 861	21 047	15.1
Total world	3 196	22 320	100.0	4 584	33 364	100.0	44 707	139 334	100.0

Source: Ministry of Finance of Japan.

a/ Fiscal year 1987 ends 31 March 1988.

effect should be to attract new investment so as to meet the local-content requirement.*

Similar debates are going on as to the definition of local content for other products such as integrated circuits, photocopying machines, videotape recorders and computer printers. The EEC Commission insists that to be described as made-in-Europe those products must have "the most substantial process" done in the region. For integrated circuits, that means that the expensive and complicated wafer fabrication should be carried out in EEC member countries. The aim is apparently to force high technology along with foreign direct investment into the region.

The reason for such measures is not difficult to find. EEC member countries have been losing their export market share in high-technology products, which are also in strong demand, to Japanese producers (see tables II.11 and II.12). That category of products includes electrical equipment, electronics and information processing equipment, automated office machines, precision instruments, chemicals and pharmaceuticals. Between 1963 and 1985, the EEC share dropped from 31.6 per cent to 25.6 per cent, while that of Japan soared from 6.4 per cent to 16.8 per cent. EEC members are eager to help arrest the trend by establishing local content requirements at least in the EEC market.

Along with policies designed to attract foreign direct investment and foreign technologies, measures have been taken to strengthen the region's industrial competitiveness through a comprehensive science and technology programme. The programme, set for the 1987-1991 period with an allocation of 6,480 million European Currency Units (ECU), was adopted in September 1987. The key components of the programme are as follows:

(a) *Information technologies* (ESPRIT), with 225 projects, 450 participating entities and 3,000 research workers, covering sectors such as micro-electronics, knowledge engineering, advanced information processing, office automation and robotics;

(b) *Telecommunications* (RACE), with the objective of developing progressively towards a community system of integrated broadband communications, starting with the integrated services digital network, and with application projects in fields such as teaching through computers, new technology in banking and finance, medical information systems and the use of information in road traffic;

(c) *New industrial technologies* (BRITE), with 200 initial projects covering such advanced technologies as lasers, computerized design and mathematical modelling to be applied in motor vehicles, aeronautics, textiles and chemicals;

(d) *Materials technology* (EURAM) to produce new materials such as new alloys, engineering ceramics and composite materials to be used in motor vehicles, construction and aeronautics.

These are considered an essential ingredient of the "large market without frontiers" to meet the challenge coming from the United States and Japan.*

*Even with local contents at 80 per cent, a Japanese carmaker could still deprive the community of access to Japan's key engine and transmission technologies, according to a former European Commissioner (see [11] p. 34).

*For more information and a discussion of the implications of EEC science and technology policy, see [12].

Table II.11. Export market shares[a/] of the EEC, Japan and the United States, 1963-1985
(Percentage)

Item	1963	1968	1973	1979	1980	1981	1982	1983	1984	1985	Difference 1973-1968	Difference 1979-1973	Difference 1985-1979
Total industry													
Europe 10	31.68	28.63	26.80	27.04	27.25	26.65	26.61	26.03	25.21	25.60	-1.83	0.24	-1.44
United States	20.92	19.06	15.43	15.20	16.35	17.92	17.20	16.49	16.59	15.99	-3.63	-0.17	0.73
Japan	6.39	8.92	10.53	11.38	12.43	15.16	14.62	15.60	16.94	16.75	1.61	0.85	5.37
Strong demand[b/]													
Europe 10	35.00	31.39	27.96	27.40	27.00	25.79	25.75	25.23	24.01	24.86	-3.43	-0.56	-2.54
United States	24.26	22.47	17.51	18.08	19.18	20.70	20.91	20.11	10.74	19.32	-4.96	0.57	1.24
Japan	6.22	10.15	12.36	13.06	14.18	17.34	16.53	18.54	10.62	20.20	2.21	0.70	7.14
Moderate demand[b/]													
Europe 10	31.52	28.17	26.98	26.69	27.66	26.49	26.32	25.34	24.32	24.27	-1.19	-0.29	-2.42
United States	25.43	23.26	18.65	17.56	18.26	20.42	19.12	18.21	17.95	17.87	-4.61	-0.99	0.21
Japan	3.82	6.37	9.22	10.86	12.24	14.76	13.98	15.03	16.38	16.52	2.85	1.64	5.66
Weak demand[b/]													
Europe 10	29.64	27.20	25.53	27.23	26.86	27.89	28.12	28.29	28.46	29.16	-1.67	1.70	1.93
United States	12.57	10.45	8.90	8.81	10.62	10.42	9.37	8.84	8.53	7.76	-1.55	-0.09	-1.05
Japan	9.98	11.64	10.93	10.53	10.99	13.43	13.52	12.90	13.02	12.38	-0.71	-0.40	1.85

Source: Commission of the European Communities, European Economy, No. 34, November 1987, p.50.

a/ Defined as the share of exports of a certain country or zone in total exports of all OECD countries (at current prices), including intra-EEC trade.
Europe 10 excludes intra-EEC trade.

b/ Products with strong demand: electrical equipment and electronics, information technology, automated office equipment and precision instruments, chemicals and pharmaceuticals. World demand grew at an average annual growth rate of around 6 per cent.
Products with moderate demand: transport equipment, food, drink and tobacco, paper pulp, packaging and printing, rubber and plastics, industrial and agricultural machinery. World demand expanded by an average of 2 - 3 per cent a year.
Products with weak demand: steel and metal ores, metal goods, textiles, leather and clothing, construction materials and non-metallic minerals. World demand grew by some 1 per cent a year.
Average annual growth rates have been calculated on the basis of the average for 1981-1982 compared with the average for 1972-1973 (in United States dollars at 1975 prices and exchange rates). The classification is based on the growth rate for the area as a whole.

The possible impact on industry of the measures to encourage science and technology development could be immense, considering what happened in Japan and the United States. However, it is difficult to measure the magnitude of the impact. The Ceachini Report commissioned by the EEC, which was the first attempt to quantify the effects of the EEC project for a single market in 1992, does not even consider the science-and-technology effect as a variable in its econometric model. The conclusions may therefore underestimate the full impact of the project. Nevertheless, it seems worthwhile to review the range of possible effects, particularly the changes likely to occur in export and import composition of extra-EEC trade (see table II.13).

Under the scenario of fully integrated markets with scale economies realized, imports of office machinery could drop by 68.2 per cent and motor vehicles by 63.5 per cent of their level in 1985. These represent the most sensitive sectors being discussed by policy-makers. It is noteworthy that nine out of 10 sectors studied will reduce imports and also that eight sectors will reduce exports. This suggests that the estimated growth of 4.5 to 7 percentage points more with a single market than without is in effect based on import-substitution rather than export expansion outside the region. That point has aroused concern among EEC trade partners despite denials expressed by EEC officials.*

The medium-term outlook for Western Europe appears bright as a result of the positive forces for industrial growth being created by the prospects of a single EEC market in 1992. However, there is also the possibility that the project could be used for inward-looking purposes at the expense of the region's trade partners. Concern arises from the increasing frequency of anti-dumping measures and the stringency of local-content requirements. Nevertheless, the project is still evolving, and the EEC has the opportunity to turn it into a positive-sum game for the global economy.

It is clearly in the interest of the global economy that Western Europe catches up with the United States and Japan in enhancing industrial competi-

*The Foreign Minister of the Federal Republic of Germany is quoted as saying: "When we tear down the barriers within the EEC, we shall not erect higher barriers to the outside world—on the contrary. An internal market does not mean more protectionism spread over a larger area, but greater scope for development with more openness to the outside" (see [13] p. 255).

Table II.12. Gains and losses in shares of export markets over the period 1979-1985[a/]
(Percentage in declining order of importance)

Branches	Losses	Branches	Gains
	Europe 10[b/]		
Electrical goods	-4.39	Leather and footwear	5.45
Motor vehicles	-4.25	Wood and furniture	4.86
Rubber and plastic products	-2.53	Textiles and clothing	3.87
Agricultural and industrial machinery	-2.49	Non-metallic minerals and products	2.47
Other transport equipment	-2.27	Food, beverage and tobacco products	2.03
Office and data machinery; precision and optical instruments	-2.23	Paper and printing products	1.25
Other manufacturing products	-0.84	Ferrous and non-ferrous ores and metals other than radioactive	1.23
Metal products except machinery and transport equipment	-0.65	Chemical products	0.51
	United States		
Other manufacturing products	-2.06	Other transport equipment	5.45
Textiles and clothing	-1.41	Rubber and plastic products	3.63
Ferrous/non-ferrous ores and metals, other than radioactive	-1.29	Office and data machinery; precision and optical instruments	3.30
Motor vehicles	-0.86	Paper and printing products	0.68
Food, beverage and tobacco products	-0.52	Electrical goods	0.66
Wood and furniture	-0.46	Leather and footwear	0.52
Non-metallic minerals and products	-0.36		
Metal products excl. machinery and transport equipment	-0.24		
Chemical products	-0.01		
Agricultural and industrial machinery	-0.01		
	Japan		
Food, beverage and tobacco products	0.0	Electrical goods	11.66
		Motor vehicles	9.40
		Office and data machinery; precision and optical instruments	5.47
		Agricultural and industrial machinery	5.26
		Other manufacturing products	5.24
		Non-metallic minerals and products	3.17
		Rubber and plastic products	3.04
		Other transport equipment	2.71
		Textiles and clothing	2.20
		Metal products except machinery and transport equipment	1.75
		Ferrous and non-ferrous ores and metals, other than radioactive	1.63
		Chemical products	1.35
		Paper and printing products	0.78
		Leather and footwear	0.42
		Wood and furniture	0.18

Source: Commission of the European Communities, European Economy, No. 34, November 1987, p. 51.

a/ Market share is defined as the exports of the United States, Japan or Europe 10 to the rest of the world in relation to exports of OECD countries to the world.

b/ Only extra-EEC trade is taken into account.

Table II.13. Predicted changes in extra-EEC trade under a scenario of fully integrated markets with scale economies realized
(Percentage)

Industry	Imports	Exports
Cement, lime, plaster	5.9	-0.01
Pharmaceuticals	-7.7	-11.5
Office machinery	-68.2	11.7
Electric motors etc.	-3.8	-4.4
Artificial and synthetic fibres	-47.5	-2.2
Machine tools	-10.3	2.6
Carpets, linoleum etc.	-20.2	-4.5
Footwear	-25.1	-3.2
Electrical household appliances	-23.6	-12.6
Motor vehicles	-63.5	-16.7

Source: Commission of the European Communities, Research on the Costs of Non-Europe, vol. 5, part A, pp. 5.31-5.43.

tiveness and high technology development. The reinvigoration of industry in Western Europe would offer greater opportunities for trading, leaving low- and medium-technology areas to the South. The seriousness with which policy-makers are taking the Single Europe Act, embodying the most comprehensive restructuring measures in history, augurs well for that approach. If successful, the threat of deindustrialization in Western Europe, be it real or imagined, would fade away.

D. Eastern Europe and the Union of Soviet Socialist Republics

In 1987 and 1988, the countries of Eastern Europe and the USSR, each at its own pace, increased the degree of their interdependence with the world economy in trade, investment and technology transfer. In the coming years those trends are expected to intensify and help to modernize the industries of the region. In the short run, however, these countries face many challenges in their efforts to create a socialist market economy and reorganize industry towards greater efficiency. The adjustment process will bring new problems of unemployment, inflation and cyclical fluctuation, making the short-run prospects for industrial growth rather uncertain.

In 1988 the region as a whole achieved a 3.9 per cent growth in industrial production compared with the planned rate of 4.8 per cent (see table II.14 and figure II.4). Hungary, Romania and the USSR fell below the planned growth rates, though the latter's planned rate appears to have been too ambitious. The performance of Poland with a 5.4 per cent growth rate in industry comes as a surprise, considering its inflation rate of 60-75 per cent in 1988, its debt burden, the largest in the region, and its political uncertainties. Poland even managed to increase exports by 24 per cent in 1987 and an estimated 21 per cent in 1988, compared with only 2.8 per cent in 1986. But imports also increased by 16.5 per cent in 1987 and 24 per cent in 1988. This helped to accelerate industrial growth through the greater availability of imported intermediate products.

The immediate future looks uncertain partly because of the two opposing aspects of the reform measures. On the one hand, the liberalization measures create new opportunities for growth-promoting investment (including foreign direct investment) and trade. Thus, for instance, some 200 joint ventures worth $150 million sprang up in Hungary in 1988 alone. In the USSR over 120 joint ventures have been launched since 1987, and negotiations or discussions on 500 more are reported to be under way. On the other hand, the reorganization of industry towards greater efficiency means closing inefficient plants and retraining the workers shed by them. Meanwhile, the transition from the centralized system of resource allocation and subsidy to a "self-financing" system at the enterprise level, with freedom to borrow, invest, produce and sell, involves learning and adjustment costs. Managers accustomed to receiving orders from above cannot be expected to become efficient, independent decision-makers, risk-analysers and entrepreneurs overnight. It is difficult to predict how such changes will affect actual output.

Furthermore, the infrastructure needed to make the fledgling market an efficient resource allocation mechanism is inadequate. That includes a banking system, a distribution system for the allocation of intermediate inputs, a capital and a labour market, as well as a system of commercial information businesses. The new institutions must evolve gradually to suit the special conditions of each country. To those requirements should be added the mastery of skills in making appropriate macro-economic policy. How the institutions develop and function will to a significant extent determine the medium-term outlook.

Nevertheless, in 1988 a few more important steps were taken in the movement for reform and greater openness in the region. In Poland two laws were enacted and took effect from 1 January 1989. First, the Law on Economic Activity stipulates that any business can be undertaken without licence requirements, except those relating to those strategic products such as weapons and explosives, precious metals and medicines, and anyone can open a business by simple registration. This reverses the earlier rule that no one could undertake a business without government authorization. The law also removes a restriction to 50 employees or less for private business, and provides for their equal treatment with State enterprises in granting access to bank credits and raw materials and in legal matters. Secondly, the new Law on Foreign Investment replaces the 1986 joint venture law which attracted only about 50 foreign investors. The new law allows foreign companies to hire an unlimited number of employees, to own 20 to 100 per cent of the business, to enjoy three- to six-year tax holidays in the case of new firms, and to repatriate profits, except that 15 per cent of foreign currency earnings must be sold to the State.

In Hungary, a bold step was taken in July 1988 to introduce joint stock companies and a stock market. During the year, 40 State-owned companies issued stocks but only State-owned banks and co-operatives were allowed to buy them. Private firms were not permitted to list their shares. Those restrictions, however, were repealed as of January 1989, thus enabling private firms to list their shares and any Hungarians or foreigners to buy shares up to 100 per cent. Hungary is now planning to set up the region's first special economic zone (or free trade zone) in the Sopron area. This reform could attract a flood of foreign investment. Bulgaria also appears ready to launch economic reform measures.

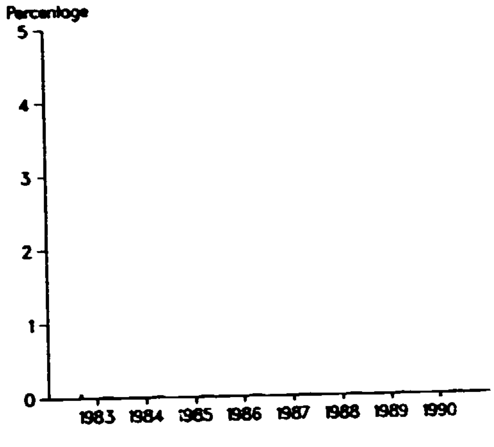
In the USSR, the reform process has progressed further with the promulgation of the Law on Co-operatives (July 1988) and the Law on the Hire or Leasing of Means of Production (June 1988). These are a sequel to the Law on Individual Enterprises enacted in November 1986, stipulating the rules for private ventures, and the Law on State Enterprise enacted in June 1987.*

The Law on Co-operatives removes the special licensing requirement to establish a new co-operative without restriction on the number of workers to be hired, safeguards rights to determine the field of activity and the structure and volume of production, and establishes rules for contracting with the State

*Comments on the latter were made in [2], p. 59.

Figure II.4. Growth rates of GDP, MVA and manufacturing employment, 1983-1990, and industrial structural change, 1975-1990: Eastern Europe and USSR

Growth rates of GDP and MVA



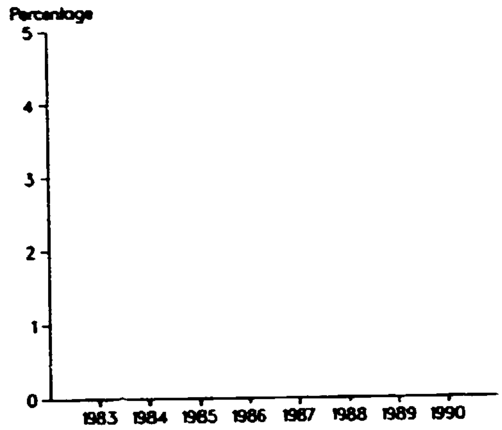
Key:

GDP

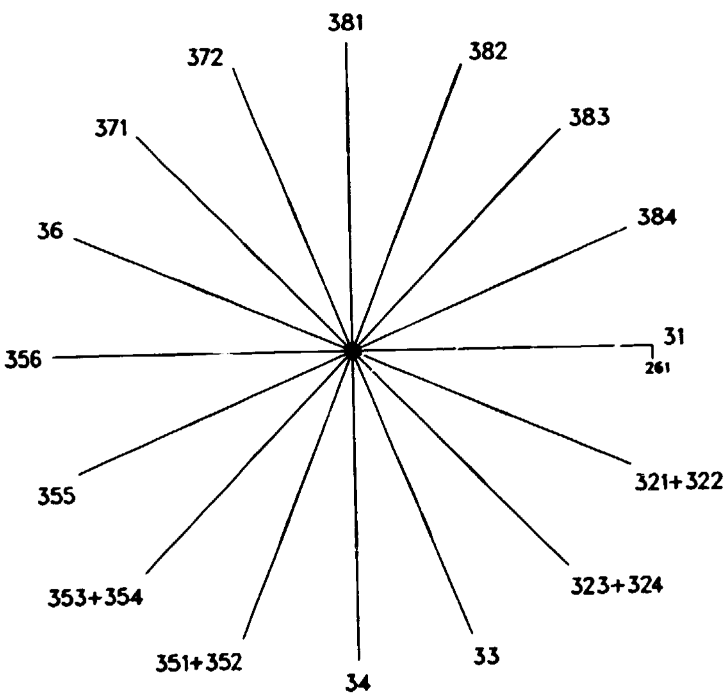
MVA

Employment

Growth rates of manufacturing employment



Industrial structural change
(Index of value added: 1975 = 100)



g =	3.97
θ =	15.39

Key:

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)

Constant prices of 1980

g = Average annual growth rate, 1975–1990 (percentage)

θ = Index of structural change, 1975–1990

1985–1990 forecast

1980–1985

1975–1980

Sources: UNIDO database, estimates and forecasts by UNIDO/PPD/IPP/GLO sector, banking and the foreign sector, including joint ventures. The Law on the Hire or Leasing of Means of Production allows leasing agreements lasting 25 to 30 years (or even 50 years in agriculture).

The above measures, however, contain some elements discriminating against private and co-operative enterprises. For instance, any purchase of a single item worth over 10,000 roubles should be accompanied by evidence of the source of funds. In addition, tax rates on their earnings are substantially higher than those on State enterprises. The latter also have priority in obtaining raw material supplies.

The most discouraging factor appears, however, to be a resistance by the bureaucracy and the general public. That point has been well expressed:

> "One of the critical preconditions of success . . . will be a change in the psychology of working people regarding high incomes. The fact is that, for a long time, workers and many government bureaucrats have come to the conviction that the desire for high incomes is a bourgeois relic. And, in essence, this had become the official point of view. People who are receiving significantly more than others in a particular work situation generally do not enjoy the support of public opinion. A change in that viewpoint in favour of higher incomes will be critically important to improving the material stimuli for harder work" ([14], p. 459).

It is therefore uncertain to what extent the pressure from the non-State sector will make the State sector more competitive and efficient* (for the current status of the non-State sector see table II.15).

*"From a handful in 1987, the companies, known as co-operatives, now number more than 60,000—with 7,000 in Moscow alone. . . . Despite all the problems, Soviet economists say Moscow co-operatives produced $1.3 billion in goods and services in 1988—up from $20 million the year before. Eventually, some economists believe co-ops could contribute up to a third of total Soviet production" (see [15], p. 21).

On the international front further liberalization measures have been adopted. The earlier requirement of 51 per cent ownership by the Soviet side in joint ventures was dropped. The new rule says that partners will determine the ownership shares by agreement between them. The top manager can come from abroad. The joint venture has rights to hire and fire as well as to decide salaries and wages of local staff. The tax-holiday period has been extended from two to three years. Furthermore, joint ventures will be allowed to buy and sell a part of their foreign currency earnings in an auction organized every four months. That will help to cover foreign currency requirements for importing inputs and make it easier to repatriate profits.

Developments in the region, along with improving East-West relations, have encouraged Western business interests to look for opportunities for greater trade and investment. In 1988, for instance, United States exports to the region jumped by 54 per cent, the total credit made available to the USSR by Western European countries reached over $9 billion, and exports by the Federal Republic of Germany to the USSR surged 20 per cent.

An innovative approach to East-West trade and investment is offered by the American Trade Consortium, consisting of Archer Daniels Midland, Chevron, Ford Motor, RJR Nabisco, Eastman Kodak, Johnson and Johnson and Mercater Corp. The Consortium has reached an agreement with its USSR counterpart involving more than 30 trade and economic organizations to set up rules for taxation, employment, accounting, arbitration and, above all, repatriation of profits in dollars. Under the agreement Chevron's joint venture with the USSR counterpart will earn foreign currency by selling petroleum abroad. That will meet the Soviet requirement for earning foreign currency covering other members of the Consortium, as well as the latter's need for repatriation of profit earned in roubles. Such an arrangement could set a precedent for others to follow.

Table II.14. CMEA gross industrial production at constant prices
(Percentage growth rates)

Country or country grouping	1975-1980	1980-1983	1983/84	1984/85	1985/86	1986/87	1988	1987-88	1988-89	1986-1990
Bulgaria	6.0	4.3	4.2	3.2	4.0	4.2	5.0 a/	5.0 a/ b/	5.0 a/ b/	4.9 a/
Czechoslovakia	4.7	2.7	4.0	3.5	3.2	2.5	2.0	2.0	2.0	3.0
German Democratic Republic	4.9	4.2	4.2	4.3	3.7	3.2	3.6	3.7	3.5	3.9
Hungary	3.4	1.9	2.7	0.7	1.9	3.8	1.0 a/	0.3 a/	-0.5 a/	2.7-3.0 b/
Poland	4.7	0.4	3.2	4.5	4.7	3.4	3.7-4.0 a/	5.4 a/	4.2 a/	3.0 a/
Romania	9.5	4.0	6.7	4.9	7.7	4.5	7.0-8.0	3.6	6.0-7.0	7.5-8.3
USSR	4.5	3.8	4.0	3.9	4.9	3.9	5.1 b/	3.9	5.2 b/	4.6
CMEA c/	4.8	3.5	4.2	3.9	4.8	3.8	4.8	3.8	4.8	4.5

Source: Wiener Institut für Internationale Wirtschaftsvergleiche, "The economy in the CMEA region and Yugoslavia", February 1989, p. 7.

a/ Socialist sector.
b/ Estimated.
c/ Council for Mutual Economic Assistance.

Table II.15. Types of enterprises in the USSR and their employees

Item	Year	Number of enterprises	Number of employees (thousands)	Average number of employees
Total	1988	..	129 700	..
Kolkhoz farms	1988	26 800	12 200	455
Agriculture, side-line enterprises	1987	43 million	..	..
State consumer co-operatives	1986	452 000[a/]	..	..
Voluntary co-operatives				
Total	1988	48 500	787	16
Service sector		17 100	276	16
Catering		6 100	51	8
Consumer goods production		10 900	205	19
Supply of secondary inputs		200	27	13
Other activities		12 400	229	18
Individual businesses				
Applied for	May 1987	200 000	..	..
Approved	May 1987	137 000	..	..
Approved	Feb. 1988	300 000	..	..
Black economy	1988	..	17-20 000	..

Sources: UNIDO calculations; Ekonomitcheskaya Gazieta, No. 52, 1988, p. 14, quoted in Armin Bohnet and Günter Jachne, "The private sector in the Soviet Union and China", Intereconomics, March/April 1989, p. 90.

a/ Retail stores and restaurants belonging to the Central Federation of Consumer Co-operatives.

Behind the reform movement towards greater openness lies the objective of revitalizing industries lagging behind those of OECD countries in technology and innovation.* As a way of closing the gap, the region intends to increase imports of Western machines that embody modern technologies superior to what is available in the region (see table II.16 for a USSR shopping list). This approach seems to have been adopted by all the countries in the region in either 1985 or 1986 (see table II.17). It is noteworthy that in 1986 investment goods imported from OECD countries jumped by 72.3 per cent for the German Democratic Republic, 35.8 per cent for Czechoslovakia, 27.3 per cent for the USSR, 26.3 per cent for Bulgaria, 23.5 per cent for Poland and 21.5 per cent for Hungary. Those growth rates are much higher than the growth rates of total investment in machinery and equipment in the respective countries. For instance, in the USSR investment in machinery and equipment grew only by 7 per cent, compared with a 27.3 per cent growth in investment goods imported from OECD countries.

The imported machines and equipment will help accelerate the modernization programme under way. In this regard, the programme of the USSR appears to be the most ambitious:

"The replacement rate of machine-building machines amounted to 3.1 per cent in 1985, whereas it is planned to increase up to 13 per cent in 1990. All this is done with a view to increasing the share of up-to-date machinery and equipment from 29 per cent to 80-90 per cent by the end of the five-year period" ([16], p. 15).

Whether the highly ambitious programme could in fact be realized is, however, a moot question, considering the recent change of priority in favour of consumer goods. The Government of the USSR announced in January 1989 that 20,000 million roubles would be spent to import finished consumer goods, compared with only 612 million roubles to import machinery and equipment for the consumer goods sector. This move reflects the urgency to curb inflation and to demonstrate the way *perestroika* is proceeding. Even the defence industry has been ordered to produce goods such as televisions, refrigerators and bicycles, in a crash programme to meet the pent-up demand for consumer goods.

The increasing voice of consumers in the region is likely to affect the structure of industrial output in contrast to the past orientation of growth towards heavy industry (see table II.18). During the 1971-1985 period, in almost all countries in the region, growth was higher in metallurgy, engineering, chemicals and construction materials than in textiles, food processing and other light industries.

*One indication of such a lag is seen in the proportion of technology-intensive goods exported from the USSR to OECD countries, which declined from 22.8 per cent in 1970 to 9.3 per cent in 1982.

Table II.16. USSR shopping list for western technologies

Technology	Business deals concluded or under discussion
Aerospace	Discussing for a joint venture to upgrade aircraft production plants and develop engines with the Federal Republic of Germany's Messerschmitt-Bölkow-Blohm.
Computers	Setting up joint ventures to import and assemble IBM-compatible personal computers in the USSR with European and United States companies, including Innovation International and Management Partnerships International.
Manufacturing	Acquired process control systems through joint ventures with Combustion Engineering and Honeywell. Hired Federal Republic of Germany's Siemens to automate medical equipment production. Discussion numerous machine tool ventures.
Nuclear power	Set up joint ventures with Asea, Brown Boveri, and Siemens to build nuclear reactor. Hired Siemens to upgrade nuclear power plants.
Semiconductors	Seeking United States and European partners to manufacture semiconductors designed by Soviet engineers.
Telecommunications	Launched a joint venture to make telecommunications cable with Finland's Nokia; buying digital switches from European and Canadian suppliers.

Source: International Business Week, 7 November 1988, p. 67.

Table II.17. Growth of machinery and equipment investment, 1981-1986
(Percentage)

Country and item	1981-1985 a/	1984	1985	1986
Bulgaria				
Machinery and equipment investment	8.5	-0.9	16.0	10.1
Investment goods imports from OECD b/	3.4	-13.2	27.4	26.3
Czechoslovakia				
Machinery and equipment investment	-	-1.4	9.7	6.0
Investment goods imports from OECD b/	-6.0	-2.7	15.7	35.8
German Democratic Republic				
Machinery and equipment investment	0.8	-5.2	7.3	11.7
Investment goods imports from OECD b/	-11.7	-44.2	-6.0	72.3
Hungary				
Machinery and equipment investment	-2.9	-2.6	1.8	7.9
Investment goods imports from OECD b/	-5.5	-7.6	19.6	21.5
Poland				
Machinery and equipment investment	-5.2	14.9	11.2	7.9
Investment goods imports from OECD b/	-17.0	3.4	26.0	23.5
Romania				
Machinery and equipment investment	0.6	8.1	3.9	..
Investment goods imports from OECD b/	-25.5	-7.1	25.8	5.4
USSR				
Machinery and equipment investment	4.6	1.4	5.1	7.0
Investment goods imports from OECD b/	-3.4	-24.1	-4.5	27.3

Source: National statistics, United Nations Foreign Trade Statistics and estimates of the Economic Commission for Europe.

a/ 1981-1985: average annual compound growth rates between the final year of period shown and the final year of the previous period.
b/ Constant prices, in 1980 United States dollars.

Table II.18. Gross industrial output by major branches[a/]
(Average annual percentage change)

Country and time period	Energy	Fuel	Metallurgy	Engineering	Chemicals	Construction materials	Wood and paper	Textiles	Other light industry	Food processing	Other industries
Bulgaria											
1971-1975	5.3	8.4	10.9	14.1	11.7	9.4	7.5	7.2	7.3	6.0	11.4
1976-1980	8.0	5.5	6.3	9.1	9.5	7.5	3.4	5.0	3.4	2.4	6.3
1981-1985	4.5	-6.3	2.7	8.9	7.0	1.4	3.0	3.2	3.4	2.1	4.3
Czechoslovakia											
1971-1975	6.1	3.2	5.4	8.4	10.0	6.6	7.2	5.9	5.8	4.7	8.6
1976-1980	4.8	2.7	2.8	6.7	5.8	4.3	5.3	3.6	3.8	2.7	4.4
1981-1985	2.3	0.1	0.5	4.9	3.2	0.7	3.0	2.0	2.1	1.5	1.3
German Dem. Rep.											
1971-1975	2.7	2.7	6.8	6.7	8.3	7.0	..	5.2	5.9	5.5	3.7
1976-1980	4.8	4.8	4.0	6.0	4.8	2.3	..	3.7	4.2	2.7	3.4
1981-1985	3.7	1.7	3.7	6.2	3.8	0.6	..	2.5	3.1	2.2	1.5
Hungary											
1971-1975	7.6	2.0	5.0	7.8	10.5	5.1	6.1	2.1	9.7	4.7	4.5
1976-1980	6.6	0.4	1.3	3.1	6.2	4.9	2.2	1.4	2.9	3.4	3.5
1981-1985	3.7	-0.1	-1.1	3.8	2.1	0.4	0.7	-0.2	3.6	1.9	4.8
Poland											
1971-1975	9.1	5.9	10.0	14.2	12.0	8.1	9.3	8.0	9.8	8.7	9.8
1976-1980	5.4	2.4	3.3	6.9	4.3	1.2	4.0	3.0	5.0	2.5	10.4
1981-1985	2.8	0.2	-2.3	1.3	0.7	-2.2	1.0	-2.2	2.8	-0.7	6.1
Romania											
1971-1975	9.7	5.2	10.8	18.1	15.8	10.0	6.9	12.1	12.9	7.4	22.0
1976-1980	4.7	3.9	7.7	12.6	9.6	12.8	6.5	10.8	8.7	6.1	9.1
1981-1985	2.8	1.5	2.2	5.5	3.8	1.6	2.8	3.0	7.6	2.3	6.7
USSR											
1971-1975	7.1	5.9	5.1	11.6	10.5	7.3	5.6	4.7	4.5	5.4	8.7
1976-1980	5.0	3.0	2.0	8.2	5.7	1.9	2.4	2.7	4.7	1.5	4.8
1981-1985	3.7	1.2	2.3	6.2	4.9	3.0	3.4	1.0	2.0	3.4	3.4

Source: Economic Commission for Europe common data base, derived from national and CMEA statistics.

a/ Though the branch entries have been standardized to the extent possible, the following main differences in coverage should be noted: metallurgy excludes non-ferrous metals in Bulgaria and the USSR, fuel includes oil refining in the German Democratic Republic and Hungary; other light industry includes clothing, leather, furs and footwear in the Soviet Union, and in the other countries it includes printing (except in Bulgaria), glass and ceramics (except in Hungary).

In the process of reform and structural change in industry, East-West co-operation looms large as a crucial ingredient of success. The region seems to need an ever-increasing inflow of financial and technological resources from Western countries, thereby adding to its existing debt (see table II.19). How the debt will be handled by both lenders and borrowers remains to be seen. The region's ability to pay back its debt depends ultimately on the building of efficient industries with an increased capacity to produce goods and to earn foreign currency. Such a development would then raise the question of how Western countries could absorb those exports without a high level of growth in their own economies.

Table II.19. The rate of indebtedness of the European CMEA countries

(Percentage)[a/]

Country	1983	1984	1985	1986	1987	1988 estimates
Bulgaria	43	21	44	140	178	178
Czechoslovakia	52	42	50	53	66	65
German Democratic Republic	97	78	78	91	106	96
Hungary	161	171	249	328	355	288
Poland	454	433	503	534	548	435
Romania	133	93	97	100	70	31
European CMEA excl. USSR	161	143	166	199	214	182
USSR[b/]	27	25	40	55	53	42
Total	89	82	105	130	134	113
Hungary[c/]	120	123	173	237	237	206
Poland[c/]	368	340	366	381	373	333
Rumania[c/]	124	87	92	88	65	33

Source: Institute for Economics, Market Research and Informatics, Planned Economies in the World Economic Trends (Budapest, 1989), p. 22.

a/ The ratio between interest charges and hard-currency exports of goods.
b/ Including net liabilities of CMEA banks.
c/ Compared to the hard-currency exports of goods and services.

E. Latin America and the Caribbean

The year 1988 saw a further decline in GDP growth in Latin America and the Caribbean to 1.3 per cent, compared with a 2.7 per cent rate in 1987 and 3.2 per cent in 1986 (see figure II.5). The spurt in the region's exports, at a brisk 15 per cent estimated in current dollar value, has failed to give an appreciable boost to industrial growth. Indications are that the growth-inhibiting factors could become even more severe in the short run. Foremost among these are the rising interest rate and debt service requirement, dwindling foreign direct investment, declining productive capacity and untamed inflation (except perhaps in Colombia and Mexico). The debt-relief plan proposed by the United States Secretary of the Treasury, known as the Brady plan, and the newly emerging industrial policies, while encouraging, may take some time to effectively counteract the general trend of weakening growth.

The slow-growth syndrome, which started with the onset of the recession in 1981, is also observable in the manufacturing sector. The annual growth of MVA averaged only about 2 per cent during the 1980-1987 period, compared with an average of 6.5 per cent during the 1970s. Some manufacturing branches had not, even as late as 1987, recovered to the absolute level of output of 1980. Those branches include apparel, leather products, footwear, furniture, printing, glass products, non-electrical machinery and transport equipment (see table II.20), which represent important items in the categories of consumer goods and investment goods. Intermediate goods industries, including industrial chemicals, other chemicals, petroleum refining, plastics, iron and steel and paper products, appear to have fared relatively well. These make up the domestic natural-resource-based industries with relatively high export demand. The pattern of change in manufacturing composition appears to reflect the efforts of big debtor countries (for example, Argentina, Brazil and Mexico) to suppress domestic aggregate demand and to maximize exports. Those efforts have involved squeezing out trade surpluses so as to service external debts.

The heavy burden of debt servicing continues to hinder growth, although the Brady plan could lighten the burden somewhat if successfully negotiated and implemented. The net outflow of financial resources has averaged $23 billion annually since 1982 (reaching $30 billion in 1988). Interest charges alone ranged between 17.0 per cent (Colombia) and 44.4 per cent (Bolivia) of exports in 1988 (see table II.21 for other countries). Since much of the private loan component of debt is based on a floating interest rate, the international money market determines a large chunk of interest charges. A worrisome factor is the current tendency towards rising interest rates. The Inter-American Development Bank has estimated that the two percentage point rise in interest rates between early 1987 and the end of 1988 will cost the region about $7 billion annually ([17], p. 98).

Such an increase in interest charges could wipe out the expected benefits of the Brady plan. If reasonably successful, the plan could cut the region's debt by 20 per cent across the board, and that would translate into an annual saving of from $6 billion to $7 billion on debt servicing. Savings of that magnitude could raise the region's investment-GDP ratio by about one percentage point. This means that to raise the investment-GDP ratio from the current 16 per cent to the 20 per cent level which prevailed during the 1970s, savings of from $24 billion to $28 billion would be needed—roughly equivalent to the current net outflow of financial resources. It remains to be seen how the Brady plan could bring sufficient relief to help growth in the region to recover to the level of the 1970s.

The debt-to-equity conversion plan has been widely applied in various countries of the region. The most successful case was that of Chile (see table II.22) which, during the 1983-1988 period, reduced 16 per cent of its debt to commercial banks (at the 1985 level) by that method. Bolivia follows with 10 per cent, then Brazil with 8 per cent. On the whole, the average amounted to only about 5 per cent. The main reason for the slow progress appears to be the fear of inflation. For instance, Brazil has suspended the selling of its debt several times because of the added increases in money supply connected with debt conversion.

Debts have to be served by squeezing out trade surpluses in the face of dwindling inflows of financial resources. It is remarkable that the region has increased its exports of goods and services from $116.7 billion in 1980 to $154.5 billion in 1987 (in 1986 constant dollars), while decreasing imports from $139.6 billion to $107.1 billion during the same period (see table II.23). This means that the region achieved a trade surplus ranging from 5 per cent (1986) to 6.4 per cent (1985) of its GDP. That marks a contrast to its earlier dependence on trade deficits for growth. The reduced availability of goods and services in the domestic market has provided an added cause of inflation in the region.

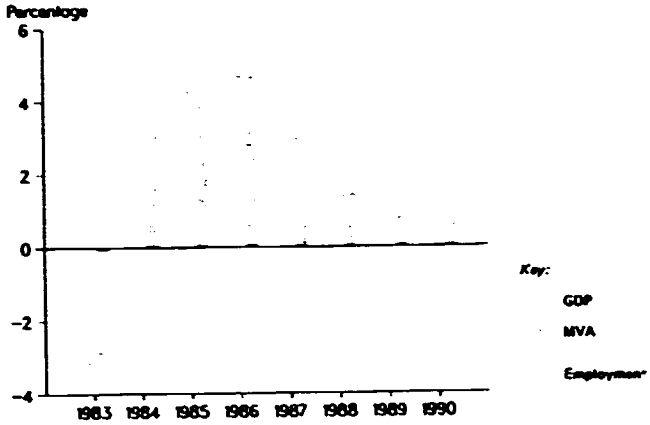
The feat of achieving trade surpluses—through reductions of consumption and investment—cost many countries of the region dearly. As of 1987, the aggregate consumption level (in 1986 constant dollars) had failed to recover to the 1980 level in Argentina, Bolivia, El Salvador, Guyana, Haiti, Nicaragua, Trinidad and Tobago, Uruguay and Venezuela (see table II.24). Many more countries (such as Mexico and Chile) would have to be added if the decline in consumption were to be computed on a per capita basis. For the region as a whole, the level of aggregate consumption increased by an average annual rate of 1.5 per cent during the 1980-1987 period, compared with the 2.3 per cent annual growth rate of the population.

Investment has suffered an even greater slump than consumption. For the region as a whole, aggregate gross investment plunged by 36.5 per cent in 1983, and in 1987 it remained at $140.9 billion (all in 1986 constant dollars). The plunge was experienced by 19 out of 24 countries listed in table II.24 (the exceptions include Colombia, Dominican Republic, Haiti, Jamaica and Nicaragua). In per worker terms, gross investment declined from $1,634 in 1980 to $1,039 in 1987. The figures would be smaller if computed net of depreciation. Such figures worry policy-makers about the future production capacity of the region.

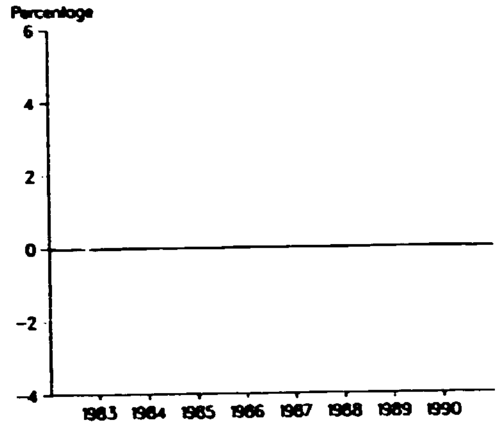
An additional worry comes from the declining trend of foreign direct investment (see table II.25). Private foreign direct investment (net of outflow) decreased

Figure II.5. Growth rates of GDP, MVA and manufacturing employment, 1983-1990, and industrial structural change, 1975-1990: Latin America and the Caribbean

Growth rates of GDP and MVA

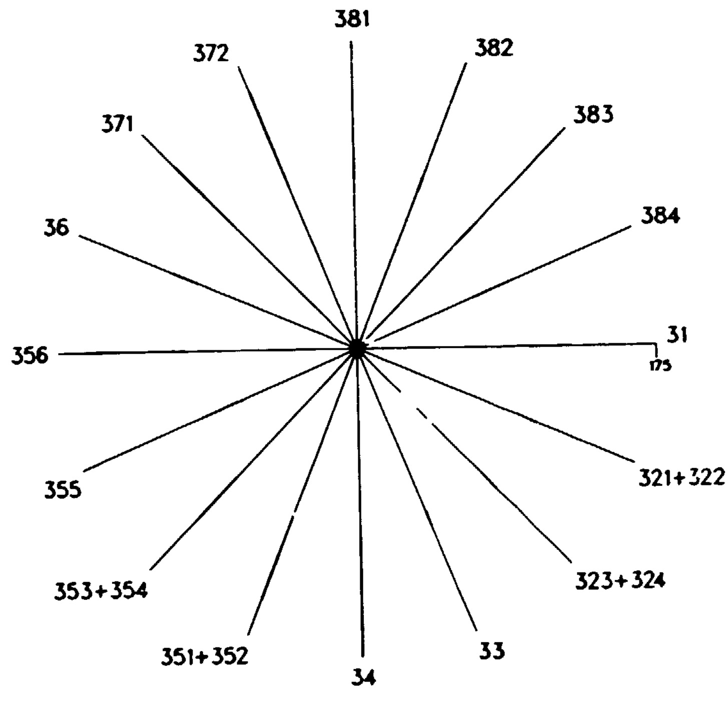


Growth rates of manufacturing employment



Industrial structural change

(Index of value added: 1975 = 100)



g =	1.22
θ =	13.08

Key:

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)

Constant prices of 1980

g = Average annual growth rate, 1975–1990 (percentage)

θ = Index of structural change, 1975–1990

1985–1990 forecast

1980–1985

1975–1980

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

Table II.20. Latin America: MVA by industry, 1980 and 1987

Branch of industry	1980	1987	Share in world total 1980	1987	Change
	(millions of 1980 dollars)		(percentage)		
Manufacturing	172 654	196 200	6.23	5.95	-0.28
Food products	31 955	37 019	10.67	10.12	-0.55
Beverages	6 907	9 083	10.36	13.15	2.79
Tobacco	3 346	3 959	13.37	14.44	1.07
Textiles	11 766	12 260	7.50	7.25	-0.25
Apparel	4 312	3 712	5.09	4.16	-0.93
Leather products	1 265	1 232	8.99	8.29	-0.70
Footwear	2 290	2 108	10.07	9.39	-0.68
Wood products	3 952	4 215	6.43	5.87	-0.56
Furniture	2 743	2 566	5.52	4.61	-0.91
Paper products	4 642	6 326	6.05	6.62	-0.57
Printing	5 348	5 310	5.48	4.38	-1.10
Industrial chemicals	6 518	10 244	5.18	6.51	1.33
Other chemicals	8 967	12 188	9.35	10.10	0.75
Petrol refining	7 486	12 835	10.03	16.57	6.54
Petrol and coal products	696	964	3.66	4.92	1.26
Rubber products	3 112	3 398	8.43	8.03	-0.40
Plastic	2 972	3 321	6.20	5.03	-1.17
Pottery	1 121	1 162	7.78	7.82	0.04
Glass	1 876	1 825	7.88	7.11	-0.77
Non-metal minerals	7 766	8 415	8.89	8.93	0.04
Iron and steel	9 390	11 001	6.05	7.14	1.09
Non-ferrous metals	3 504	4 297	6.13	6.71	0.58
Metal products	8 536	9 547	5.41	5.44	0.03
Non-electric machinery	10 602	9 099	2.99	2.03	0.96
Electric machinery	7 299	7 307	3.27	2.22	-1.05
Transport equipment	11 042	9 150	4.66	3.23	-1.43
Professional and scientific equipment	814	922	1.41	1.31	-0.10
Others	2 429	3 235	5.11	5.33	0.22

Source: UNIDO statistical data bank (25 countries, Industrial Statistics).

Table II.21. Indicators of Latin American debt burden

Country	Debt outstanding a/ Total (billions of dollars)	Private (percentage)	Debt service b/ 1988-1990 Total	Interest	Debt ratios Debt/GNP	Interest/exports	Annual growth 1982-1988 GDP	Investment	Consumption
			(billions of dollars)				(percentage average)		
Argentina	59.6	79.4	17.7	11.4	73.9	41.5	1.4	-2.1	-0.4
Bolivia	5.7	27.3	1.8	0.8	133.7	44.4	-1.4	-16.7	-1.6
Brazil	120.1	76.8	63.4	21.8	39.4	28.3	4.8	2.8	2.6
Chile	20.8	74.3	7.0	5.2	124.1	27.0	4.3	15.1	-0.8
Colombia	17.2	48.0	10.3	3.6	50.2	17.0	4.1	-0.1	1.3
Costa Rica	4.8	53.2	2.2	0.7	115.7	17.5	3.6	9.3	2.6
Ecuador	11.0	63.6	5.5	2.1	107.4	32.7	1.5	-2.1	-2.4
Mexico	107.4	78.1	43.5	24.0	77.5	28.1	0.2	-4.5	-1.8
Peru	19.0	61.5	7.4	2.4	40.5	27.2	2.9	-11.9	-1.4
Uruguay	4.5	77.1	1.8	0.8	58.6	17.7	1.7	-3.4	1.0
Venezuela	35.[illegible]	99.3	15.6	7.8	94.5	21.9	1.2	-1.6	-1.4

Source: World Bank, quoted in "The prospect opens for making progress", *Financial Times*, 20 December 1988.

a/ Estimated external liabilities in 1988.

b/ Based on long-term debt at end of 1987.

Table II.22. Debt-for-equity conversions, selected countries in Latin America a/

Country	Cumulative 1983-1988 (billions of dollars)	As percentage of end-1985 debt to commercial banks
Argentina	1.32	5
Bolivia	0.06	10
Brazil	5.89	8
Chile	2.35	16
Mexico	2.40	3
Venezuela	0.35	1
Total	12.94	5

Source: Morgan Guaranty Trust Company, World Financial Markets, No. 7 (1988).

a/ Excluding conversions outside formal programmes.

Table II.23. Exports and imports of goods and services, by country in Latin America, 1980 and 1987

(Millions of 1986 dollars)

Country	Exports		Imports	
	1980	1987	1980	1987
Argentina	10 195	11 663	16 333	9 452
Barbados	646	546	664	481
Bolivia	1 397	1 168	1 099	955
Brazil	25 265	38 845	31 534	28 395
Chile	5 997	7 846	7 696	6 402
Colombia	6 132	8 136	7 342	7 210
Costa Rica	1 771	2 421	2 097	2 170
Dominican Republic	1 527	1 513	2 363	2 124
Ecuador	2 486	2 966	3 688	3 059
El Salvador	1 203	892	1 261	991
Guatemala	2 510	1 584	1 701	1 128
Guyana	557	405	598	367
Haiti	521	437	792	653
Honduras	1 216	1 339	1 355	1 201
Jamaica	1 343	1 923	1 440	2 168
Mexico	20 093	35 849	24 351	13 965
Nicaragua	715	487	1 277	870
Panama	2 084	2 269	1 820	1 683
Paraguay	757	1 313	1 930	11 571
Peru	6 644	6 200	6 556	4 600
Suriname	819	438	883	473
Trinidad and Tobago	1 349	1 060	3 829	2 703
Uruguay	1 525	1 842	2 057	1 686
Venezuela	19 968	23 313	17 893	12 783
Latin America total	116 720	154 454	139 558	107 090

Source: [18], p. 543.

from $7.5 billion in 1981 to $2.8 billion in 1986. Traditionally, foreign direct investment has provided an important source of production capacity, employment, innovation using modern technology and export earnings in the region. Reduced foreign direct investment has not been replaced by its domestic counterpart. Foreign companies have been beset, like domestic companies, by chronic inflation, recurring price policy changes (freezes and thaws) and exchange and interest rate changes. In short, business risks and uncertainties have prevented them from planning and investing for the long term.

To avoid those risks and uncertainties, even domestic private capital has fled the region. The cumulative value of capital flight has been estimated at $244 billion for 1987, compared with $49 billion in 1980 (see table II.26). Unless debt relief schemes are managed carefully, there seems to be a danger that reduced debt may in effect finance further capital flight instead of releasing funds for real investment in the region. Herein lies the urgent need for a growth-oriented industrial policy in conjunction with a financial relief policy. The latter does not automatically translate itself into the former, although financial market stability is a prerequisite for an effective industrial growth policy.

Thus, in May 1988, Brazil launched a "new industrial policy" comprising three major components:

Table II.24. Total consumption and gross domestic investment, by country in Latin America, 1980 and 1987

(Millions of 1986 dollars)

Country	Total consumption		Gross domestic investment	
	1980	1987	1980	1987
Argentina	74 274	71 941	21 126	11 330
Barbados	714	746	226	149
Bolivia	4 350	4 192	800	449
Brazil	227 140	280 286	63 899	52 728
Chile	20 972	21 339	6 048	4 963
Colombia	31 883	37 916	7 505	8 501
Costa Rica	3 953	4 200	1 448	1 161
Dominican Republic	6 748	7 921	2 004	2 097
Ecuador	9 953	10 954	3 166	2 294
El Salvador	4 190	3 999	592	540
Guatemala	9 798	10 084	1 370	1 064
Guyana	657	509	239	173
Haiti	1 873	1 707	339	352
Honduras	2 572	2 885	810	634
Jamaica	3 410	3 766	474	552
Mexico	140 975	147 390	50 973	31 970
Nicaragua	3 017	2 826	495	635
Panama	3 373	4 294	1 122	917
Paraguay	3 545	4 597	1 337	1 158
Peru	19 677	24 449	7 788	5 394
Suriname	951	1 126	314	72
Trinidad and Tobago	4 047	3 746	2 853	1 216
Uruguay	7 612	7 415	1 614	785
Venezuela	54 951	52 740	15 824	11 770
Latin America total	640 634	711 026	192 367	140 906

Source: [18], p. 542.

Table II.25. Net private foreign direct investment, by country in Latin America, 1981, 1986 and 1987

(Millions of dollars)

Country	1981	1986	1987
Argentina	930.4	574.9	-19.0
Bahamas	34.4	-12.8	..
Barbados	7.2	5.0	..
Bolivia	75.6	10.0	22.0
Brazil	2 317.1	331.0	500.0
Chile	362.0	56.3	97.0
Colombia	228.8	673.4	350.0
Costa Rica	66.1	61.9	83.1
Dominican Republic	79.7	50.0	..
Ecuador	60.0	70.0	75.0
El Salvador	-5.8	..	..
Guatemala	127.6	67.5	90.0
Guyana	-1.8	..	..
Haiti	8.1	5.0	..
Honduras	-3.7	30.0	30.0
Jamaica	-11.6	-4.6	..
Mexico	2 541.1	895.1	..
Nicaragua	0.0	0.0	0.0
Panama	5.7	-3.9	..
Paraguay	32.0	31.6	0.0
Peru	128.5	19.9	23.0
Suriname	34.4	-33.2	..
Trinidad and Tobago	258.1	-21.8	33.3
Uruguay	48.6	-4.5	..
Venezuela	183.9	16.4	60.0
Latin America total	7 506.5	2 817.4	..

Source: [18], p. 573.

Table II.26. Flight of capital assets, from selected countries in Latin America, 1980, 1982 and 1987

(Billions of dollars)

Country	1980	1982	1987
Argentina	11	35	46
Bolivia	1	1	2
Brazil	6	8	31
Chile	0	1	2
Colombia	0	0	7
Ecuador	3	4	7
Mexico	19	44	84
Peru	0	1	2
Uruguay	0	2	4
Venezuela	15	33	58

Source: [18], p.9.

first, an Integrated Sectoral Programme to choose sectors for modernization, with incentives allowing them to import equipment at a reduced tariff, a 90 per cent reduction in the case of ground and satellite digital telecommunications (a newly organized Industrial Development Secretariat is to consider 100 new sectoral proposals in 1989); secondly, an Industrial Technology Development Programme which reduces taxes on imported technology by 90 per cent, and allows companies to write off large portions of research and development expenditures from corporate income tax; and thirdly, a Special Export Programme to award generous tax concessions to companies on their net foreign exchange earnings.

Controversy remains over the market reservation policy for domestic information and electronics technology through the banning of imports of, or foreign investment in, such technologies in Brazil. The technology protection thus afforded resulted in domestic price higher than international prices for installed computers, peripherals and automated equipment,* although domestic technology is said to be lagging three to four years behind the equipment used in developed countries. That has reduced the competitiveness of the users of such equipment. Brazil's pulp and paper manufacturers provide a case in point. In developed countries, computerized equipment controls moisture content and material weight throughout the production process, yielding high-quality output. Brazilian producers cannot adopt the new technology owing to the import ban, although a comparable technology is unavailable from Brazilian sources. How such a dilemma is going to be solved remains to be seen.

Meanwhile, Brazil appears to be losing ground in its fight against inflation (over 900 per cent in 1988), despite the anti-inflation plan introduced in January 1989. The plan pushed up interest rates to 25 per cent, limited credit supply, and froze prices, but the effect was to slash consumer spending (particularly on durables) and investment expenditure amid renewed expectation of monthly double-digit inflation. The Government soon realized that the plan should be abandoned. The macro-economic environment also appears to be unfavourable to a reversal of the 3 per cent drop in industrial production in 1988.*

In combating inflation, Mexico seems to have done better than Brazil, though at the cost of falling investment, employment and industrial output. Consumer prices rose by only 21 per cent during the 12-month period to March 1989, the lowest rate since December 1979. However, investment fell by 14 per cent, industrial output by 3.5 per cent and real wages by 15 per cent in 1988. Tight credit and controls on prices are expected to ease slowly in 1989 and 1990.

Industrial recovery in Mexico depends on how effectively the Pact on Economic Stabilization and Growth will be carried out. The Pact aims at stimulating growth by quick renegotiation of foreign debts, reactivation of idle capacity and greater tax incentives for foreign investment. To supplement the Pact, there is a new national industrial plan for promoting medium-term growth by making private industry more competitive. The plan is to liberalize imports of technology, remove excessive paperwork, particularly for exports, and channel investment into priority sectors with export potential through preferential credits and lowered taxes. The prospects for industrial recovery look reasonably good over the next few years.

Chile represents an exceptional case of steady industrial growth with relatively low inflation. In 1988 GDP and MVA grew by 6.5 per cent and 7.8 per cent, respectively. Consumer durable goods led in MVA growth with 30.7 per cent, and capital goods recorded 18.8 per cent. Inflation slowed to 14.7 per cent from 19.9 per cent in 1987. The degree of confidence in the economy is reflected in the level of foreign direct investment, which totalled $1.05 billion in 1988. Prominent foreign direct investment activities include: Escondida (the largest copper-refining project in the world) with BHP of Australia, RTZ of the United Kingdom and Mitsubishi of Japan; the Megallan International Nitrogen Company (fertilizer) with United States Combustion Engineering; and Simpson Paper joined by Bank of America, Manufacturers Hanover and Chemical Bank as a group. The prospects for 1989 and 1990 continue to be favourable, with growth rates comparable to those of 1988.

The review of economies of the region suggests that policy-makers have begun to grapple with the structural weaknesses of heavy protected industries. Policy packages are allowing some foreign competition through import liberalization, inducement of foreign direct investment and active technology transfer encouraged by greater tax incentives—a significant turnaround from past policies. The heightened awareness of the need for competitiveness-oriented, supply-side industrial policy is encouraging. However, the new policy packages are less clear on the connection between performance and benefits received under the new incentives system. Discretionary elements in awarding benefits still remain, and they seem to require clearer rules for effective implementation.

*Computer-operated machine tools made in Brazil cost five times more than foreign ones (see [18], p. 162).

*The official estimate of industrial output is said to be too low: "Official figures on the manufacturing sector tend increasingly to underestimate the sector's size . . . Thus, in the production of garments, shoes, wood furniture and some foodstuffs, the informal sector seems not only to have grown substantially but to have replaced the formal sector, sometimes through competition but also often by collaborating with it. For example, some garment factories have closed but continue to produce, contracting out piecework to be done at home" (see [18] p. 65).

The Caribbean emerges as a manufacturing site for marketing in North America and Western Europe

The countries of the Caribbean basin have increased garment exports to the United States at 15 times the rate of other areas. The Caribbean countries have advantages over competitors, particularly now that the United States' geopolitical concerns have strengthened the amount of economic and promotional support it is prepared to give the region. For example, the Caribbean benefits from easy access to the United States market, especially through the Caribbean Basin Initiative (CBI), which has more and longer-term benefits than the Generalized System of Preferences and items 806 and 807 of the United States Tariff Code. The volume of Caribbean textile exports to the United States grew from 354 million square metres in 1986 to 446 million square metres in 1987. In gaining a foothold in the United States garment market the Caribbean region now accounts for more than 9 per cent of imports and is ahead of the EEC as a source of United States imports.

Many South-East Asian businesses are now looking at the Caribbean as an alternative production site, and no longer just for textiles. Investment missions from Hong Kong, Japan, Republic of Korea and Taiwan Province are studying the region closely. For many Hong Kong business men, there is the added attraction of finding an alternative country and nationality, even though China is committed to maintaining the present economic system in the area of Hong Kong for at least 50 years after the end of United Kingdom rule in 1997. In order to attract such migrant investors, Haiti changed its nationality law in 1984.

The Caribbean is in a transitional phase, and its potential is clearly demonstrated by the number of new projects coming on stream. A survey conducted by Caribbean/Central American Action, a private United States association promoting Caribbean opportunities, identified 250 companies as being able either to undertake investments or to enter into major import commitments. Over 20 per cent responded to the survey. Of those responding, 91 per cent were considering new or expanded Caribbean operations. A United States Department of Commerce survey puts the number of export-oriented businesses starting up in the Caribbean Basin (Central America and Panama included) between January 1984 and May 1985 at 285; this represented an investment of $209 million and the creation of 35,891 new jobs.

One avenue for investment recently explored is the twin plants agreement, which is essentially a form of production sharing between two or more countries, often using accumulated tax relief funds. Twin plant investments offer an opportunity to capitalize on low-cost locations in CBI countries to maintain international competition. These are found mainly in assembly operations covering a wide range of product groups. The Lomé and Caribbean Conventions, which offer duty-free access to the European Economic Community and Canada, also provide additional market access incentives for potential twin plant investment, particularly with respect to the English-speaking Caribbean. This remains the case, even though the main driving force at present is the offer by CBI of duty-free access to the United States. Available data indicate that between 1986 and 1987 about $70 million were invested in twin plant operations between Puerto Rico and the rest of the Caribbean, a total of 39 joint projects in 10 countries, with creation of 5,000 jobs in electronics, textiles, pharmaceuticals, leather goods manufacture and telecommunications. The offer by CBI of duty-free access to the United States tends to exert greater influence than the array of concessions offered by Lomé, but access to Europe could also be of greater significance if related to greater promotional effort.

Source: "Industrialization in ACP countries: issues and options for industrial co-operation" (UNIDO PPD 106); and "The Caribbean region", UNIDO Industrial Development Review Series (PPD 51).

F. Tropical Africa

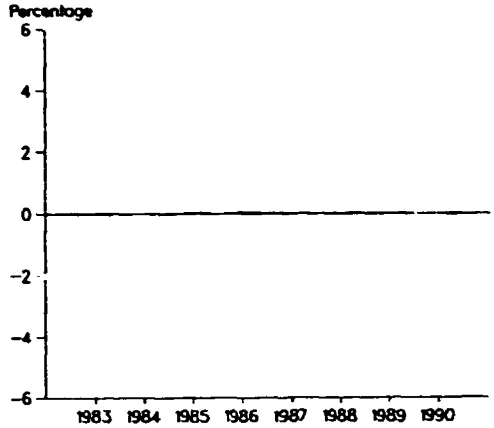
Though the immediate prospect of industrial growth in the region has improved in recent years compared with the early part of the 1980s, the medium- and long-term prospects seem rather gloomy. MVA growth averaged about 2.5 per cent annually during the 1985-1987 period (see figure II.6). It increased to 3.8 per cent in 1988, but is expected to rise to 4.6 per cent in 1989 thanks largely to the rebound of commodity prices (see table II.27). Still, the burden of debt service hangs heavily on the region, in addition to internal problems such as inflation, budget deficits, the import-dependent nature of industry, shortage of skills, persistent under-utilization of capacity and inadequate basic economic infrastructure (such as transportation and communications system). It is doubtful whether the current industrial recovery marks a reversal of the long-run slow-down in industrial growth. During the 1960s annual MVA growth averaged 6.5 per cent, falling to 4.5 per cent during the 1970s and 2.5 per cent during the 1981-1988 period.*

The declining MVA growth has partly mirrored the structural weakness of the region's industry. The majority of industrial establishments were initially designed for import substitution by assembling imported inputs and using imported machines and spare parts. Export earnings from the sale of primary commodities financed the assembly of products ranging from motor cars to radios. Input-output linkages with domestic sectors, however, have not developed sufficiently to withstand a drop in essential imports when export earnings fall.

*The growth rate of population during the latter period averaged 3.1 per cent annually, compared with a growth rate of GDP of only 0.7 per cent annually. This implies that the non-manufacturing sector grew at an even slower rate than manufacturing, and that the standard of living was deteriorating.

Figure II.6. Growth rates of GDP, MVA and manufacturing employment, 1983-1990, and industrial structural change, 1975-1990: Tropical Africa

Growth rates of GDP and MVA



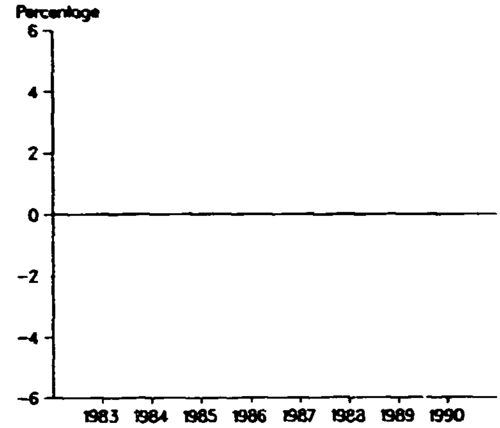
Key:

GDP

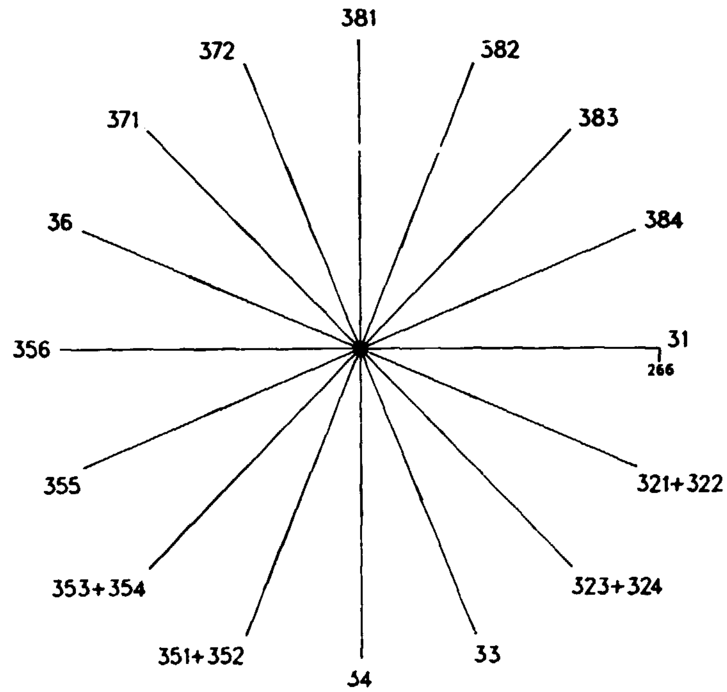
MVA

Employment

Growth rates of manufacturing employment



Industrial structural change
(Index of value added: 1975 = 100)



g =	2.81
θ =	10.87

Key:

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)

Constant prices of 1980

g = Average annual growth rate, 1975–1990 (percentage)

θ = Index of structural change, 1975–1990

1985–1990 forecast

1980–1985

1975–1980

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

Table II. Commodity prices, 1987-1988

Commodity	Unit	1987 average	1988 average[a/]	Percentage change
Cocoa	SDR[b/]/tonne	1 543.3	1 182.9	-23.5
Coffee				
Average	$0.01/pound	108.0	115.2	6.7
Robusta	$0.01/pound	102.0	93.8	- 8.0
Tea				
Kenya	pence/kilogram	104.8	104.4	- 0.4
Malawi	pence/kilogram	79.6	75.6	- 5.1
Sugar	$0.01/pound	6.8	10.1	49.6
Cotton	$0.01/pound	74.7	63.8	-14.6
Rubber	pence/kilogram	64.7	66.6	3.0
Copper	£stg./tonne	1 074.5	1 413.9	31.6
Aluminium	£stg./tonne	953.2	1 437.2	50.8
Gold	dollars/ounce	446.6	438.7	- 1.8
Oil	dollars/barrel	18.4	15.1	-17.3

Source: African Economic Digest, December 1988, p. 24.

a/ Average for first 11 months.
b/ Special drawing rights.

The pattern of sectoral growth reflects that situation (see table II.28). During the 1980-1987 period, the absolute level of output fell in transport equipment, electrical machinery, professional and scientific equipment, other chemicals (for example, pharmaceuticals, paints, detergents, perfumes and explosives), petroleum refining, petrochemical products and footwear.

The countries of the region had hoped to modernize their economies through import substitution in normally capital-intensive industries. On the whole, the industrial strategy adopted during the 1960s and early 1970s may be considered properly attuned to the economic environment and philosophy at that time. But the world recession during the early 1980s

Table II.28. Tropical Africa: manufacturing value added by industry, 1980 and 1987

Industry	1980 (millions of 1987 dollars)	1987 (millions of 1987 dollars)	Percentage share of the region in world total: 1980	1987	Change
Manufacturing	14 484	16 105	0.52	0.49	-0.03
Food products	2 635	3 443	0.88	0.94	0.06
Beverages	1 632	1 903	2.45	2.75	0.30
Tobacco	679	872	2.71	3.18	0.47
Textiles	1 898	1 999	1.21	1.18	-0.03
Apparel	418	454	0.49	0.51	0.02
Leather	82	84	0.58	0.57	-0.01
Footwear	214	183	0.94	0.82	-0.12
Wood products	453	460	0.74	0.64	-0.10
Furniture	235	293	0.47	0.53	0.06
Paper	242	369	0.31	0.39	0.08
Printing	437	539	0.45	0.44	-0.01
Industrial chemicals	243	273	0.19	0.17	-0.02
Other chemicals	925	891	0.96	0.74	-0.22
Petroleum refining	473	369	0.63	0.48	-0.15
Petroleum and coal production	37	21	0.19	0.11	-0.08
Rubber production	176	205	0.48	0.49	0.01
Plastics	144	184	0.30	0.28	-0.02
Pottery	34	44	0.23	0.29	0.06
Glass	77	105	0.32	0.41	0.09
Non-metal mineral products	460	590	0.53	0.63	0.10
Iron and steel	305	391	0.20	0.25	0.05
Non-ferrous metals	209	228	0.37	0.36	-0.01
Metal products	736	937	0.47	0.53	0.06
Non-electrical machinery	150	163	0.04	0.04	-
Electrical machinery	250	218	0.11	0.07	-0.04
Transport equipment	1 117	645	0.47	0.23	-0.24
Professional and scientific equipment	8	6	0.01	0.01	..
Other	214	233	0.45	0.38	-0.07

Source: UNIDO statistical data bank.

wrought havoc with their plans, and their industries have not been able to fully recover largely because of their inability to secure sufficient imports.

It is little wonder that industrial capacity utilization is extremely low in many countries of the region. In the mid-1980s, for example, the average rate in major industries was 33 per cent in Sudan, 36 per cent in Liberia, 25 per cent in United Republic of Tanzania and between 30 and 50 per cent in Zambia. However, import cuts are not the sole reason for low capacity utilization.* Domestic causes also play their part. These include a lack of managerial skills, frequent failures in power supplies, inadequate technical service facilities, absence of information and marketing weaknesses.

A keen awareness of these basic problems has led policy-makers to revise industrial development strategies along with macro-level demand management policies in recent years. Of 45 countries in the region, about two thirds have embarked on significant policy reforms. Most have done so with support from the IMF or the World Bank, while a few have initiated reforms on their own initiative; for example, Angola, Guinea-Bissau and Zimbabwe.

Most reforms, though with varying degrees of extensiveness, aim at liberalizing the environment in which manufacturing operates by reducing government ownership and control, promoting private domestic and foreign investment, shifting emphasis to small- and medium-scale industries using local raw materials and strengthening domestic input-output linkages. Those supply-side policy measures are coupled with macro-level demand management measures designed to restore internal and external balances through reduced budgetary spending and tighter monetary policies. Foreign exchange reforms aim at a more competitive exchange rate (through devaluation) as well as a foreign exchange auction system designed to improve its allocation (as in Ghana, Nigeria, Gambia and Mauritania).

Among the reform measures, the strengthening of input-output linkages deserves special attention. That avenue of industrial policy has received growing emphasis only since the crushing balance-of-payment difficulties experienced during the last world recession. The evidence is still too scarce to permit an assessment of the extent to which it could make a contribution to growth. But scattered information suggests that much can be achieved, particularly with regard to linkages between agriculture and manufacturing.

The case of Zimbabwe illustrates the growing importance of strengthening such linkages. Table II.29 provides some figures about the extent to which agricultural sector output is used as an input in the manufacturing sector. Between 1965 and 1982, the proportion of agricultural output sold to the manufacturing sector increased from 13 per cent to 44 per cent. From the viewpoint of the manufacturing sector, the proportion of inputs coming from the domestic agricultural sector increased from 10 per cent to 29 per cent during the same period. The commodities include grain for food processing, tobacco leaves for cigarettes, cotton for textiles, beef for canning and beverage materials (tea, coffee, raw sugar etc.). Exports of processed agricultural goods brought home much higher earnings than exports in unprocessed form.*

The linkage also flows also, from the manufacturing to the agricultural sector (see table II.30). The proportion of agricultural inputs supplied by the domestic manufacturing sector increased from 42 per cent in 1965 to 48 per cent in 1982. The same flow as a proportion of total manufacturing output increased from 3 to 7 per cent. The products consist of stockfeeds, paper and packaging materials, fertilizers, crop chemicals, agricultural machinery and transport equipment.

It is noteworthy that in the process of strengthening agriculture-industry linkages, Zimbabwe adopted both import substitution (domestic supply of agricultural inputs) and export substitution strategies (greater value added before exporting agricultural output).** A similar strategy formed the basis of the success of newly industrializing economies in South-East Asia, although the natural-resource base in that region was much weaker than elsewhere, even at the initial stage of industrialization. When domestic supplies of natural resources were exhausted, the Asian NICs began importing raw materials for value-added processes. Zimbabwe's successful efforts to develop a relatively well-balanced sectoral pattern of industrialization seems due, at least in part, to the pragmatic choice of such a strategy.***

Intersectoral and inter-industry linkages are unusually well developed in Zimbabwe compared with other countries in the region.**** The most important industrial branches in 1986 were food products and beverages, textiles and wearing apparel, iron and steel and fabricated metal products, the latter including a growing spare parts and components industry. Food products and beverages dominated with 23.3 per cent of MVA and 19.4 per cent of manufacturing employment. Textiles and wearing apparel followed with 13.5 per cent of MVA and 21.1 per cent of employment. Finally, iron and steel and fabricated metal products accounted for 7.6 per cent and 8.7 per cent, respectively.

Foreign investment helped to further diversification and linkage creation. Foreign ownership accounts for approximately 48 per cent of total manufacturing assets, and it dominates in metal products, chemicals and petroleum products, paper and printing, beverages and tobacco.*****

*It has been argued that much of the negative growth in total factor productivity of manufacturing measured in Kenya, the United Republic of Tanzania and Zambia and the low but positive growth in Zimbabwe is due to underutilization of capacity. See [19]

*"For instance, Zimbabwe has recently been selling (manufactured) meat to the Federal Republic of Germany at $4 per kilogramme. If this had been processed into canned meat it would have earned the country $7 per kilogramme" (see [20], p.63).

**This combination of strategies is reiterated in a recent report (see [21], pp.2-40, particularly pp. 9-10 and 30).

***"Indeed the sophistication of the Zimbabwean economy and the pivotal place occupied by its manufacturing industry have led to the suggestion that . . . Zimbabwe could be the first country in sub-Saharan Africa to join the ranks of the handful of newly industrialized countries, currently confined to Asia and Latin America" (see [20], p.1). If such a prospect becomes a reality, its demonstration effect could be significant in the region.

****Zimbabwe's MVA share in GDP was 29 per cent in 1985—a high figure compared with others.

*****Details are available in [22], p.31.

Table II.29. Agricultural output supplied as manufacturing input in Zimbabwe, selected years

Item	1965	1975	1981-1982
Percentage of agricultural output used as input by manufacturing sector	12.8	31.1	43.9
Percentage of commercial agricultural output used as input by the manufacturing sector	16.0	38.6	59.2
Percentage of inputs used by manufacturing sector originating in the domestic agricultural sector	9.7	20.4	29.2

Source: [20], p.61.

Table II.30. Supply of material inputs from the manufacturing sector to the agricultural sector in Zimbabwe, selected years

Item	1965	1975	1981-1982
Percentage of inputs provided by the manufacturing sector a/	42	43	48
Percentage of inputs directly imported	9	7.5	10.4
Inputs from manufacturing to agriculture as a percentage of total manufacturing output	3	6	7

Source: [20].

a/ The data for 1981/82 do not reflect capital purchases by the agricultural sector.

By way of contrast, Angola lies almost at the other end of the spectrum in the degree of industrialization. In 1987 Angola produced $9 worth of MVA per capita while Zimbabwe produced $158 worth of MVA (both in 1980 dollars). Angola's weak intersectoral linkages may be seen as both a problem to be solved and an opportunity to exploit for balanced industrialization. Zimbabwe's experience could provide a model to emulate in so far as exploiting linkages as a source of growth is concerned.

Angola is blessed by generally good conditions for agriculture, with fertile soils, favourable climate and adequate water for irrigation. The food processing subsector has, however, registered substantial reductions in output since the mid-1970s. In addition to the civil war, the failure to stimulate agricultural production and marketing of produce by proper policies has reduced the availability of raw materials for the food processing subsector. Meanwhile, continuous degradation of processing equipment and installations is seriously hampering the industry as a whole. This is the result of a deficient supply of spare parts caused by foreign exchange constraints and inadequate maintenance.*

At present, the backward linkages of industry to the agricultural sector are disrupted on account of unavailability of raw materials. Dairy processing, for example, has to rely on imported skim milk powder. The situation is similar in vegetable oils and fats and flour milling; insufficient supplies from local sources force processors to import oil-bearing seeds for the former and wheat and maize for the latter. Meat for processing is not available, and often fish is used as a substitute in a meat-processing plant in an effort to keep production going. And yet, available capacity is not fully used (see table II.31).

Most of the other countries in the region may be said to lie between Angola and Zimbabwe regarding the problem of weak inter-industry linkages and capacity under-utilization.

The general problem of capacity under-utilization in the region is exacerbated by infrastructural shortcomings. A deficient internal transport network impedes the growth of intersectoral and inter-industrial linkages within a country. Between countries in the region, transport networks appear even more primitive and neglected, though changing (with, for example, the Tan-Zam railway and the pan-African highway project). Telecommunications is another field where much progress is yet to be made. Private credit institutions for industry appear to be almost non-existent in many countries of the region.

Given the prevailing conditions, the financial austerity measures often found in the adjustment programmes appear to wreak havoc on many subsectors of manufacturing, and the programmes take much longer than expected to bring results. The medium-term outlook for industrial development in the region should be assessed with such structural factors in mind.

*For further details on the problem and the search for new approaches to solve it, see [23].

Table II.31. Capacity utilization in the Angolan food-processing industry

Product	Available capacity		Utilization percentage	
	Tonnes	Hectolitres	1984	1987[a]
Maize flour	78 514		37.6	30.9
Wheat flour	76 000		36.4	41.8
Noodles	10 792		74.3	33.4
Biscuits	2 893		23.7	31.8
Margarine	2 545		22.1	9.3
Instant coffee	134		20.0[b]	
Beer		1 435 800	45.6	32.5
Fermented drinks		65 500	45.8	45.8
Soft drinks		366 650	49.6	19.6
Wine		280 000	21.8	12.1
Liqueurs and spirits		20 500	101.3	68.3

Source: Ministry of Industry of Angola.

a/ Estimated.
b/ 1982 figure.

G. North Africa and Western Asia

The economic environment of the region has been improving considerably, starting with the end of the eight-year war between Iraq and the Islamic Republic of Iran in August 1988, coupled with the recovering oil prices in early 1989. A boom period of reconstruction in the region and improved prospects for export earnings are expected to provide a major driving force for further industrial growth. The EEC, a paramount trade partner of the region, might offer an opportunity for faster growth, but the longer-run trade outlook appears uncertain, mainly because of the possibility that the EEC will be inward-looking after 1992 and of some likelihood that USSR oil and gas will compete with oil from the region. Its aggregate MVA is anticipated to grow by 6 per cent annually in 1989 and 1990, compared with a 4.4 per cent growth in North Africa and 5.9 per cent in Western Asia in 1988 (see figure II.7).

In general terms, the predominance of oil in the region's economy constrains the industrialization process through both demand-side and supply-side effects. An increase in oil export revenues provides incomes to buy consumer goods (mostly imported) on the demand side, and a means for the production sector (business) to import intermediate inputs, capital goods, parts and components, technology and even accountants, engineers and managers, along with unskilled labourers when needed.* These imported productive factors have played a crucial role in developing the oil-based downstream industries such as petrochemicals, fertilizers and energy-intensive industries, including iron and steel, aluminium, cement etc. Those industries have been the growth leaders in manufacturing, thanks to the advantages of feedstock availability at low prices (see table II.32). They are expected to continue to lead industrial growth in the future, as Governments in the region plan to diversify out of dependence on oil exports, although efforts to promote import substitution of light consumer goods (clothing, processed food etc.) would be an added source of growth.

In spite of the general trend of steady growth of manufacturing in the region, the individual country performances and the level of industrialization are rather uneven (see table II.33). Three countries (Islamic Republic of Iran, Saudi Arabia and Turkey) dominate with 60 per cent of MVA produced in the region. Turkey's growth performance is remarkable; between 1980 and 1987, its MVA grew by over 74 per cent (an average annual rate of 8.3 per cent). In part, this growth performance is due to the Gulf-War-related demand for Turkish exports, and in part to the regional boom associated with the high oil price of the early 1980s. Turkey's industrial structure provides an essential complement to the oil-producing economies of the region.*

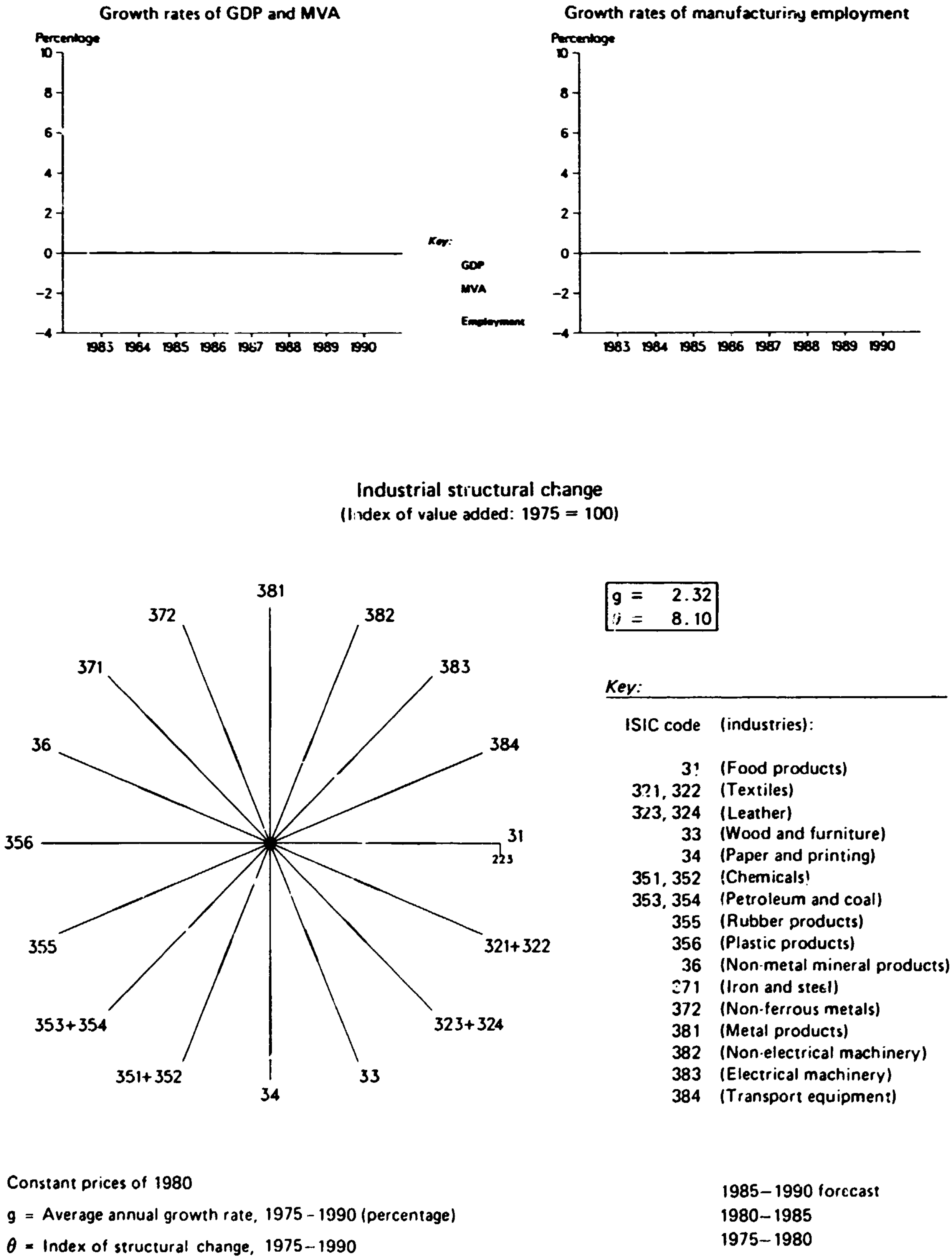
However, some smaller countries have performed even better. Oman, United Arab Emirates and Yemen Arab Republic more than doubled their MVA during the 1980-1987 period, though from a low base level.

Now that the Gulf War is over and active reconstruction and moderately rising oil prices are in prospect, the region appears ready to sustain higher MVA growth. Furthermore, most countries of the region have been adopting measures to remove business restrictions and to privatize State-owned enterprises in the hope of making them more efficient under private management and relieving Governments

*"A recent study by a researcher at King Abdel-Aziz University in Jeddah has revealed that only 9.5 per cent of employees in the Kingdom's (Saudi Arabia) non-government sector (primarily manufacturing concerns) are Saudi nationals. ... The report goes on to show that if companies belonging to the Saudi Basic Industries Corporation (Sabic) were excluded from the sample, the proportion of Saudi workers would fall to 4.9 per cent" (see [24], p. 12).

*The share of industry in Turkey's GNP reached 34 per cent in 1988, and about 80 per cent of export revenues came from manufactures in the same year.

Figure II.7. Growth rates of GDP, MVA and manufacturing employment, 1983-1990, and industrial structural change, 1975-1990: North Africa and Western Asia



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

Table II.32. North Africa and Western Asia: MVA by industry, 1980 and 1987

Industry	MVA 1980 (millions of 1980 dollars)	MVA 1987 (millions of 1980 dollars)	Percentage of world total 1980	Percentage of world total 1987
Total manufacturing	42 971	61 708	1.55	1.87
Food products	5 741	7 628	1.92	2.08
Beverages	929	1 044	1.39	1.51
Tobacco products	1 446	1 823	5.78	6.65
Textiles	5 475	7 409	3.49	4.38
Apparel	1 136	1 566	1.34	1.75
Leather products	291	401	2.07	2.70
Footwear	461	586	2.03	2.61
Wood products	720	972	1.17	1.35
Furniture	[illegible]04	647	1.01	1.16
Paper products	863	1 253	1.12	1.31
Printing	574	663	0.59	0.55
Industrial chemicals	1 623	2 890	1.29	1.84
Other chemicals	1 498	2 277	1.56	1.89
Petroleum refineries	7 629	10 261	10.22	13.25
Petroleum and coal products	353	465	1.86	2.38
Rubber products	561	782	1.53	1.85
Plastic products	793	1 111	1.65	1.68
Pottery, china	205	222	1.43	1.50
Glass products	354	548	1.49	2.13
Non-metal mineral products	3 035	4 493	3.47	4.77
Iron and steel	619	1 051	1.08	1.64
Metal products	1 741	2 652	1.10	1.51
Non-electrical machinery	1 311	1 541	0.37	0.34
Electrical machinery	1 440	2 536	0.65	0.77
Transport equipment	1 693	3 137	0.71	1.11
Professional and scientific equipment	66	90	0.11	0.13
Other manufactures	221	367	0.47	0.55

Source: UNIDO statistical data base - Industrial Statistics.

Table II.33. North Africa and Western Asia: MVA by country, 1980 and 1987

Country	MVA 1980 (millions of 1980 dollars)	MVA 1980 Percentage	MVA 1987 (millions of 1980 dollars)	MVA 1987 Percentage	MVA per capita 1980 (1980 dollars)	MVA per capita 1987 (1980 dollars)
Algeria	3 826	7.0	5 631	8.0	176	244
Egypt	3 220	6.9	5 309	7.5	78	106
Libyan Arab Jamarahiya	723	1.5	1 227	1.7	237	300
Morocco	2 774	5.9	2 980	4.2	143	128
Sudan	789	1.7	857	1.2	42	37
Tunisia	1 030	2.2	1 719	2.4	161	225
Bahrain	526	1.1	843	1.2	1 512	1 812
Cyprus	378	0.8	520	0.7	600	763
Iran (Islamic Republic of)	8 528	8.3	11 957	17.0	219	233
Iraq	2 363	5.1	1 818	2.6	178	107
Jordan	363	0.8	414	0.6	124	109
Kuwait	1 582	3.4	1 745	2.5	1 149	938
Lebanon	495	1.1	143	0.2	186	52
Oman	45	0.1	355	0.5	45	266
Qatar	258	0.6	419	0.6	1 121	1 280
Saudi Arabia	5 800	12.4	8 129	11.5	619	647
Syria	465	1.0	797	1.1	53	71
Turkey	12 770	27.3	22 292	31.6	287	425
United Arab Emirates	1 131	2.4	2 635	3.7	1 113	1 811
Yemen Arab Republic	160	0.3	657	0.9	27	90
Democratic Yemen	34	0.1	64	0.1	18	26
Total	46 719	100.0	70 508	100.0	94	245

Source: UNIDO statistical data bank.

from the burden of subsidizing loss-makers. Thus, private firms are expected to boost their investment and production, adding to the existing momentum for industrialization. This general trend is worth reviewing in some detail.

In Iraq, a highly centralized economy, the heavy debt and the scarcity of foreign exchange reserves were the major reasons for privatization. Privatization measures aimed mainly at reducing the borrowing requirement of the inefficient public sector. The trend towards privatization, which started in 1987, became more pronounced during 1988, with sales of more than 50 State-owned enterprises in a wide range of industrial branches, including poultry, grain milling, dairy products, canning beverages, textiles, bricks, asbestos and others.

Iraq has practised the auction system in the selling of public manufacturing enterprises to the private sector, in order to ensure the highest price. However, for private investors, the purchase of an existing public enterprise is still not very attractive since the scarcity of foreign exchange makes it difficult and costly to import machinery or equipment.

Privatization of public enterprises has been launched with new laws and regulations designed to encourage private investment, enlarge the scope of private sector activities and create a suitable environment for entrepreneurs. By government control decree, all Iraqis are allowed to import goods without foreign exchange quotas and controls. Individual companies are also allowed to import required raw materials, spare parts and equipment, and price controls have been lifted.

In addition, other regulations and laws were issued in 1988 to encourage private investment in manufacturing activities. For instance, a new regulation enables the private and mixed sectors to develop the existing automobile parts industries and to establish new ones. It also provides for various incentives such as exemption from customs duties. Another law encourages Arab investment through tax exemptions, profit repatriation and other incentives, provided the capital invested exceeds 500,000 Iraqi dinar (about $1.6 million). The private sector is now permitted to compete in all branches of manufacturing, including those which were previously reserved for the public sector. The encouragement of private investment in manufacturing is also reflected in a recent regulation which exempts, as of January 1989, all existing and future industries from all taxes for a period of 10 years.

In the Gulf Co-operation Council (GCC) countries, privatization of public enterprises is still in its early stage. The public sector established heavy industries because of their insufficient attractiveness for the private sector and the high risk they entail. Privatization of public enterprises could be considered as soon as the private sector is ready to take over those enterprises. The current development plans of most GCC countries call upon the private sector to shoulder a greater part of the responsibility in manufacturing activity. The sharp decline in oil prices and revenue in recent years has led most GCC Governments to reconsider their budget expenditure, to rely more heavily on private investment and to show more reluctance in launching large and risky industrial projects.

Under a new measure adopted in February 1988 by the GCC financial and economic committee, share dealings are liberalized in the GCC region. Hitherto, only nationals could buy shares in companies in their country of residence. The recent agreement between GCC member States aims at encouraging the private sector to invest in industrial projects rather than in real estate, trade and foreign companies. It is worth noting that the GCC measure will be more effective with the expected opening of the Omani and Bahraini Stock Exchanges, which could play an important role in the dealing of shares of manufacturing enterprises. After the selling of 20 per cent of government shares in the Saudi Basic Industries Corporation (SABIC) to the private sector in 1984, the Government of Saudi Arabia continued in 1988 to sell additional shares, as well as its shares in the Gulf International Bank.

The Saudi Arabian private sector is performing well and increasing its participation in manufacturing activities. The largest private company is the Saudi National Industrialization Company, which is now executing a number of projects aimed at strengthening the Saudi Arabian industrial base. Such projects will include plants for manufacturing glass, wire products, batteries, furniture and titanium dioxide. In addition, an iron foundry project with a capacity of 12,000 tonnes per year is planned to be built in Dammam. The plant will produce drain and manhole covers, waste and sewerage pipes and fittings, agricultural implements, car parts, liquid pumps and valves. Other planned projects consist of a $10 million toxic waste treatment plant in Jubail and a $32 million disposable glass bottle factory in Jeddah.

In Oman, where private investment enjoys several incentives, the Government has taken further steps to increase the role of the private sector in the economy. A new committee set up in May 1988 and chaired by the deputy prime minister has the objective of encouraging the private sector to play a bigger role in the national economy. The committee consists of five representatives each from the Government and the Oman Chamber of Commerce and Industry.

In Jordan, privatization of public and mixed manufacturing enterprises has not started yet, though a special committee at ministerial level was established in 1986 to assess possibilities for privatization, whether through transfer of ownership to the private sector, or through introducing private management systems in public sector enterprises. Three public enterprises were identified as targets for privatization, the Public Transport Corporation, Royal Jordanian Airlines and the Telecommunications Corporation. Detailed studies of those enterprises recommended the reform of management and accounting structures before proceeding to privatization [25].

In Egypt, public manufacturing enterprises are being restructured, as a step towards their transfer to the private sector. Restructuring involves the introduction of private management techniques to public enterprises which no longer receive government subsidies and which have to rely on commercial banks for their financing. The government has recently permitted publicly enterprises to import or export directly, without approval by the public owned Foreign Trade Corporation

In spite of the efforts to diversify the region's economy through a better balance of private and public sectors, the oil industry (State-owned invariably) still plays a decisive role and has a direct impact on the level of economic activity in both oil- and non-oil-producing countries of the region. It is expected that oil prices will gradually increase and then stabilize in the 1990s. Such a development will allow the Governments of the region to increase public expenditures and implement some of the projects that have been postponed because of financial constraints.

The 1990s are also likely to witness increased co-operation between economies of the region. Regional, and particularly subregional, co-operation, is more and more seriously viewed as a means of enhancing economic development and promoting industrialization. Towards that end, two new subregional groupings have recently been formed; namely, the Arab Co-operation Council (Egypt, Iraq, Jordan and Yemen Arab Republic) and the Arab Maghreb Union (Morocco, Tunisia, Algeria, Libyan Arab Jamahiriya and Mauritania). The objective of both groups is to intensify economic co-operation and expand trade. In parallel, the GCC member States are adopting a series of measures to enhance subregional co-operation through the abolition of barriers to subregional trade and the establishment of regional institutions and projects.

In spite of these positive developments, prosperity in the region would depend on the world demand for oil and the development of oil prices, unless member countries effect structural changes in favour of agriculture and manufacturing, for the oil exporting economies. The long-term objective and strategy should be economic diversification with a view to reducing dependence on the oil sector. In the non-oil countries of the region, the commodity processing sectors will be called upon to increase production in order to meet local and regional demand. Economic diversification and development of exports constitute major and common objectives of development plans of most countries of the region.

It is too early to assess the results of the recent privatization measures in many countries in the region. These cannot be considered successful unless there will be improvement in the efficiency and productivity of the privatized companies. Yet, with the exception of food processing industries, the private sector has, in general, no real industrial experience.

Furthermore, privatization will not be effective without the liberalization of the economy, relaxation of financial controls, restructuring of industrial finance and credit, and the creation of stock markets. In fact, the private sector still has not full confidence on the measures adopted by the governments, since a long-term policy covering all economic sectors is needed. For instance, the creation of stock markets at both the country and regional level is needed.

Economic diversification and development of exports have been reflected in the establishment and expansion of heavy industries and the processing of local natural resources. The industrial branches that witnessed an expansion during the 1980s are petrochemicals and fertilizers, iron and steel, aluminium, cement and textile industries. The prospects for the 1990s vary, however, between these branches.

So far as the petrochemical industry is concerned, further redeployment of production capacities from industrialized countries to the region is not very likely. In recent years, with the fall in oil prices, more and more developing countries have established their own petrochemical industries. The establishment of additional capacities in the developed economies would intensify international competition. Under these conditions, companies in the region need to increase their efforts to improve their efficiency and productivity, develop new products and open up new markets. With more successful efforts in this direction, the competitiveness of the petrochemical industry will eventually become less dependent on oil price developments.

For the aluminium sector, development perspectives appear particularly promising. Despite the competition from producers of substitute products, global demand will further increase, especially in the developing world. The aluminium industries are likely to develop production and diversify products at growth rates higher than average. Chances are that the GCC member states will more and more specialize in this sector and eventually assume the role of leading suppliers in South-North and South-South trade.

For the cement industry the outlook appears to be rather dim. The major problem facing the cement industry is the absence of co-ordination between producers of the region. The establishment of several cement industries has resulted in over-capacities and increased competition. At the same time, some countries of the region, such as Saudi Arabia and Egypt, continue to import cement from extra-regional markets. The performance of the cement industry in the region would therefore depend on co-ordination between member countries with regard to investment in additional capacities and marketing.

The development of the iron and steel sector has proved to be very heterogeneous. Production results and commercial viability varies from country to country and from one project to another. However, with the economic indicators generating cautious optimism, the iron and steel industry can also look forward to increasing demand, which will facilitate consolidation and partial further expansion of the sector in the near future.

Summing up, the medium-term prospects for industrial growth appear cautiously bright, especially if oil prices remain at a steady level around $18 per barrel or above. The policy-makers' consciousness of the need for achieving an efficiency-based industrial growth is also encouraging. Furthermore, the recently formed Arab Co-operation Council and Arab Maghreb Union can join hands with the Gulf Co-operation Council (GCC) to counterbalance the EEC single market of 1992 in bargaining as well as to enhance profitable co-operation activities among themselves (especially avoiding duplication of investment and overcapacity within the region in products such as in cement, fertilizers, etc.) Policy-makers are worried, however, that the EEC single market may raise barriers against the region's petrochemicals and other manufactured goods (see table II.34 for the extent of the region's trade with the EEC).

Table II.34. EEC imports from and exports to selected countries in North Africa and Western Asia, 1987 and 1988
(ECU millions)

Country	EEC imports		EEC exports	
	1987	1988	1987	1988
Algeria	5 383	4 793	3 883	3 693
Bahrain	97	108	516	435
Egypt	2 121	1 606	3 735	3 611
Iran (Islamic Republic of)	3 859	3 094	3 088	2 867
Iraq	3 852	2 772	1 513	2 371
Jordan	140	112	1 055	1 018
Kuwait	2 537	2 043	1 406	1 388
Lebanon	81	109	608	830
Libyan Arab Jamarahiya	5 239	5 083	2 338	2 680
Morocco	1 929	2 254	2 253	2 608
Qatar	239	69	402	382
Saudi Arabia	5 622	5 479	7 715	7 534
Syria	538	421	704	646
Tunisia	1 542	1 517	1 782	1 984
United Arab Emirates	1 391	643	2 504	2 265
Total	34 560	30 103	33 502	34 312

Source: European Commission, Brussels, as quoted in Middle East Economic Digest, 2 June 1989, pp.4-5.

Exchange rate: $1 = ECU 0,8666 (1987); 0,8460 (1988).

H. Indian Subcontinent

Led by India, the region appears to have begun reaping the benefits of gradual economic liberalization, coupled with the on-going deregulation of industry. This recent trend departs from the traditional policy stance in developing domestic industrial and technological capabilities, particularly in India and Pakistan (see table II.35 and figure II.8). In recent years, however, inflows of foreign investment and technology have begun to receive greater encouragement, providing competition to domestic industries and a source of foreign exchange earnings. The impact of the new industrial policy is being felt in a rapid growth of trade, a larger variety of consumer durable goods available to domestic households (e.g., television sets, automobiles, cassette tape recorders and personal computers), an increasing number of new enterprises and a diversification into more modern industrial branches. The region's manufacturing sector is expected to grow at 10.2 per cent in 1989 and 6.5 per cent in 1990 (6.9 per cent in 1988).

It is encouraging to note that during the 1980-1987 period, despite a world recession and three years of drought, the region's manufacturing sector grew continuously, at an average annual rate of 6.3 per cent. The growth-leading industrial branches were of the higher-technology variety. Those branches whose output more than doubled during the period include, among others,

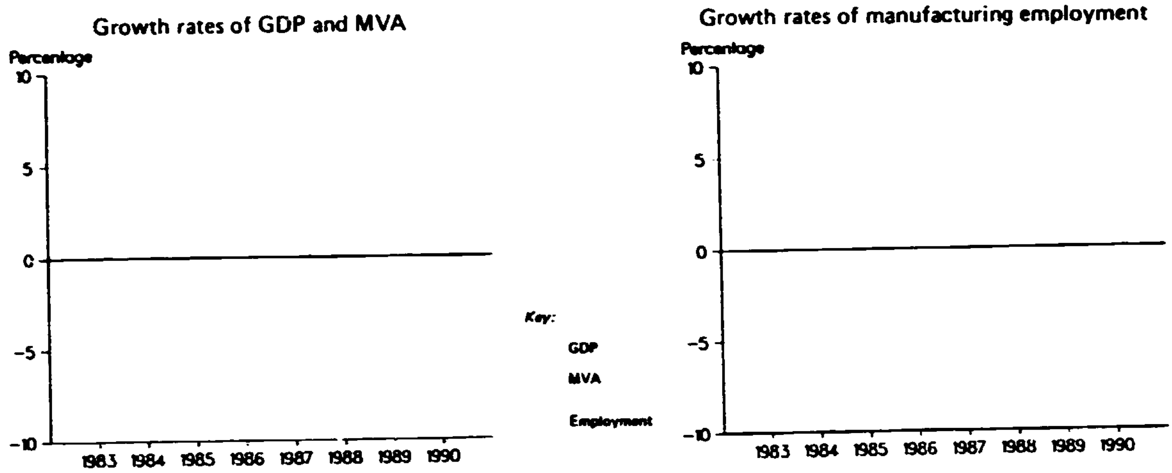
Table II.35. Indian Subcontinent: MVA by country, 1980 and 1987
(In 1980 United States million dollars)

Country or region	MVA				MVA per capita (In 1980 United States dollars)	
	1980	Per cent	1987	Per cent	1980	1987
India	27 526	79.7	47 738	80.9	40	60
Pakistan	4 138	12.0	7 390	12.5	49	67
Bangladesh	1 479	4.3	1 887	3.2	17	18
Sri Lanka	751	2.2	1 061	1.8	51	64
Myanmar, Union of a/	558	1.6	813	1.4	17	21
Nepal	78	0.2	103	0.2	5	6
Bhutan	6	0.0	9	0.0	4	6
Indian Subcontinent	34 537 b/	100.0	59 000 b/	100.0	37	54

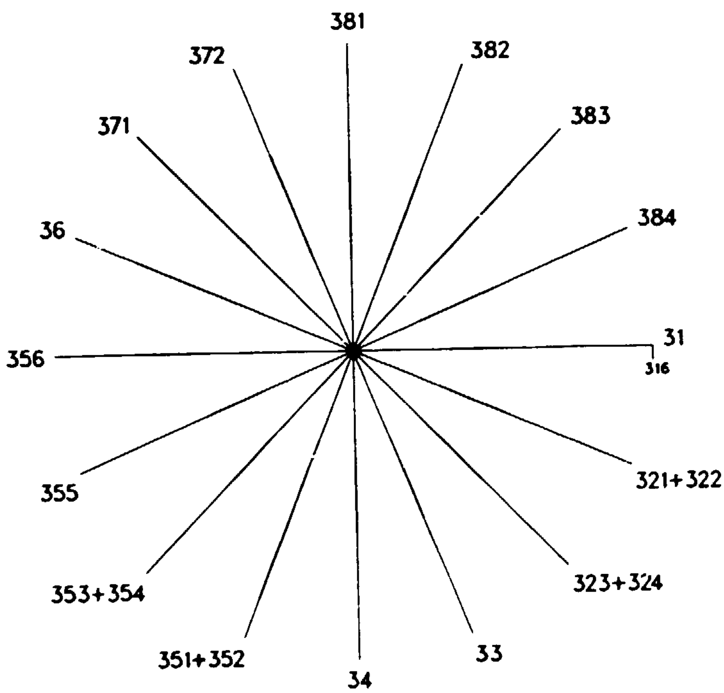
Source: UNIDO statistical database - National Account Statistics.

a/ Formerly Burma.
b/ The total differs from MVA total in the next table due to the difference of data source: this table is based on national income statistics while the next table is based on industrial surveys.

Figure II.8. Growth rates of GDP, MVA and manufacturing employment, 1983-1990, and industrial structural change, 1975-1990: Indian Subcontinent



Industrial structural change
(Index of value added: 1975 = 100)



g =	4.65
θ =	8.38

Key:

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)

Constant prices of 1980

g = Average annual growth rate, 1975–1990 (percentage)

θ = Index of structural change, 1975–1990

1985–1990 forecast

1980–1985

1975–1980

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

industrial chemicals, electrical machinery and professional and scientific equipment (see table II.36). Other above-average growth performers were paper products, printing, other chemicals, petroleum refining and related products, non-metal mineral products and transport equipment. This compositional change appears to reflect largely the industrial modernization drive taking effect in India and, though less forcefully, in Pakistan.

Since 1985 India has been decontrolling investment by exempting initially 25 branches of industry from licence requirements, anti-trust regulation and output ceilings, and thereafter adding new branches to the list. Tariffs have been lowered and quotas abolished on many capital goods and input materials, particularly in modern product lines (mostly non-durable consumer goods and products of small- and medium-scale industries)* that do not directly compete with existing industries. Those measures have resulted in a spurt of production in non-traditional branches of industry, including television sets, personal computers (hardware and software), watches, cameras, paints, pharmaceuticals and many other goods.

Among the growth-leading branches, the rapid development of electronics and information-related industry is worth noting. An abundant supply of well-trained engineers,* scientists, and mathematicians has been attracting foreign direct investment from such companies as AT&T, Digital Equipment, Hewlett-Packard, Honeywell, Microsoft, Parallel Computers, Sun Microsystems, Texas Instruments and Wang Laboratories. They have taken advantage of the recent liberalization of technology and components imports, delicensing and cuts in excise duties. The output of computers and consumer electronics products grew from 8.1 billion rupees (Rs) in 1980 to Rs 37 billion in 1986. Exports of software soared to Rs 1.1 billion in 1988 from Rs 100 million in 1982. Such exports are expected to hit Rs 3 billion in 1989. The industry appears to have a bright future not only for its own growth, but also for its technological spillover effects other branches of industry that will be using an increasing amount of electronics output for modernization.

*For welfare reasons the Government reserves for small-scale industry the production of goods such as utensils, coir products, soaps, matches, cooking oil, hand-loom products, footwear and watches. "Since the early 1950s, the Government has reserved some items exclusively for manufacture in the small-scale industry sector. The list of items was expanded from about 250 to more than 800 in 1978. At present about 840 items are listed" (see [26], p. 102). The problem with the protected sector is that the Government provides financial aids when an enterprise goes bankrupt because of its inability to raise output prices or lay off workers under the law defining the terms of protection. The lack of effective competition has prolonged inefficiency at the firm level, spawned sick enterprises and drained government coffers through subsidy expenditures. There are about 158,000 ailing enterprises, mostly small-scale industries.

*An engineer or senior manager in India is paid about $7,000 plus perquisites annually in India (about one fifth of the United States level). Recently, India has been producing about 10,000 computer-educated workers per year. An English-speaking workforce adds to India's attraction for foreign direct investment.

Table II.36. Indian Subcontinent: MVA of 28 industries in 1980 and 1987

Industry	1980	1987	Share of world total 1980	1987	Change
	(millions of constant 1980 dollars)		(percentage)		
Total manufacturing	31 240	47 840	1.13	1.45	0.32
Food products	3 374	4 892	1.13	1.34	0.21
Beverages	326	380	0.49	0.55	0.06
Tobacco	759	754	3.03	2.75	-0.28
Textiles	6 842	7 635	4.36	4.52	0.16
Apparel	1 514	1 749	1.79	1.96	0.17
Leather	217	281	1.54	1.89	0.35
Footwear	345	447	1.52	1.99	0.47
Wood products	832	876	1.35	1.22	-0.13
Furniture	104	111	0.21	0.20	-0.01
Paper products	622	1 087	0.81	1.14	0.33
Printing	497	908	0.51	0.75	0.24
Industrial chemicals	1 632	3 506	1.30	2.23	0.93
Other chemicals	1 861	3 303	1.94	2.74	0.80
Petroleum refineries	358	643	0.48	0.83	0.35
Petroleum and coal products	206	320	1.08	1.63	0.55
Rubber products	484	506	1.32	1.20	-0.12
Plastic products	119	175	0.25	0.27	0.02
Pottery	100	138	0.69	0.93	0.24
Glass products	177	224	0.74	0.87	0.13
Non-metal mineral products	1 064	1 740	1.22	1.85	0.63
Iron and steel	1 960	2 931	1.26	1.90	0.64
Non-ferrous metals	264	375	0.46	0.59	0.13
Metal products	715	1 067	0.45	0.61	0.16
Non-electrical machinery	1 608	2 168	0.45	0.48	0.03
Electrical machinery	1 600	5 026	0.72	1.53	0.81
Transport equipment	1 599	2 298	0.67	0.81	0.14
Professional and scientific equipment	165	425	0.29	0.60	0.31
Other manufactures	1 899	3 874	3.99	6.38	2.39

Source: UNIDO data bank - Industrial Statistics.

In order to progress further along the path of modernization, the Government of India has announced new guidelines to encourage international research and development ventures and other forms of co-operation with foreign research firms. Such a measure marks a turn-about from the traditional policy of technological self-sufficiency, which proved an ineffective strategy for catching up with the rapid pace of global technological progress and change.* The new guidelines encourage private research and development joint ventures in technologies designed to help export-oriented and import-substitution industries, and in resource- and energy-efficient technologies, while giving a more restrictive focus to collaborative research in defence, atomic energy, space biology, agriculture and some fields of medical science. The specification of priority areas does away with the past practice of case-by-case examination and licence-granting. The new measures have resulted in numerous research and development joint ventures, including nine between India and the United States (worth a total $5.9 million) under the Programme for Advancement of Commercial Technology.

Over the seventh plan period (1985/86 to 1989/90) the electronics industry is expected to lead other industries in growth, with projected annual growth rates as follows:

Branch	*Percentage growth rate*
Computers	50
Aerospace and defence	40
Communications	40
Consumer electronics (television sets etc.)	35
Industrial electronics	30
Components	30

Most of the advanced parts used in each branch still rely on imported technology, but some come from indigenous sources, for example, high-grade polysilicon using an Indian (Metkem) technology, and the C-Dot system for telephone exchanges (digital switching system).

Along with electronics, another growth-leading industry has been chemicals, and it is expected to remain so. Petrochemicals and fertilizers are among its largest branches. The thriving plastic goods industry, with 12,000 plants, could not yet fill a feedstock (polymers) gap of 300,000 tonnes (estimated to be worth Rs 10 billion), which needed to be imported in 1988. Demand for polymers is expected to grow at an annual rate of over 15 per cent until the mid-1990s. Foreign companies (such as Mitsui of Japan, Shell and British Petroleum) have lined up for negotiations. And India's gas supply (a feedstock to polymer production) is becoming plentiful as new gas fields are discovered and exploited in Tapti, Krishna Godavari, Cambay and Tripura, where total gas reserves could quadruple by the year 2000.

The burgeoning of the chemicals industry has, however, been overshadowed by industrial catastrophes. The Bhopal disaster which claimed the lives of 2,500 people in 1984 represents the most glaring example. To ward off future hazards, the Government is preparing a comprehensive safety programme with international assistance. The programme is designed to identify, analyse and devise inspection systems and emergency measures to control hazardous chemicals and processes involving some 5,000 plants. It may very well set a precedent for other developing countries aspiring to industrialize rapidly.

In contrast to the thriving electronics and petrochemicals industries, the textiles industry has not been performing well in despite an abundant labour supply and its apparent comparative advantage (see table II.37). Part of the reason lies in the difficulty of modernizing textile mills that are under State control.* Changes in the level, mix and price of output and in investment and employment are not allowed without official approval. Those restrictions are said to have caused many mills to under-utilize capacity and incur losses. Thus, 78 mills remained closed in 1985. They were taken over by the Central and State Governments, and the public-sector National Textile Corporation and its subsidiaries were charged with reorganizing and revitalizing them.** The operation had to comply with the Industries Development and Regulation Act of 1951, which provides for the protection of workers affected by closures.

Partly because of those legal requirements, the National Textile Corporation, founded in 1968, has been losing money. Its cumulative losses rose to Rs 13 billion by 1986/87. In the 1987/88 fiscal year alone, the loss amounted to Rs 2.2 billion. Furthermore, in that year 137 mills had become "sick" and ready to be taken over by the Corporation.*** The need to devise a new policy represents a challenge to policy-makers in face of bulging government budget deficits (8 per cent of GDP in 1987/88) and the resulting inflationary pressures.

Notwithstanding those problems, industry as a whole has been improving in growth and capacity utilization. Industrial output grew by about 10 per cent in 1988/89, and a similar growth rate is expected in 1989/90. The rate of capacity utilization rose from 73.3 per cent in 1980/81 to about 80 per cent in 1987/88. New fertilizer, cement, mini steel and petrochemical firms have reported achieving capacity utilization rates of from 110 to 120 per cent. The modernization drive under the current five-year plan (1985/86 to 1989/90) seems to be bearing fruit.****

Like India, Pakistan has also moved towards less government control, greater trade liberalization and encouragement of foreign direct investment as well as indigenous private investment. Between 1982/83 and 1987/88, the manufacturing sector grew by an annual average rate of 7.7 per cent, a respectable performance, though still below the target of 9.3 per cent (see table II.38). In 1987/88, manufactures contributed

*A case study of India's past technology development has well illustrated the need for a bold policy change. "... most of the factories of India do not bother about modernization; naturally, they are not eager to come to the research organizations for acquiring knowledge of up-dated machines and technology. Protection to local industries and absence of competition from abroad have also aggravated the tendency of not turning to more productive and lower-cost technologies even if the latter are more profitable in the long run" (see [27], p. 1184).

*India also has an uncontrolled textile industry producing special lines of textile goods such as those using specific synthetic fibres.

**Such take-overs numbered 103 in 1972/73.

***Persistent losses are also reported in other State-owned industries such as the steel, metal products and fertilizer industries.

****For more details, see [28].

17.5 per cent of GDP and 53 per cent of all exports. The bulk of exports, however, consists of cotton yarns, textiles and garments. The State-owned sector, including steel, automobiles, cement, fertilizers and textile machines, increased its sales by 5.2 per cent in 1987/88, compared with 7.6 per cent for the manufacturing sector as a whole.

The seventh plan (1989/90 to 1994/95) envisaged a total investment of 100.7 billion Pakistan rupees in the manufacturing sector over the five-year period, with 90.5 per cent of that amount coming from the private investors according to the following breakdown:

Industry	*Percentage*
Textiles	26
Engineering	24
Small-scale agro-industry	21
Chemicals and fertilizers	17
Others	2.5

Most of the investment is intended to upgrade the industrial base with imported technology and machines and to raise the low domestic content of modern industries producing items such as trucks, buses, cars,

Table II.37. India: growth rates of manufacturing, by industry, 1980/81 to 1986/87
(Percentage)

Industry	1980/81 weight	Annual average growth rate 1980/81 - 1985/86	1986/87
Food products	5.33	5.0	6.1
Beverages	1.57	2.4	-12.1
Cotton textiles	12.31	2.3	1.9
Jute textiles	2.00	0.4	4.0
Footwear and textile products	0.82	2.8	-22.8
Wood and wood products	0.45	19.0	10.3
Paper and paper products	3.23	8.5	9.9
Leather and leather products	0.49	12.7	5.6
Rubber, plastics and petroleum	4.00	9.1	-2.2
Chemicals	12.51	9.2	13.7
Non-metal mineral products	3.00	9.7	1.9
Base metals and alloys	9.80	3.5	8.4
Metal products	2.29	3.2	8.5
Non-electrical machinery	6.24	3.5	8.9
Electrical machinery	5.78	15.6	27.0
Transport equipment	6.39	6.4	6.7
Other manufacturing	0.90	12.5	54.2
All manufacturing	77.11	6.5	9.3
Mining	11.46	11.0	6.0
Electricity	11.43	8.8	13.0
General Index	100.0	7.3	9.1

Source: Reserve Bank of India, quoted in Economist Intelligence Unit, Country Report: India, No.3 (London, 1988), p.32-33.

Table II.38. Pakistan: index and volume of manufacturing output, 1983/84 and 1987/88
(1980/81 = 100)

Item	Unit	1983/84	1987/88a/
Index of manufacturing output		132.8	176.9b/
Sugar		1 147	1 541
Vegetable ghee	10^3 tonnes	595	454
Cotton yarn	10^6 kilograms	432	501
Cotton cloth	10^6 square metres	297	203
Jute textiles	10^3 tonnes	84	54c/
Motor tyres	Thousand	238	532
Cycle tyres	Thousand	3 735	3 517
Cement	10^3 tonnes	4 503	5 219
Ure	10^3 tonnes	1 798	1 492
Other fertilizers	10^3 tonnes	878	665
Bicycles	Thousand	448	502
Paper-board	10^3 tonnes	30	26
Mild steel products	10^3 tonnes	654	642

Source: Quoted in Economist Intelligence Unit, Pakistan: Country Profile 1988-1989 (London, 1989), pp. 32 and 33.

a/ July 1987 - March 1988.
b/ Estimate for the whole year.
c/ Six-months estimate.

motor cycles, scooters, air-conditioners, refrigerators, freezers and radios.

In 1987 the Government introduced new rules setting out local content guidelines for new investment. The rules require new contracts to include clauses specifying a timetable for technology transfer, progress of local content to a targeted level and exports. But so far the policy has not been strictly adhered to. Even after six years, the Suzuki automobile venture, for instance, has failed to reach the level of 30 per cent local content, as against its goal of 80 per cent. There seem to be problems with local components producers, including frequent interruptions of supplies and a slow pace of learning new technologies.

The short- and medium-term outlook for macroeconomic development is clouded by shortages of investment resources in both government and private sectors. Private savings in 1987/88 fell to 11.5 per cent of GNP from 13.7 per cent in the previous year. Total investment in current prices grew by 8.6 per cent during 1987/88, a fall from 15 per cent in 1986/87. As a proportion of GNP, gross fixed investment fell from 14.6 per cent to 14.2 per cent—hardly sufficient to sustain medium-term growth. Deficit financing (8.5 per cent of GDP in 1987/88) is threatening to add to inflationary pressures. Given the situation, the role of foreign direct investment and foreign aid has gained.

If the immediate outlook for Pakistan is disturbing, that of Bangladesh is somewhat bleak, largely because of the devastating floods in 1987 and 1988 which submerged 84 per cent of the country for several weeks. The need to import food and provide rehabilitation subsidies has gobbled up resources earmarked earlier for annual development programmes. Manufacturing output fell by 3.2 per cent in 1987/88 owing to a decline in domestic demand and production constraints caused by a reduction of imported inputs. Although foreign aid for disaster relief increased, the prospects for a full recovery of manufacturing output appear dim at least in the immediate future. Another year of negative growth is likely before a possible turnaround.

Nevertheless, Bangladesh has several rapidly growing manufacturing industries. Exports of textiles and garments filled the slack in domestic demand, with clothing becoming an important non-traditional export item mainly to Europe and the United States.* Chemicals production grew by 24.4 per cent and fertilizers jumped by 43.7 per cent in 1987/88, though from a low base, conforming to the longer-run trend. The discovery and exploitation of natural gas has given rise to a prospering chemicals and fertilizer industry since the early 1980s (see table II.39). Another star performer is the electrical machinery (mainly the chips industry), the output of which more than doubled between 1981/82 and 1986/87.

Much of the progress achieved in modern industries is due to the setting-up of joint ventures with foreign companies. The Foreign Private Investment Promotion and Protection Act promulgated in 1980 marked

*The Bangladesh Textile Mills Corporation (a state-owned enterprise) reported a record high number of spindles and looms in operation and high profit earnings ($313,000) in the month of October 1988 alone.

Table II.39. Bangladesh: index of manufacturing output by industry, 1981/82 and 1986/87
(1973/74 = 100)

Industry	1981/82	1986/87
All manufacturing	143	156
Food products	174	160
Fisheries products	93	209
Flour milling	57	116
Bakery products	211	50
Sugar	222	201
Edible oils	177	167
Beverages (excluding tea)	187	123
Tobacco products	133	123
Textiles	109	116
Cotton	114	120
Jute	114	109
Other	41	210
Paper and paper products	136	172
Rubber products	55	91
Chemicals and chemical products	182	287
Fertilizers	143	339
Industrial chemicals	71	149
Paints and varnishes	118	161
Petroleum products	313	284
Non-metal products	518	561
Glass	165	218
Cement	615	585
Basic metals, iron and steel	167	147
Non-electrical machinery	304	265
Electrical machinery	322	729
Transport equipment	115	73
Miscellaneous manufacturing	58	98

Source: Monthly Statistical Bulletin of Bangladesh, quoted in Economist Intelligence Unit, Bangladesh: Country Profile 1988-1989 (London, 1989) p.29.

the beginning of an open-door policy. New incentives were added in 1986, including a tax holiday of five years (10 years for high-technology industries) if the investment was made in developing parts of the country, of seven to nine years in a less developed region, and of 12 years in the specialized export-processing zones. Moreover, the Act permits a 100 per cent depreciation allowance for plant and equipment during the tax-holiday period, complete exemption from customs duties, free remittances of profits and dividends after tax and repatriation of foreign capital and profits. The most recent development is the establishment of a Board of Investment (an amalgamation of the 10 earlier investment agencies), which considers applications for foreign direct investments. In its first meeting, six joint ventures worth a total of $1.1 billion, with a foreign exchange component of $84 million, were approved in textiles and light engineering.

Along with the efforts to attract foreign direct investments, the Government has been privatizing a significant number of state-owned firms since 1982, when a policy of denationalization was announced. The purpose is to eliminate loss-making plants, reorganize them under private ownership and turn them into profit-making businesses. Thus by 1984, 33 out of 71 jute mills and 22 out of 52 textile mills in the State-owned sector were sold. More sales, which are expected to help mitigate declining government revenues, are planned in the future. The Ministry of Industries has committed itself to privatize all State-owned enterprises sooner or later. In the short-run, however, the sales could not be expected to provide the thrust needed for quick recovery. An immediate push could come only from a continued rise in export demand and foreign aid.

Smaller countries in the region (Afghanistan, Union of Myanmar, Nepal and Sri Lanka) have been plagued by socio-political unrest which has clouded their outlook for industrial growth. The war in Afghanistan, student demonstrations in the Union of Myanmar, tension between India and land-locked Nepal and the Tamil uprising in Sri Lanka have all had a negative impact, including the disruption of employment, shortages of goods, budget deficits and consequent inflationary pressures. With the possible exception of Sri Lanka, all are faced with the prospect of a slowdown in manufacturing activities which bodes ill for regional industrial growth. Furthermore, their trade and investment have so far had a more extraregional orientation. Lasting peace and prosperity in the region will depend, however, on the achievement of greater intraregional co-operation.*

I. South-East Asia

Despite signs of an unfavourable world economic environment, the region seems set to continue double-digit industrial growth in 1989 and 1990. Troubling factors include an expected slowdown in world trade, rising interest rates in global money markets, the impact on the region's export products of increasing protectionism in the EEC and the United States, and appreciation of the currencies of some NICs against the dollar. But other factors which appear powerful enough to offset the negative ones include intensified trade and investment among the countries on the region, increased demand for the region's manufactured goods by Japan and China, and current policy reforms designed to support industrial restructuring and innovation based on regional resource complementarity, thus creating new opportunities for co-operation particularly between Asian NICs and member countries of the Association of South-East Asian Nations (ASEAN). UNIDO projections show that the region's MVA will grow by 10.2 per cent and 9.4 per cent in 1989 and 1990 respectively, compared with 9.8 per cent growth in 1988.

The high growth expected in manufacturing is a continuation of the region's past performance. During the 1980-1987 period, the growth of MVA averaged 9.8 per cent annually in spite of the world recession in the earlier years of the period.

The growth-leading industrial branches in South-East Asia include electrical and non-electrical machinery, fabricated metal products, transport equipment, professional and scientific equipment, non-ferrous metals, plastic products, footwear and "other manufactures" (see table II.40 and figure II.9). Between 1980 and 1987, the output in those branches more than doubled. By contrast, in Latin America as late as 1987 output levels in most of those branches had not recovered from the impact of the 1980-1982 world recession.

Originally, the engineering-intensive branches of industry in South-East Asia had started to grow largely on the basis of labour-intensive assembly operations. Much capital, new technology and managerial skills came from Japan and the United States to serve their own markets. But gradually, indigenous producers joined the foreign-funded ventures to learn the new technology and skills and to produce and export. Further, the indigenous producers expanded their simple assembly operations into the production of intermediate inputs, instead of importing them.* Thus, the share of domestic value added could increase before exporting the final output. That process involves importing the relevant technology needed in inputs production and investing in new production facilities. The learning process had to be sufficiently fast so that the output would be accepted in the world market for its quality as well as price. Such market pressures provided an important stimulus to the region's performance in production and trade particularly in electrical machinery and automobiles. Tables II.41 and II.42 illustrate the process of adding value with the case of automobile production in the Republic of Korea during the 1960s and 1970s.

*Major issues and the scope of possible intraregional co-operation are discussed in [29].

*This is an important form of import substitution, proceeding hand-in-hand with export-led growth. Such a strategy is still followed in the Republic of Korea. "The Korean machinery industry has succeeded in developing 162 machines and parts during the first seven months of this year (1988) under a government-subsidized project, while solving 17 technological problems. . . . So far 813 such items have been developed under the ministry plan which calls for developing 1,798 items to replace foreign ones. . . . Their achievements will have an effect of decreasing imports by $930 million this year" (see [30], p. 20).

Table II.40. South-East Asia: MVA in 28 industries, 1980 and 1987

Industry	1980 (1980 constant dollars)	1987 (1980 constant dollars)	Share of world total 1980 (percentage)	Share of world total 1987 (percentage)	Share of world total Change (percentage)
Manufacturing	66 818	128 522	2.41	3.89	1.48
Food products	8 634	15 333	2.88	4.46	1.58
Beverages	1 482	2 498	2.22	3.62	1.40
Tobacco products	1 789	2 626	7.14	9.58	2.44
Textiles	7 069	10 499	4.51	6.21	1.70
Apparel	4 016	7 057	4.74	7.90	3.16
Leather	334	550	2.37	3.70	1.33
Footwear	367	946	1.56	4.21	2.65
Wood products	1 879	2 426	2.67	3.38	0.71
Furniture	457	724	0.88	1.30	0.42
Paper products	1 026	2 013	1.34	2.11	0.77
Printing	1 406	2 274	1.44	1.87	0.43
Industrial chemicals	2 897	5 452	2.30	3.47	1.17
Other chemicals	2 427	4 260	2.53	3.53	1.00
Petroleum refineries	5 324	5 450	7.13	7.04	-0.09
Petroleum and coal products	567	776	2.98	3.96	0.98
Rubber products	1 500	2 720	4.08	6.43	2.35
Plastic products	2 258	4 899	4.71	7.42	2.71
Pottery and china	271	399	1.89	2.69	0.80
Glass products	485	830	2.04	3.23	1.19
Non-metal mineral products	2 420	3 894	2.77	4.13	1.36
Iron and steel	2 292	4 186	1.48	2.72	1.24
Non-ferrous metals	556	1 184	0.97	1.85	0.88
Fabricated metal	2 914	7 690	2.00	4.38	2.38
Non-electrical machinery	2 355	6 731	0.75	1.50	0.75
Electrical machinery	6 216	19 039	2.78	5.79	3.01
Transport equipment	3 382	7 554	1.43	2.66	1.23
Professional and scientific equipment	947	1 983	1.64	2.82	1.18
Other manufactures	1 549	3 532	3.26	5.82	2.56

Source: UNIDO statistical data bank - Industrial Statistics.

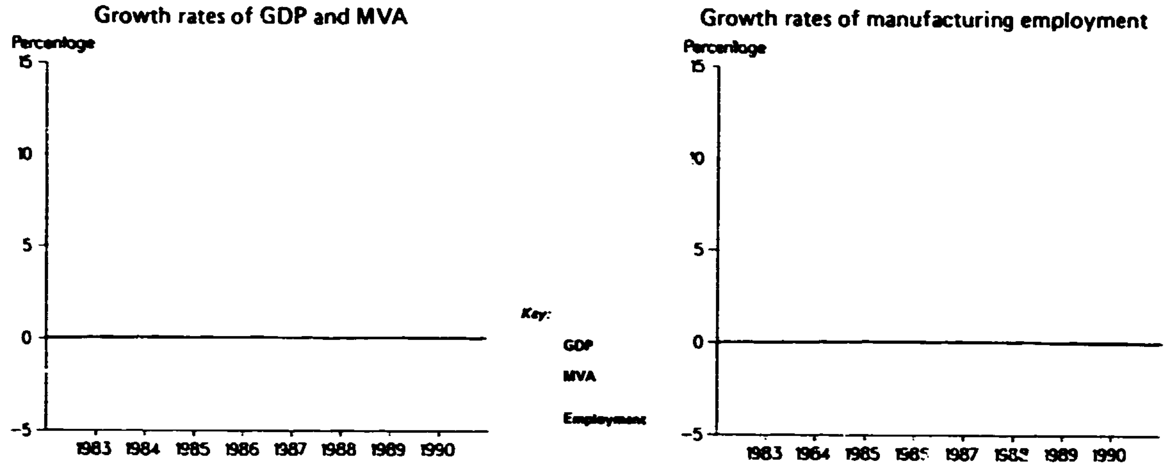
The growth-leading role of the engineering-intensive branches has only been accentuated in recent years (especially since 1985). The soaring value of the yen prompted Japanese enterprises (large and small) to seek sourcing of inputs in neighbouring economies, including Asian NICs and ASEAN countries that offered cost advantages. The Japanese also shifted many of their production operations by transferring investment funds, technical know-how and management and marketing skills. They often formed joint ventures with local counterparts.

Many United States enterprises followed suit, because the cost advantage in the region included skilled as well as cheap and unskilled labour. For some details of United States investment in the region, see table II.43. The salary level of highly trained electronics engineers, for example, is still only about one fifth of that in the United States. Japanese competition in the United States market forced United States firms to emulate the Japanese by making use of intelligent but inexpensive human resources in the region.

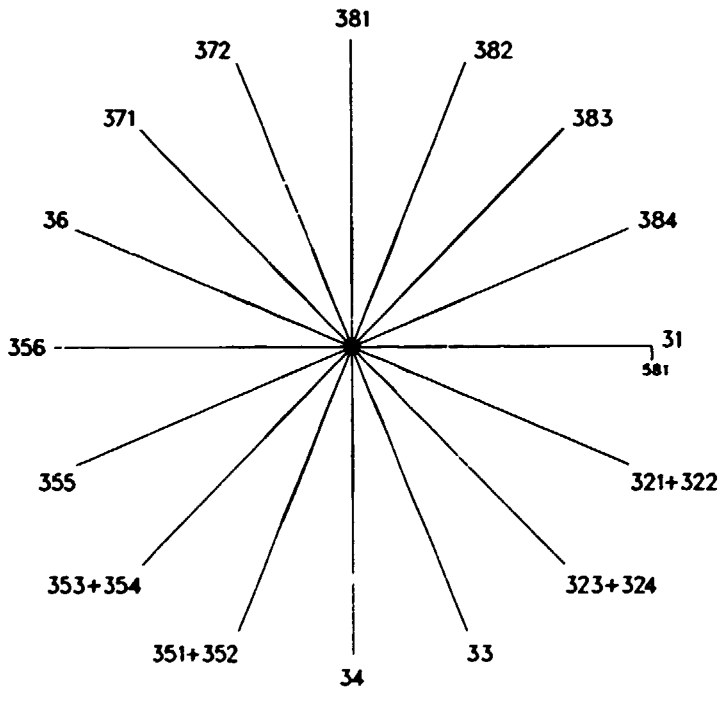
Foreign direct investment from Japan and the United States was welcomed by the Asian NICs because of their need to upgrade their industrial base away from traditional branches, such as apparel, footwear, leather goods and toys. Rising wage rates in the NICs have been erasing comparative advantage in those branches rather fast. The rapid appreciation of the won and the Taiwan dollar as well as their "graduation" from the group of countries enjoying the benefits of the Generalized System of Preferences has forced many enterprises of the Republic of Korea and Taiwan Province to migrate to Indonesia, Philippines and Malaysia.*

*"Taiwan Province, Hong Kong and Singapore, with their large Chinese populations, have close ties with Chinese business interests throughout the ASEAN countries, making such relocation of production far easier. In fact, the outstanding balance of investment by the Asian NICs in Indonesia, Malaysia, the Philippines and Thailand has already reached 31 per cent, 43 per cent, 30 per cent and 46 per cent, respectively, of Japan's direct investment in these countries. These percentages are almost certain to rise" (see [31] p. 12)

Figure II.9. Growth rates of GDP, MVA and manufacturing employment, 1983-1990, and industrial structural change, 1975-1990: South-East Asia



Industrial structural change
(Index of value added: 1975 = 100)



g =	5.44
θ =	27.35

Key:

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)

Constant prices of 1980

g = Average annual growth rate, 1975–1990 (percentage)

θ = Index of structural change, 1975–1990

1985–1990 forecast
1980–1985
1975–1980

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

Table II.41. Value of exports by the Republic of Korea, selected years
(Thousands of current dollars)

Automobile part	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Springs	119	49	73	77	687	676	1 031	1 455	3 478	3 615	3 359
Bulbs	..	..	..	..	102	557	1 595	2 018	2 276	2 958	3 104
Tyre chains	..	..	..	..	200	712	1 272	1 748	1 455	1 303	2 821
Engines	..	..	..	..	..	..	..	31	261	5 196	2 154
Piston rings	172	144	130	190	409	1 030	1 310	1 402	1 153	1 151	1 978
Ball-bearings	..	..	11	15	16	..	..	40	215	144	758
Pistons and pins	40	83	32	27	94	525	902	884	745	759	751
Metal bearings	10	..	23	37	83	207	382	262	408	615	650
Clutch discs	..	..	..	..	..	..	..	6	57	513	537
Lamps	..	..	..	..	..	101	79	39	79	108	421
Elements	..	..	..	51	7	29	53	91	237	233	276
Bumper lamps	..	..	..	..	..	..	..	..	180	185	266
Radiators	..	..	..	..	8	27	57	26	81	48	265
Wiper blades	..	..	..	..	..	..	..	107	149	265	251
Wheel cylinders	..	..	31	37	33	21	31	56	252	146	241
Gears	..	..	..	..	..	..	5	71	577	191	234
Axle shafts	49	15	40	..	37	106	137	130	216	71	164
Propeller shafts	..	..	..	..	..	..	..	..	260	915	151
Tie-rod ends	..	..	..	..	..	..	125	166	164	269	151
Wheel discs	..	..	..	..	..	8	175	310	225	166	144
Cylinder liners	42	46	36	74	102	169	252	300	325	317	139
Other	89	52	103	464	408	870	1 101	546	1 163	4 181	10 991
Total	519	387	479	972	2 182	5 038	8 507	9 688	13 956	23 349	29 806

Source: Chuk Kyo Kim and Chul Heui Lee, "Ancillary firm development in the Korean automotive industry", Korea International Economic Institute Working Paper No.13 (Seoul, 1980), pp. 24 and 48.

Table II.42. Domestic content ratios for various models made in the Republic of Korea, selected years
(Percentage)

Model and maker	1966	1968	1969	1970	1973	1975	1978	1980
Passenger cars								
Corona (Shinjin)	21	28	38	41				
Cortina (Hyundai)		23	31	31	62	64	64	62
Brisa (Kia)					72	78	90	92
Pony (Hyundai)						87	92	90
Gemini (Saehan)							75	85
Record (Saehan)							65	62
Bus								
Hyundai				76	82	83	87	87
Trucks								
0.5 T P/U (Kia)					51	78	88	91
2.5 T (Kia)					61	66	76	70
4.5 T (Kia)					55	61	65	60
1 T (Hyundai)							78	80
3 T (Hyundai)							80	74

Source: Chuk Kyo Kim and Chul Heui Lee, "Ancillary firm development in the Korean automotive industry", Korea International Economic Institute Working Paper No.13 (Seoul, 1980), pp. 24 and 48.

Table II.43. United States direct investment in South-East Asia, 1985 and 1987

(Millions of current dollars)

Item	Four NICs[a/]		Four ASEAN member countries[b/]	
	1985	1987	1985	1987
All industries	6 662	10 304	7 721	7 533
Petroleum	723	1 034	5 246	4 913
Manufacturing	2 134	3 378	1 173	1 421
Food products[c/]	92	92	46	239
Chemicals	448	591[c/]	415	430[c/]
Metals[c/]	18	30	22	26
Non-electrical machinery[c/]	247	515	3	9
Electrical machinery	872	1 500	512[c/]	507
Transport equipment[c/]	114	104	-2	-2
Other manufactures[c/]	167	106	140	111
Wholesale operations[c/]	1 707	2 330	182	185
Banking	956	1 157[c/]	299	319
Finance	870	2 121	307	216
Service	103	152	62[c/]	67[c/]
Other[c/]	45	50	367	766

Source: United States Department of Commerce, Survey of Current Business, Washington, D.C. 1988), pp.47 and 49.
a/ Hong Kong, Republic of Korea, Singapore and Taiwan Province.
b/ Indonesia, Malaysia, Philippines and Thailand.
c/ Some country data suppressed to avoid disclosure of individual company data.

In response, the ASEAN countries have been continuously opening up their economies in recent years. For instance, Indonesia has been adding an increasing number of business areas in the priority list for foreign direct investment since the late 1970s. In November 1988, a "negative list" system replaced the "priority list", specifying a limited number of restricted business areas (a total of 74 out of several thousands) in which foreigners are allowed to invest. The minimum investment requirement is now lowered from $1 million to $250,000. This step opens the door for small- and medium-scale, labour-intensive, export-oriented industries from NICs to invest in Indonesia. Even in the 74 restricted areas, foreign companies may enter if more than two thirds of their output is to be exported. In 1988, foreign direct investment jumped to $4.4 billion from $1.5 billion in 1987.*

Another example is offered by the Philippines, which is taking measures to attract foreign direct investment and to liberalize imports. The new policy reverses the erstwhile inward-looking industrialization strategy. Thus, in January 1989 alone, foreign investment approvals reached a record level of 187 projects worth 18 billion pesos ($847 million).** The newly instituted "debt-for-assets" scheme could give a boost to the burgeoning foreign direct investments. The scheme allows foreign investors to purchase State-owned industrial enterprises at nearly 50 per cent discount without resorting to "debt-for-equity" swaps. Many regard the latter as inflationary because they involve the issuance of new money.

The new strategy has already produced promising results with the success of the Cebu Province pilot project. The booming economy of the island province is led by the Mactan export processing zone, set up with foreign direct investment where companies produce computer components, car and telephone parts etc.

Exports for the first half of 1988 soared by 42 per cent compared with the first half of 1987. Investment more than doubled in 1988 over the 1987 figure. Those results compare with the national average of a 25 per cent growth in exports and over 25 per cent growth in investment in 1988. The economy appears poised for export-driven growth stimulated particularly by export-oriented projects coming from the Asian NICs, which lost benefits under the Generalized System of Preferences in the United States.* Non-traditional exports such as footwear, garments and electronic parts earned over 1 billion dollars in foreign exchange in 1987, and their share in total exports rose to 73.4 per cent. An intelligent work-force, but one of the least costly in the region, appears to be the major attraction for foreign investors.

*Between 1981 and 1987, total foreign direct investment is estimated to have been $9.5 billion in Indonesia and $8 billion in Thailand.

**Foreign direct investment (net of outflow) grew fast.

1984 — $ 17 million

1985 — $ 17 million

1986 — $140 million

1987 — $205 million

1988 — $457 million (1 January to 31 August)

(See [32], p.1).

*In 1988, investment from Taiwan Province, totalling $107 million, exceeded other countries' investments in the Philippines, overtaking even that of Japan.

Intraregional investment is expected to receive further impetus from new opportunities created by the complementarity in basic resources and concomitant changes in comparative advantage among the members of the region. The resultant changes in productive capacities have in turn fuelled growth and mutual trade. The movement of labour-intensive branches of industry from the Asian NICs to lower-cost neighbours enabled the former to upgrade their industry into higher-technology production.* The high value of the yen made Japanese components more expensive and prompted the Asian NICs to increase their mutual sourcing of inputs. Thus, Singapore and Taiwan Province more than doubled their imports from Hong Kong of electronics parts and components in 1988 over the level of 1987. In return, Hong Kong depended heavily on Taiwan Province and the Republic of Korea for the supply of some high-precision parts. The Republic of Korea's combined exports to Hong Kong, Singapore and Taiwan Province jumped by 60 per cent during the 12-month period to September 1988 and its exports to the world increased by 25 per cent during the same period.

*Such an upmarket movement reflects the high investment efficiency achieved in Hong Kong, Republic of Korea, Singapore and Taiwan Province. Indicators of investment effort and efficiency are shown below.

[illegible]	[illegible][a]		[illegible][b]	
	[illegible]	[illegible]	[illegible]	[illegible]
Hong Kong	24	40	24	33
Republic of Korea	31	36	7	33
Singapore	42	21	21	15
Taiwan Province	21	36	19	44
France	20	12	8	9
Germany, Federal Republic of	20	13	0	12
Japan	29	15	12	15
United States	17	18	0	23

[illegible] No. 1, 1989, p. 10.

[a] Gross fixed capital formation as percentage of GDP.

[b] Incremental output capital ratio, in percentage, estimated as ratio of annual average GDP growth to investment effort.

The Asian NICs' supply of manufactured goods to Japan also surged.* The product quality and price must have been good enough to satisfy Japanese requirements. Japanese imports of non-ferrous metal products, textiles and machinery and equipment from the Asian NICs grew in 1987 by 108.1 per cent, 71.6 per cent and 61.5 per cent respectively (see table II.44). It is remarkable that manufactured goods accounted for 66.3 per cent of the total exports of the NICs to Japan in 1987, compared with 39 per cent in 1970. Such results provide food for thought about the complaints heard from United States and Western European traders that Japanese markets are impenetrable.

The ascent of the region, including Japan and China, as trade partners and high-growth performers has helped to reduce the region's export dependence on United States markets (see table II.45). Between 1986 and 1988, the share of exports of the Asian NICs to the United States declined from 37.3 per cent to 30.2 per cent, while those to China, Japan, other Asian NICs and Europe all rose by over two percentage points. By contrast, the United States share in the imports of Asian NICs increased from 16.1 per

*Much of the intraregional trade has increasingly consisted of intra-industry transactions. For evidence and analysis see [33].

Table II.44. Japanese imports of manufactured goods from the Asian NICs

(Millions of dollars)

Year	Total value	Value of manufactured goods	Chemical products	Machinery and equipment	Other	Steel	Textiles	Non-ferrous metals	Ratio of manufactured goods to total
1970	655	257	12	35	210	5	-	7	39.0
1975	2 764	1 452	90	323	1 039	23	594	8	52.5
1980	7 366	4 270	456	872	2 942	301	1 377	48	58.0
	(-7.6)	(-7.7)	(26.7)	(17.5)	(-16.5)	(3.8)	(-28.2)	(17.1)	
1981	8 524	4 843	487	971	3 385	425	1 650	28	56.8
	(15.7)	(13.4)	(6.8)	(11.4)	(15.1)	(41.2)	(19.8)	(-41.7)	
1982	8 145	4 599	467	808	3 324	525	1 583	34	56.5
	(-4.4)	(-5.0)	(-4.1)	(-16.8)	(-1.8)	(23.5)	(-4.1)	(21.3)	
1983	8 125	4 511	458	922	3 131	582	1 217	35	55.5
	(-0.2)	(-1.9)	(-1.9)	(14.1)	(-5.8)	(10.9)	(-23.1)	(2.9)	
1984	10 034	5 733	525	1 286	3 922	636	1 705	61	57.1
	(23.5)	(27.1)	(14.6)	(39.5)	(25.3)	(9.3)	(40.1)	(74.3)	
1985	9 838	5 689	498	1 271	3 920	564	1 563	51	57.8
	(-2.0)	(-0.8)	(-5.1)	(-1.2)	(-0.1)	(-11.3)	(8.3)	(-16.4)	
1986	12 519	7 803	759	1 687	5 358	633	2 206	79	62.3
	(27.3)	(37.2)	(52.4)	(32.7)	(36.7)	(12.2)	(41.1)	(54.9)	
1987 January to October	14 938	9 904	745	2 200	6 958	690	2 938	129	66.3
	(44.0)	(59.4)	(20.0)	(61.5)	(64.5)	(29.9)	(71.6)	(108.1)	

Source: Ministry of Finance of Japan, quoted in Toshio Watanabe, "Helping the NICs help the world economy", Journal of Japanese Trade and Industry No. 4 (Tokyo, 1988), p. 12.

Note: Figures in parentheses are percentage changes from the preceding year.

Towards more open economies and foreign investment: Viet Nam and the Lao People's Democratic Republic

Amid growing East-West détente and Asian economic dynamism, Viet Nam and the Lao People's Democratic Republic are poised to open up their economies to integration with the world economy. The two war-ravaged countries sorely need to rebuild their economies, and an increasing number of foreign companies and countries have become interested in opportunities for co-operation. Well endowed with raw materials for mutually profitable exploitation (oil, bauxite and other minerals, marine products etc.) and human resources eager to work and learn, they are ready to embark on programmes for economic and industrial reconstruction. Recent policy changes toward trade liberalization and deregulation in the region appear encouraging.

Viet Nam and the Lao People's Democratic Republic each enacted a foreign investment law in December 1987 and July 1988 respectively. Both laws invite foreign companies to come in with capital and technology to set up joint ventures with local counterparts, or even fully foreign-owned establishments in some priority areas, allowing them tax benefits, freer trade and generous possibilities for the repatriation of profits. Although the precise interpretation to be given to the laws and the steps involved in their implementation remain to be seen, they have already evoked considerable, though cautious, interest among potential investors.

In 1988, some 3,000 foreign business men visited Viet Nam to explore trade and investment opportunities. During the first 10 months after the new foreign investment law was enacted, 48 investment licences worth $450 million were granted. Roughly half of that amount went to offshore oil and gas exploration in projects involving Hydrocarbons India, Shell of the Netherlands, Petrofina of Belgium, Total of France, British Petroleum and a British-French consortium including Enterprise Oil of the United Kingdom.

In non-oil areas, joint ventures have begun to emerge. Samsung Company has set up a factory in Ho Chi Minh City to assemble knocked-down kits imported from the Republic of Korea. P.T. Astra, an Indonesian manufacturer, has established a joint venture, Indovina International, to assemble Honda motor cycles and light vehicles. The Viba Company from West Berlin has established a factory in Ho Chi Minh City to produce electronic telephone switchboards. The Japan-Vietnam Trade Association, representing 120 Japanese companies, has been negotiating for many business operations, proceeding cautiously to avoid any diplomatic or geopolitical conflict of interest.

Nevertheless, the cut-back in State controls on enterprises through the open-door policy and deregulation contributed to a 21.2 per cent rise (to $1.07 billion) in the exports of Viet Nam and 5.4 per cent GNP growth in 1988. The export performance compares favourably with an average growth rate of 7.5 per cent recorded during the 1983-1987 period (for details on export composition and destination, see tables II.46 and II.47). With its export proceeds the economy has been importing mostly capital and intermediate goods, which account for over 85 per cent of total imports. This reflects the seriousness of policy-makers' efforts to reconstruct and revitalize the economy, particularly infrastructure (roads, telephones etc.) and light industry, which have been neglected. They also wish to lessen their dependence on non-convertible-currency countries as trade partners.

Like Viet Nam, the Lao People's Democratic Republic (a land-locked country) has also been rapidly increasing its trade in recent years. For instance, in 1988 it exported 300 million baht ($12 million) worth of goods, excluding electricity, a jump of 125 per cent over 1987. Imports increased by 11 per cent to $3.8 million in 1988. Thailand has recently reduced the number of "strategic goods" banned from export to the Lao People's Democratic Republic from 61 to 29 and opened five trading posts. This reflects a marked improvement in bilateral relations since the termination of the border fighting from December 1987 to February 1988. The Lao People's Democratic Republic can also serve as a channel for Thai goods to Viet Nam.

The Lao People's Democratic Republic and Thailand appear to have strong potential for economic complementarity. Although the lack of data precludes a systematic study, casual information on informal trade activities in the past suggests that the Lao People's Democratic Republic needs textiles, bicycles, rubber sandals and processed foods in exchange for rattan, timber, minerals and electricity. Furthermore, the sort of Thai technology available today appears to fit the needs of the Lao People's Democratic Republic. A Thai-financed apparel factory operating in Vientiane exports its entire output to the EEC and Canadian markets. An increasing number of private Thai companies are forming business groups to deal exclusively with counterparts, usually government agencies and co-operatives in the Lao People's Democratic Republic. Prominent among them is the Friendship Agro-Industry and Trading Corporation, which initially concentrated on food processing, wood products and rattan furniture.

As of March 1989, the Government of the Lao People's Democratic Republic had received 68 applications for foreign direct investment worth $40 million, and 27 had been approved.

Recent economic trends could signal the beginning of a new era for the countries concerned. Once the pending political settlements are reached, a flood of new trade and investment should enable those countries to join their neighbours and share the benefits of high growth.

Table II.45. Export orientation and import sources of Asian NICs, 1980, 1986 and 1988

(Percentage)

Country or area	Export destination 1980	1986	1988	Import source 1980	1986	1988
United States	24.9	37.3	30.2	17.7	16.1	18.3
Japan	10.1	10.3	12.8	23.4	26.9	24.7
EEC	16.8	12.7	14.9	9.4	10.9	11.0
China	2.0	6.1	8.5	5.7	10.2	10.1
Asian NICs	9.2	8.4	10.3	7.3	8.7	10.1
Other	37.0	25.2	23.3	36.5	27.2	25.8
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Morgan Guaranty Trust Company, "The Asian NICs: wrestling with success", World Financial Markets, 17 April 1989, pp. 3 and 4.

Table II.46. Viet Nam: major exports by commodity and by area of destination, 1983 and 1987

Commodity and destination	1983	1987
	(Millions of dollars)a/	
Exports by central enterprises	538	720
Coal	28	12
Convertible area	22	10
Non-convertible area	6	2
Rubber	30	28
Convertible area	5	6
Non-convertible area	25	22
Tea	14	16
Convertible area	3	2
Non-convertible area	11	14
Coffee	5	28
Convertible area	--	24
Non-convertible area	5	4
Wood flooring (all to convertible area)	10	19
Marine products	40	73
Convertible area	40	73
Non-convertible area	--	--
Agriculture and forestry products	125	198
Convertible area	35	38
Non-convertible area	90	160
Handicrafts and light industrial goods	286	221
Convertible area	69	10
Non-convertible area	217	211
Petroleum (all its convertible area)	--	30
Unclassified	--	95
Convertible area	--	77
Non-convertible area	--	18
Exports by local enterprises (all to non-convertible area)	50	160
Marine products	20	40
Agricultural products	26	100
Handicrafts and light industrial goods	4	20
Total	588	880
Convertible area	224	430
Non-convertible area	364	450
	(percentage of total)	
Proportion of exports to		
Convertible area	38	49
Non-convertible area	62	51
Proportion of exports from		
Central enterprises	91	82
Local enterprises	9	18

Source: UNIDO, Regional and Country Studies data file.

a/ Valuation of the ruble is at par with the United States dollar.

Table II.47. Viet Nam: imports, by area of origin and type of enterprise, 1983 and 1987

Item	1983	1987
	(Millions of dollars)[a]	
Imports by origin		
Total imports	1 310	2 191
Convertible area	330	465
Non-convertible area	980	1 726
Consumer goods	145	314
Convertible area	110	234
Non-convertible area	35	80
Capital and intermediate goods	1 165	1 877
Convertible area	220	231[b]
Non-convertible area	945	1 646
Imports by type of enterprise	1 240	2 026
Consumer goods	125	244
Food grains	10	60
Other	(115)	184
Capital and intermediate goods	1 115	1 782
Machinery and equipment	140	548
Fuel and raw materials	975	1 234
Local enterprises	70	165
Consumer goods	20	70
Capital goods	50	95
	(Percentage of total)	
Proportion of imports from		
Convertible area	25	21
Non-convertible area	75	79
Proportion of imports by		
Central enterprises	95	92
Local enterprises	5	8

Source: UNIDO, Regional and Country Studies data file.

Note: Figures in parentheses are estimates.
a/ Valuation of the ruble is at par with the United States dollar.
b/ Including $30 million in imports for a joint Soviet-Vietnamese petroleum venture.

cent in 1986 to 18.3 per cent in 1988, while Japan's share decreased from 26.9 per cent to 24.7 per cent. It thus seems that the shift in the trade pattern of the Asian NICs is helping to reduce the trade imbalances between the United States and Japan.*

In the medium term will the South-East Asia region continue to grow as rapidly as in the past? Most probably yes, considering the main source of growth: namely, learning by doing, through the effective transfer of investment funds and new technology, restructuring towards a more sophisticated industrial base, and a more open trade strategy than in other developing regions. The technology-learning capabilities and the organizational mechanisms for utilizing market forces at home and abroad appear to be firmly institutionalized in the Asian NICs and are now being slowly emulated by the ASEAN countries.* However, trade friction and the possibility of trade wars across the Pacific, though remote at present, remain a major concern.

*The diversification efforts of the Asian NICs are beginning to pay off in the form of the crossing of ideological lines to reach socialist countries (for example, China, Czechoslovakia, Hungary, Poland as well as the USSR). Such a movement could provide an additional source of growth in a climate of renewed East-West detente.

*For a discussion of institution-building and the underlying policy making apparatus and theory in the East Asian NICs, see [34], pp. 87-128, and [35].

J. China

The review of China presented in this section was written a few weeks before the political events of June 1989 in Beijing dramatically transformed the outlook for the reform process and industrial growth. A substantial shift in policy may be expected to affect major growth determinants such as domestic investment plans, foreign direct investment, government expenditure, control of consumption, exports and imports. The following review serves only as an assessment of past policy and not as a basis for projections into the future.

The process of industrialization has accelerated in China in recent years, causing policy-makers to worry about overheating. Domestic reforms have continued to reduce central control of the economy by expanding the factory responsibility system for State-owned enterprises, promoting co-operative and privately-owned enterprises, and experimenting with a "Chinese-style" capital and labour market. Liberalization has also meant an opening up of the economy, inducing a greater inflow of foreign capital, technology and managerial skills, mostly through joint ventures. Those factors appear to be helping to modernize Chinese industry, enabling it to produce a greater variety of new goods through more efficient use of resources in response to competitive pressure from foreign companies provide. The result has been remarkable industrial growth.

Total industrial output grew by 20.7 per cent in real terms in 1988, the tenth year since the reform process began. That rate of growth tops the record of 17.7 per cent achieved in 1987, which was thought too rapid because of inflationary pressures and the emerging shortages in energy supply, raw materials and transport infrastructure.* Indeed, those problems worsened in 1988 with a consumer price hike of 21.3 per cent in urban areas and 17.1 per cent in the countryside (averaging 18.5 per cent). Those rates compare with a 7.5 per cent rise in average national inflation registered in 1987. A slower-growth policy was definitely needed. (The rapid pace of growth in different categories of activity is shown in table II.48).

*In both 1987 and 1988 a growth of from 7 to 8 per cent in net material product was thought optimal, but actual figures turned out to be 10.5 per cent and 11 per cent, respectively.

Table II.48. China: key economic statistics, 1988

(Current Rmb billions unless otherwise specified)

Item	1987	1988	Nominal percentage change 1986-1987	Nominal percentage change 1987-1988
	(billions of current yuan resiminbi)			
Output				
Total industrial output	1 499.6	1 810.0	17.7[a]	20.7[a]
Light industry	730.0	895.0	15.1[a]	22.6[a]
Heavy industry	770.2	915.0	14.5[a]	18.8[a]
Gross agricultural output	544.4	561.8	5.8[a]	3.2[a]
Net material product[b]	1 035.3	1 153.3	10.5[a]	11.4[a]
Gross national product[c]	1 245.8	1 385.3	10.6[a]	11.2[a]
Investment				
Investment in fixed assets	364.1	431.4	20.5	18.5
State-owned enterprises	229.8	269.5	16.2	17.3
Collective enterprises	54.7	62.1	39.6	13.5
Private enterprises	78.8	98.8	21.4	25.4
Capital construction	134.3	154.3	14.2	14.9
Energy	29.9	37.1	21.6	24.0
Industrial raw materials	18.2	20.6	22.7	13.4
Transport and telecommunications	19.1	21.8	1.1	14.1
Investment in projects under construction	1 160.7	1 300.0	d/	12.0
Domestic trade				
Total value of retail sales	582.2	744.0	17.6	27.8
State enterprises	226.3	294.0	15.6	29.9
Collective enterprises	205.2	248.7	15.4	21.2
Joint ownership	2.1	2.7	31.3	27.7
Individual ownership	102.2	123.8	24.2	21.2
Sales of rural workers to non-rural residents	46.4	59.9	24.1	29.1
Consumer goods	511.4	654.1	16.9	27.9

Source: Communiqué of the State Statistical Bureau of China, 28 February 1989.

a/ Real growth rates.

b/ The concept of net material product is comparable to national income.

c/ Gross national product is the added value of all material and non-material output, excluding the value of all intermediate products and services, plus net foreign assets.

d/ Not announced.

In early 1989, the Government announced a set of measures to bring down both output growth and inflation. The measures include a 21 per cent reduction of fixed capital investment, stoppages of some 18,000 construction projects, limits on production of goods using excessive amounts of energy, allowance of 100 per cent foreign ownership in ventures producing intermediate inputs, tighter monetary and fiscal policy, and greater resources to be allocated to energy, transport, communications and agriculture.

The emergence of bottlenecks, shortages and supply imbalances has been in the making since the beginning of the current reform. The shift of emphasis from heavy to light industry was intended to raise consumption levels and living standards. A decomposition of industrial output reveals that the aim has been achieved to a significant extent, but at the cost of lagging branches which support infrastructure (see table II.49).

It is noteworthy that since 1987 production of new consumer durables has soared from a previously negligible amount. Salient examples are television sets, tape recorders, cameras, washing machines, refrigerators and motor vehicles. In contrast, the growth in the output of energy goods (such as coal and oil), steel and locomotives has lagged. The standard fuel equivalent of total energy output grew by about 4.2 per cent annually between 1987 and 1988.*

The energy shortage was felt throughout 1988, but it had reached crisis proportions by early 1989. The Ministry of Energy Resources admitted in January 1989 that nearly one third of China's industrial production capacity was standing idle mainly because of energy shortages. Many factories in industrial centres such as Shanghai, Tiangsu Province and Guangdong received electric power only three days a week. No immediate solution to the problem seemed to be in sight. The activities of coal exporters, lured by the prospect of earning foreign exchange, exacerbated the situation, as 75 per cent of power generation relies on coal. In 1988, for instance, 43.5 per cent of coal output was distributed by the State at a price far below the market price, spurring the beneficiaries to sell abroad for a quick profit.

*In comparison, industrial growth in Taiwan Province, at an annual average rate of 11.7 per cent, was supported by 7.7 per cent growth rate of total commercial energy supplies during the 1954-1965 period.

Table II.49. Indicators of output by selected industrial products in China, 1978 and 1988

Product	1978	1988
	(millions of units)	
Cloth (metres)	11 030.00	17 600.00
Woollen fabrics (metres)	88.85	265.00
Sugar (tonnes)	2.27	4.55
Crude salt (crates)	19.53	22.00
Cigarettes (crates)	11.82	30.95
Bicycles	8.54	41.22
Television sets	0.052	24.85
Colour television sets	-	10.28
Tape recorders	0.047	23.44
Cameras	0.018	2.92
Washing machines	0.0004	10.46
Refrigerators	0.028	7.40
Cotton yarn (tonnes)	2.38	4.54
Paper and board (tonnes)	4.39	12.10
Synthetic detergent (tonnes)	0.32	1.29
Aluminium wares (tonnes)	56.50 a/	85.70 a/
Total energy: standard fuel equivalent (tonnes)	627.70	951.00
Coal (tonnes)	618.00	970.00
Crude oil (tonnes)	104.05	137.00
Electricity (kilowatt hours)	256 600.60	543 000.00
Steel (tonnes)	31.78	59.18
Rolled steel (tonnes)	22.08	46.98
Cement (tonnes)	65.24	203.00
Timber (cubic metres)	51.62	63.00
Sulphuric acid (tonnes)	6.61	10.98
Soda ash (tonnes)	1.33	2.59
Chemical fertilizer (tonnes)	8.69	17.67
Chemical insecticides (tonnes)	533.00 a/	194.60 a/
Power-generating equipment: capacity (kilowatt-hours)	4.84	10.97
Machine tools	183.20 a/	200.00 a/
Motor vehicles	149.10 a/	646.70 a/
Tractors	113.50 a/	52.10 a/
Locomotives	521	843
Steel ships for civilian use (tonnes)	..	1.41

Source: State Statistical Bureau, of China.
a/ Thousand of units.

Shortages of intermediate inputs were also felt across the board in industry. While assembly and processing industries grew by 23 per cent in 1988, intermediate industry grew by only 10 per cent in the same year. Only imports of intermediate inputs in large amounts could alleviate the shortfall.

Thus iron and steel, for example, was the largest product category in the import list for 1987 and 1988 (see tables II.50 and II.51). Other intermediate inputs imported in large amounts include artificial resins and plastic materials, textile yarns and fabrics, textile fibres, organic chemicals, cork and wood and non-ferrous metals.

Those inputs were obviously used in assembly and processing industries to add value and sell the final product in the domestic market—a typical import substitution approach. In the long run, however, import substitution could be pushed further back to the production of intermediate inputs in addition to new export products, but that requires further investment and learning new technology and skills with new machines. Chinese industry appears to favour such an approach, as reflected in the quantity of various machines imported in 1987 and 1988, including specialized machines for particular industries, electrical machinery, general industrial machinery, telecommunications equipment and power generating machinery.

Another piece of evidence on high-technology imports provides an indication that the Chinese industrial base is being upgraded (see table II.52). The value of Chinese imports of high-technology items from United States sources alone increased from $630 million in 1982 to $1.72 billion in 1988. The total exceeded $8 billion. In February 1989, the United States Department of Commerce announced the easing of restrictions on 13 categories of high-technology items including telephone circuit-switching equipment, underwater ultrasonic communication equipment, integrated flight instrumentation systems, spare parts and equipment for manufacturing printed circuit boards and semiconductors.

Table II.50. Major imports of China, 1988

SITC Rev.2 Code	Import commodities	1987 (millions of dollars c.i.f.)	1988 (millions of dollars c.i.f.)	1987/88 percentage change
	Total	43 215.62	55 250.73	27.8
67	Iron and steel	4 787.17	4 624.85	-3.4
72	Specialized machinery for particular industries	4 976.69	4 598.82	-7.6
58	Artificial resins and plastic materials, cellulose esters and ethers	1 469.50	3 558.03	142.1
65	Textile yarn, fabrics, made-up articles, n.e.s. and related products	1 848.06	2 387.77	29.2
56	Manufactured fertilizers	1 399.23	2 335.49	66.9
77	Electrical machinery, apparatus and appliances, n.e.s. and electrical parts	1 593.45	2 303.68	44.6
74	General industrial machinery and equipment, n.e.s. and machine parts, n.e.s.	1 739.26	2 134.91	22.7
26	Textile fibres (other than wool tops) and their wastes	1 130.78	1 945.67	72.1
04	Cereals and cereal preparations	1 687.60	1 854.79	9.9
76	Telecommunications and sound-recording and -reproducing apparatus and equipment	1 460.28	1 823.72	24.9
51	Organic chemicals	997.79	1 701.45	70.5
78	Road vehicles (including air-cushion vehicles)	1 299.30	1 490.54	14.7
79	Other transport equipment	1 269.85	1 184.24	-6.7
24	Cork and wood	582.01	1 155.43	98.5
71	Power-generating machinery and equipment	567.29	1 048.50	84.8
68	Non-ferrous metals	734.44	877.84	19.5
06	Sugar, sugar preparations and honey	299.44	866.06	189.2
87	Professional, scientific and controlling instruments and apparatus, n.e.s	862.56	817.98	-5.2
75	Office machines and automatic data processing equipment	721.50	690.26	-4.3
33	Petroleum, petroleum products and related materials	397.09	637.90	60.6
89	Miscellaneous manufactured articles, n.e.s.	475.61	632.42	33.0
63	Cork and wood manufactures (excl. furniture)	544.31	618.39	13.6
64	Paper, paperboard and articles of paper pulp, of paper or of paperboard	727.17	609.67	-16.2
23	Crude rubber (including synthetic and reclaimed)	391.81	589.57	50.5
69	Manufactures of metals, n.e.s.	517.14	586.57	13.4
25	Pulp and waste paper	403.64	580.63	43.8
28	Metalliferous ores and metal scrap	525.22	532.36	1.4
52	Inorganic chemicals	421.72	448.31	6.3
66	Non-metallic mineral manufactures, n.e.s.	342.03	430.13	25.8
59	Other chemical materials and products, n.e.s.	244.60	392.59	60.5

Source: General Administration of Customs, China.

Table II.51. Major exports of China, 1988

SITC Rev.2 Code	Export commodities	1987 (millions of dollars c.i.f.)	1988 (millions of dollars c.i.f.)	1987/88 percentage change
	Total	39 437.04	47 540.34	20.5
65	Textile yarn, fabrics, made-up articles, n.e.s. and related products	5 790.35	6 458.16	11.5
84	Articles of apparel and clothing accessories	3 749.24	4 871.56	29.9
33	Petroleum, petroleum products and related materials	4 002.65	3 372.32	-15.7
89	Miscellaneous manufactured articles, n.e.s.	1 325.67	1 675.66	26.3
26	Textile fibres (other than wool tops) and their wastes	1 508.32	1 672.01	10.9
05	Vegetables and fruit	1 289.57	1 617.39	25.4
67	Iron and steel	421.87	1 009.97	139.4
69	Manufactures of metals, n.e.s.	796.70	1 005.63	26.2
03	Fish, crustaceans and mollusca and preparations thereof	721.01	986.53	36.8
08	Feeding-stuff for animals (not including unmilled cereals)	541.94	862.67	59.2
68	Non-ferrous metals	588.35	815.39	38.6
76	Telecommunications and sound-recording and -reproducing apparatus and equipment	502.54	789.36	57.1
52	Inorganic chemicals	552.83	762.21	37.9
85	Footwear	485.30	727.40	49.9
29	Other crude animal and vegetable materials, n.e.s.	645.02	724.40	12.3
22	Oil-seeds and oleaginous fruit	673.71	683.53	1.5
04	Cereals and cereal preperations	579.03	681.70	17.7
32	Coal, coke and briquettes	535.65	593.79	10.9
01	Meat and meat preparations	520.42	584.96	12.4
66	Non-metallic mineral manufactures, n.e.s.	439.45	579.18	31.8
51	Organic chemicals	500.20	575.32	15.0
77	Electrical machinery, apparatus and appliances, n.e.s. and electrical parts	335.84	570.60	69.9
07	Coffee, tea, cocoa, spices and manufactures	488.28	524.32	7.4
54	Medicinal and pharmaceutical products	408.14	468.40	14.8
27	Crude fertilizers/crude minerals (excluding coal, petroleum and precious stones)	361.35	445.70	23.3

Source: General Administration of Customs, China.

Table II.52. United States exports of high technology to China, 1982-1988

Year	High technology export licenses approved for China a/: Number of applications	High technology export licenses approved for China a/: Total value (billions of dollars)	Total value of actual exports a/ (billions of dollars)
1982	2 020	0.5	0.63
1983	2 834	0.9	0.65
1984	4 443	2.0	0.82
1985	8 637	5.5	1.71
1986	6 157	3.4	1.28
1987	5 777	2.3	1.43
1988	5 724	2.9	1.72

Source: United States Department of Commerce, Office of Export Licensing.

a/ Represents only strategic technologies under the COCOM restrictions on the export of such technologies.

b/ These figures not only represent actual licensed shipments, but also include items not subject to strategic technology controls.

Imports of modern technology have also come from other sources, such as Japan, Federal Republic of Germany, Italy and Switzerland. For example, Marubeni and Mitsubishi Petrochemical of Japan were contracted jointly with an Italian engineering company to build a $70 million plant to manufacture high-pressure polyethylene with an annual production capacity of 80,000 tonnes. Daimler-Benz of the Federal Republic of Germany agreed to upgrade the technology level for producing heavy-duty trucks at China Northern Industries Corporation in Baotou, inner Mongolia, with an annual production target of 6,000 trucks in the first five years. Schindler Holdings of Switzerland entered into a joint venture worth $8 million with Suzhon Elevator Company in Jiongsu to produce new versions of escalators and elevators.

According to the latest estimates, the number of contracts for equity joint ventures jumped to 3,900 in 1988 from only 83 during the 1979-1982 period. Contracts for co-operative joint ventures soared to 1,580 in 1988 from 793 during the 1979-1982 period (see table II.53). Those joint ventures have brought with them not only investment funds but also technologies new to China and managerial expertise in production and marketing in virtually all branches of industry.*

The effectiveness of technology learning (a crucial ingredient for upgrading an industrial base) is shown by the output of goods of acceptable quality in the world market. Thus foreign-funded enterprises increased their exports from a value of $320 million in 1985 to $380 million in 1986, $960 million in 1987, and $2.1 billion in 1988. This implies an annual average growth rate of 87.2 per cent, exceeding the growth of all exports by 20.2 per cent annually during the same period. The share of all exports by the foreign-funded enterprises rose from 1 per cent in 1985 to 5 per cent in 1988.

As foreign factors of production (capital, technology and managerial skills) were flowing in to make domestic factors (labour, land and natural resources) more productive than otherwise, progress was being made in institutional reform. By June 1988, 90 per

*"A survey of 4,100 foreign-funded enterprises in operation before the end of 1986 discovered that 37.3 per cent could be said to be managed well, 48.2 per cent reasonably and 14.5 per cent had problems of one form or another" (see [36], p.24).

Table II.53. Breakdown of foreign investment in China, contracted and utilized
(Value in billions of dollars)

Item	1979-1982	1983	1984	1985	1986	1987	January-September 1988	Cumulative total
(a) Contracted								
<u>Direct investment</u>								
Value	4.608	1.731	2.650	5.931	2.834	3.709	3.316	24.781
Number of projects	922	470	1 856	3 073	1 498	2 233	3 700	13 752
Project breakdown								
Equity joint ventures								
Value	0.127	0.188	1.067	2.030	1.375	1.950	1.875	8.612
Number	83	107	741	1 412	892	1 395	2 474	7 104
Co-operative joint ventures								
Value	2.727	0.503	1.484	3.496	1.358	1.283	1.031	11.882
Number	793	330	1 089	1 611	582	789	1 052	6 246
Fully foreign-owned								
Value	0.332	0.040	0.100	0.046	0.020	0.471	0.378	1.386
Number	33	15	26	46	18	46	171	355
Joint oil exploration								
Value	1.422	1.001	-	0.360	0.081	0.005	0.033	2.901
Number	13	18	-	4	6	3	3	47
<u>Other foreign investment</u>a/								
Value	0.927	0.185	0.224	0.402	0.496	0.610	0.634	3.480
(b) Utilized								
<u>Direct investment</u>	1.168	0.635	1.258	1.658	1.875	2.314	1.595	10.502
Project breakdown								
Equity joint ventures	0.100	0.074	0.255	0.580	0.804	1.486	0.844	4.142
Co-operative joint ventures	0.531	0.227	0.465	0.585	0.794	0.620	0.486	3.708
Fully foreign-owned	0.040	0.043	0.015	0.013	0.016	0.025	0.100	0.251
Joint oil exploration	0.497	0.292	0.523	0.481	0.260	0.183	0.165	2.400
<u>Other foreign investment</u>a/								
Value	0.832	0.281	0.161	0.298	0.369	0.333	0.281	2.555

<u>Source</u>: Ministry of Foreign Economic Relation and Trade, China.
a/ Includes international leasing, compensation deals and processing and assembly.

China's Silicon Valley

After the State Council approved the Provisional Act on the Beijing New-Tech Industrial Development Experimental Zone in May 1988, land prices in the 100 square kilometres around north-west Beijing's Zhongguancun area soared. Attracted by a three-year exemption from tax and another three years of reduced tax rates, investors poured in. New firms mushroomed along the Baishiqiao, Haidian and Zhongguancun roads.

This is China's "Silicon Valley", except the Chinese call it "Zhongguancun Electronic Street". By May 1989, 150 scientific and technological enterprises employing 3,800 people (including 46 per cent of which were scientific and technical personnel) had set up shops. More than 80 per cent of those businesses were based in electronics. Between 1984 and 1987 they had sold over 400 million yuan renminbi's worth of computers.

The Electronic Street owed its development to its proximity to China's largest academic and research community. The area has 50 institutions of higher learning and 138 scientific research institutes staffed by a work-force of 80,000 (one third of whom are senior or middle-level scientists and technicians). The Government has invested over 10 billion yuan renminbi in the area, equipping it with first-rate experimental and research equipment.

In 1980 a group of scientists and technicians, headed by a research fellow of the Institute of Physics of the Chinese Academy of Sciences, founded an Advanced Technology Development and Service Department. Unprecedented in China, the department was given the task of popularizing technology, along the lines of Silicon Valley in California. Thus was formed the embryo of the Electronic Street.

In 1984, business turnover of the Electronic Street totalled 18 million yuan renminbi. By 1987, however, it had topped 900 million yuan renminbi, and some formerly unknown companies with minimal financial capacity had leaped to national fame. Stone Group, for example, was founded with a loan of 20,000 yuan renminbi by several scientists and technicians who had resigned from the Chinese Academy of Sciences. It quickly expanded by constantly turning out new products. Its turnover increased on average by 300 per cent annually, and in 1987 it had the biggest sales volume of all China's computer companies.

Next door to the Stone Group, on the busiest section of the Electronic Street, stands a State-owned computer business, the Institute of Computing Technology of the Chinese Academy of Sciences. Of all State-owned computer companies in the area, the Institute has been the most successful. Since its establishment in November 1984, its turnover has jumped from 3 million yuan in 1985 to 18 million yuan renminbi in 1986 and up to 71.4 million yuan renminbi in 1987, proving that State-owned businesses truly can be competitive. Clearly there is no problem with the form of ownership if operation and management are sound. The experience of the Institute has blazed a new way for the reform of China's scientific and technological structures.

The success of the Institute lies in factors shared by many businesses on the Electronic Street: a pioneering spirit, highly efficient management and capable leadership. Unsure of its initial role, however, the Institute even sold roller skates when it started. That mistake was immediately recognized, and the Institute's breakthrough came when it decided to collaborate with a research fellow who had invented a Chinese character input system applicable to large computers. Institute officials assured him that they could give his invention the treatment necessary to commercialize it as quickly as possible.

At the time, because most computer operators had little knowledge of English, the thousands of computers imported by China could not be fully utilized. Many were merely employed to demonstrate office modernization. After repeated experiments, a way was found of incorporating the invention into microcomputers. The product was named the LX Chinese card. About the size of two books, it can be strapped on to existing hardware and enable computers to be operated in Chinese. In addition, as soon as an operator types a Chinese character, many related vocabularies are displayed on the screen, thus helping increase work efficiency.

Soon after it came into production, the LX card was awarded first prize at a Beijing computer competition. That was followed in 1986 by a prize at a national exhibition of computer applications, and in 1987 by another prize from the Chinese Academy of Sciences for technological progress. To date, the product has been updated eight times and is available in three models. Much favoured at home, it has sold well in Hong Kong and Singapore.

To maintain its competitive edge, the company closely followed global trends. Hearing that IBM had developed new PS/2 microcomputers and put them into trial production in April 1988, the Institute immediately organized its senior scientists to develop a Chinese-English compatible system and put it on the market. Even IBM voiced surprise at their high speed of innovation.

Source: "China's Silicon Valley in the Ascendent", Beijing Review, 19-25 September 1988, pp. 15-18.

cent of large- and medium-sized State-owned industrial enterprises had adopted a contract management responsibility system, and over 53 per cent of small enterprises had been either leased to individuals or released to collective ownership. Some indicators show significant gains in efficiency. For instance, during the past 10 years, the amount of energy used for every 100 million yuan renminbi's worth of industrial output fell by 30 per cent and steel consumption dropped by 23 per cent, according to a recent sample survey conducted by the State Statistical Bureau.

The number of input materials distributed solely by the State fell from 279 items in 1979 to 24 in 1987. The proportion of those items distributed according to a central plan has also dropped. For instance, in 1988, the state distributed 46.8 per cent of steel products, 43.5 per cent of coal, 25.9 per cent of timber and 13.6 per cent of cement. The remainder of those products were procured through the input market or the "Horizontal Economic Association" networks.

The reorganization of State-owned enterprises meant that redundant labourers had to be retrained and relocated. Today, roughly 15 to 20 million workers are estimated to be surplus labour, or 8 to 15 per cent of total employees in State-owned enterprises. They are subject to redeployment in new subsidiary projects that create productive employment within the State enterprises under a fixed-term labour contract system, or in collectively-owned (co-operative) or even private enterprises. Between 1979 and 1987, 70 million urban jobs were created, 40 per cent of which were in collectively owned or private businesses.

According to the State Statistical Bureau, such reorganization produced dramatic changes:

> "Productivity of State-owned enterprises was 8.8 per cent higher in the first half of 1988 compared with the same period last year, while the number of employees fell by 390,000—an unprecedented phenomenon for many years" [37].

The issue of developing a Chinese-style capital market is still being debated although some experiments have taken place, such as the opening of stock exchanges at Shanghai and at Shenzhen (the special economic zone near Hong Kong). Some 6,000 enterprises have issued share capital so far, and the sum of stocks and bonds reached 20 billion yuan renminbi ($5.4 billion) as of August 1988. The main hurdles against a fuller development appear to consist of the framing of a system of property rights (that is, defining the ideological content of Chinese socialism, or who can own what productive assets, how much and how long) and the establishment of a stock market infrastructure (that is, setting up securities companies and exchanges, training personnel, passing laws to regulate trading etc.).

In spite of the significant progress made in reforms and industrialization during the past decade, difficult problems remain. At the micro-plant level, it is reported that factory directors face the so-called "three pests", in the form of officials who resell goods in short supply at [illegible] prices, indiscriminate and arbitrary charges or requests for donations from local administrations, and frequent administrative interference in enterprise decision-making. At the macro-level, policy makers have yet to master the administrative skills needed to control total money supply as well as government expenditure overruns. For instance, in 1988 the budget plan was to cut administrative expenses by 20 per cent, but in the end 22 per cent more was spent than in 1987. There was a maladjustment of the inter-industry price structure and a lack of adequate physical infrastructure (such as transport and communication). Improvements were also needed to enable the market to function as an efficient resource allocator among different industries and regions. Similar improvements in the other problem areas would provide a new driving force for the economy in future.*

K. Concluding remarks

The world economy is going through a transitional period with two major imbalances which require correction. On the one hand, financial imbalances raise the threat of a permanent crisis marked by mounting external debt in many countries, both developed and developing, and by the limitation of exchange rate adjustment as a tool for improving trade and financial imbalances. On the other hand, technostructural imbalances, as reflected in the different rates at which innovation sharpens industrial competitiveness among major trading countries, are being felt in the following ways: winners are forcing losers to bear tremendous adjustment costs of plant closure and unemployment; there are increasing threats of regional protectionism through the formation of blocs; and overinvestment designed to circumvent the effects of protectionism is contributing to global overcapacity in an increasing number of industries. Such overinvestment could lead to cut-throat competition and dumping, which could in turn fan more protectionism and feelings of insecurity. In short, there is a danger of a vicious circle. The strength of protectionist sentiment, overcapacity and trade imbalances, if combined with a short-sighted contractionary policy based on the fear of inflation, could set off trade wars and a world recession.

An opposing scenario could also be envisaged, whereby the enlarged three regions of the EEC single market of 1992, the United States and Canada, and the alliance of Japan and the countries of Asia and the Pacific would co-operate toward correcting structural and technological imbalances. The possibility for sharing technology with trading partners looms large as an essential ingredient which ought to replace traditional technological nationalism. If the process were combined with more open trade, a positive-sum game could prevail. The world industrial economy thus faces a major choice.

But if the imbalances worsen, then the losers may be tempted to resort to protectionist strategies or contractionary adjustment or both. If Latin American and Tropical African debtor countries should be compelled to default, then the world financial system would face a real danger of collapse.

Bold new thinking is needed for the Latin American region, a way of thinking that emphasizes the need to combine financial assistance to debtor countries with an injection of technology. In other words, recycling of technological resources is just as important as recycling of financial resources. The aim is to restructure industry toward greater efficiency and export competitiveness. There is a need to redress the past practice of making the manufacturing sector the primary victim under an austerity programme. The region needs a coherent policy providing for technology inducement and industrial restructuring, as well as a financial relief policy linked to the debt. Financial relief alone does not automatically lead to industrial revival and restructuring.

The Programme and Budget Committee of UNIDO, at its 1989 session, proposed a special regional co-operation programme for the industrial recovery of Latin America. Suggested priority areas include the production of capital goods, human resource development, agro-industries and the application of biotechnology, electronics and new materials technology. The main thrust of the new programme is to step up efforts towards economic and technical co-operation among developing countries in the region, including enterprise-to-enterprise co-operation, consolidation of

*Current debates on how to approach the sequencing of reforms are summarized in ([38], pp. 461-466).

industrial activities, and broadening of local technological capabilities—a painful, long-term task, yet a precondition for resolving the chronic debt problem.

The manufacturing sector in Tropical Africa, like its Latin American counterpart, was originally designed for import substitution. The majority of enterprises assembled imported inputs with imported parts and machinery. Export earnings from selling primary commodities financed assembly operations and goods ranging from automobiles to radio receivers. Input-output linkages with domestic sectors have not developed sufficiently to withstand curtailed imports of inputs when export earnings fall. As a result, the rate of capacity utilization in manufacturing is extremely low in many countries of the region.

An increasing awareness of these basic problems has in recent years made policy-makers rethink and revise industrial development strategies in the region. The new strategy advocated emphasizes a shift to agro-based small- and medium-scale enterprises as an important element in the industrial sector. The new strategy also includes a selective rehabilitation of ailing industries, retraining employees and their trainers, and repairing deficiencies of institutional infrastructure so as to provide a more hospitable environment for the growth of the rehabilitated enterprises. Along with other organizations such as the World Bank, UNIDO has been actively engaged in providing much-needed technical co-operation for industrial rehabilitation in the region.

III. South-South industrial co-operation for the development of industrial sub-contracting of parts and components

Industrial growth in the 25 years since 1964 has shown several quantitative as well as qualitative features. The quantitative features which have been highlighted in previous *Global Reports* have been the rapid growth in the first half of this period and the slow-down in the second half. This slow-down has especially hit developing countries. Though some of them have broken through the development barrier and are well on their way to joining the community of industrialized countries, the majority have been left behind and their industrial progress has been curtailed. Everywhere there is an urgent search for ways to resume rapid growth of the world industrial economy.

One strategy for speeding up industrial growth in the developing economies is that of multilateral co-operation. Ever since its first *Global Report*, UNIDO has explored ways in which rapid growth in one part of the world would benefit the rest. The first *Global Report* studied the potentialities offered by South-South co-operation while emphasizing that North-South co-operation was still the first best option. Subsequent *Global Reports* have rebutted the argument that industrialization in the South could have caused deindustrialization in the North. Structural change has been yet another constant theme as both North and South have faced its effects.

South-South co-operation is again the special theme of *Global Report 1989/90* but now the emphasis is different. One reason for this is the increasing globalization of the division of labour in manufacturing. Its early signs were confined to the Northern economies as the international movement of capital and the pattern of technical change made possible a dispersed geographical location of the manufacture of component parts of a final product and its final assembly in different countries as dictated by costs and market size. While this has not yet happened in the South to any great extent, some Southern economies are at the receiving end of the overspill of this process.

This move towards globalization and dispersal represents a major reversal in the traditional pattern of industrialization. Over much of the previous 100 years before 1975, it was vertical integration and locational concentration of production dictated by economies of scale which formed the principal technological feature of industrialization. At present, although transnational corporations represent a large concentration of financial assets in single firms, production is scattered. What is more, there is an increasing tendency to sub-contract the production of component parts. The sub-contracting of parts becomes feasible because, on the one hand, the markets for the final products (automobiles, television sets, computers) are becoming even larger, while, on the other hand, the standardization of component technology and specialization yields economies in production to the ancillary sub-contracting firms.

The geographical dispersal of production, the sub-contracting of component parts and the economies of standardization and specialization are the qualitative features of the new industrial economy. Those features can be exploited in a strategy of South-South co-operation. The need for such a strategy of co-operation arises as much out of the low overall rate of manufacturing growth as from its very uneven incidence among the Southern economies.

A. Conceptual Issues

Industrial activities are heavily concentrated in a handful of developing countries in the South, and a large number of developing countries seems to remain virtually untouched by the process of global industrialization. A cursory examination of figures, given in tables III.1 to III.3, reveal this disquieting trend vividly. The top 10 countries, in table III.1, accounted for over 60 per cent of total MVA of 116 developing countries, and the top 18 countries for nearly 80 per cent in 1985. But the absolute size of MVA may not reflect the degree of industrial development as well as per capita MVA. Using per capita MVA as a proxy for measuring the extent of industrialization, 53 developing countries, about 45 per cent of the total sample, were found to be in the group with per capita MVA of less than $100 in 1985, while the per capita MVA of 19 developing countries remained within a range of $500-$2,500 (see table III.2). The imbalance is equally evident in manufactured exports, with the top five countries accounting for almost 60 per cent of the South's total manufactured exports and the top 19 nearly three quarters of the total. Indeed, as shown in table III.3, some 99 developing countries together export not much more than the top exporter among the developing economies.

Table III.1. Manufacturing value-added in selected developing countries, 1985
(Millions of dollars)

Country or area	MVA	Per capita MVA
Brazil	58 089	428
India	28 942	38
Republic of Korea	24 219	587
Mexico	19 526	247
Argentina	17 954	587
Yugoslavia	15 140	654
Saudi Arabia	13 769	1 193
Turkey	13 320	270
Iran, Islamic Republic of	12 897	289
Indonesia	12 432	75
Venezuela	10 556	610
Malaysia	9 281	597
Hong Kong	8 696	1 567
Puerto Rico	8 166	2 366
Philippines	8 090	148
Thailand	7 696	150
Colombia	7 417	258
Singapore	4 310	1 684
Developed market economies	2 007 692	2 554
Developing economies	354 665	144

Source: Handbook of Industrial Statistics 1988 (UNIDO publication, Sales No. E/F.88.III.E.5).

III.2. Frequency distribution of per capita MVA of developing countries, 1985
(Dollars)

Per capita MVA	Number of developing countries	Number of oil economies	Percentage of total
Below 20	23	1	19.8
20 - 50	18	1	15.5
50 - 100	12	1	10.3
100 - 200	23	1	19.8
200 - 500	21	6	18.1
500 -1 000	11	3	9.5
1 000 -2 500	8	5	6.9
Total	116	18	100.0
Average per capita MVA for			
Developed market economies	2 554		
Developing economies	144		

Source: Handbook of Industrial Statistics 1988 (UNIDO publication, Sales No. E/F.88.III.E.5).

In the next section the globalization and dispersal of production in recent years are surveyed. It is important to note that these features have arisen as a response to competitive pressures and the search for profit opportunities rather than as a result of some normative plan for international co-operation. In section C the experience of selected industries is studied as pertaining to this process. As will be seen in these studies of the automobile industry and of some consumer durables and electronic products, some Southern economies are already emerging as major actors. But if this experience is to be used for devising a South-South strategy, the micro-economics of sub-contracting and the specific problems that the less industrialized among the developing countries may face have to be looked at carefully. This is done in section D. Market size rather than technological complexity of production emerges as the binding constraint. UNIDO's feasibility studies show that the developing economies have the ability to produce component parts of many of the products currently being out-sourced, but that they lack markets in which to realize economies of scale. This argues for a strategy of pooling the Southern markets and dispersing the production of components to spread industrialization. It is in light of those considerations that a strategy for South-South complementation is outlined towards the end of this chapter.

Table III.3. Top exporters of manufactures of the South, 1985
(Millions of dollars)

Country or area	Manufactured exports
Republic of Korea	29 134.0
Singapore	19 399.7
Hong Kong	16 068.3
Brazil	15 024.2
Mexico	11 165.1
Malaysia	7 937.9
Argentina	4 735.1
Thailand	4 585.9
Indonesia	4 128.0
India	4 109.4
Pakistan	2 482.9
Philippines	2 401.8
Chile	2 223.3
Peru	1 455.6
Morocco	1 172.7
Colombia	931.5
Tunisia	908.5
Other developing countries a/	29 617
Total developing countries	157 481

Source: Handbook of Industrial Statistics 1988 (UNIDO publication, Sales No. E/F.88.III.E.5).
Economist, 4 March 1989, p. 94.
a/ 99 developing countries.

B. Global production and international sourcing of parts and components

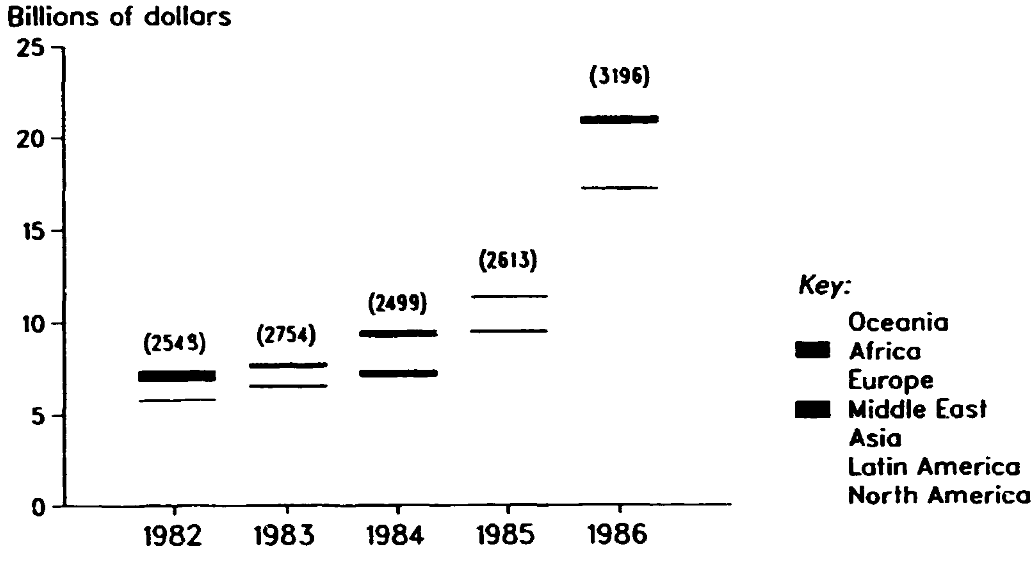
The global network of industrial production has been expanding at an unprecedentedly rapid pace since the early 1980s. This fundamental change in the global industrial landscape is, in a great measure, reflected in the phenomenal growth of foreign direct investments in recent years by Japan, the United States and other Western European countries. In 1988, United States companies invested about $42 billion in plant and equipment in foreign countries, about 8 per cent of total fixed capital expenditures of $530 billion, and that percentage has been rising for the past three years [39]. In 1986, Japan's foreign direct investment made a quantum jump of 83 per cent over that of the previous year, from $12.2 billion to $22.3 billion of which $11.1 billion (about 50%), were in industry and manufacturing (see figure III.1). According to the 1987 survey of Japanese companies in foreign countries, 54 per cent of the manufacturing enterprises surveyed in Japan, 660 companies, established their foreign production bases in 120 countries, particularly in South-East Asia, Europe and the United States [40]. The value of total world-wide foreign direct investment outstanding increased from $644 billion in 1985 to $755 billion in 1986, an increase of 20.4 per cent or $111 billion, which is quite substantial even after discounting the effect of dollar depreciation ([2], p. 19).

There are many reasons for this ever-growing trend in global production. Transferring production abroad has been partly prompted by the changing patterns of international comparative advantage. In recent years, developing countries have become increasingly competitive in labour-intensive production, taking advantage of the disparities in wages while costs of transport and communication continued to drop and become less formidable as trade barriers.

Another major reason for actively seeking the internationalization of production is protectionism. Symptoms of protectionism abound. They include, among other things, voluntary export restraints, orderly trade agreements and anti-dumping clauses. Another example is the Omnibus Trade and Competitiveness Act of 1988 adopted by the United States Congress, with particular reference to two clauses dealing with the control of foreign direct investment inflows and access to foreign markets by United States companies. Western Europe is also not immune from the suspicion of protectionism. Apart from the possible impact of the Single European Market Act (1992) on international trade, many overt or covert trade barriers, such as the introduction of local content rules (requiring up to 80 per cent of value in local content), voluntary export restraints and anti-dumping clauses, are already evident. The United States-Canada Free Trade Agreement, like Europe 1992, could be another trade-diverting move.

An additional driving force for internationalization is highly volatile exchange rates, in particular the drastic appreciation of the Japanese yen and the deutsche mark, and even of the currencies of some NICs such as the Republic of Korea and Taiwan Province, driving them to step up their overseas production.

Figure III.1. Japan's foreign direct investment, 1982-1986



Source: Ministry of Finance of Japan

Note: Figures in parentheses are the number of cases of foreign direct investment

The globalization of industrial production is spreading through both North-North and North-South linkages, but for different reasons. Developed countries transferred largely low-skilled, labour-intensive production, mainly in the form of assembly operations for export, while more highly-skilled operations were performed in developed countries, in an attempt to take advantage of the low-cost advantage of developing countries in labour-intensive lines of production.

Assembly operations are mainly concentrated in a few types of manufacture—automobiles, electronics and apparel. Because of the relatively high value-to-weight ratios, transport costs as a trade barrier seem less problematic for those products. They comprise numerous parts and components and can be broken down in different production processes, thus enabling manufacturers to separate labour-intensive routine assembly operations from capital- and skill-intensive activities. Developed countries could certainly respond to the low-labour-cost advantage of developing countries by automation. But given the relatively short life cycles of many of these products with rapid innovation and continuous technological change, the need for frequent changes in automation systems requiring a large fixed-capital investment and large production runs each time may deter them from pursuing this alternative strategy.

In particular, production of consumer electronics products, automobiles, and certain high-technology electronics products such as semiconductors has been integrated vertically across North-South boundaries in response to foreign competition for some time. For instance, there are now 23 United States- and Japanese-owned integrated circuit plants in Malaysia which are producing integrated circuit assemblies. More importantly, many of these multinationals, including National Semiconductor, Motorola and Intel are integrating the so-called "back end" of industry involving the testing and assembly of integrated circuits into the "front end" of industry which entails high-technology capital-intensive wafer fabrication in which the circuitry of the integrated circuit is etch-printed on to a wafer of silicon. The main reasons for transnational corporations to integrate the front and back ends of the industry is to shorten the production and delivery cycles, making access easier to rapidly growing markets in East and South-East Asia as end-users of semiconductors ([41], p. 72).

On the other hand, the main force driving the North-North manufacturing investment is the need to react to a rising wave of actual or prospective protectionism and to offset the negative impact of currency appreciation on trade. But the real underlying motive for the rush by many transnational corporations to manufacture abroad is the pull of the growing wealth of consumers in Western Europe, North America, Japan and the NICs. Overseas production is often influenced by the notion that exports permit only a limited penetration of the growing markets, and that only on-site production may enable transnational corporations to establish a sizeable share, say 40 to 50 per cent, of those markets. The trend toward redeploying manufacturing abroad may indeed be profitable for individual companies, but may spell disaster for the merchandise trade gap of the economy, as is seen in the case of the United States.

A frantic drive to locate production overseas is now nowhere more evident than in Europe where the 12-nation EEC is in the process of abolishing internal trade barriers by the end of 1992. Many United States companies are eager to establish European manufacturing operations because of the fear of "Fortress

Europe" blocking many imports from outside this huge market. In fact, the presence of United States-owned firms in Europe is already dominant, with its foreign direct investment stock in manufactures amounting to around $54 billion as of December 1986. At the end of 1988, Japanese manufacturing companies operating in Europe had increased by 116 to 392 from 276 in 1987. In the first two months of 1989, more than 50 additional major Japanese companies announced plans for new manufacturing ventures in Europe. Three major routes used by Japanese companies penetrating European markets are direct investment, merger and acquisition and internal corporate reorganizations ([42], p. 24). What concerns Japanese manufacturers most is the EEC doctrine of "reciprocity", requiring equal privileges in mutual markets, which is also a common feature of all trade negotiations between Japan and the United States. Responding to various forms of trade-restricting measures, the Japanese have been stepping up their local production in Europe in many manufacturing industries.

The current trend toward locating production abroad as a survival strategy is a phenomenon not unique to developed countries, but also beginning to appear in some NICs such as the Republic of Korea and Taiwan Province. Overseas investments by the Republic of Korea and Taiwan Province are still small by United States or Japanese standards, but they are rapidly increasing. In the case of Taiwan Province, higher domestic labour costs and currency appreciation were the main causes of the rapid growth of overseas investments concentrated in labour-intensive industries. Taiwan Province has some 300-400 projects with a total investment of about $1 billion in Thailand alone. Taiwan Province's overseas investment grew at a remarkable rate of 80 per cent and 113 per cent in 1987 and 1988 respectively [43].

The rapid growth of the Republic of Korea's overseas investment has been prompted by its strategy of moving closer to markets and forestalling protectionism, especially in the EEC, although rapidly escalating labour costs and currency appreciation are also seen as an important contributing factor. The Republic of Korea's overseas investments at the end of June 1988 stood at $1.4 billion with 663 projects. Its investments are concentrated in three regions: North America ($587 million), North Africa and Western Asia ($317 million) and South-East Asia ($310 million) [44]. However, in the past two years, the Republic of Korea has been uneasy about "Fortress Europe", as is Japan, and most of the major business conglomerates of the Republic of Korea have established their manufacturing bases in Europe. On the other hand, because of rapidly rising wage costs, offshore production by the Republic of Korea in the lower labour-cost countries of South-East Asia will be expected to accelerate in the coming years.

No single industry appears to be more advanced in the global integration of production than the automobile industry. The extent of the internationalization of automobile production is partly shown by a complex interlocking network of production and capital investment among car producers in the United States, Japan, Western Europe, the Republic of Korea and Taiwan Province as shown in figure III.2. For instance, the Daewoo Automobile Company in the Republic of Korea is planning to turn out 310,000 units of the Pontiac LeMans five-passenger cars in 1989, out of which 210,000 units are earmarked for exports. Three foreign companies, Isuzu and Nissan in Japan and General Motors in the United States, are linked with Daewoo in producing the LeMans model. Nissan offers technology and Isuzu supplies knocked-down sets to Daewoo, while General Motors contributed 50 per cent of Daewoo's capital. Daewoo exports the assembled LeMans to General Motors for sale in the United States market. General Motors also put up 41.6 per cent of Isuzu's capital, while Isuzu supplies General Motors with CBUs (small passenger cars and small- and medium-sized trucks) and engines.

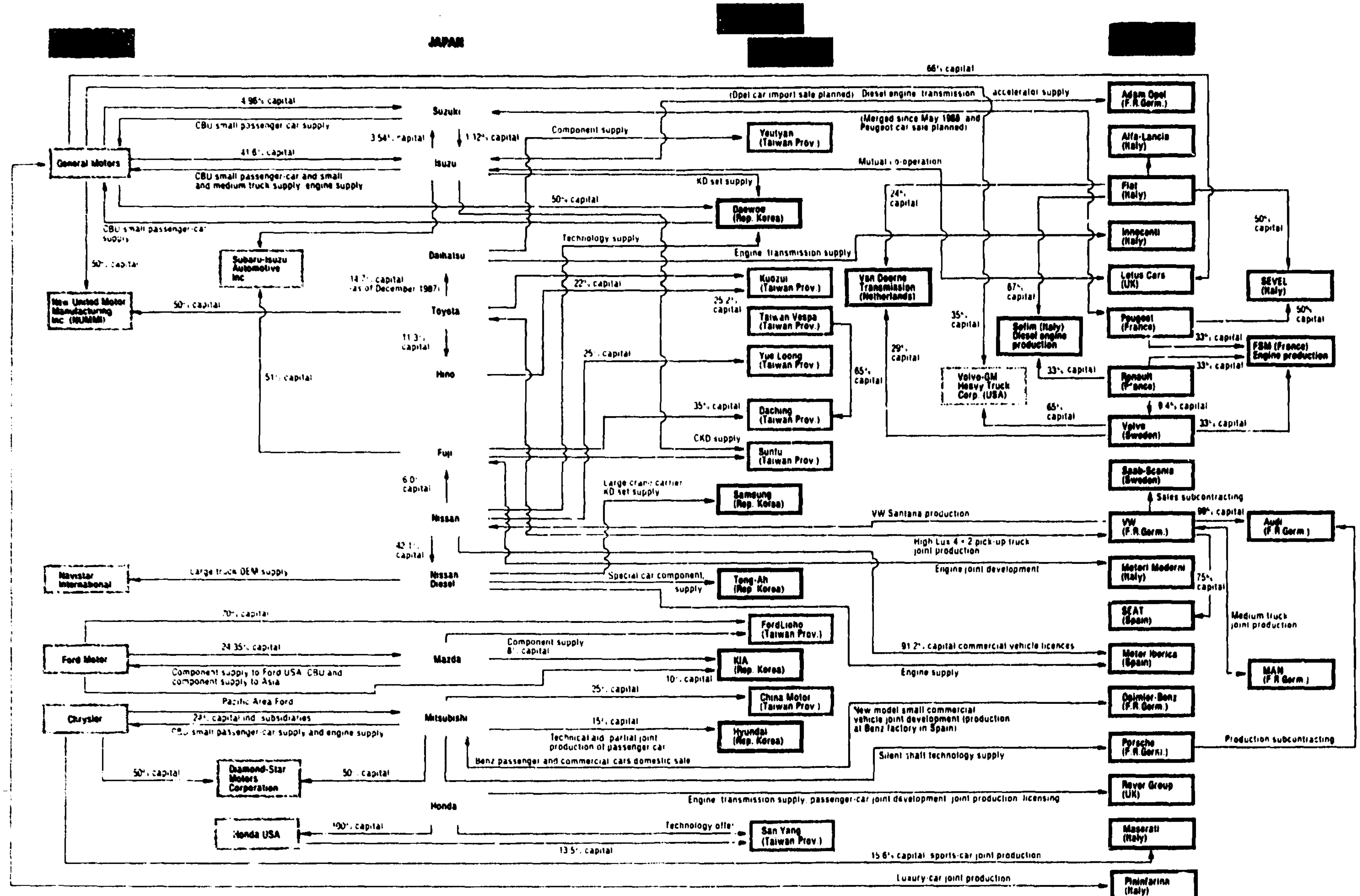
General Motors' world-wide linkages with car-makers are even more extensive. Apart from its connections with Daewoo and Isuzu, as described above, General Motors has also established a link with the Suzuki Automobile Company, which supplies it with CBUs (small passenger cars). General Motors, which owns 35 per cent, has a joint venture with the Volvo Company producing heavy trucks in Europe. It has a similar arrangement with the Lotus Company of the United Kingdom, with the General Motors share of capital amounting to 66 per cent, while producing luxury cars jointly with Pininfarina in Italy.

As a vanguard for spreading the internationalization of car production, Japanese four-wheel knocked-down units were assembled in 40 countries, and two-wheel knocked-down units in 31 countries world-wide in 1987 ([45], pp. 26-27). In particular, Japan established a dominant presence in the United States, the world's largest market. All major Japanese automobile-makers manufactured their cars and parts and components, either independently or in joint ventures with a local partner. They are Honda, Nissan, Toyota, Mazda, Mitsubishi, Fuji, Isuzu, and Suzuki. Total Japanese car production in the United States among them increased to 6.3 million passenger cars in 1987, from slightly over half a million units in 1983, although their truck production remained constant around 1 million units during the same period ([45], p. 25).

Similarly, Japanese car-makers are making considerable headway in Europe, where Toyota and Nissan are producing independently. On the other hand, many Japanese car-makers are producing cars jointly with local partners. Honda and the Rover Group are already co-designing and producing cars in the United Kingdom. Mitsubishi Motors and Daimler-Benz are planning to produce commercial vehicles at a Daimler plant in Spain. Isuzu, partially owned by General Motors, will produce recreational vehicles in the United Kingdom. Mazda is considering purchasing a plant from the Spanish State run commercial car-maker ENASA, while Fuji Heavy Industries, maker of Subaru, is reported to be negotiating a joint production agreement with Volvo.

The global integration of manufacturing final products may also bring about a parallel development of globalizing the production of parts and components. International sourcing of parts and components, particularly those with high value-to-weight ratios such as automobiles and electrical and electronic parts and components, has been growing rapidly in the 1980s. Many major automobile components such as engines and transmissions are being produced jointly among

Figure III.2. Inter-firm linkages among car-makers in the United States, Japan, Western Europe, Republic of Korea and Taiwan Province



Source: Japanese Automotive Industry Association, The Motor Industry of Japan (Tokyo, 1988).

Notes: F.R.Germ. Federal Republic of Germany, UK United Kingdom, USA United States.
CBU Completely built-up, KD knocked-down, CKD completely knocked-down, OEM original equipment manufacturer.

big car-makers scattered all over the world as already shown in figure III.2. The rapid growth of international trade in some selected parts and components for electrical and electronics products and automobiles can be discerned in table III.4. Most of the items in table III.4 registered a remarkable growth between 1982 and 1986, even with allowance being made for inflation. Among most rapidly growing components are switching gear, resistors, television picture tubes, diodes, microcircuits and condensers.

One clear measure of the rapid growth of global production and trade of parts and components is provided by United States imports of various parts and components under United States Tariff items 806.30 and 807.00 (henceforth 806/807), which permit the duty-free re-entry of United States components sent abroad for processing or assembly. Basically, 806.30 permits the reimports of fabricated, but unfinished, products in the United States for further processing, while 807.00 permits only the assembly of finished goods for re-export to the United States for final consumption. What is most relevant for the present analysis is Tariff item 806.30, but separate statistics were not available and table III.5 represents the combined statistics of items 806/807, and only for 1969 and 1982. It is clear from table III.5 that 806/807 imports are largely dominated by motor vehicles and parts, semiconductors and parts, and, to a lesser extent, by television receivers and parts, office machines and parts, and textile products. It is worth noting that almost all the motor vehicles and parts imports came from developed countries, with almost all the other 806/807 imports from developing countries.

Although the most recent statistics available were for 1982, which are somewhat outdated, United States imports of 806/807 items from developing countries showed a phenomenal growth in all 11 major product groups between 1969 (the year in which the Tariff 806/807 programme started) and 1982. United States imports of semiconductors increased almost thirtyfold from $106 million to $3,131 million, television receivers and parts over tenfold from $87 million to $943 million and office machine parts almost eight times from $100 to $764 million during the period. Eleven product groups, as a whole, showed a dramatic increase of nearly thirteenfold between 1969 and 1982, an extraordinary growth even after allowing for inflation.

It should be noted that a drastic upsurge in many of the United States 806/807 imports was prompted by a response of United States manufacturers to Japanese competition. This is particularly true of semiconductors and television sets. Large-scale assembly of United States semiconductors and parts production began in South-East Asia as a response to low-cost transistors imported from Japan. Likewise, the United States television industry was heavily affected by Japanese competition. As a survival strategy, United States firms moved many of their assembly operations, and even parts and components productions, to Mexico, Taiwan Province, and, later, to Singapore.

The impact of global integration of manufacturing on the exports of parts and components of some individual countries is quite pronounced. For instance, exports of electrical and electronic parts and components from the Republic of Korea grew over fortyfold from $103 million in 1972 to $4,231 million in 1987 [46], while exports of automobile parts and components grew at an average rate of about 25 per cent per year from $37 million in 1979 to $165 million in 1986, with export items increasing from 58 to 188 between 1972 and 1986 [47]. Japanese performance, in this regard, is equally remarkable. Japan's exports of parts and components of passenger cars doubled in only two years from $5,228 million in 1985 to $10,714 million in 1987, although a large part of this increase is due to yen appreciation ([45], p. 5). By contrast, Japan's exports of parts and components of home appliances grew almost 2½ times from 22,763 million yen in 1982 to 55,689 million yen in 1985, but its exports steadily declined after the 1985 peak to 42,494 million yen in 1986 and 35,757 million yen in 1987, reflecting Japan's accelerated overseas redeployment of production of parts and components to low-wage-cost areas particularly in South-East Asia, as part of a

Table III.4. World trade of selected parts and components, 1982 and 1986
(Millions of dollars)

SITC	Item	Imports 1982	Imports 1986	Percentage change	Exports 1982	Exports 1986	Percentage change
772.1	Switchgear	10 249	15 025	46.6	10 830	14 438	33.3
772.3	Fixed, variable resistors	1 097	1 546	41.0	965	1 429	48.1
776.1	Television picture tubes	1 161	1 902	63.8	1 162	2 102	80.9
776.2	Other electronic tubes	921	993	7.9	702	1 115	58.9
776.3	Diodes, transistors etc.	2 751	4 375	59.0	2 857	3 818	33.6
776.4	Electronic microcircuits	7 999	14 440	80.5	5 353	13 986	161.3
778.1	Batteries, accumulators	2 286	3 054	33.6	2 200	2 747	24.9
778.3	Electric lamps, bulbs	1 678	2 374	41.5	1 342	2 132	58.9
778.3	Automotive electronic	2 775	3 377	21.7	2 440	3 606	47.8
778.84	Electrical condensers	1 591	2 387	50.0	1 518	2 278	50.1
784.1	Motor vehicle chassis	1 428	1 720	20.5	997	1 194	19.7
785.39	Parts of motor cycles, scooters etc	1 464	1 983	35.4	1 315	1 697	29.1

Source: International Trade Statistics Yearbook 1986, vol. II (United Nations, Sales No. E/F.88.XVII.2).
Note: Data refer to world market economies only.
Conversion of values from national currencies into United States dollars done by currency conversion factors based on official exchange rates. Currencies that are subject to fluctuation are converted by using weighted average exchange rates, which are mostly furnished by the International Monetary Fund.

Table III.5. Selected significant groups of products imported under United States Tariff items 806.30 and 807.00, 1969 and 1982
(Millions of dollars)

Product group	1969 total		1982 total		Percentage change
Motor vehicles and parts	771.3	(42)	8 360.8	(46)	1 000.8
Semiconductors and parts	106.2	(6)	3 131.5	(17)	2 948.7
Television receivers and parts	87.1	(5)	943.3	(5)	1 080.3
Office machines and parts	96.9	(5)	764.0	(4)	788.4
Radio apparatus and parts	51.1	(3)	299.7	(2)	586.5
Textile products	34.8	(2)	649.7	(4)	1 886.9
Equipment for making/breaking/ connecting electrical circuits	6.5a/		263.9	(1)	4 060.0
Electrical conductors	4.2a/		244.4	(1)	5 819.0
Motors and generators	7.7a/		220.2	(1)	2 859.7
Internal combustion engines and parts	16.1	(0.9)	212.5	(1	1 319.8
Game machines and parts	0.7a/		211.3	(1)	30 185.7
Total, 11 product groups	1 182.6	(64)	15 301.3	(84)	1 293.9
Total, all 806/807 imports	1 838.8	(100)	18 275.5	(100)	993.9

Source: Adapted from table 2.3 in J. Grunnwald and K. Flamm, The Global Factory: Foreign Assembly in International Trade (Washington, D.C., Brookings Institution, 1985), p. 17.
Note: Percentage of total in parentheses.
a/ Less than 0.5 per cent.

strategy designed to cushion the severe impact of post-1985 yen appreciation and to avoid rising trade frictions [48].

Today, international sourcing of parts and components is a familiar feature of the manufacture of passenger cars, despite intensified efforts of both developed and developing countries to increase the domestic-content ratios. For instance, in the case of the model Pontiac LeMans, a car produced by Daewoo Automobile Company of the Republic of Korea in a joint venture with General Motors of the United States, almost 90 per cent of all parts and components were produced locally in 1988, although this ratio may tend to grossly overstate the true domestic content, since the import content of various parts and components assembled locally is not counted. The remaining 10 per cent of parts and components were procured from various countries as shown in table III.6. There are also 70 other knocked-down imported parts (not shown here) earmarked for local production to be completed before 1990 as part of the Government's overall localization programme. Table III.6 shows the sourcing of automobile parts and components from eight different countries, but three countries, namely Federal Republic of Germany, United States and Japan, dominated the parts and components supply.

The automobile industry is important in another respect as well. Just as the cotton textile industry was the route by which countries embarked on the industrialization process in the nineteenth and early twentieth centuries, the automobile industry is the key to late-twentieth-century industrialization. In the next section, the experience of Japan is examined as well as that of some NICs. Yet another clutch of products is consumer electronics and consumer durables. The transistor, the television, the computer and the refrigerator are everywhere symbols of having arrived at a sophisticated standard of living. They also reveal interesting patterns of globalization and international sourcing.

Table III.6. Selected imported parts and components for the assembly of LeMans passenger cars in the Republic of Korea, 1988

Group	Item	Import source
T/axle	Transaxle, A-G/S 4- and 5-speed	Japan
Steering	Steering Knuckle (casting)	Japan
Body electrics	Antenna A-auto	Japan
Axle and suspension	Grooved ball bearing	Japan
Engine	LPG Mixer A	Japan
Engine	Hose-air cleaner	Germany, Federal Republic of
Engine	Catalytic converter	Australia
Engine	EXH O_2 sensor	United States
Engine	Bearing	Germany, Federal Republic of
Axle and suspension	Height adjuster A	Germany, Federal Republic of
Engine	Ball - 11	Germany, Federal Republic of
Engine	EGR valve	Canada
Engine	s/w A-sensor, oil	Germany, Federal Republic of
Engine	Pressure plate	Austria
Engine	Screw cap (surge tank)	Germany, Federal Republic of
Engine	Screw cap (fuel tank)	United States
Engine	Ball-8	Germany, Federal Republic of
Engine	CAM follower	Germany, Federal Republic of
Engine	Key valve spring	Germany, Federal Republic of
Engine	Rotary cap A-valve	Germany, Federal Republic of
Engine	Hydraulic lash adjuster	United States
Engine	Control unit A-MSTS	Singapore
Engine	Check valve	United Kingdom
Engine	Pierce nut	Germany, Federal Republic of
Engine	Valve-idling control	Germany, Federal Republic of
Engine	Vacuum sensor	United States
T/axle	Worm-gear, S.D-driven	Germany, Federal Republic of
Axle and suspension	Torsion profile-RR/axle	Germany, Federal Republic of
Axle and suspension	Hollow bumper	Germany, Federal Republic of
Axle and suspension	Inclined ball-bearing	Germany, Federal Republic of
Electrics	Bulb-12 V, 0.5 W	Germany, Federal Republic of
Electrics	Bulb-12 V, 1.2 W	United States
Body	Split sleeve	Germany, Federal Republic of
Air conditioner	Air-conditioner control A	Germany, Federal Republic of
Air conditioner	Cut off s/w A-compressor	United States
Air conditioner	Pipe A-liquid	Germany, Federal Republic of
Auto T/M	Auto TMS	United States
Body	Gas-operated spring	Germany, Federal Republic of

Source: Korean Automobile Industry Association, 1988.

C. Selected industry studies

1. Automotive Industry

(a) *The role of automotive industry in industrialization*

The automotive industry has been traditionally seen as one of the most strategic and favoured manufacturing sectors targeted for development in many developing countries. The reasons for the priority choice of the automotive industry in planning industrial development are manifold. One reason is its balance-of-trade implications. To meet the transport needs of a growing economy, imports of motor vehicles may have to be increased, and the trade gap may widen in the absence of import substitution. Another is that the domestic production of cars enhances national prestige and symbolizes the nation's industrial prowess. However, fundamental justification for launching the automotive industry in developing countries centres around three interrelated elements—industrial linkages, employment creation and technology diffusion.

The automotive industry is typically regarded as one of the most integrated industries with strong backward and forward linkages. Automotive manufacture requires, as inputs, a wide range of industrial raw materials such as iron and steel, rubber, glass, paints, plastics, aluminium etc. and a whole host of machines, tools and equipment to produce a myriad of parts and components and to assemble cars. Automotive manufacture induces the development of numerous service-related activities. Most important, forward-linked demands pertain to oil refining, wholesale and retail of refined oil products, transport-related services, sales and maintenance of cars, parts and components, finance and insurance. In fact, some developing countries (for example, Indonesia) actively pursued the local manufacture of motor vehicles as part of a broad industrial policy to foster the growth of metal and machine-tool industries as well as the development of basic industries such as petrochemicals, iron and steel, foundry and forging. It is based on the premise that local production of numerous parts and components would stimulate the development of those industries.

The most significant aspect of developing automotive manufacturing capacities is that the motor vehicle industry offers the maximum potential for the ancillary firm development, and hence employment generation through sub-contracting to small- and medium-sized firms, and at the same time facilitates inter-firm technological diffusion. Automotive products, whether an automobile, a scooter, an engine or a transmission, are composed of numerous parts and components, and therefore provide considerable scope for vertical inter-firm linkages of parts and components suppliers. For instance, a typical completely knocked-down unit consists of about 20,000 parts, many of which involve different production processes.

The potential of the automotive industry for generating employment and forging inter-industry linkages could well be illustrated by the estimated economy-wide employment impact of the automotive industry in Japan as depicted in figure III 3. In 1986, about 5,550,000 people worked in the automotive-related industries, accounting for about 10 per cent of the country's total employment. The automotive industry itself employed 753,000 people, of which 192,822 were for assembly operations, 503,931 for parts and components manufacturing and 55,891 for car body and accessories. It is especially notable that employment in parts and components manufacture accounts for 67 per cent of employment in the automotive industry proper, the largest source of employment. Moreover, the average employment multiplier of automotive manufacture seems to be around 7.4 (5,550 ÷ 753), implying that each job created in automotive manufacture may induce over a sevenfold increase in employment, economy-wide. So far as the sectoral impact is concerned, the greatest impact is felt in transport services with a multiplier of about 3.5, followed by sales and maintenance with a multiplier of 1.5. By contrast, the employment impacts of automotive manufacture on raw materials industries, and business related to refining, distribution, finance and insurance were shown to be less pronounced with a multiplier value of less than one.

Undoubtedly, the recent Japanese experience may not be relevant to the general conditions which prevail in developing countries today. In particular, to maximize the linkage effects of automotive manufacture, as evidenced by the Japanese case, usually requires the presence of mature basic industries and relatively sophisticated capital-goods industries capable of designing processes to produce parts and components not only for automotive manufacture, but for all other industries. Prior to the advent of the automotive industry, the United States and Japan had already developed a broad industrial base to manufacture a wide range of standardized parts and components for other manufacturing industries. As a result, car production was designed to fit the existing structure of parts and components production or process technology.

In most developing countries, the underpinnings of basic industries and machine tool industries for automotive manufacture are either virtually absent or rudimentary. It would seem an enormous, if not impossible, task for any single developing country to embark on a simultaneous development of a large number of supporting industries as an alternative to importing all parts and components for assembly operations. South-South industrial co-operation could play an important role in overcoming this initial barrier to automotive manufacture. The difficult task of building up the basic supporting industries as well as the manufacture of required parts and designing processes could be divided in a complementary manner among a group of developing countries according to resource endowments and technological capacity of individual countries. Co-operative endeavours of this sort, through co-production across national boundaries, seem essential, since basic industries such as iron and steel (including foundry, forging and casting), non-ferrous metals and chemicals are extremely capital-intensive and require sophisticated maintenance and operational technologies.

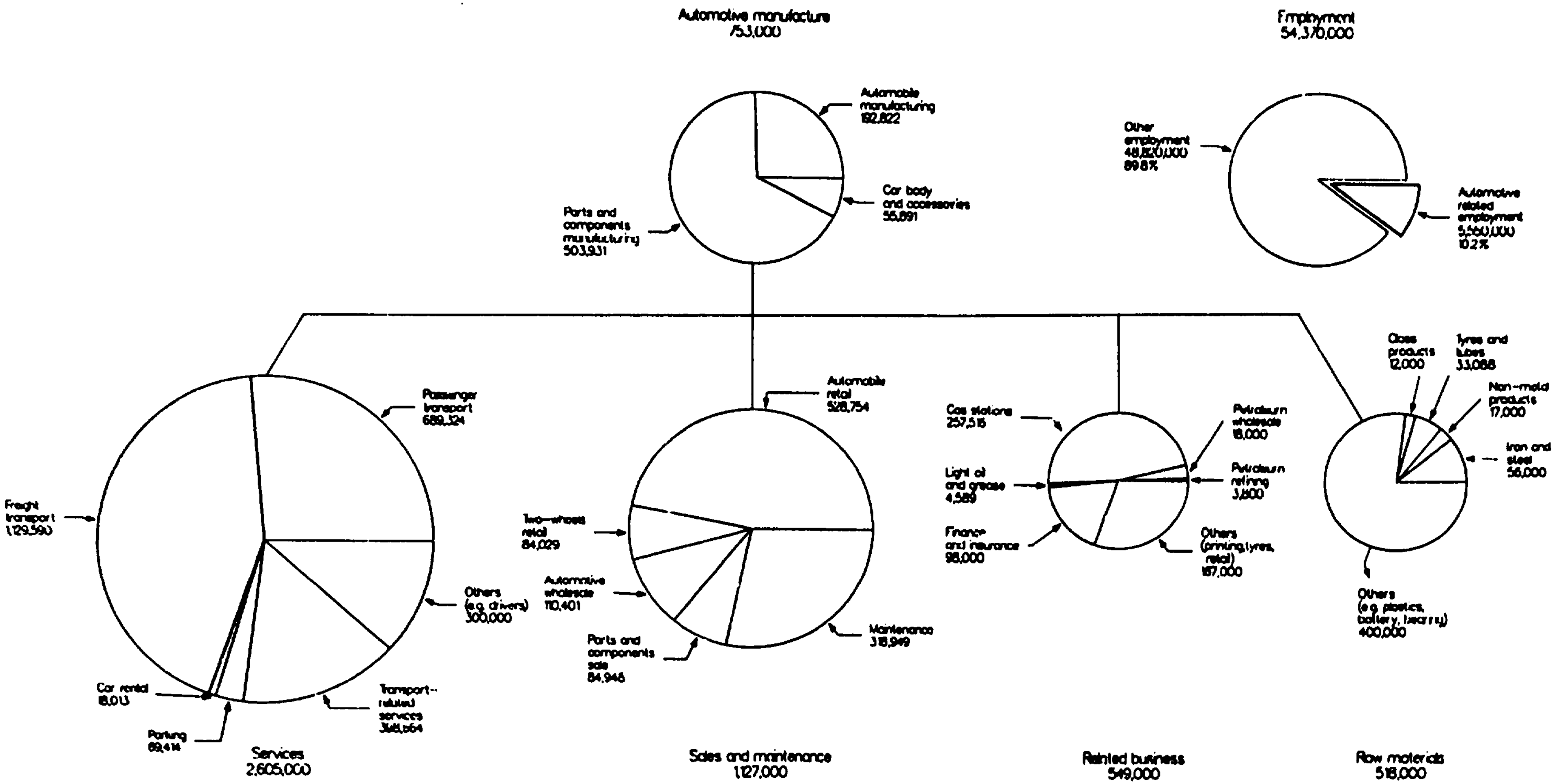
(b) *A shift of emphasis on parts and components specialization from the car assembly*

Almost every developing country has a cherished dream of making its own national car. But the business of making cars is very capital-intensive and technically complex, and above all needs a large market to produce them at internationally competitive prices. A large number of developing countries do not have a domestic market large enough to justify such an undertaking. As shown earlier, in some cases, car-making seems hardly viable, even when several developing countries pool together to form a larger common market.

Export options to circumvent the small domestic market constraint may seem equally bleak for most developing countries. A few developing countries such as the Republic of Korea and Mexico, with low labour costs, are penetrating the low-price end of the market in developed countries, particularly in the United States, replacing Japan as the traditional leader in this segment of the market and forcing it to go upmarket. The market for low-priced cars is price-sensitive, fiercely competitive and often saturated. Successful exporters of low-priced cars from developing countries usually enjoy not only large home markets, but also supportive Governments and skilled work-forces capable of applying and adapting foreign technology, along with growth experience in manufacturing other goods. Only a few countries fit that bill, perhaps the Republic of Korea, Mexico, Brazil India and Yugoslavia.

Although prospects for making its own national cars may appear dim for many developing countries, there seems to be ample room for them to find profitable niches in parts and components markets. Many good

Figure III.3. Employment impact of the automotive industry of Japan in 1986



Source: *The Automotive Industry of Japan 1988*. (Tokyo. Japanese Automobile Industry Association, 1988)

Note: Figures represent number of employees reasons can be found for pursuing a South-South complementation scheme for parts and components production. First, automotive parts and components manufacture is likely to be more labour-intensive and add higher value than many other industries, thus contributing to greater job creation and economic growth. The experience of the Republic of Korea certainly confirms this observation as shown in table III.7. The capital-intensity of parts and components manufacture, as measured by capital assets per worker, although steadily climbing from 17,320 won to 25,067 won between 1982 and 1986, was lower than that of car assembly, at slightly over one third of capital per worker used in car assembly in 1986. In fact, the capital intensity of car parts and components manufacture was lower than any other industry listed in table III.7, including machine tools and electrical and electronics industries. On the other hand, it was consistently most labour-intensive among the industries compared, while producing the highest value added to output ratio during the period. In fact, parts and components manufacture was almost three times as labour-intensive as car assembly in 1986, while it generated twice as much value added as the assembly operations. The last observation is not surprising, since many of the parts are of high value added, for instance, gearboxes or axles, where a large amount of labour is required to transform a mass of steel into a component.

It was noted in the preceding section that, as the car industry is accelerating the process of global production, prompted by falling trade barriers, advanced communications which allows companies to run globally, and intensified competition world-wide, the markets for automotive parts and components are also being globally integrated at an equally rapid pace. Components and materials usually claim the biggest share of the ex-factory cost of a car, often as much as 50-60 per cent, compared with about 20 per cent for direct labour costs and the remainder for other overheads. Given intensified competition among major world car-makers, little wonder that the business of outsourcing is also undergoing a fundamental change. National sources are no longer favoured, because of their proximity, over foreign sources. As a survival strategy to drive down production costs, the world's major car-makers are increasingly outsourcing parts and components from South-East Asian and Latin American countries, where labour costs are lower.

Today, many automotive components are being produced and traded world-wide as final products, and hence many big component manufacturers with world-wide reputations are emerging with special competence in certain areas, such as Bosch of the Federal Republic of Germany in electronics and GKN of the United Kingdom and Easton of the United States in transmissions. These component-makers are positioned to operate on a global scale like car-makers, and the global markets for components are likely to be dominated by three or four dozen big-name companies equipped with special know-how and resources to meet the global challenge of car manufacture.

It seems obvious, however, that not all the parts and components markets are easily accessible to developing countries. The manufacture of major components like engines and transmissions requires enormous capital investments and complex technology, and hence may be beyond the economic and technological reach of many developing countries. For instance, the manufacture of a gearbox may require an initial capital investment of about $500 million to design and equip a factory for production, as well as sophisticated technical know-how. It seems crucially important, therefore, to identify and concentrate on niche markets for South-South industrial co-operation, where de-

Table III.7. Production characteristics of selected industries in the Republic of Korea

Year	Item	Car assembly	Machine tools	Automotive parts and components	Electrical and electronics industry	Manufacturing
1982	Capital intensity a/	48 766.6	29 156.1	17 319.7	13 600.3	24 189.6
	Labour content b/	7.7	13.8	18.9	12.2	8.7
	Value-added ratio b/	21.7	28.7	36.6	26.4	21.1
1983	Capital intensity a/	47 649.0	39 898.8	16 693 0	15 326.1	26 347.6
	Labour content b/	9.1	13.5	15.2	11.4	8.7
	Value-added ratio b/	23.9	31.0	36.0	24.5	21.3
1984	Capital intensity a/	59 055.9	32 126.2	19 417.4	19 519.0	28 601.8
	Labour content b/	7.3	13.6	14.7	10.7	8.4
	Value-added ratio b/	24.3	28.1	31.3	21.0	21.0
1985	Capital intensity a/	65 682.7	39 155.5	20 617.2	24 186.6	31 725.0
	Labour content b/	7.1	12.7	14.7	10.2	8.5
	Value-added ratio b/	22.3	26.8	32.4	22.3	21.6
1986	Capital intensity a/	73 163.0	41 942.9	25 066.7	32 391.4	34 574.4
	Labour content b/	4.8	11.5	13.9	12.8	8.4
	Value-added ratio b/	13.7	25.1	30.1	21.5	26.9

Source: Bank of Korea, *Financial Statement Analysis*, various annual issues.

Note: Capital intensity = total assets per worker; labour content = labour cost as percentage of total cost; value-added ratio = value added as percentage of total cost.

a/ Thousands of won.

b/ Percentage.

veloping countries could expect to compete best in world markets; namely, in producing parts and components at the lowest costs without compromising the stringent quality standards of the world markets. For instance, Malaysia, equipped with probably one of the best rubber technology centres in the world, may have a comparative advantage in the manufacture of parts made from natural rubber.

One fruitful way to seek potential candidates for South-South complementation would be to take stock of parts and components which are currently being produced by developing countries, and compare their domestic prices with their import prices. Obviously, the picture varies drastically from country to country. For instance, two sets of prices are compared for spare parts manufacture in Malaysia in table III.8. Generally, local prices compare favourably with imported ones, which on the average cost three times as much as local parts. However, considerable price differentials shown here were largely attributable to the quality difference. For instance, obviously, the quality of an original Toyota exhaust-silencer is superior to a locally manufactured one. The same applies to fan belts and BBC cables. But, in other cases, such as engine mountings, oil filters, filter elements and brake-pads, the quality difference is not obvious, and hence the price differentials may be due to monopoly pricing of the imported parts.

By contrast, experience of the Republic of Korea showed the prices of domestically produced parts and components in 1976 on the average about 50 per cent higher than imported ones (table III.9). Some items, for example, water pumps, propeller shafts, coil springs, and rod assemblies cost less than imported parts and hence were cost-competitive. In fact, the bulk of parts and components listed here cost slightly higher than the imported items and hence could be potentially price-competitive if quality standards are met. The exceptions were only a few items such as metal bearings, steering and brake assemblies, alternators, spark plugs and starter motors.

Table III.10 provides another extreme case of highly-priced local parts and components made by Thai manufacturers for a typical Japanese small passenger car as compared with completely knocked-down parts evaluated at c.i.f. values sampled by the Thai Ministry of Industry. The car battery is the only item whose cost is lower than the imported one. Other parts proved to be, on the average, three times more expensive than completely knocked-down items.

These results must obviously be interpreted with great caution. Local prices compared in the above tables are not constant, but change frequently according to the expansion of production scale or the type of machine used. Also, domestic costs can be affected by a change in the import duty on raw materials and machines, or by the Government's preferential tax treatments for local production.

In general, locally produced parts and components tend to be of poorer quality and higher prices than the imported ones. The relatively inferior quality and high costs of local parts and components is largely due to small-scale production, poor technology and the general paucity of expertise. But these factors are interrelated, and pose a "catch-22" problem. For example, locally produced plastic components are inferior in quality because manufacturers use inferior machines. But, because of the low volume production, they cannot afford the relatively more expensive and sophisticated Japanese or Italian machines.

Today, parts and components which are most commonly produced by developing countries and areas, perhaps with the exception of Brazil, the Republic of Korea and Taiwan Province, are generally confined to standard components with high replacement frequency and relatively low technological requirements. They include, among others, tyres, batteries, fan belts, brake linings, carbon brushes, and exhaust systems. It would seem advisable, therefore, that the search for South-South complementation should start from this familiar domain and gradually extend toward technically more difficult items. For

Table III.8. Retail prices for selected parts of a Toyota Corolla - imported and local in Malaysia, 1975
(Dollars)

Spare parts	Retail price	
	Imported	Local
Engine mounting	21.10	4.00
Piston	214.00	145.00
Oil filter	7.25	6.80
Radiator hose (top)	13.10	5.00
Fan belt	8.95	3.00
Spark-plug (set of four)	6.60	6.00
Air-filter element	8.40	8.00
Front brake-pad (set of two)	65.75	15.00
Rear brake-pad (set of two)	40.75	8.00
Front exhaust-silencer	103.75	31.20
Rear exhaust-silencer	180.75	40.20
Speedometer cable	18.75	5.50
BBC cable (front)	32.00	6.60
BBC cable (rear)	29.00	7.00

Source: C.P. Lim and F.C. Onn, "Malaysian motor vehicle industry", in The Motor Vehicle Industry in Asia, by K. Odaka ed. (Singapore, Singapore University Press, 1983).

Table III.9 Price comparison of domestic and imported automobile parts and components in the Republic of Korea, 1976

Item	Units	Engine size (cubic centimetres)	Price (A) Domestic[a/] (won)	(B) Import[b/] (won)	A/B
Piston	4	1 250	4 200	3 167	1.33
Piston ring	12	1 250	2 000	1 244	1.61
Metal bearing	8 (pairs)	1 300	1 800	650	2.77
Water pump	1	1 250	3 000	3 114	0.96
Fuel pump	1	1 250	2 250	1 673	1.34
Radiator	1	1 300	12 000	6 750	1.78
Clutch disc assembly	1	1 250	2 500	1 901	1.32
Clutch cover assembly	1	1 250	5 000	3 186	1.57
Transmission assembly	1	1 250	96 473	72 828	1.32
Propeller shaft	1	1 250	15 000	15 103	0.99
Axle assembly	1	1 300	127 277	108 440	1.17
Wheel disc	4	1 300	11 200	6 900	1.62
Leaf spring	2	1 300	6 200	5 360	1.16
Coil spring	2	1 300	2 000	2 445	0.82
Shock absorter	2	1 250	6 000	5 464	1.10
Steering assembly	1	1 250	46 473	14 763	3.15
Tie-rod assembly		1 250	4 315	7 100	0.61
Brake assembly	1	1 250	91 723	41 842	2.19
Starter motor	1	1 250	26 900	8 221	3.27
Alternator and regulator	1	1 250	22 900	10 544	2.17
Spark-plug	4	1 300	1 100	356	3.09
Ignition	1	1 250	2 000	1 353	1.48
Wiper motor	1	1 250	9 700	7 406	1.31
Total					1.52

Source: C.K. Kim and C.H. Lee, "Ancillary firm development in the Korean automobile industry", in The Motor Vehicle Industry in Asia, K. Odaka, ed. (Singapore, Singapore University Press, 1983).

a/ Domestic price is based on delivery to assembly plants.
b/ Import price includes tariffs.

Table III.10. Cost penalty of local parts in Thailand, 1978
(Baht)

Group	Description	Part price: Completely knocked-down part (c.i.f.)	Local
Power plant	Radiator	399.5	535.0
	Coil - ignition	44.3	140.0
	Alternator	259.7	670.0
	Strap - alternator	1.2	7.0
	Bracket - alternator	17.5	35.0
	Regulator	50.8	125.0
	Cord	1.9	2.0
	Starter	251.0	690.0
General and chassis components	Battery	277.8	240.0
	Tyre set	1 798.7	2 025.0
	Silencer - main	134.7	198.0
	Silencer - pre-	127.7	140.0
	Horn electric, low-tone	25.8	75.0
Chassis indirect material	Paint and thinner	-	3 030.0
Wiring	Wiring assembly - front	283.3	386.0
Clips-chassis and body	Wiring assembly - instruments (dashboard)	23.9	27.0
	Wiring assembly - engine	26.2	46.0
	Cable - battery position	21.7	40.0
	Cable - battery earth	18.5	42.0

Group	Description	Part price: Completely knocked-down part (c.i.f.)	Part price: Local
	Wiring assembly - room lamp	10.3	16.0
	Wiring assembly - rear No. 1	158.8	151.0
	Wiring assembly - rear No. 2	44.6	73.0
Operating hardware	Motor set - wiper	122.0)	
	Cover	3.1)	350.0
	Band	0.3)	
Trim panels and soft top	Ceiling	111.8	180.0
Trim	Cushion	2.3	24.0
	Trim - centre pillar, RH	2.7)	
	Trim - centre pillar, LH	2.7)	28.0
	Trim front side, RH	6.1)	
	Trim front side, LH	6.1)	60.0
	Trim - front door, RH	30.4)	
	Trim - front door, LH	30.4)	340.0
	Trim - rear door, RH	24.8)	
	Trim - rear door, LH	24.8)	
	Trim-upper tyre house, RH	0.8)	14.0
	Trim-upper tyre house, LH	0.8)	
Seats	Seat - front, RH	762.3)	
	Seat - front, LH	761.5)	
	Rear seat cushion	347.2)	3 840.0
	Rear seat back	317.1)	
	Headrest	-	
Sealers, V strip	Screen B	5.2	
Insulator and indirect material	Screen C	2.8)	
	Screen A	1.2)	30.0
	Screen A	1.3)	
	Screen A	1.3)	
	Screen B	0.9)	
	Pad - trunk	13.4	28.0
	Pad - tyre house, RH	-)	
	Pad - tyre house, LH	-)	16.0
Glass	Glass front door, RH	71.5	190.0
	Glass front door, LH	71.5	190.0
	Glass for windshield	324.8	600.0
	Glass back door	151.3	400.0
	Glass rear door, RH	42.1	120.0
	Glass rear door, LH	42.1	120.0
	Glass quarter wind, RH	27.6	85.0
	Glass quarter wind, LH	27.6	85.0
Convenience item	Sun visor, RH	14.6	100.0
	Sun visor, LH	14.6	100.0
Accessory equipment	Tank assembly	29.9)	
	Washer - nozzle	2.0)	115.0
	Hose	1.1)	
	Auto - radio	316.5)	
	Condenser	3.4)	1 155.0
	Condenser	3.4)	

Source: S. Nawadhinakh, "Ancillary firm development in the Thai automotive industry", in The Motor Vehicle Inudstry In Asia, K. Odaka, ed. (Singapore, Singapore University Press, 1983).
Note: RH = right hand; LH = left hand.

instance, the manufacture of body parts is considered most difficult among numerous components, requiring sizeable scale economies and highly capital-intensive technology which allows little room for factor-substitution. The power train comes next to the car body in terms of manufacturing difficulties. Therefore, these items should receive low-priority consideration for co-production among developing countries, perhaps at the later stages of the complementation scheme.

2. *Selected consumer electronics and durable goods: recent trends for electronic components markets*

The consumer electronics industry is one of the most remarkable growth industries in the world. The combined consumption of electronic equipment in the six major developed countries alone (United States, Japan, Federal Republic of Germany, United Kingdom, France and Italy) is sizeable, estimated at around $408 billion in 1988, of which the United States account for about 43 per cent and Japan around 26 per cent (see figure III.4). Annual world production of electronics products, as a whole, was worth over $600 billion in 1988.

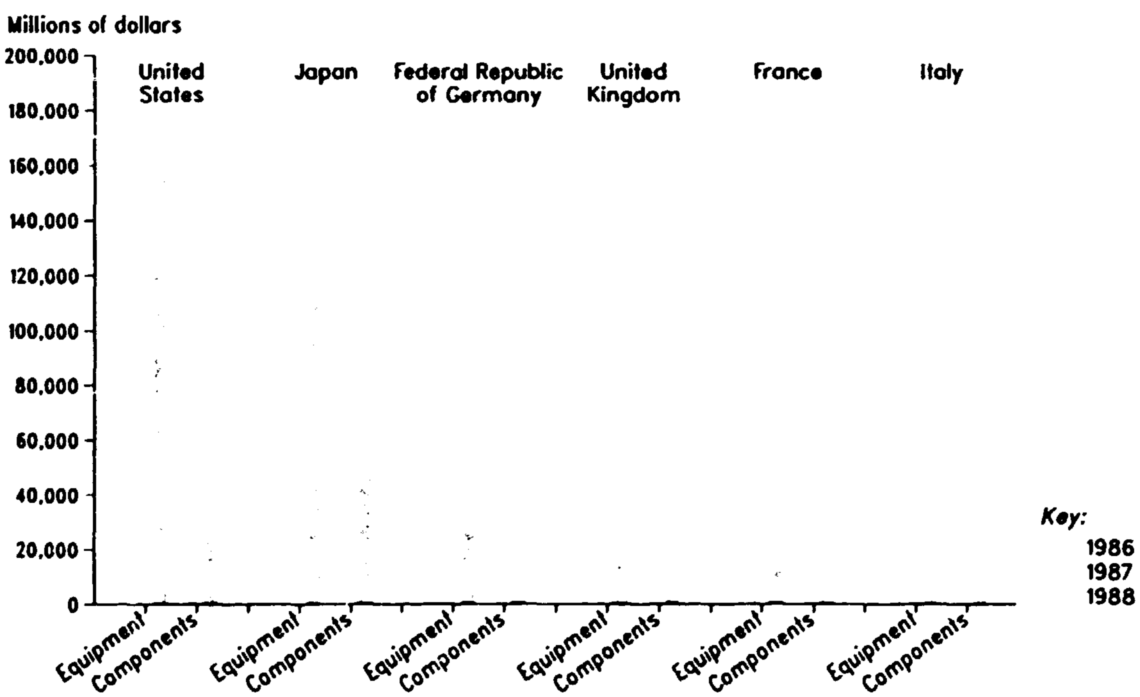
The most significant aspect of the consumer electronics industry (also designated "brown goods") is that it is critically dependent on rapid technological change and product development of another industry, namely electronic components. This is also true of the consumer appliances industry (also referred to as "white goods"), although to a somewhat lesser extent.

A substantial fall in prices of consumer electronics products and appliances, accompanied by an expansion of product ranges and considerable quality improvement, have been made possible only after costs have dropped and quality has improved in the electronic components industry.

Few industries come close to the electronic components industry in terms of the rapid pace of technological change, critical importance to industrial development and fierce competition. In particular, technological change in electronic components is one of the fastest among all industries, with product life ranging from three to five years, depending on the nature of the product. For instance, it took less than 10 years to move from 4 bits to 32 bits in the evolution of microprocessors. Rapid technological change means shorter product cycles requiring swift adjustment in design, development, production, planning and marketing.

It is not surprising to find, therefore, that most manufacturers of consumer durable goods deliberately attempt to remain separated from the manufacture of components, which is marked by continuously falling prices caused by intense competition and rapid technological change. As a result, few industries have developed stronger vertical inter-firm linkages between manufacturers of final products and their parts suppliers than consumer durable goods industries. This close relationship between manufacturers and inputs suppliers augurs well for developing a South-South industrial sub-contracting system, analogous to the automotive industry.

Figure III.4. Markets for electronic products in major developed countries, 1986-1988



Source: Electronics, January 1988

The market for electronic components is rapidly emerging in its own right as a dominant force in global industry. A combined consumption of electronic components in six major developed countries amounted to almost $90 billion in 1988 as shown in table III.11. The Japanese market for electronic components remains the world's largest at $45.5 billion, followed by the United States market at $25 billion. Among various component items, markets for semiconductors and passive and mechanical components (for example, capacitors, connectors, resistors, switches and transformers) remain the two largest markets in the six developed countries mentioned above.

As discussed earlier, the electronics industry, both parts and final products, is now undergoing rapid globalization, with transnational corporations playing an active role in this global transformation. Aggregate data are only available in a fragmentary form, and detailed data for overseas co-production of electronic components, at the enterprise level, are hard to come by. Since Japan is a pace-setter in the offshore production of electronic components as well as many other lines of electronic products, annual survey data on overseas Japanese companies, published by the Japanese Electronic Machinery Industry Association, may reveal some of the salient features of global production of electronic parts and components. Table III.12 summarizes the number of Japanese companies involved in the offshore production of various electronic components in different countries, in both developing and developed regions, and their investment motives.*

According to the results obtained from a questionnaire survey of member companies of the Japanese Electronic Machinery Industry Association conducted in October, 1986, a total of 434 Japanese enterprises were engaged in offshore production of electronics products in 38 countries. The breakdown of their activities are as follows: 170 for consumer electronics, 70 for industrial electronics and 241 for electronic parts, allowing for double-counting of companies producing more than one category of electronics products. Parts and components, therefore, represent the most important category of offshore production of Japan's electronics industry as measured by the number of companies involved.

Not surprisingly, the geographic distribution of Japanese overseas production of electronic parts and components was heavily concentrated in South-East Asia, accounting for almost 70 per cent of the total, and limited to a small number of countries and areas in that region; namely, Taiwan Province (62), the Republic of Korea (42), Singapore (30) and Malaysia (14). The only developing country that registered a

*For the name, identification and addresses of Japanese and host country companies, number of employees, capital ratios, type of relationship, amount of capital raised, market destination of products and other information, see [49].

Table III.11. Electronic components markets in six major developed countries
(Millions of dollars)

Country	Year	Passive and mechanical	Hybrid and modular	Tubes	Opto-electronic devices	Semi-conductors	Total
Japan	1986	17 481	1 440	3 199	2 157	15 753	40 030
	1987	18 337	1 560	3 206	2 325	16 424	41 852
	1988	19 006	1 680	3 288	2 629	18 905	45 508
Germany, Federal Rep. of	1986	3 529	159	752	136	2 161	6 737
	1987	3 513	163	773	132	2 005	6 586
	1988	3 577	166	801	139	2 094	6 777
United Kingdom	1986	1 968	170	450	101	1 327	4 016
	1987	2 072	189	522	108	1 487	4 378
	1988	2 187	207	559	120	1 687	4 760
France	1986	1 631	243	625	61	936	3 496
	1987	1 672	234	619	65	992	3 582
	1988	1 729	234	637	75	1 079	3 754
Italy	1986	732	23	360	40	695	1 850
	1987	781	25	370	41	702	1 919
	1988	827	28	396	44	74	2 042
United States	1986	18 498	362	2 110	306	10 915	20 970
	1987	20 023	384	2 223	341	12 810	22 630
	1988	21 895	408	2 333	384	15 221	24 636
Total	1986	43 839	2 397	7 496	2 801	31 787	77 099
	1987	46 398	2 555	7 713	3 012	34 420	80 947
	1988	49 221	2 723	8 014	3 391	39 733	87 477

Source: *Electronics*, 21 January 1988.
Note: Figures for 1988 are estimates based primarily on a questionnaire survey by *Electronics*.

Table III.12. Overseas production of electronic components of Japanese enterprises, 1987

Electronic parts

Country or area	Number of Japanese companies	1 Resistor	2 Condenser	3 Transformer (including coil)	4 Audio parts (speaker, microphone)	5 Magnetic head	6 Small motor	7 Connector	8 Switch	9 Small machine parts	10 Component parts	11 Printed circuit board	12 Magnetic tape	13 Semiconductor	14 Integrated circuit	15 Television brown tube	16 Others
Developing																	
Republic of Korea	42 (22.5)	4	11	16	4	2	1	2	6	1		1		3	3		10
China	4 (2.1)													2		1	2
Taiwan Province	62 (33.7)	7	11	16	8	6	7	5	10		1			3	1		18
Hong Kong	7 (3.7)	1	1	2			1		1								3
Thailand	2 (1.1)			1			1										1
Singapore	30 (15.6)	2	5	6	4	1	3	2	2	1	2			1	2	1	6
Malaysia	14 (7.5)	4	4	6	1	1								1	2	1	9
Philippines	2 (1.1)		1											1			
Indonesia	1 (0.5)																1
Mexico	7 (3.7)		1							1			1	1	1		3
Puerto Rico	1 (0.5)						1										
Venezuela	1 (0.5)				1												
Peru	1 (0.5)				1												
Brazil	13 (7.0)	3	4	5	1	1		2						3			4
	187 (100)	21	38	52	20	11	14	11	19	3	3	1	1	15	9	3	57
	Percentage	(7.5)	(13.6)	(18.7)	(7.2)	(4.0)	(5.0)	(4.0)	(6.8)	(1.1)	(1.1)	(0.4)	(0.4)	(5.4)	(3.2)	(1.1)	(20.5)
Developed																	
United Kingdom	6 (11.6)			1	2	1							1			1	4
Ireland	2 (3.8)													1	2		
Belgium	2 (3.8)							1									1
France	1 (1.9)												1				
Germany, Federal Republic of	7 (13.5)		2		1								1		2		4
Spain	2							1				1					
Italy	1 (1.9)												1				
Canada	2 (3.8)															1	1
United States	31 (59.7)	2	4	1	4					1	2	1	3	2	6	3	11
	54 (100)	2	6	2	7	1		2		1	2	2	7	3	10	5	21
	Percentage	(2.8)	(8.5)	(2.8)	(9.9)	(1.4)		(2.8)		(1.4)	(2.8)	(2.8)	(9.9)	(4.2)	(14.1)	(7.0)	(29.6)

Investment motives

Country or area	Number of Japanese companies	1 Cheap raw materials	2 Superior quality parts and raw materials	3 Stable supply of parts and raw materials	4 Cheap labour	5 Superior quality of labour	6 Stable supply of labour	7 Easy access to local capital	8 Easy co-operation with local capital	9 Favourable treatment of host government	10 Related parts and instruments makers are present	11 Exports from Japan difficult	12 Trade friction	13 To avoid the possibility of trade friction	14 Domestic market share assurance	15 Re-export to Japan	16 Re-export to third countries	17 Response to exchange rate problems	18 Others
Developing																			
Republic of Korea	42 (22.5)	3			25	7	5		2	12	8	2		1	13	10	6	3	2
China	4 (2.1)				3										4				
Taiwan Province	62 (33.7)	4		7	35	11	14		8	12	19	12		3	28	8	11	7	1
Hong Kong	7 (3.7)			1	1	1	1	1			1	1			5		4	2	
Thailand	2 (1.1)								1	1		2			2		1	1	
Singapore	30 (15.6)	3		3	7		2	1	1	12	14	2		1	15	1	6	4	1
Malaysia	14 (7.5)				7	2	1		2	7	1				4		9		2
Philippines	2 (1.1)	1		1	1	1	1		1								1		
Indonesia	1 (0.5)								1			1							
Mexico	7 (3.7)			2		1						1	1	2		1		1	1
Puerto Rico	1 (0.5)			1						1									1
Venezuela	1 (0.5)											1				1			
Peru	1 (0.5)													1		1			
Brazil	13 (7.0)			1	1		2			4		7			12		1		1
	187 (100)	11		16	80	23	26	2	16	49	43	29	1	8	83	22	39	18	8
	Percentage	(2.3)		(3.4)	(16.9)	(4.9)	(5.5)	(0.4)	(3.4)	(10.3)	(9.1)	(6.1)	(0.2)	(1.7)	(17.5)	(4.6)	(8.2)	(3.8)	(1.7)
Developed																			
United Kingdom	6 (11.6)				1	1	1		2	1	2	1		5	2		2		
Ireland	2 (3.8)				1								1	1					
Belgium	2 (3.8)									2				2			1		1
France	1 (1.9)					1	1								1				
Germany, Federal Republic of	7 (13.5)									2		1	1	2	5	3			3
Spain	2								1	1					1		1		1
Italy	1 (1.9)																		
Canada	2 (3.8)									1				1	1				1
United States	31 (59.7)				1	2	2			1	2	1	1	13	24		1	2	6
	54 (100)				3	4	4		3	8	4	3	3	24	35	3	5	2	12
	Percentage				(2.7)	(3.5)	(3.5)		(2.7)	(7.0)	(3.5)	(2.7)	(2.7)	(21.2)	(31.0)	(2.7)	(4.4)	(1.8)	(10.6)

Source: Japanese Electronic Machinery Industry Association, *List of Japanese Overseas Enterprises* (Tokyo, 1987).

Note: Numbers in parentheses are percentage shares.

substantial number of Japanese companies outside that region was Brazil (13). The electronic components that are most sought by Japanese companies for offshore production in developing countries were transformers (52), condensers (38), resistors (21), audio parts (20), switches (19), semiconductors (15), small motors (14), magnetic heads (11), connectors (11) and integrated circuits (9). Reasons for investment are diverse. Most prominently cited among them are domestic market assurance (83), cheap labour (80), favourable treatment of foreign direct investment by host Governments (49), the presence of related parts- and components-makers (43), possibilities for re-export to third countries (39), the difficulty of exporting from Japan (for example, the problem of protectionism) (29), stable supply of labour (26) and superior quality of labour (23). Shifts of production abroad due to the appreciation of the yen (18) received relatively minor attention. Likewise, cheap raw materials (11) and the stable supply of parts and raw materials (16) appear to be of lesser importance. Unlike developed countries, trade friction is not a major motivating factor for overseas production.

By sharp contrast, the preponderance of Japanese overseas production of electronic components in developed countries is located in the United States, 31 cases out of 54 ventures, for two main reasons, namely retention of domestic market share and the avoidance of possible trade frictions. The Federal Republic of Germany (7) and the United Kingdom (6) trail far behind the United States. Japan's co-production of components with partners in developed countries seems to be more evenly distributed among different categories, with some small concentration on a few items such as integrated circuits (10), magnetic tape (7), audio parts (7), condensers (6) and television tubes (5). As in the case of the United States, the retention of domestic market share and circumvention of possible trade frictions appear to be the most dominant factors for the decision of Japanese enterprises to produce electrical components in various developed countries. In this regard, it is worth noting that the desire to penetrate and retain a sizeable domestic components market seems to be the most important motive for Japanese overseas production in both developing and developed countries, but the similarity ends there. For instance, cheap labour and favourable treatment of foreign investment by host Governments are seen to be significant factors in Japan's investment decision in developing countries, but of little importance in developed countries. Furthermore, Japanese overseas production of components in developing countries appears to be heavily influenced by geographic proximity and industrial maturity of the host country.

One of the most remarkable developments in the global consumer electronics and consumer durables industry in recent years is the emergence of cross-border sourcing of parts and components within a global network of the same transnational corporations. Different parts are produced in different countries and shipped to various assembly points to rationalize operations and maximize profits on a global scale.

The manufacture of washing machines by Japan's Matsushita Company in Malaysia may provide a good illustration of how the shipment of parts and components within a given transnational corporation is carried out.* Washing machines are currently being assembled by a joint-venture company formed between Matsushita and a local partner in Malaysia for local consumption, re-exports to Japan and exports to third party countries. About 55 per cent of parts and components were sourced from Japan, 7.6 per cent from local sources, 18 per cent from other countries and 19 per cent in-house production. The Japanese portion of components sourcing is expected to be reduced to 22 per cent, and more will be sourced from local suppliers and other countries, particularly South-East Asian countries in 1988. The sources of procurement of major components (as of December 1987) were as follows:

Component		*Source*
1.	Maker-case (balancer attached to back of motor to regulate vibration)	Japan, but local supplies from 1988
2.	Control unit	Japanese component-maker in Japan
3.	Motor	Matsushita subsidiary in Taiwan Province
4.	Valve magnet	Japan, but to be sourced from a parts-maker affiliated to a Japanese company in the Republic of Korea from 1988
5.	Condenser	Japan, but to be sourced from a Matsushita subsidiary in Thailand from 1988
6.	Tank A	Local suppliers in Malaysia
7.	Board/outside	Local suppliers in Malaysia
8.	Autobalancer	Local suppliers in Malaysia
9.	D shaft	Japan

*This information was obtained in an interview with a senior technical adviser at the headquarters of Matsushita Company in Japan.

More importantly, most of the above components themselves are also assembled using parts outsourced from different countries, as illustrated by the example of a motor used for manufacturing washing-machines in Malaysia. The motor is assembled in Taiwan Province, using various parts and raw materials sourced from external suppliers. One of its major parts, the stator, is from Japan, which requires a special steel sheet as an input. Rotors, which are made with die-cast aluminium, are sourced from both Canada and Japan, while shafts and frames are locally manufactured in Taiwan Province, using pressed steel sheets and other steel products.

The case of washing-machine assembly in Malaysia, as illustrated above, offers an example of an industrial sub-contracting system spread widely all over the world under the umbrella operation of transnational corporations. And the trend towards the internationalization of production of consumer durables is likely to accelerate in the years to come. For instance, one of the key strategies for Matsushita's overseas production in the field of consumer electronics and durable goods is to rationalize and consolidate its overseas production of numerous parts and components scattered all over the world. More specifically, according to the plan, a network of overseas production centres will be developed, each of which will specialize in the production of specific parts and components for global markets in order to reap economies of scale and improve quality, and will ship their parts to various assembly points around the world. To this end, Matsushita plans to upgrade the management systems of its overseas subsidiaries and affiliated companies to a level comparable to that of the headquarters company in Japan, particularly focusing on the aspects of operation related to design technology, purchasing, marketing and system-wide integrated management.

The ever-increasing trend towards global production on the part of transnational corporations may have important implications for South-South industrial co-operation in the manufacture of parts and components. Given their dominant position in production, marketing and access to financial and technological resources in world markets, it would seem highly worthwhile to explore the possibilities of linking a South-South parts and components complementation scheme with a world-wide network of production and marketing of transnational corporations, particularly in the case of sophisticated components. Mutual interests may exist in this sort of North-South industrial co-operation. Transnational corporations may be able to exploit untapped potential for outsourcing cheaper parts and components from developing countries, while developing countries could take advantage of the existing global marketing networks of those corporations for their products, and could avail themselves of their expertise and experience in international sub-contracting, as well as their technology and financial resources, to upgrade product quality and improve production efficiency. The *modus operandi* for establishing a link between a South-South complementation scheme and transnational corporations may differ considerably among numerous components, depending upon production and technological characteristics of a given component, and hence must be formulated on a case-by-case basis.

Moreover, South-South industrial sub-contracting may facilitate technological diffusion throughout developing countries, as the development of domestic sub-contracting does within a national economy. Initial technological linkages may take the form either of a South-South joint venture or of technological tie-ups between developing countries at different phases of industrialization, and a more advanced developing country, and inter-firm technological diffusion may occur via several avenues such as the transfer of technological skills through "learning opportunities" provided by the training of management and workers in the supplier firms, provision of input specifications and assistance in quality control production techniques and plant layout, and even collaborative design and production. In short, it is tantamount to technological diffusion via technological co-operation among developing countries.

In sum, South-South industrial co-operation for the development of supplier industries of parts and components may be designed to achieve the following multiple objectives: the development of small- and medium-scale enterprises; a more even distribution of industrial development in the South; and technological diffusion through co-operation among developing countries.

D. Devising a South-South strategy for complementation

The problems in adapting the global, mainly Northern, experience of dispersal and sub-contracting to the South have to do with the specific strengths and weaknesses of economies with only a recent experience of industrialization. In the abstract, the micro-economics of sub-contracting are no different for the North or the South, but as the comparison of the prices of imported and home-produced components in Malaysia, Thailand and the Republic of Korea showed, a lot depends on the individual histories of the economies. At the same time, if countries are to find niches in the components market they must compete not only in price but also in quality.

1. Is the Japanese experience of sub-contracting relevant for developing economies?

One argument made frequently is that Japanese sub-contracting systems are relevant for the developing economies. Sub-contracting of components to smaller ancillary firms is extensively used by Japanese industry. An elaborate network of parts and components producers has been developed, over time, to improve both productive efficiency and product quality. In general, these parts and components producers tend to be small-scale manufacturers, employing modern technology and scientific management techniques in the modern sector. Undoubtedly, small-scale producers and industrial sub-contracting has been, and continues to be, an important source of Japan's rapid industrial growth.* In fact, recent study of Japanese sub-contracting [illegible]s suggests that rapid technological advancement [illegible] Japan has not dented the growth of sub-contracting as a principle of manufacturing organization, and, more importantly, the sub-contracting system may be responsible, in great measure, for the remarkable competitive edge that Japan continues to enjoy in world markets [51].

The relevance of the Japanese model of industrial sub-contracting to developing countries has been, however, questioned in the literature. Empirical evidence on the creation of vertical inter-firm linkages via industrial sub-contracting in developing countries seems inconclusive. Some empirical studies yielded rather disappointing results. They include, among others, Watanabe's study of the Philippines automobile industry [52], Papola and Mathur's study of Kanpur's metal products industry in India [53], and Hill's study of Philippine manufacturing ([54], pp. 245-262). Particularly, it is worth noting the main conclusion of Hill's study emerging from the 1981 survey of assemblers in the Philippine automotive and appliance industries that "... despite some increase in local content ratios and greater technology spin-offs in a few areas, the programmes have met with only limited success. Assembler-supplier sub-contracting relationships are generally weak and sporadic, and the linkages in terms of financial, raw-material, labour, and technological flows have, on the whole, been minimal ..."([54], p 259).

On the other hand, many recent studies and particularly Lall's study of the Indian trucking industry ([55], pp. 203-226) and Amsden's study of the machine tool industry in Taiwan Province ([56], pp. 271-284) have led to a rather optimistic conclusion about the potential of industrial sub-contracting in linkage creation.

The conclusions derived from Lall's in-depth study of two Indian truck manufacturing firms, Ashok Leyland, and Tata Engineering and Locomotive Company, were, among other things, that the extent of linkages between assemblers and parts and component producers seems much greater than suggested by some of the earlier studies, and that the flow of technology and information between them is stronger than commonly believed. In fact, the patterns of development of industrial sub-contracting observed in India were remarkably similar to those in the United Kingdom and United States, although the linkages are not as extensive and intense as in the earlier stages of Japanese industrialization ([55], p. 222).

Perhaps the divergent conclusions obtained from different studies may be attributable to the vastly different industrial structures of the economies investigated. For instance, Hall's study points out that weak inter-firm linkages in the Philippines may result from the fact that the Philippine industrial sector is still relatively small, and the process of backward linkage integration and the development of capital goods industries has barely begun. By contrast, both India and Taiwan Province have developed a broad industrial base with a fairly sophisticated capital goods

*For a more detailed treatment of this subject, see [50] and [51], pp. 15-23 industry. Most important of all, as underscored in the Philippine study, a small domestic market coupled with the large number of assemblers militated against the development of efficient supplier industries and strong sub-contracting networks. Again, the Philippine case poses a sharp contrast to the large domestic market in India, and the market size expanded through exports in Taiwan Province. In particular, it seems pertinent to observe one of the conclusions derived from Amsden's study on the basis of factory surveys of Taiwan Province's machine tool industry. "An increase in market size generated largely by exports had led to pronounced changes in the division of labour. A well-articulated system of sub-contracting and satellite shops has evolved, similar to that in Japan. The division of labour has increased both as between firms and within them. Some small firms have continued to produce machine tools but have begun to sub-contract a substantial portion of value added. Others have begun to devote themselves exclusively to the manufacture of parts and components for export and local industry . . . " ([56], p. 276). This leads to the question of the relationship between industrial sub-contracting and economies of scale, which is discussed in the next section.

2. *Division of labour is limited by the extent of the market*

The integration of broad segments of the population in productive activities through the creation of a large number of small firms implies specialization through the division of labour. In other words, the production process should be broken down in the ever more differentiated process of division of labour which would enable a large number of small firms to specialize in a few types of disaggregated production activities. However, the vertical disintegration of an original integrated industry into many differentiated subprocesses—that is, final assembly, subassemblies, and numerous parts and components production—would be possible only with the growth of demand for the industry's final products, as enunciated by Adam Smith in his famous observation that the division of labour is limited by the extent of the market [56, 57].

Moreover, some subprocesses, parts or components so disaggregated may require a larger minimum efficiency scale than the assembly operation of a final good for which they are produced. This is so regardless of the type of efficiency measure used, such as the break-even level of production or the unit-cost minimizing level of production. For instance, a study conducted by a Japanese automobile assembler, in the 1960s, showed a wide range of minimum monthly automobile production required for various subprocesses, as follows: 800-1,500 for assembly; 1,000-2,000 for the machine shop; 1,500-3,000 for the forging shop; 3,000-4,000 for the casting shop; and 4,000-5,000 for the press shop ([58], p. 8). It should be noted that the minimum efficiency scale critically depends on the type of equipment and technology used.

In the above case, the press shop operation requires the largest minimum efficiency scale with a monthly automobile production requirement of from 4,000 to 5,000 units, compared to only 800-1,500 units for the assembly operation.* This explains why foreign direct investment in manufacturing in developing countries usually begins with an assembly operation, and subsequently undertakes the production of parts and components in step with the increase in demand for the final product. Technology is often a lesser problem than demand. For instance, PT Honda Federal, a Thai component manufacturer of motor cycles in a joint venture with Honda Motor Company of Japan, had considerable difficulty in securing sub-contractors for simple parts such as a wire harness to meet the requirements of a local-content programme in the late 1970s. Although the technology required was quite simple, nobody was interested in the sub-contracting work because of the very small profits resulting from the small scale of production ([58], p. 50).

One way to circumvent the greater demand constraint imposed on the production of parts and components relative to assembly operations is to concentrate on those which can be standardized and made interchangeable, namely parts and components which can be fitted into different final products and different models of the same product.

Historical examples of a substantial cost reduction coupled with quality improvement resulting from specialization and standardization abound. A recent historical study of the gasoline engine and sewing machine industries in Japan by the International Development Centre of Japan lends empirical support to this idea [59]. Before the Second World War there were two different groups of manufacturers of gasoline engines for agricultural machinery in Japan. One group consisted of the large-scale manufacturers that were concentrated in Osaka and Tokyo, who produced, in-house, most of the parts and components required for assembling gasoline engines. Another group comprised small-scale assemblers in the Okayama region of Japan with an average size of less than 10 employees. Since small firms in the Okayama region were too small to produce their own parts and components, they specialized in assembly operations with all their parts and components supplied by local ancillary firms which specialized in producing a few types of parts in large volume for sale to many local assemblers. The price comparison of gasoline engines manufactured by both groups yielded a striking result. The prices of oil engines assembled by Okayama makers were about 40 per cent lower than those of comparable quality produced by the big firms. The reason for the price advantage that Okayama makers enjoyed was the procurement of their parts and components at far lower costs from various parts-makers who were

*The structure of production which prevailed in Japan in the 1960s may now be too outdated and obsolete for the Japanese industrial economy particularly owing to the rapid technical developments of the past two decades. For instance, it is quite possible in the near future that a significant portion of parts and components production at the secondary and tertiary stages of the sub-contracting systems could be replaced by in-house production at the primary firm level using the flexible manufacturing system designed for small-lot multi-product production. But notwithstanding rapid technological advances, there seems to be no sign of weakening vertical inter-firm linkages in Japanese manufacturing today. Irrespective of most recent developments in Japan, the historical example given here may be still valid for a large majority of developing countries, some of which are currently at a stage of industrial development roughly comparable to, and some at a stage of less advanced than, that of Japan in the 1960s.

producing only a few types of parts in large volume to capture economies of scale.

Post-Second World War developments in the sewing-machine industry in Japan also shed some light on the importance of specialization and standardization of parts and components production in raising productivity and improving product quality. Immediately after the War, the sewing-machine industry in Japan consisted of many small- and medium-sized firms along with about 15 large firms. The majority of either small assemblers or parts-makers, over 3,000 firms altogether including household production units, were located in the Osaka area. Since most parts-makers had to produce many different parts with different specifications in small lots, manufactured parts were costly and substandard in quality, requiring a large amount of additional work by assemblers, such as filing and grinding, when they were put together.

Confronted with this problem, the sewing-machine industry convened the Sewing-Machine Technological Conference in October 1946 to explore the possibility of standardizing the specifications for parts and components. In June 1947, The Conference drafted standard specifications for Model HA-1. More importantly, the interchangeability of standardized parts was demonstrated at the Conference, with three different models being assembled and tested with interchanged standardized parts. Subsequently, the implementation of the Conference programme for the standardization and specialization of parts production led to a dramatic improvement in product quality and production costs in the sewing-machine industry in Japan [59]. As a result, the sewing-machine industry could supply much better quality products at much lower costs than before, because by adhering to the guidelines established, many parts-makers were able to concentrate on a few lines of standardized parts such as shuttles and feed cams, which were supplied to many different assemblers at lower prices, thus realizing economies of scale. Specialization in a few kinds of parts enabled many parts-makers to simplify their production processes and produce highly accurate and reliable parts at cheaper costs. A mass production system of parts organized in this way also contributed to a significant reduction in the assembly costs.

It seems clear now that no amount of technical and financial assistance to small-scale enterprises will be effective unless the fundamental issue of market size is squarely tackled. Perhaps many of the ambitious small-scale industry development projects and programmes have failed to show tangible results because of insufficient attention given to this demand constraint.

In that connection, it should be noted that many developing countries do not have a domestic market large enough to achieve the optimal production volume for a wide array of manufacturing products. The same problem often continues to persist even when those countries pool their domestic markets to form a regional market. The following simple example aptly illustrates this point. In table III.13, the combined GDPs of two regional groupings, ASEAN and the Andean Pact, are compared with those of selected individual developed countries, both small- and medium-sized, in terms of population. In 1986, the aggregate GDP of the ASEAN countries, with a combined population of almost 300 million, was nearly $200 billion. This figure was smaller than the GDP of Spain, $230 billion, with a population of 39 million, and only about twice as large as the GDP of Austria, with a population of 7.5 million. The combined GDP of the five countries comprising the Andean group was only $125 billion, with a total population of 84 million. This is not much larger than the GDP of most small developed countries with a population of less than 8 million, such as Austria, Denmark, Finland and Switzerland. It is only by pooling their markets and dispersing production among themselves that the Southern economies can hope to speed up their industrialization.

So far, the gist of the argument has been that small-scale industry development may be best promoted by specialization through the division of labour, but the division of labour is blocked by the demand constraint.

3. *The nature and patterns of ancillary firm development*

In this study an ancillary (supplier) firm is a firm involved in production, subassembly or processing of parts and components for the assembly of a final product or replacement parts. A primary firm is a producer of finished products or an assembler.

The production of manufactured goods, and particularly durable goods, can be vertically divided into a multiple layer of discrete production stages of backward linkages. For instance, final assembly may require many different major components, each of which, in turn, requires parts and components produced through several stages of processing and subassembly operations. Conceivably, an ancillary firm can be developed for each different stage of the production process. Moreover, the backward linkages of parts and components production extend to the production of processed and semi-manufactured intermediate goods and raw materials, such as iron and steel, chemicals and feedstocks, and the manufacture of general-purpose machines and tools needed to produce parts and components and to assemble final products. At the same time, the production of a final product as well as a major component, such as a motor, generates forward linkages to a multitude of end-users.

The automobile industry may provide a good example of the hierarchical structure of parts and components production of many manufacturing branches. Some 6,000 different parts (or 30,000 if all the same nuts and bolts are counted separately) go into the manufacture of a standard passenger car. The number and types of parts and components and the kinds of raw materials used in the assembly of a car may increase rapidly as the car becomes more functionally sophisticated and technically complicated. Taking a representative car, the structure of a car can be divided into two major elements, body and chassis. These elements can be further broken down into progressively finer elements from subassemblies and major components to components and parts, as shown in the five-stage classification in table III.14.

Given the hierarchical structure of the parts and components production of a given industry, there exists a wide range of possibilities for the development of

Table III.13. A comparison of market size of ASEAN and the Andean Pact versus selected developed countries in 1986

Country or country grouping	Population (millions)	GDP (billions of dollars)	Per capita GDP (dollars)
ASEAN Countries			
Brunei	0.24	3.22	13 178
Indonesia	169.48	75.23	444
Malaysia	15.91	27.57	1 732
Philippines	55.77	30.74	551
Singapore	2.59	17.35	6 700
Thailand	52.30	41.77	799
Total ASEAN	296.29	195.88	
Andean Pact			
Bolivia	6.55	5.49	839
Colombia	29.33	33.80	1 153
Ecuador	9.65	11.13	1 154
Peru	20.21	24.54	1 214
Venezuela	17.79	49.97	1 809
Total Andean Pact	83.53	124.93	
Selected Developed Countries			
Small countries			
Australia	15.90	160.25	10 080
Austria	7.50	93.83	12 507
Belgium	9.91	112.18	11 316
Denmark	5.12	82.46	16 102
Finland	4.91	70.46	14 350
Switzerland	6.38	111.68	17 503
Large countries			
France	54.79	713.98	13 030
Spain	38.77	229.10	5 910
United Kingdom	56.36	549.70	7 754

Source: UNIDO data base.

vertical inter-firm linkages. One extreme case would be a completely integrated production process where a primary firm produces, in-house, all parts and components needed for the assembly of a product. There would be no vertical inter-firm linkages in such a case. Another opposite extreme case would be a completely disintegrated production system where numerous small supplier firms, at the base of a pyramid structure, produce a few lines of parts and components, which would be sold to the next layer of supplier firms which put them together to produce components which, in turn, would be passed on to the next higher echelon of supplier firms for further assembly operation, and so on. The Japanese industrial sub-contracting system may approximate the pyramidal form of networks of primary and ancillary firms, with a few assemblers at the top and a multitude of parts and components suppliers at the base, as depicted in table III.15. By contrast, a typical form of networks of primary and ancillary firms in a developing country may be represented by an inverted pyramid with many assemblers at the top and a small number of ancillary firms at the base. One of the major reasons for these anomalies is the paucity of ancillary firms which are capable of producing technically high-quality standard parts and components required for assembly operations ([60], pp. 145-149).

An important implication of the above analysis is that the final product usually consists of a large number of parts and components, and the process of producing them can be discrete and subject to decreasing costs or scale economies. As a result, the vertical disintegration of the discrete production process would enable many small firms to operate efficiently and hence contribute to industrial dispersion as opposed to industrial concentration, if demand for the final products assembled with the parts and components is large enough to satisfy the minimum efficiency volumes of all parts and components involved and, at the same time, a sufficiently large number of supplier firms can be technologically upgraded to produce high quality products. In the

Table III.14. Functional classification of parts and components of a standard passenger car

First stage	Second stage	Third stage[a/]	Fourth stage[a/]	Fifth stage[a/]
Engine base	Engine block	5 (cylinder head)	23 (head body)	91 (head body)
	Fuel system	3 (fuel supply)	13 (fuel tank)	22 (tank assembly)
	Cooling system	2 (cooling system)	9 (radiator)	29 (radiator)
	Electrical component	3 (charging system)	5 (starter motor)	36 (motor clutch)
Power train	Clutch system	2 (clutch control system)	8 (clutch pedal assembly)	23 (pedal)
	Transmission	3 (gear)	7 (main drive gear)	101 (bearing radial ball)
	Propeller	2 (shaft)	4 (shaft)	10 (tube assembly)
	Rear axle	3 (axle shaft)	10 (bearing shim)	39 (bearing)
Chassis	Suspension	3 (front axle frame)	11 (cross member)	41 (cross member)
	Steering	3 (steering wheel shaft)	7 (wheel assembly)	32 (wheel assembly)
	Brake	3 (brake control)	6 (master cyclinder and bracket)	16 (master brake unit)
	Wheel assembly	2 (wheel)	4 (wheel drum)	43 (wheel drum)
Body	Frame and deck	(mounting)	(engine mounting)	(insulator)
	Body shell	4 (front and rear)	23 (bonnet, panel and bracket)	73 (bonnet assembly)
Others	Interior body	5 (floor and roof)	17 (floor mat)	49 (floor front mat assembly)
	Exterior body	2 (body shell trim)	9 (bumper)	30 (front bumper assembly)
	Others	5 (battery)	13 (battery)	30 (battery)
Total 5	17	50	169	642

Source: Ministry of Industry and Commerce, Republic of Korea.
a/ Parts and components listed as examples.

Table III.15. Sub-contracting systems in the automobile industry in Thailand and Japan: number of parts- and components-makers for a representative assembler of passenger cars

Item	Thailand	Japan			Total
	First stage	First stage	Second stage	Third stage	
Engine parts	11	25	912	4 960	5 897
Electrical parts	5	..	34	352	387
Brake, clutch and steering	6	31	609	7 354	7 994
Suspension, wheel and transmission	4	18	792	6 204	7 014
Accessories	7	18	926	5 936	6 880
Chassis parts	1	3	27	85	115
Body parts	9	41	1 213	8 221	9 475
Others	12	31	924	8 591	9 546
Total	55	168	5 437	41 703	47 308
Net total[a/]	32	168	4 700	31 600	36 468
Percentage share of small- and medium-sized firms		20.5	88.5	97.5	96.0

Source: Shigemi Yahata and Junko Mizuno, The Division of Labour Between Japanese Overseas Enterprises and Local Enterprises (Tokyo, Institute of Developing Economies, 1988), table 1.6, p. 19 (In Japanese).
a/ Derived by eliminating the double counting of firms supplying more than one type of parts and components. Thailand's figures refer to 1984 and Japanese figures to 1987.

next section a detailed example is worked out to show how a complementation scheme may work in the context of South-South co-operation.

4. *Example of a parts complementation scheme for component assembly*

As numerous components arrive at a car-assembly plant tested and ready to be fitted, a modular system can be also devised for the component assembly operation. Different parts can be independently manufactured and tested by different parts manufacturers in different countries and shipped at different points of time to an assembly plant. This modular approach to a parts complementation scheme will be illustrated using an example of the assembly process for seat adjusters.

Figure III.5 describes an assembly process for seat adjusters used by a Thai automobile components manufacturer. The process described here could also be easily applied in any other developing country. The seat adjuster is a device for moving the driver's seat forward or backward to get the most comfortable position, and it is not a technically complicated device, as are many automotive components. And yet, as many as 10 different machines (numbered from 1 to 10 in figure III.5), and over a dozen different parts are needed for the assembly operation. Most importantly, this relatively simple device could be broken down to nine separate activities in which several developing countries could participate for the co-production of seat adjusters. For example, at stage I, country A could produce three parts, namely, the lower channel, holder and stopper, weld them together using a CO_2 auto-welding machine and spot welder, and send the semi-finished products to country B, at stage II, which could caulk, paint and grease them with rivets and brackets made by itself or others. Country B will need an air bender and a paint-film curing-oven for this process, and will send the finished items to the assembly plant. Meanwhile, country C, at stage III, could produce upper channels and brackets and weld and paint them, using CO_2 welding machines and a 300-tonne press before sending the end-products to the assembly plant. Similar modular activities involving the manufacture of different parts and processes all converge at the assembly point as sketched in figure III.5. The assembly operation itself is composed of five different sequential subassemblies and performance tests on various parts supplied at different points of the assembly operation.

As noted earlier, 10 different machines are required to manufacture parts needed for the assembly of seat adjusters. In the case of this particular Thai manufacturer, three of them were previously set up, and the remaining seven were imported from Japan. Two of the new machines imported were for general purposes, but the other five machines were custom-designed for small-lot production and for the most efficient process control at this particular plant. It is important to note, however, that all parts needed for the seat adjusters could be manufactured with ready-made universal machines available on the market, and hence greater cost savings could be realized if the market demand were large enough to absorb the large production volumes necessitated by the use of such general-purpose machines. But because of the small market size, more costly specialized machines designed for small-lot production were used.

The form and complexity of a parts complementation scheme may vary vastly from component to component, depending on technical sophistication, the number of parts required for the assembly and scale economies required by the manufacturers of various components. There would be no hard-and-fast rules for establishing the *modus operandi* for designing a South-South sub-contracting system, and each component should receive expert technical assessment on a case-by-case basis.

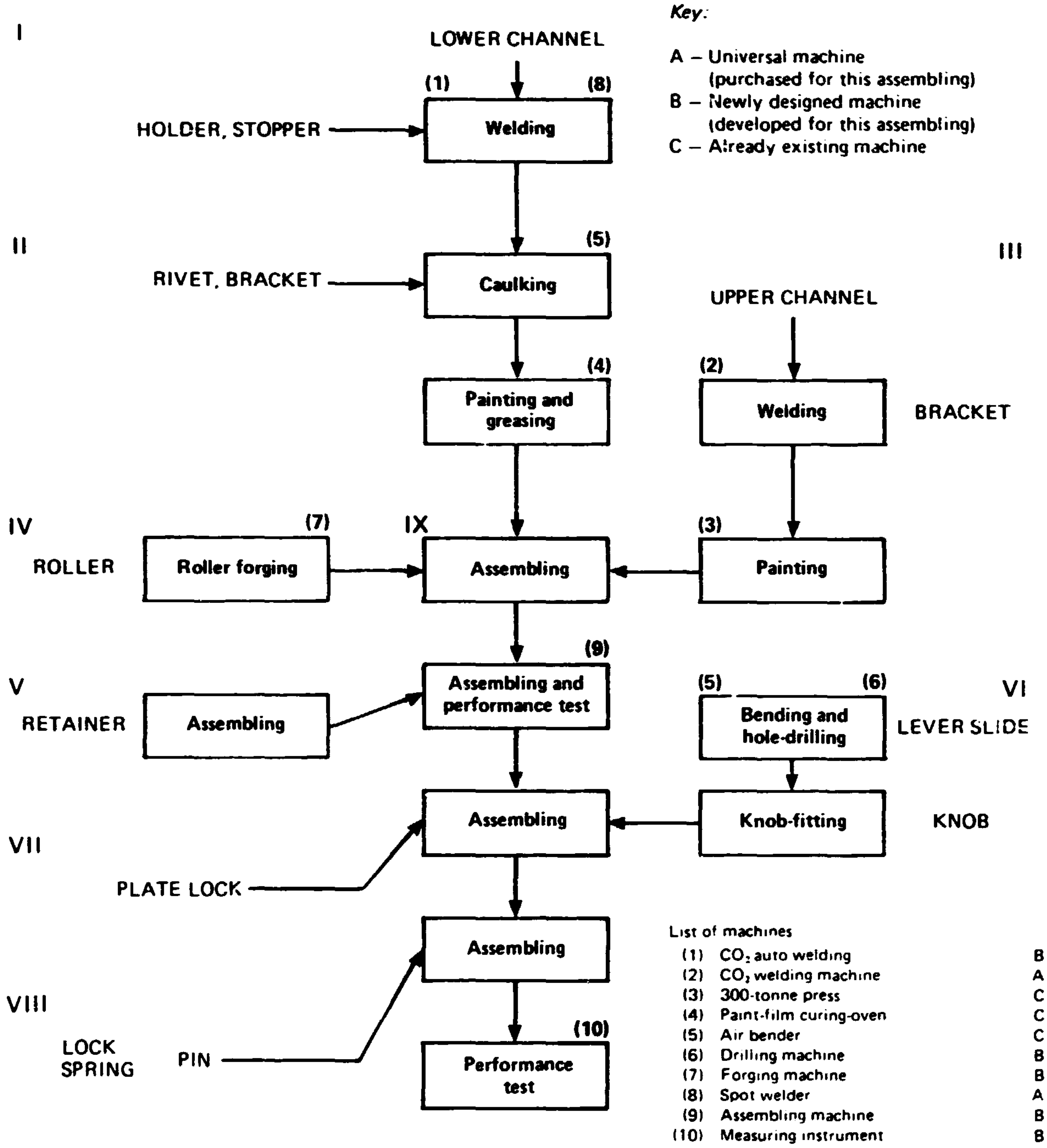
5. *Economies of scale in the production of automotive parts*

In principle, any automotive part can be manufactured anywhere and anytime if drawing and processing machines are available, and technology, no matter how sophisticated it may be, is procurable in world markets. Cost is the decisive factor for selecting parts for South-South industrial co-operation and the cost depends critically on scale economies.

In South-East Asian countries, particularly Thailand, Philippines, Malaysia and Indonesia, parts and components production have been given "pioneer status" and are "priority products", and the localization programmes for automotive parts and components have been vigorously promoted regardless of economies of scale. But this has created a general condition of over-investment and substantially increased production costs. A large part of the penalty cost of local components may be contributed by small-scale production with large excess capacities. Usually, the problem of small-scale production is aggravated by the proliferation of vehicle makes and models. For instance, an exhaust-pipe-maker in Malaysia was manufacturing 400 different items for the local market, while he needed to produce only 20 items for export to Australia. In Indonesia, there were seven motor cycle assemblers in 1979, Vespa, Honda, Yamaha, Suzuki, Bajaj, Binter and Harley Davidson, and several models for each make, for the annual total production of 300,000 units divided among the seven manufacturers. Over 45 firms were involved in supplying parts and components to the assemblers. Automobile manufacture was even worse. In 1980, there were 51 makes and 147 models with a total production capacity of about 120,000 units per year ([58], p. 255). With highly fragmented markets for parts and components, and for assembly operations as well, it is not surprising to observe a steeply rising "Branson curve" in these countries; namely, a disproportionately faster rise in the marginal penalty cost associated with each incremental percentage increase of local contents. For instance, the Automotive Institute Inc. of the Philippines estimated, in 1979, that an increase in local content from 50 to 60 per cent would result in a rising cost penalty of 23.5 per cent, and a further escalation of the cost penalty by 32.5 per cent for an increase of local content from 60 to 65 per cent, using an example of a standard 1,600 c.c. passenger car model.

As emphasized earlier, it seems essential for the viability of South-South industrial co-operation that selected components targeted for co-production should

Figure III.5. Process of assembling seat adjusters and sub-contracting of parts



Source: Automobile Division, Bangkok-Japanese Chamber of Commerce, November 1982

be produced, not only at internationally competitive prices, but also must meet the stringent quality standards exacted by world markets. This implies that each part which goes into the component assembly must also meet the twin requirements of quality and cost-competitiveness. To produce such quality parts at low prices, the following requirements, among other things, should be met: sufficient production capacity to realize economies of scale; adequate machines, tools and equipment; sufficient technological capacity; skilled manpower; and sound management. However, the scale economies associated with production volumes seem to overwhelm the importance of all other factors. As discussed earlier, large production volumes may enable manufacturers to use superior quality machines and equipment, and less costly general-purpose machines instead of more expensive customized ones for small-scale production. There are also economies of scale in management and manpower training. Moreover, large-volume production may be conducive to upgrading technological capacity and promoting research and development activities. In essence, the demand constraint that prevents manufacturers from exploiting scale economies constitutes the core of the problem and the South-South complementation scheme is a deliberate attempt to remove this constraint.

There are, however, conceptual and technical difficulties in measuring the economies of scale for a myriad of parts, and economies of scale are likely to vary vastly from part to part, even if a commonly agreed yardstick is to be used. It may be said that at the risk of oversimplification, in economic theory, economies of scale refer to a change in the total unit cost (fixed plus variable) associated with a change in the level of production. In practice, one needs to obtain detailed engineering and accounting information at the plant level on various expenditure items per unit of output such as capital charge, parts, raw materials, labour costs, other operating costs, working capital, licences, transport etc., and this unit cost information must be gathered and compared for various levels of output. Since production technology and particularly factor proportions, raw materials costs, wages and capital costs are likely to vary considerably from country to country, the economies of scale for producing any given part or component may also differ markedly among individual countries.

Unfortunately, empirical information related to the economies of scale for the manufacture of various parts and components are very difficult to come by, although such estimates for various makes and models of automobiles are available in a highly fragmented form. Most information, if available, usually provides only the minimum production volume for commercial viability instead of unit cost variations associated with output variations. For instance, such minimum efficiency scales were roughly estimated for various motor cycle components by an industry source in Indonesia in 1979, as shown in table III.16. It is

Table III.16. Estimates of scale economies for motor-cycle components in Indonesia, 1979
(Motor-cycle equivalents)

Components	Economic scale
Engine block complete	200 000
Carburettor	400 000
Air cleaner	150 000
Dynamo assembly	300 000
Kick starter lever	150 000
Gear shifting lever	150 000
Exhaust pipe	150 000
Silencer (damper)	150 000
Drive chain	300 000
Frame	150 000
Centre stand and side stand	100 000
Brake pedal	150 000
Front footrest	100 000
Rear footrest	100 000
Fuel tank	150 000
Fuel cock	150 000
Dual seat	100 000
Frame right cover	100 000
Frame left cover	150 000
Front fork	150 000
Front bumper	150 000
Handle	150 000
Brake cable	150 000
Starter cable	150 000
Rear swing arm	150 000
Chain case	150 000
Rear shock absorber	150 000
Rear bumper	150 000
Front wheel	150 000
Front axle and nut	200 000
Front panel	300 000
Rear wheel	150 000
Rear axle and nut	200 000
Chain adjuster	300 000
Rear hub panel	300 000
Tyre and tube	500 000
Battery and holder	150 000
Selenium rectifier	150 000
Headlamp	300 000
Ignition coil	200 000
Main switch	300 000
Stop switch	300 000
Tail lamp	150 000
Front winker	150 000
Rear winker	150 000
Horn	200 000
Flasher	150 000
Wire harness	100 000
Speedometer	300 000
Speedometer cable	150 000

Source: K. Odaka, ed., The Motor Vehicle Industry in Asia (Singapore, Singapore University Press, 1983), pp. 58-59.

obvious that the minimum efficiency scales for all the components listed in the table were beyond the reach of components manufacturers in Indonesia, given the annual production volume of less than 300,000 units, and the annual volume of the largest-selling make of around 100,000 units (all models) at that time.

To shed further light on the technological characteristics of production of individual parts needed for the assembly of major components, the Centre for International Co-operation and Development in Ljubljana, Yugoslavia, in collaboration with UNIDO, has collected plant-level technical and engineering data on selected automotive and consumer electronics parts and components. Automotive parts selected for study are those for engine, gearbox with clutch housing, front axle, rear axle, frame and cab for a 15-tonne truck and spin-on oil filter made for BMW.

Technical and engineering information on selected parts for the manufacture of a 15-tonne truck were obtained from Tovarna Automobilov in Motorjev (TAM), a major truck assembler in Yugoslavia, and they are summarized in table III.17. More specifically,

Table III.17. Production and technological characteristics of selected component parts for truck manufacture in Yugoslavia, 1989

No.	Name of part	Original design capacity (pieces per year)	Number of parts in final product	Percentage reduction of costs if production capacity doubled	Standardization[a/]	Interchangeability[b/]	Technological complexity[c/]	Supplier[d/]
	Engine							
1	Cylinder head	15 600	6	5	B	C	B	A
2	Cone valve	510 900	48	5	B	B	B	C
3	Spring valve	206 400	24	5	A	C	B	C
4	Housing rocker arm	42 000	12	10	C	C	B	A
5	Washer	18 023 550	133	5	A	A	C	B
6	Tappet valve	70 250	12	20	B	B	B	A
7	Ring sealing	2 713 100	24	5	A	A	C	B
8	Rocker arm	80 000	12	10	C	C	C	A
9	Bracketed rocker arm	41 050	6	5	C	C	B	A
10	Nut	6 884 700	18	5	A	A	C	B
11	Connection rod	22 100	6	20	C	C	B	A
12	Bush gudgeon pin	149 500	12	5	B	B	B	C
13	Bearing connecting pad	44 100	12	5	B	B	A	C
14	Crankshaft	1 800	1	10	C	C	B	A
15	Counterweight	17 800	8	5	B	B	C	A
16	Pin	149 100	2	5	A	A	C	B
17	Capscrew	2 084 900	16	5	A	A	C	B
18	Bushing spring	101 100	8	5	C	C	C	A
19	Plug	33 300	3	5	C	C	C	A
20	Camshaft	1 800	1	15	C	C	B	A
21	Pin, cylindrical	149 100	1	5	A	A	C	B
22	Gear	3 500	1	15	B	C	C	A
23	Injector	16 050	6	15	B	B	B	B
24	Stud cylinder head	139 100	36	10	B	B	B	A
25	Ring sealing	111 600	6	5	A	A	B	C
26	Piston	32 500	6	5	B	B	B	A
27	Cylinder	49 250	6	5	B	B	B	A
28	Oil sump	750	1	5	C	C	C	A
29	Oil dipstick	800	1	10	C	C	B	C
30	Crankcase	1 000	1	15	C	C	B	A
31	Carrier of aggregrates	3 000	1	10	C	C	B	A
32	Air-cooling blower	700	1	10	C	C	B	A
33	Stator	3 500	1	5	C	C	C	B
34	Rotor	1 800	1	5	C	C	C	B
35	Flywheel	750	1	10	C	C	C	B
36	Starter	650	1	5	B	B	C	B
	Gearbox with clutch housing							
37	Gearbox	[illegible]00	1	15	B	B	B	B
38	Clutch housing	650	1	10	C	C	C	A
39	Ball pin	1 350	1	5	C	C	C	A
40	Clutch lever	1 100	1	15	C	C	C	A
41	Circlip	107 950	1	5	A	A	B	B
42	Bearing	900	1	15	B	B	B	C
43	Washer	48 799 250	239	5	A	A	C	B
44	Cylinder	6 500	1	20	B	B	B	B

No.	Name of part	Original design capacity (pieces per year)	Number of parts in final product	Percentage reduction of costs if production capacity doubled	Standardization[a]	Interchangeability[b]	Technological complexity[c]	Supplier[d]
45	Screw	583 100	4	5	A	A	C	B
46	Protec	650	1	5	C	C	C	B
47	Joint	8 300	1	15	B	B	C	B
48	Nut	42 900	3	5	A	A	C	B
49	Handle	950	1	10	C	C	C	A
50	Flange	1 500	1	10	C	C	C	A
51	Connection	4 850	1	5	C	C	C	A
52	Gear shift rod	200	1	5	C	C	C	A
53	Supporting rod	1 050	1	10	C	C	C	A
54	Ball joint	5 931	1	5	A	A	C	A
55	Sealing cone	1 937 900	5	5	A	A	C	B
56	Reducing socket	678 550	3	5	A	A	C	B
	<u>Front axle</u>							
57	Axle	1 550	1	10	C	B	B	B
58	Axle steering	5 350	1	20	C	C	B	A
59	Bolt	4 650	4	5	C	C	C	B
60	Drum	2 500	2	10	C	B	B	B
61	Hub	3 250	2	15	C	C	C	A
62	Screw 1	162 100	20	5	B	C	B	B
63	Sealing washer	86 900	4	5	C	C	B	C
64	Ring	4 900	4	10	C	C	C	A
65	Bearing taper	229 300	4	10	A	A	A	C
66	Screw 2	3 703 250	24	5	A	A	C	B
67	Split pin	232 500	4	5	A	A	C	B
68	Nut	5 638 250	20	5	A	A	C	A
69	Brake duplex	900	1	20	C	B	B	A
70	Mechanism	23 300	4	15	C	B	B	B
71	Brake shoe	6 400	4	10	C	B	B	A
72	Rivet	16 227 100	152	5	A	A	C	C
73	Spring 1	4 850	4	5	C	C	C	B
74	Plug	10 400	8	10	C	C	C	B
75	Holder	25 750	12	10	C	B	C	A
76	Spring 2	17 950	12	5	C	C	C	B
77	Pipe	3 250	4	10	C	C	C	A
78	Breather	3 300	4	10	C	C	C	A
79	Plug	98 900	12	5	C	C	C	B
80	Ring	4 900	2	10	C	C	C	A
81	Bearing needle	134 000	8	10	A	A	A	C
82	Bushing	1 350	1	5	C	C	C	A
83	Handle steering	1 500	1	15	C	C	C	A
84	Rod connecting	1 700	1	15	C	C	C	B
	<u>Rear axle</u>							
85	Rear bridge	700	1	10	C	B	B	B
86	Bearing spring	2 750	2	5	C	C	C	A
87	Support tube	5 500	2	20	C	C	B	A
88	Flange	6 950	2	10	C	C	C	A
89	Nut 1	7 650	2	10	B	B	C	A
90	Axle shaft	1 200	2	15	C	C	B	A
91	Brake servo mechanism	650	1	20	C	B	B	A
92	Wall protective	2 350	1	5	C	C	C	A
93	Wall supporting	5 000	2	10	C	C	C	A
94	Screw	1 301 100	7	5	A	A	C	B
95	Washer	68 222 150	359	5	A	A	C	B
96	Dust cap	7 600	2	10	C	C	B	B
97	Brake shoe	10 800	4	10	C	B	B	A
98	Gear housing	3 350	1	15	C	C	B	A
99	Gear cover	3 750	1	15	C	C	B	A
100	Gear and pinion	1 350	1	20	C	B	B	A
101	Gear cone	22 450	4	15	C	C	B	A
102	Bearing taper	342 300	2	10	A	A	A	B
103	Ring	5 400	2	10	C	C	C	C
104	Sun gear	9 400	2	15	C	C	B	A
105	Guide piece	6 000	1	10	C	C	C	A
106	Cover	2 050	1	15	C	C	C	A
107	Bearing taper	736 750	2	10	A	A	A	C
108	Flange	1 250	1	10	C	C	C	A
109	Strainer	6 600	1	10	B	B	C	A
110	Nut 2	1 736 900	11	5	A	A	C	B

Table III.17 (continued)

No.	Name of part	Original design capacity (pieces per year)	Number of parts in final product	Percentage reduction of costs if production capacity doubled	Standardization[a/]	Interchangeability[b/]	Technological complexity[c/]	Supplier[d/]
	Frame							
111	Cross member	1 000	1	5	C	C	C	A
112	Angle	2 700	2	5	C	C	C	A
113	Holder 1	1 250	2	15	C	C	B	A
114	Bracket	10 450	12	5	C	C	C	B
115	Reinforcement	650	1	5	C	C	C	A
116	Nut 1	12 846 800	72	5	A	A	C	B
117	Rivet	70 800	4	5	A	A	C	B
118	Screw	171 950	4	5	A	A	C	B
119	Clamp	1 000	1	10	C	C	C	A
120	Pin	2 500	1	10	C	C	C	A
121	Trailer coupling	5 200	1	15	C	B	B	B
122	Front spring	600	2	10	C	C	B	B
123	Nut 2	150 200	6	5	A	A	C	C
124	Stirrup	2 150	2	10	C	C	C	A
125	Buffer	8 100	2	10	C	C	C	B
126	Rear spring	1 300	2	10	C	C	B	B
127	Lining 1	1 550	4	5	C	C	C	A
128	Washer	1 300	2	5	C	C	C	A
129	Lining 2	1 200	2	5	C	C	C	A
130	Nut 3	650 700	12	5	A	A	C	B
131	Rear cross member	400	1	5	C	C	C	A
132	Hinge	2 800	4	10	C	C	B	B
133	Plate supporting	2 050	2	10	C	C	C	A
134	Clamp	1 100	2	10	C	C	C	B
135	Holder 2	900	1	5	C	C	C	A
136	Cab, bracketed	950	1	10	C	C	C	B
	Cab							
137	Cab floor	350	1	15	C	C	C	A
138	Nut	3 763 450	32	5	A	A	C	B
139	Ring	2 400	2	5	C	C	C	A
140	Plate	2 250	1	5	C	C	C	A
141	Section	5 600	2	5	C	C	C	A
142	Reinforcement	22 700	12	5	C	C	C	A
143	Bushing	23 750	12	5	C	C	C	A
144	Angle	2 150	2	5	C	C	C	A
145	Screw	7 986 250	16	5	A	A	C	B
146	Bracket	4 200	4	5	C	C	C	A
147	Bearing brass	5 600	4	5	C	C	C	A
148	Slat	4 400	4	5	C	C	C	A
149	Tape	3 600	2	5	C	C	C	A
150	Rail	2 150	1	5	C	C	C	A
151	Holder	4 700	2	5	C	C	C	B
152	Pin	47 100	2	5	B	B	C	B
153	Gasket	51 700	2	5	B	B	B	B
154	Covering	2 150	1	10	C	C	C	A
155	Duct	1 250	1	5	C	C	C	A
156	Door	2 900	1	10	C	C	B	A
157	Pump	8 300	1	15	C	B	B	B
158	Brake door	850	2	10	C	C	C	B
159	Distributor	5 000	1	10	C	C	C	B
160	Sun visor	5 550	2	10	C	C	C	B

Source: Tovarna Automobilov in Motorjev (TAM), Maribor, Yugoslavia, and Centre for International Co-operation and Development, Ljubljana, Yugoslavia.

a/ Standardization: A - easy; B - difficult; C - impossible.

b/ Interchangeability: A - easy; B - difficult; C - impossible.

c/ Technological complexity: A - highly complex (only developed countries such as Germany, Federal Republic of, Japan, United Kingdom and the United States); B - intermediate (produced by relatively more industrialized developing countries such as Brazil, India, the Republic of Korea, Taiwan Province and Yugoslavia); C - simple (produced by any developing country).

d/ Suppliers: A - produced by the assembler of components; B - supplied by local subcontractors; C - imported.

table III.17 provides, for each selected part, information on production capacity, the number of parts needed for the assembly of a component, scale economies, possibility for standardization and interchangeability, technological complexity and supply sources. The following notable general observations can be inferred from the data.

First, the Yugoslavia data strongly support the argument that technology poses no major problem, but the demand constraint does. Only three out of 160 parts examined here are beyond the technological capacity of developing countries and the rest of the parts listed are well within the technological reach of most developing countries. Three imported parts are bearing connecting rods for engines, bearing tapers for front and rear axles, and bearing needles for front axles.

Secondly, the data seem to bear out our earlier observation that optimal production scales of individual parts tend to be much larger than that of a final product into which these parts go. Assuming that the originally designed production capacity approximates such an optimal scale, the production capacities of selected parts for a truck engine are calculated in terms of the number of engine equivalents from table III.17, which is the same as truck equivalents, since each truck

Table III.18. Production capacities for engine parts
(Number of truck equivalents per year)

Part	Truck equivalents
Nut	382 483
Pin, cylindrical	149 100
Washer	135 515
Capscrew	130 306
Bushing spring	126 375
Ring sealing	113 046
Pin	74 559
Ring sealing	18 600
Bush gudgeon pin	12 458
Plug	11 100
Cone valve	10 644
Spring valve	8 600
Cylinder	8 208
Bracketed rocker arm	6 842
Rocker arm	6 667
Tappet valve	5 854
Piston	5 417
Stud cylinder head	3 864
Connecting rod	3 683
Bearing connecting rod	3 675
Housing rocker arm	3 500
Stator	3 500
Gear	3 500
Carrier of aggregates	3 000
Injection	2 675
Cylinder head	2 600
Counterweight	2 225
Crankshaft	1 800
Rotor	1 800
Crankcase	1 000
Oil dip stick	800
Oil pump	750
Flywheel	750
Air-cooling blower	700
Starter	650

Source: Derived from table III.17.

needs only one engine, and arranged in the descending order in table III.18. Most striking is an immense gap between the largest and smallest production capacities, ranging from 382,483 truck equivalents for nuts to 650 truck equivalents for starters. More importantly, the bulk of the parts listed in the table requires far larger production capacities than the assembly of trucks (the actual capacity of which is undisclosed).

Thirdly, different parts showed widely divergent sensitivity to scale economies. For a hypothetical doubling of the present production capacity, the unit production cost of eight items is estimated to decrease by 20 per cent, 22 items by 15 per cent and 50 items by 10 per cent. The list of parts with a unit cost reduction of 20 per cent and 15 per cent is as follows:

Parts	*20 per cent reduction* *Components**	*Technical difficulty***
Taper valve	Engine	B
Connecting rod	Engine	B
Cylinder	Gearbox with c.h.	B
Axle steering	Front axle	B
Brake duplex	Front axle	B
Support tube	Rear axle	B
Brake servomechanism	Rear axle	B
Gear and pinion	Rear axle	B

Parts	*15 per cent reduction* *Components**	*Technical difficulty***
Camshaft	Engine	B
Gear	Engine	C
Injector	Engine	B
Crankcase	Engine	B
Gearbox	Gearbox with c.h.	B
Clutch lever	Gearbox with c.h.	C
Bluring	Gearbox with c.h.	B
Joint	Gearbox with c.h.	C
Hub	Front axle	C
Mechanism	Front axle	C
Hanule steering	Front axle	C
Connecting rod	Front axle	C
Axle shaft	Rear axle	B
Gear housing	Rear axle	B
Gear cover	Rear axle	B
Gear cone	Rear axle	B
Sun gear	Rear axle	B
Cover	Rear axle	C
Holder	Frame	B
Trailer coupling	Frame	B
Cab floor	Cab	C
Pump	Cab	B

*c.h. clutch housing.
**See Table III.17 for explanation.

Fourthly, a fairly large number of parts can be standardized and made interchangeable for different makes and models very easily, with some minor difficulty in some cases. Not surprisingly, parts with the greatest potential for standardization and interchangeability are those most commonly used for the assembly operation of cars as well as other manufactured products. The list of such commonly used parts is given below:

Most easily standardized and interchangeable parts		
Parts	Components*	Technological complexity**
Washer	Engine, gearbox with c.h. rear axle	C
Ring sealing	Engine	C
Nut	Engine, gearbox with c.h. front axle, frame, cab	C
Pin	Engine	C
Capscrew	Engine	C
Pin, cylindrical	Engine	C
Circlip,	Gearbox with c.h.	B
Screw	Gearbox with c.h. front axle, rear axle, frame, cab	C
Balljoint	Gearbox with c.h.	C
Sealing cone	Gearbox with c.h.	C
Reducing socket	Gearbox with c.h.	C
Bearing taper	Front axle, rear axle	A
Split pin	Front axle	C
Rivet	Front axle, frame	C
Bearing needle	Front axle	A

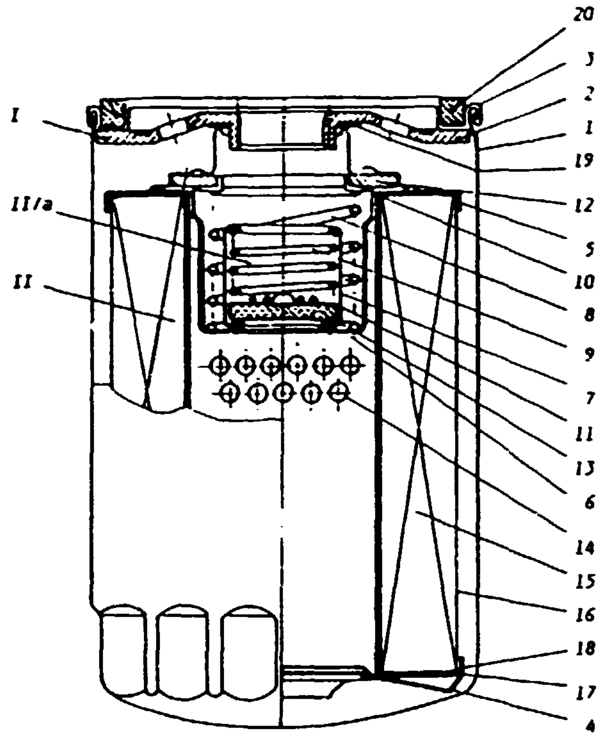
*c.h. = clutch housing.
**See table III.17 for explanation.

Lastly, about 9 per cent of a total of 160 parts examined here are imported from abroad, and the remainder are locally produced. Moreover, almost 60 per cent of all local parts are manufactured, in-house, by either the truck assembler or component-makers, and the remaining 40 per cent are supplied by local sub-contractors. This may imply that, in the case of truck manufacture, Yugoslavia is capable of producing a large proportion of required parts (90 per cent) locally, but its sub-contracting network of parts production appears to be still in its embryonic stage.

Similarly, figure III.6 and table III.19 provide detailed technical and engineering information on the manufacture of a specific automotive component, the spin-on oil filter, which is supplied to BMW in the Federal Republic of Germany by Donit Company in Yugoslavia. Donit Company is one of the largest automotive filter producers in Yugoslavia, with an annual production volume of around 3 million units. The company produces filters using its own technical know-how and many different production lines. One of the production lines is the assembly line for spin-on oil filters designed for the manufacture of smaller filters for passenger cars.

As compared with the manufacture of truck components, the actual production volume of oil filters (around 3 million per year) is sufficiently large to match the original design capacity of output for a majority bulk of parts, more precisely 14 out of 23 parts. The problem of excess capacity does not appear to be serious for the remaining parts. The potential for scale economies also seems to be much smaller than in the case of truck components, ranging between 3 and 11 per cent reduction in unit cost for doubling production capacity. But this particular result is not entirely unexpected because of the relatively small number of parts involved in the assembly of oil filters. Moreover, none of the parts

Figure III.6. Spin-on oil filter P/N 43.10.37



Key:

I and II: Main compounds
II/a: Compound
1–20: Single parts

Source: Donit, Kemicna Industrija, Medvode Yugoslavia

involved is technically difficult to make, and all of them can be standardized easily or with only minor problems. But the possibility for interchangeability is very limited for all parts. Most parts are made in-house, except for various gaskets and glue.

6. *Economies of scale in selected electronic parts and components production*

In recent years UNIDO has been active in undertaking feasibility studies on the manufacture of various electronic products and components in various developing countries. Nearly all feasibility studies invariably pointed to one important conclusion, that limited market size was a major barrier to the manufacture of electronic products and components. Because of limited space, only three case-studies will be highlighted, namely those of the Syrian Arab Republic, Tunisia and Yugoslavia, mainly from the viewpoint of scale economies required for the manufacture of selected electronic products and components.

(a) *Production of compressors in the Syrian Arab Republic*

UNIDO undertook a feasibility study of manufacturing compressors for refrigerators in the Syrian

Table III.19. Production and technological characteristics of spin-on oil filter P/N 43.10.37 manufactured in Yugoslavia, 1988

No.	Name of part	Original design capacity (pieces per year)	Number of parts in final product	Percentage reduction of costs if production capacity doubled	Standardization[a/]	Interchangeability[b/]	Technological complexity[c/]	Supplier[d/]
1.	Housing (pot)	3 000 000	1	11	C	A	C	A
2.	Disc	3 000 000	1	9	C	A	C	A
3.	Gasket retainer	3 000 000	1	9	C	A	C	A
4.	Membrane spring	3 000 000	1	9	C	A	C	A
5.	Valve and cap	3 000 000	1	9	C	A	C	A
6.	Valve housing	3 000 000	1	9	C	A	C	A
7.	Spring guide	3 000 000	1	9	C	A	C	A
8.	Spring 1	5 000 000	1	3	C	A	C	A
9.	Spring 2	5 000 000	1	3	C	A	C	A
10.	Ring 1	3 000 000	1	9	B	A	C	A
11.	Ring 2	3 000 000	1	9	B	A	C	A
12.	Gasket 1	5 000 000	1	6	C	A	B	B
13.	Gasket 2	5 000 000	1	6	C	A	B	B
14.	Centre tube	3 000 000	1	8	C	A	C	A
15.	Membrane	3 000 000	1	9	C	A	C	A
16.	Clip	3 000 000	1	2	C	A	C	A
17.	End cap	3 000 000	1	9	C	A	C	A
18.	Glue	5 000 000	-	5	B	A	B	B
19.	Inner gasket	5 000 000	1	6	C	A	B	B
20.	Outer gasket	6 000 000	1	6	C	A	B	B
21.	Single box	9 000 000	1	-	B	A	C	A
22.	Etiquette	9 000 000	1	-	B	A	C	A
23.	Bulk box	375 000	1	-	B	A	C	A

Source: Donit Kemicna Industrija, Medvode, Yugoslavia and Centre for International Co-operation and Development, Ljubljana, Yugoslavia, 1989.
Note: See table III.17 for notes.

Arab Republic in the early 1980s [61]. The study arrived at the following cost variations of scale economies among many findings (see table III.20).

The import price of a 1.6-horsepower compressor including import duty of 17 per cent was $49.14 at that time. The doubling of output is expected to reduce the per unit manufacturing cost by about 13 per cent from $51.50 to $44.83, and hence makes it attractive to undertake import substitution. Moreover, if the import duty on raw materials, $4.69 per unit, is exempted, the unit cost would be further reduced to $40.06, which appears highly competitive relative to the import price.

The crux of the problem is that although the Syrian Arab Republic already manufactures refrigerators and is technically capable of producing compressors using technology transferred from abroad, its domestic demand with a population of 12 million may not be sufficient to absorb even 250,000 compressors per year.

Even if the demand constraint is eased by exports, all cast-iron parts for the manufacture of compressors—namely, the cylinder housing, motor housing, crankshaft, connecting rod, valve plate, cylinder head and piston—would have to be imported. In addition, it would be necessary to import suction and discharge valves, as well as ceramic insulated electrical connectors, which are specialized parts produced by European compressor manufacturers. On the other hand, other parts such as motor laminations for stator and rotor,

Table III.20. Manufacturing costs of compressors
(Dollars per unit)

Item	250,000 units	500,000 units	500,000 units without import duty
Material	19.59	19.59	14.90
Labour	5.06	5.06	5.06
200 per cent overheads	10.12	10.12	10.12
10 per cent depreciation of capital	16.73	10.06	10.06
Total	51.50	44.83	40.06

Source: "Techno-economic study for production of compressors" (DP/ID/SER.A/351).

and various sheet-metal parts such as feet, suspension brackets and silencer covers, could be produced domestically without difficulty, for instance, at the Electric Motor Co. at Lattakia.

It is worth noting that to set up and operate a foundry economically to produce the seven cast iron parts mentioned above would require a minimum of 1 million units of output, a level of production which is well beyond the reach of a relatively small country like the Syrian Arab Republic. At the same time, this would seem further to strengthen the case for South-South co-operation in industrial sub-contracting.

(b) *Electronic components manufacture in Tunisia*

UNIDO recently carried out an in-depth survey of the electronics industry in Tunisia [62], including the components branch. The study covered many selected passive and mechanical parts and components, almost all of which confronted the market-size limitation with some minor exceptions. For instance, the manufacture of printed circuit boards in Tunisia was hindered by the lack of standard specifications and design rules compatible with the international standards, apart from those relating to small-scale production. Loudspeakers could be produced only with foreign technology even if the potential markets existed. Television yokes, flybacks, tuners and other related parts could be economically manufactured at output levels about three or four times the present market demand. In quartz crystals, it could be profitable to produce the custom-made type, as it is a precision and labour-intensive activity and there are many potential customers in the army, police and civil radio communications. The study ruled out, however, the feasibility of producing standard quartz used for watches, televisions and computers since the minimum efficiency output level may go beyond hundreds of millions of pieces per year. A wide range of antennas was perceived to be a potentially productive area for investment, since technology is fairly simple and less demanding in the scale economies. Transformers could also provide a technically feasible opportunity, but their weight and volume make them hardly exportable.

The study found almost all segments of semiconductors highly capital-intensive. Hence, in addition to a substantial research and development capacity, they require high-volume production to be price-competitive. These barriers proved to be insurmountable for Tunisia. Finally, the minimum size of production in cathodic tubes was estimated to be between 500,000 to 1 million units per year, which well exceeded the local market demand.

(c) *Electronic parts manufacture in Yugoslavia*

Once again, company-level technical and engineering data on various electronic components collected by the Centre for International Co-operation and Development at Ljubljana will be analysed to characterize the technological and economic dimensions of production of individual parts needed for the assembly of major components for selected consumer electronic products. The products listed below, and the components covered, are summarized in tables III.21 to III.24.

Product	*Original design capacity per year (number of units)*
Washing-machines "PS 412"	383,000
Refrigerators "HZS 203"	100,000
Colour television sets "ORBIT 916"	80,000

Table III.21. Production and technological characteristics of selected component parts for the manufacture of washing-machine model "PS 412" in Yugoslavia, 1989

Name of part	Original design capacity (pieces per year)	Number of parts in final product	Percentage reduction of costs if production capacity doubled	Standardization[a]	Interchangeability[b]	Technological complexity[c]	Supplier[d]
Assembly: washing group							
Tub supporting cross	383 000	1	15	C	C	C	B
Motor steady pin	383 000	1	15	C	C	B	A
Counterweight gasket	383 000	1	20	C	C	C	B
Driven pulley	383 000	1	0	C	C	C	B
Counterweight	383 000	1	0	A	A	C	B
Suspension leg	776 000	2	0	C	B	B	C
Drum housing	383 000	1	0	C	C	C	A
Port for water protection	383 000	1	10	C	C	C	B
Drum	383 000	1	0	C	C	C	A
Bowl gasket	383 000	1	20	C	C	C	B
Fixing element for spring	383 000	1	15	C	C	C	A
Distance ring	383 000	1	10	C	C	C	B
Suspension leg	776 000	2	20	C	B	B	C
Screw M 8x20	1 532 000	4	20	A	A	C	B
Nut M 8	3 447 000	9	20	A	A	C	B
Seeger ring	776 000	2	20	A	A	C	B

Name of part	Original design capacity (pieces per year)	Number of parts in final product	Percentage reduction of costs if production capacity doubled	Standardization[a]	Interchangeability[b]	Technological complexity[c]	Supplier[d]
<u>Assembly: drum compound</u>							
Drum housing	383 000	1	0	C	C	C	A
Fixing element for motor	383 000	1	15	C	C	C	A
Fixing element for cross support	383 000	1	15	C	C	C	A
Tub bottom	383 000	1	10	C	C	C	A
Fixing part for counterweight	776 000	2	15	C	C	C	A
Block part	383 000	1	20	C	C	C	A
Fixing element for motor	383 000	1	15	C	C	C	A
<u>Assembly: housing</u>							
Housing	383 000	1	0	C	C	B	A
Support element for tub	383 000	1	10	C	C	B	A
Lower support element	383 000	1	10	C	C	B	A
Corner	776 000	2	15	C	C	B	A
Locking rod	776 000	2	15	C	C	B	A
Protecting sheet	776 000	1	10	C	C	C	A
Cabinet	383 000	1	0	C	C	C	A
<u>Assembly: assembly sheet</u>							
Screw A 4.2x9.5	383 000	1	20	A	A	C	B
Nut M 4	383 000	1	20	A	A	C	B
Washer A 4	1 149 000	3	25	A	A	C	B
Screw M 3.5x9.5	776 000	2	20	A	A	C	B
Connector	383 000	1	5	A	A	C	B
Screw M 5x8	776 000	2	20	A	A	C	B
Timer holder	383 000	1	10	C	C	C	A
Thermal block	383 000	1	0	C	C	C	B
<u>Assembly: door compound</u>							
Doorhold glass	383 000	1	0	B	B	B	B
Fixing sheet	2 298 000	6	15	A	A	C	A
Door handle	383 000	1	10	B	B	B	A
Screw A 4.8x16	776 000	2	20	A	A	C	B
Porthole ring	383 000	1	0	C	B	C	B
Part for door handle	383 000	1	0	C	B	B	B
Handle spring	383 000	1	0	C	B	B	B
Screw 4.8x13	2 298 000	6	20	A	A	C	B
Fixing part for suspension legs (R+L)	776 000	2	15	C	C	C	A
<u>Assembly: lock system</u>							
Locking part	776 000	2	15	C	C	C	A
Pod	776 000	2	15	A	A	C	A
Distance tube	383 000	1	15	C	C	C	B
Plastic plug	776 000	2	15	C	C	C	A
Rubber grommet	776 000	2	15	B	A	B	B
<u>Assembly: other parts</u>							
Mains lead	383 000	1	10	A	A	A	C
Rubber piece	2 298 000	6	15	C	C	C	A
Protecting sheet	383 000	1	10	B	C	C	A
Bottom spring	383 000	1	20	A	A	C	A
Table top holder	776 000	2	10	C	C	C	A
Inlet hose	383 000	1	15	A	A	C	B
Pressostat	383 000	1	15	C	C	C	B
Porthole hinge	383 000	1	0	C	C	B	B
Bottom cover part	776 000	2	0	C	B	C	A
Label	383 000	1	30	C	C	C	C
Flexible mains lead	383 000	1	25	C	C	C	A

<u>Source</u>: "Gorenje" Gospondinjskiaparati, Titovo Vilenje, Yugoslavia, and Centre for International Co-[illegible] Development (CICD), Ljubljana, Yugoslavia.
<u>Notes</u>: See table III.17 for notes.

Table III.22. Production and technological characteristics of selected component parts for the manufacture of refrigerator model "HZS 203" in Yugoslavia, 1989

Name of part	Original design capacity (pieces per year)	Number of parts in final product	Percentage reduction of costs if production capacity doubled	Standardization[a/]	Interchangeability[b/]	Technological complexity[c/]	Supplier[d/]
Assembly: housing							
Interconnecting Tubing	800 000	1	25	C	C	C	B
Wall side	100 000	1	0	C	C	C	A
Backside with button	100 000	1	0	C	C	C	A
Evaporator mullion	100 000	1	0	C	C	C	A
Water drain tubing	100 000	1	5	C	C	C	A
Support of shelves	800 000	8	0	C	A	C	A
Narrow inlet	100 000	1	0	C	A	C	A
Narrow panel	100 000	1	0	C	C	C	A
Heating tube	100 000	1	0	B	C	C	B
Edge, lower	100 000	1	0	C	B	C	A
Side wall of evaporator	100 000	1	0	C	C	C	A
Bung of heating tube	100 000	1	0	C	A	C	B
Liner	100 000	1	10	C	C	C	A
Housing	100 000	1	0	C	C	C	A
Forge A 3.8x7	300 000	3	20	A	A	A	B
Insulation tube	100 000	1	10	A	A	A	B
Strengthening for hinge	200 000	2	5	C	A	C	A
Assembly: Door							
Door support	400 000	4	5	A	A	C	A
Door	100 000	1	5	C	C	C	A
Bung closing	100 000	1	5	C	A	C	A
Assembly: other parts							
Screw A 4.2x9.5	600 000	6	10	A	A	C	B
Screw 3.2x13	1 000 000	10	20	A	A	C	B
Nut M5	200 000	2	25	A	A	C	B
Washer A4	200 000	2	25	A	A	C	B
Tubing PVC (metres)	65 000	0.65	5	A	A	C	B
Screw M4x16	200 000	2	20	A	A	C	B
Nut M4	200 000	2	25	A	A	C	B
Clamp 6	400 000	4	5	A	A	C	B
Holder	100 000	1	15	A	A	C	B
Regulating foot	200 000	2	0	A	A	C	A
Glass protector	100 000	1	0	C	C	C	A
Adhesive tape "Max 10W"	100 000	1	10	A	A	C	B
Cup ice	100 000	1	0	A	A	C	A
Buffet rubber	400 000	4	0	C	C	C	B
Attacking element	400 000	4	0	A	A	B	A
Bottom spring	100 000	1	0	A	A	B	B
Main lead	100 000	1	15	A	C	B	C
Lampholder E 14	100 000	1	0	A	A	C	B
Support of compressor	100 000	1	0	C	A	C	A
Distance element	200 000	2	0	C	C	C	A
Upper hinge	100 000	1	0	C	C	C	A
Cover of hinge (upper)	100 000	1	0	C	A	C	A
Bung of hinge (lower)	100 000	1	10	A	A	C	B
Support of hinge	100 000	1	0	C	A	C	A
High foot	200 000	2	0	C	A	C	A
Holder	100 000	1	5	C	A	C	A
Lamp guard	100 000	1	0	C	A	C	A
Glass shelves	100 000	1	10	A	C	C	B
Net for shelves	200 000	2	5	A	C	C	A
Half-net for shelves	100 000	1	5	C	B	C	A
Evaporator protector	100 000	1	10	C	B	C	A
Distance element for evaporator	100 000	2	0	C	B	C	A
Process tubing	100 000	1	0	A	B	C	B
Evaporating drain pan	100 000	1	0	C	C	C	A
Leg support	100 000	2	0	C	C	C	A
Spring of vessel cover	100 000	2	0	C	A	C	B
Narrow element	100 000	1	5	C	C	C	B
Bulb E 14	100 000	1	0	A	A	C	B
Vessel for vegetables	100 000	1	10	C	A	C	A

Name of part	Original design capacity (pieces per year)	Number of parts in final product	Percentage reduction of costs if production capacity doubled	Standardization[a/]	Interchangeability[b/]	Technological complexity[c/]	Supplier[d/]
Vessel for eggs	200 000	2	10	C	A	C	A
Cover vessel	100 000	2	10	C	A	C	A
Profile of net	100 000	1	5	C	A	C	A
Thermostat button	100 000	1	15	C	A	C	A
Compressor	100 000	1	10	C	A	B	B
Name-plate	100 000	1	5	C	C	C	B

Source: Tovarna Automobilov in Motorjev (TAM), Maribor, Yugoslavia, and Centre for International Co-operation and Development, Ljubljana, Yugoslavia.
Note: See table III.17 for notes.

Table III.21 summarizes technology and production characteristics of manufacturing the washing-machine "PS 412". The original design capacity for all parts strictly conforms with that of the final product. It is difficult, therefore, to estimate excess capacities in the absence of actual demand figures for washing-machines. However, there seems to be ample scope for the scale economies in parts production. Out of a total of 63 parts listed, 17 parts are likely to gain 20 to 30 per cent unit cost reduction for the doubling of original production capacity, and 19 items, a 15 per cent reduction.

Despite considerable potential for scale economies, the majority of parts are found to be very difficult to standardize (41 parts out of 63) and also difficult to be made interchangeable (37 parts out of 63). However, all parts except a few (mains lead and suspension leg) are either technologically simple or somewhat complex. Reflecting this relative technological simplicity, almost all parts are either produced in-house or supplied by local contractors. Only four out of 63 parts are imported. It is also worth noting that 28 out of 63 parts are supplied by local sub-contractors, while 31 parts are produced in-house. This would seem to suggest that a sub-contracting system for washing-machines has taken root but not yet fully developed in Yugoslavia.

By contrast, the majority of parts used in the assembly of refrigerators shows generally weaker sensitivity to scale economies than those shown in the manufacture of washing-machines (see table III.22). Almost 85 per cent of parts, 54 out of 65 parts, showed a reduction in per-unit production cost associated with the doubling of capacity by 10 per cent or less. In fact, nearly half of them, 31 parts, show zero cost response to output variations. This many imply one of two possibilities: either the original design capacity is optimal, or a much larger capacity expansion than the doubling of output is needed for realising the scale economies. However, a small number of parts exhibited a considerable potential for scale economies, in particular the interconnecting tubing (25 per cent), forge A 3, 8x7 (20 per cent), screw 3, 2x13 (20 per cent), screw M 4x16 (20 per cent) and nut M 4 (25 per cent). These are mainly nuts, bolts and screws which are highly standardized and interchangeable for many different purposes. Although the possibilities for standardization and interchangeability of the remaining parts are relatively limited, most of them are found to be technically very simple to manufacture for any developing country. Therefore, nearly all of them are domestically produced, largely by the assemblers themselves, and to a lesser extent by local sub-contractors.

For colour television sets, the potential for scale economies in parts and components production is heavily concentrated within a narrow range of 3 to 10 per cent, except for standard items such as nuts, bolts and washers (see table III.23).

A fairly large number of parts listed in the table are shown to be very difficult to standardize or make interchangeable, although they are by and large technologically not complex to manufacture. However, the assembly of television sets seems to depend more on imported parts than the assembly of washing-machines or refrigerators.

Lastly, table III.24 summarizes production and technological characteristics of the assembly of selected television components; namely, speakers, condensers, resistors and transformers. Since the assembly of these components depends entirely on the imported parts, it was not possible to obtain the estimates of original capacity and scale economies of individual parts. A large number of these parts are found to be very difficult to standardize or make interchangeable, but none of them are beyond the reach of developing countries in terms of technological complexity.

(d) *Conclusions*

It is clear from this survey of the feasibility of components production in three economies that technological complexity is not the stumbling-block that it is often thought to be. The problem is market size. What is needed is a strategy that is both economically sensible (that is, not wasteful of resources) and technologically feasible. It is in this respect that the trend towards disintegration and dispersal points the way out for developing economies to achieve not only a decent level of industrial growth but also its dispersal across economies, and within each economy across firms.

Stated differently, the disintegration of the production process into numerous differentiated subprocesses may permit a large number of small firms to specialize in producing a few types of parts and components or subassemblies. But a large number of subassemblies, parts and components which go into the assembly of a

Table III.23. Production and technological characteristics of selected component parts for the manufacture of colour television set "ORBIT 916" in Yugoslavia, 1989

Name of part	Original design capacity (pieces per year)	Number of parts in final product	Percentage reduction of costs if production capacity doubled	Standardization[a/]	Interchangeability[b/]	Technological complexity[c/]	Supplier[d/]
Screw A 2.9x9.5	400 000	5	20	A	A	C	B
Washer 8	320 000	4	25	A	A	C	B
Distance piece	160 000	2	0	C	C	C	A
Spring	80 000	1	0	C	C	C	B
Fuse gear	320 000	4	5	C	A	C	B
Jack socket	80 000	1	15	C	C	C	C
Board assembly NE	80 000	1	10	C	C	C	B
Demagnetisation coil	80 000	1	10	C	C	C	B
Board holder	80 000	1	20	C	C	C	B
Coil 2x27 MH	80 000	1	10	A	A	C	B
Heat zinc	80 000	1	10	C	C	C	A
Release	80 000	1	10	C	A	C	B
Connector	80 000	1	10	C	C	C	C
Contact pin	2 400 000	30	10	A	A	C	B
Prevent IR	160 000	2	10	C	C	B	B
Hinge	160 000	2	10	C	C	B	C
Guide	80 000	1	10	C	C	C	A
Transparent cover	160 000	1	10	C	C	C	A
Jack cover	80 000	1	10	C	C	C	A
Rubber ring	240 000	3	10	C	C	C	B
End wall	80 000	1	10	C	C	A	A
Housing	80 000	1	5	C	C	B	A
Picture tube	80 000	1	3	A	A	A	C* B**
Chassis frame	80 000	1	10	C	C	B	A
Heat zinc F	80 000	1	10	C	C	C	A
Tuner	80 000	1	5	C	A	C	C
Small pot	80 000	1	5	C	A	C	A
Nut M 3	160 000	2	25	A	A	C	B
Capacito.· 1000 mF/16V	80 000	1	5	A	A	B	B
Connecting cable	80 000	1	5	A	A	C	B
Integrated circuit TDA 3562 A	80 000	1	3	B	A	A	C
Flat cables (metres)	240 000	3	5	B	A	B	C
3-Pole connector	80 000	1	3	B	A	B	A
Delay line	80 000	1	3	C	C	B	C
Cc.nector	320 000	4	3	B	A	C	C
Transistor BC 547	800 000	10	5	A	A	A	C
Resistor 1 k	800 000	2	5	B	A	C	C
Push button	800 000	10	5	C	A	C	C
Integrated circuit socket	160 000	2	5	A	A	C	C
Tube PVC (metres)	8 000	0.1	5	A	A	C	B
Distance holder	80 000	1	3	C	C	B	C
Coaxial connector	80 000	1	5	C	A	C	B
Resistor holder	80 000	1	5	C	C	C	B
Main transformer	80 000	1	10	C	C	C	B
Knited wire (metres)	120 000	1.5	10	C	A	C	B
Frame for Z cover	80 000	1	10	C	C	C	B
Coil peaking 5.5 MHz	80 000	1	5	C	C	B	C
Label	80 000	1	10	C	C	C	B
Angle	80 000	1	5	C	C	C	A
Membrane switch	80 000	1	5	C	C	A	B
Pin 3.6x11.5	320 000	4	5	C	C	C	C

Source: "Gorenje" Gospondinjskiaparati, Titovo Vilenje, Yugoslavia, and Centre for International Co-operation and Development, Ljubljana, Yugoslavia.

Note: See table III.17 for notes.

* - 40 per cent; ** - 60 per cent.

finished product may require, in terms of that product, a minimum efficiency scale larger than the domestic market can support. To overcome market constraints, it is proposed that developing countries as a whole or in regional groupings, should in some cases pool their markets and develop a network of supplier firms which would specialize in the production of a few types of parts and components and engage in mutual trade within the newly expanded market. In short, it represents a South-South industrial complementation scheme aimed at the promotion of small-scale industries and, more importantly, the participation in regional industrial co-operation of many small developing countries which might otherwise be relegated to the sideline of the global industrialization scene. The scheme would also provide a mechanism for promoting intra-industry trade among member countries of a regional grouping through the trading of similar, but slightly differentiated, parts and components among them.

Table III.24. Production and technological characteristics of selected components for the manufacture of colour television set "ORBIT 916" in Yugoslavia, 1989

Name of part	Number of parts in final product	Standard- ization[a/]	Interchange- ability[a/]	Technological complexity[a/]	Supplier[a/]
<u>Speaker</u>					
Membrane	1	C	C	C	C
Coil	1	C	C	C	C
Metal housing	1	C	C	C	C
Magnet	1	C	C	B	C
Connector	2	C	A	B	C
Isolating part	1	C	C	C	C
Absorber - rubber	1	C	C	C	C
Distance piece	1	A	A	B	C
Membrane	1	A	A	B	C
Core	1	A	A	B	C
Rubber	1	C	C	C	C
Connecting wire	1	A	A	C	C
Rivet	2	A	A	C	C
<u>Aluminium electronic condenser</u>					
Metal housing	1	C	C	C	C
Dielectric foil	1	C	C	C	C
Connecting wire	2	C	C	C	C
Isolating plate	1	C	C	C	C
<u>Fixed resistor</u>					
Ceramic body of resistor	1	C	C	B	C
Connecting wire	2	C	C	B	C
Resistor layer	1	C	C	B	C
Protection - paint	1	A	A	B	C
Marking	1	A	A	B	C
<u>Variable resistor</u>					
Metal part	1	C	C	B	C
Pertinax part	1	C	C	B	C
Contact	1	C	C	B	C
Resistor layer	-	C	A	B	C
Big rivet	2	A	A	B	C
Small rivet	1	A	A	C	C
Contact	2	A	B	C	C
<u>Transformer</u>					
Laminated core	30	C	C	C	C
Coil body	1	C	C	C	C
Primary winding	1	C	C	C	C
Connecting piece	2	C	C	C	C
Plastic cover	2	C	C	C	C
Secondary winding	1	C	C	C	C

<u>Source</u>: "Gorenje" Gospondinjskiaparati, Titovo Vilenje, Yugoslavia, and Centre for International Co-operation and Development, Ljubljana, Yugoslavia.
<u>Note</u>: See table III.17 for notes.

7. *General considerations for a scheme of South-South complementation*

It is clear that the development of a network of ancillary firms for the industrial complementation scheme in developing countries is constrained by both demand and supply factors, in particular market size and technology. But a limited market size appears to be ultimately a more constraining factor than technology in developing ancillary firms. In a slightly different context, the same conclusion was drawn for the development of the capital goods sector in developing countries in *Global Report 1988/89*. Although some technological barriers seem very daunting, some of the most advanced technologies are, at least in principle, procurable in the open market. Furthermore, technological leap-frogging may be possible for developing countries, for they have a far wider access to a bewildering array of new materials, sophisticated tools and machines and new engineering know-how than developed countries had at the same stage of industrialization. More importantly, the learning process could also be far more efficient today.

Many developing countries are attempting to forge ahead vigorously with their "domestic content" programmes in as many possible lines of manufacturing production as possible. But the local production of parts and components is often impeded by the limited domestic market size for final products in many developing countries. Given this demand constraint, a local content programme, which is traditionally formulated within the context of a national economy, may not be justified in many cases. It is proposed, therefore, that local content programmes, viewed from the narrow boundary of a national economy, should yield to a broader concept for localizing production within a regional grouping or, in some cases, among developing countries as a whole. Under such a South-South industrial co-operation scheme, each developing country may specialize in the production of a limited range of parts and components most suitable to its own resource endowments and technological capacity.

The next logical question for South-South industrial co-operation is how to identify a potential set of parts and components that could be targeted for such a co-operative endeavour. On the basis of the conceptual analysis of ancillary firm development presented above, the following sequential identification procedure may be suggested:

(a) A finished product or a major component considered for South-South industrial co-operation should be broken down into its constituent parts and components at the greatest disaggregation levels possible, followed by the establishment of a hierarchical structure of the multiple layers in the production process, moving up from individual parts to components and major components, to subassemblies and then final assembly;

(b) Each individual part and component so disaggregated, at the base of the hierarchical structure of production, should receive expert appraisal as to the minimum efficiency scale of production, technological difficulty, and the possibility of standardization and interchangeability of parts and components for mass production.

If the minimum efficiency scale of output required is small relative to domestic demand, such output should not be considered for South-South industrial complementation. In a similar vein, if scale economies require an output level greater than a regional market could support, that output also should be ruled out.

The elimination procedure should be applied to the remaining parts and components in the assessment of technological complexity. In other words, those parts and components whose production is clearly beyond the technological capabilities of all member countries participating in an industrial complementation scheme should be deleted from the reduced list. The word "all" emphasizes the fact that if any one member of the group is technologically capable of producing a particular part or component, the country in question may specialize in its production or assist other member countries in producing it through technology transfer and technical co-operation among developing countries. This factor takes on an added importance in view of the rapidly growing list of sophisticated parts and components that many NICs such as Brazil, India, Republic of Korea, Singapore and Taiwan Province are technologically capable of producing.

The next step would be a technical and engineering appraisal of potential for the standardization and interchangeability of parts and components, with a view to extending the scope for scale economies through mass production. The final step for South-South industrial co-operation would entail production allocation and trading arrangements among member countries for parts and components included in the final list along with the designation of an assembly point, presumably taking into account such relevant factors as resource endowment, competitive advantage and technological capabilities of each member country. In this regard, it might be useful to draw on some of the experiences of Japanese transnational corporations in developing countries, particularly in East and South-East Asia. Many of those corporations have established a division of labour across developing countries in manufacturing a wide range of electronic goods and automobiles, whereby different parts and components are produced in one country and assembled in another.

E. Summary and conclusions

For certain industries, particularly manufactured durable goods, the production process can be broken down into numerous differentiated subprocesses, and this disintegration may permit a large number of small firms to form vertical inter-firm linkages with each one specializing in a few types of parts and components or subassemblies. But a large number of subassemblies, parts and components which go into the assembly of a finished product may require, in terms of that product, a minimum efficiency scale larger than the domestic market can support. To overcome a market constraint, it is proposed that developing countries as a whole, or in regional groupings, should in some cases pool their markets and develop a network of supplier firms which would specialize in a few types of parts and components production and trade with one another within the newly expanded market.

The above proposal represents a South-South industrial complementation scheme aimed at the promotion of small-scale industries and, more importantly, the participation of many small developing countries in regional industrial co-operation which might otherwise fail to materialise. The scheme would also provide a mechanism for promoting intra-industry trade among member countries of a regional grouping through the trading of similar, but slightly differentiated, parts and components among them.

The advantages of standardization and specialization through the division of labour cannot be overemphasized. Specialization would facilitate the production of superior-quality parts with a high degree of precision, yielding fewer defective parts. Lower production costs, and hence lower prices, may result from economies of scale attained through mass production. In this regard, it would be even more useful to produce interchangeable, standardized parts; in other words, parts that can be fitted into different models and adapted to different product specifications, thus enhancing the possibility of expanding the production volume for a given demand. By contrast, the production of many different parts with different specifications by a firm is likely to be complicated, inefficient and deficient in quality and precision. The empirical evidence obtained from manufacturing plants in Yugoslavia tends to demonstrate the ample scope for standardization and interchangeability in parts production.

Many developing countries, whether large or small, would undoubtedly like to manufacture a wide range of their own final products such as automobiles and numerous consumer electronics products. But the business of making cars and video cassette recorders is very capital-intensive and technically complex, and above all needs a large market to produce them at internationally competitive prices. A large number of developing countries do not have a domestic market large enough to justify such an undertaking. For instance, car-making seems hardly viable, even when several developing countries pool together to form a larger common market.

Export options to circumvent the constraint of the small domestic market may seem equally bleak for most developing countries. Automobile markets provide a case in point. A few developing countries such as the Republic of Korea are penetrating the low-price end of the market in developed countries, particularly in the United States, replacing Japan as the traditional leader in this segment of the market and forcing that country to go upmarket. The market for low-priced cars is price-sensitive, fiercely competitive and saturated.

In consumer electronics, the markets for low-end products such as radio receivers, cassette recorders, black and white television sets, calculators, watches and some other audio equipment are also equally saturated and extremely price-competitive with very low profit margins. Currently, the Republic of Korea has a share of 33 per cent in this segment of the market, India, 13 per cent, and Taiwan Province, 10 per cent, with a shrinking world market share. On the other hand, the markets for medium- and high-end products (such as colour television sets, video tape recorders, high-fidelity equipment, home satellite receiving equipment, home automation) are still growing, but dominated by developed countries, particularly Japan, the only exception being the Republic of Korea which has a market share of 15 per cent.

Successful exporters of low-priced cars and consumer electronics products from developing countries usually enjoy not only large home markets, but also supportive Governments and skilled work-forces capable of applying and adapting foreign technology, and possessing growth experience in manufacturing other goods. Only a few countries, possibly including the Republic of Korea, Taiwan Province, Brazil, India and Yugoslavia, fit that description.

More importantly, in most developing countries the underpinning of basic and machine-tool industries for the manufacture of automobiles and other durables such as industrial and consumer electronics goods are either virtually absent or rudimentary. It would seem an enormous, if not impossible, task for any single developing country to embark on the simultaneous development of a large number of supporting industries as an alternative to importing all parts and components for assembly operations. South-South industrial co-operation could play an important role in overcoming this initial barrier. The difficult task of building up the basic supporting industries, the manufacture of required parts and process designing could be divided in a complementary manner among a group of developing countries according to the resource endowments and technological capabilities of each country. Co-operative endeavours of this sort, through co-production across national boundaries, seem essential, since basic industries such as iron and steel (including foundry, forging and casting), non-ferrous metals and chemicals are extremely capital-intensive and require sophisticated maintenance and operational technologies.

Although prospects for making their own national cars and television sets may appear dim for many developing countries, there seems to be ample room for them to find profitable niches in parts and components markets. For instance, automotive products, whether an automobile, a scooter, an engine or a transmission are composed of numerous parts and components, and therefore provide considerable scope for vertical inter-firm linkages of parts and components suppliers. Usually, a typical completely knocked-down automobile consists of about 20,000 parts, many of which involve varied production processes. Moreover, parts and components manufacture is likely to be more labour-intensive and add higher value than many other industries, thus contributing to greater job creation and economic growth.

On the other hand, as global integration of production spreads rapidly from one industry to another, markets for parts and components also become increasingly integrated globally. Parts and components supplies will be ever more diversified from wider sources, irrespective of location and national boundaries, wherever they are produced cheapest for a given acceptable quality. This implies that more and more parts and components will be produced and traded in global markets, virtually removing demand constraints. In these vastly expanded global markets, certain parts and components can be produced, exploiting fully the scale economies, as end-products, not as intermediate inputs whose production is limited by the quantity of a specific final product to be assembled in a certain location. It seems important, therefore, that South-South industrial co-operation should be targeted at the production of such globally traded components which, in turn, may permit the division of labour among developing countries in the production of numerous parts needed for the assembly of such components. In that context, the global integration of parts and components markets would certainly broaden the scope for South-South industrial complementation.

Given the accelerating trend for globalization of production and trade in parts and components industries, it seems imperative that for the viability of South-South industrial co-operation, selected components targeted for co-production should be produced, not only at internationally competitive prices, but also according to the stringent quality standards exacted by world markets. This implies that each part which goes into the component assembly must also meet the twin requirements of quality and cost-competitiveness. To produce such quality parts at low prices requires, among other things, the following: sufficient production capacity to realize economies of scale; adequate machines, tools and equipment; sufficient technological capacity; skilled manpower; and sound management.

Recognizing the importance of industrial sub-contracting as a potentially powerful instrument for industrial development and particularly the development of small- and medium-scale industries in developing countries, UNIDO has been actively engaged in the development of industrial sub-contracting systems in different regions and subregions. UNIDO projects involving member countries of ASEAN and countries in Latin America, North Africa and Western Asia have reached varying stages of formulation and implementation.

By and large, the initial focus of projects is on the establishment of national sub-contracting exchange centres, although the ultimate aim is to develop a regional network of exchange centres. The primary function of the exchange is seen as a mechanism for collecting, compiling and disseminating information on parts and component production capabilities at the enterprise level in various manufacturing branches. The status of UNIDO projects involving the above-mentioned countries will be briefly reviewed.

A. ASEAN

Studies jointly carried out by UNIDO and the Economic and Social Commission for Asia and the Pacific (ESCAP) on the promotion of supporting industries are currently being translated by UNIDO into concrete technical assistance projects in ASEAN countries. The projects in Malaysia relate to four selected areas: development of the foundry and engineering industry; development and upgrading of sub-contracting in the automotive industry; investment requirements, and support measures for the production of plastic parts and packaging; and development of supporting industries as a result of the relocation of assembly operations from Singapore to Johore.

In Singapore, a comprehensive assessment of the capabilities of supporting industries is currently under way. A survey of some 120 companies is being conducted by the Singapore Institute of Standards and Industrial Research in collaboration with the International Research and Development Centre in Canada, with a view to upgrading the technological capabilities of small- and medium-scale industries in precision engineering, plastics, food-processing and electronics. The results of this survey should prove to be of great importance to the development of supporting industries in neighbouring countries such as Indonesia and Malaysia as well as in Singapore. It is worth noting that the ASEAN-EEC Business Council programme for the promotion of joint ventures between small- and medium-scale enterprises has won support in Singapore.

In Thailand, a series of discussions between the UNIDO-ESCAP team, industry associations and individual enterprises have been held to elaborate specific proposals for the promotion of supporting industries.

B. Latin America

A UNIDO proposal for a regional programme to develop sub-contracting in Latin America has been finalized. The participating countries are Argentina, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay and Venezuela. Its primary aim is to set up a regional network of national exchange centres, to establish new exchange centres where none exists, and to upgrade existing centres to meet the requirements of regional operations.

The industries targeted for sub-contracting development are as follows: metalworking; mechanical, electrical and electronic engineering; plastics and rubber; textiles and leather; woodworking, ceramics and

However, scale economies associated with production volumes seem to overwhelm the importance of all other factors. Despite the apparently daunting nature of technological barriers, some of the most advanced technologies are, at least in principle, procurable in the open market. In addition, technological leap-frogging may be possible for developing countries, given their far greater access to a bewildering variety of new materials, sophisticated tools and machines and new engineering know-how than the developed countries had at the same stage of industrialization. The learning process could also be far more efficient today. In this regard, it is worth noting that the data received from Yugoslavia strongly support the argument that technology poses no major problem, but the demand constraint does. Only three out of 160 automobile parts examined are imported, and the rest of the parts listed are produced locally.

Large production volumes may enable manufacturers to use superior quality machines and equipment and less costly general-purpose machines instead of more expensive customized ones for small-scale production. There are also economies of scale to be made in management and manpower training. Moreover, large-volume production may be conducive to upgrading technological capabilities and promoting research and development activities. In essence, the demand constraint that prevents manufacturers from exploiting scale economies constitutes the core of the problem, and the South-South complementation scheme is a deliberate attempt to remove that constraint.

In recent years the globalization of production through transnational corporations has become increasingly evident in many industries. For instance, many Japanese transnational corporations have created a division of labour across developing countries in the manufacture of a wide range of electronic goods and automobiles, whereby different parts and components produced in one country are assembled in another. The ever-increasing trend toward global production by transnational corporations, may have important chemicals: and industrial services. such as repair and maintenance. testing and quality control. financial accounting. computer services. research and development. marketing. packaging and transport.

This programme builds on the existing sub-contracting exchanges or systems which have received UNIDO co-operation. Such co-operation has been extended to the following countries for particular projects: Mexico in 1982. project at the Ministry of Commerce and Industrial Promotion: Ecuador in 1982. project at the Centre for Industrial Development of Ecuador: Peru in 1982/83. establishment of Lima exchange: and in 1985/86. establishment of Arequipa and Trujillo exchange: Colombia in 1987/88. establishment of Bogotá exchange. and in 1989. establishment of Medellin and Cali exchange.

UNIDO has so far concentrated on the establishment of national sub-contracting exchanges. but no regional mechanism has yet been built to link separate national exchanges. The primary purpose of the new proposal is to create a regional industrial sub-contracting system by interlinking existing national exchanges and joining them with new ones built in the future.

C. *North Africa*

UNIDO is currently involved in the formulation and implementation of a project for an integrated Arab sub-contracting exchange with the initial participation of the three Maghreb countries: namely. Algeria. Morocco and Tunisia. Tunisia has already established a fully operational exchange and Algeria and Morocco are in the process of establishing national exchanges. An integrated regional network of sub-contracting completion of national exchange centres in the latter countries.

The priority industries identified for the project are mechanical engineering. electricity and plastics. All other industries will also be examined for possible inclusion. One of the salient features of the project is the computerization of all aspects of exchange operations ranging from building a data base to searching for potential buyers and suppliers and linking with other regional exchange centres.

Apart from the Maghreb project. UNIDO has been exploring the feasibility of developing a larger regional network of sub-contracting exchanges linking together not only the three Maghreb countries. but also other Arab countries: namely. Egypt. Iraq. Jordan and Syrian Arab Republic. For this purpose. in 1986 UNIDO drafted a project document containing. among other things. a co-operation agreement between the UNDP and the participating countries. It was agreed that each participating country would carry out an in-depth survey of its existing industrial capabilities. prepare or update national sub-contracting directories. construct computerized data banks and establish national sub-contracting exchanges or promotion centres.

Some of the measures considered necessary include the following: adoption and application of a common methodology for the formulation of exchange projects in all participating countries: use of a common industrial classification or nomenclature. along with a common terminology: development of common or compatible computer software: facilitating the flow of information through the exchange of national directories or resource books. interlinking of national data banks. periodic regional meetings. and specialized sub-contracting newsletters: organizing annual Arab regional sub-contracting fairs. and developing a legal basis for a regional sub-contracting network.

implications for South-South industrial co-operation in the manufacture of parts and components. Given their dominant position in production. marketing. and access to financial and technological resources in world markets. it seems highly worthwhile to explore the possibilities of linking a South-South parts and components complementation scheme with a world-wide network of production and marketing by transnational corporations. particularly in the case of sophisticated components. Mutual interests may exist in this sort of North-South industrial co-operation. Transnational corporations may be able to exploit untapped potential for outsourcing cheaper parts and components from developing countries. while the latter. in their turn. could upgrade their product quality and improve production efficiency by availing themselves of the existing global marketing networks. of the expertise and experience in international sub-contracting. and of the technology and financial resources of those corporations. The *modus operandi* for establishing a link between a South-South complementation scheme and a transnational corporation may differ considerably for different components. depending on production. technology and marketing considerations and hence must be formulated on a case-by-case basis.

PART TWO

IV. A survey of selected manufacturing industries

Nine relatively comprehensive industry surveys and four less comprehensive reviews focused on selected industries and industrial branches are presented in this chapter. Included among the nine comprehensive surveys are three high-technology industries, namely machine tools (ISIC 3823), semiconductors (ISIC 383228) and telecommunications equipment (ISIC 3832), which are of crucial importance to the development of the capital goods industry. These are followed by surveys of aluminium (ISIC 372022-372034), man-made fibres (ISIC 351), agrochemicals (ISIC 351216), and plastics (ISIC 3513), which constitute important intermediate inputs industries, and of two consumer goods industries, wearing apparel (ISIC 322) and soap and detergents (ISIC 3523).

The four relatively brief review articles cover iron and steel (ISIC 371), footwear (ISIC 324), newsprint (ISIC 341) and brewing (ISIC 3133).

In the comprehensive surveys detailed statistical information is provided on each industry to illustrate current supply and demand conditions, the trade pattern, profits and losses, production costs, capacity utilization and employment, at both country and company levels. The features of restructuring are examined using indicators of overcapacity or 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, particularly the build-up of productive capacity, financing, cash flow, profit potential and technological trends as they affect the competitive position of those countries. Finally, the short- and medium-term outlook for demand, prices, employment, trade and investment is presented, within the context of an evolving world industrial structure and a changing international division of labour.

The four review articles are more specific in their focus. The iron and steel review deals with new technological developments in this now relatively mature industry, and with its implications for the developing industry of the South. The review of the brewing industry highlights the dominance of certain major companies world-wide and the likelihood of their lead being reinforced. The review of the footwear industry concentrates on illustrating how labour costs have been instrumental in moving production sites to low-cost countries The review of the newsprint industry focuses on the possible negative impact of the looming overcapacity in the North on the South's drive toward greater self-sufficiency in this industry, which is of critical importance to the social dimension of development.

The surveys and reviews vary in scope and depth according to the availability of data, which are still obtainable in only scant quantities 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 in the following 10 points:

(a) Growth has remained strong in nearly all industries, despite fears of a slow-down in the latter part of 1989. In some of the resource-based industries, notably aluminium and plastics, capacity has been stretched to its limit, and shortages have become evident. A decline in demand is, however, expected during 1989, and by mid-year there were already signs of a deterioration in market price levels.

(b) Trends toward consolidation have been evident among the more advanced industries, particularly in high technology, as companies gear up to global competition. Thus, merger and acquisition activity has been extensive in the semiconductor and telecommunications equipment industries, and adverse economic conditions have made it necessary to consolidate in the plastics and synthetic fibres branches of the chemical industry.

(c) Manufacturing capacity in developing countries has shown differing degrees of progress in different industries. For labour-intensive production, such as that of footwear and apparel, 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 their less developed neighbours. They are now concentrating efforts on the upper end of the market. In the high-technology industries, where research and development is more important than equipment and labour costs, developing countries generally find themselves at the lower end of the market.

(d) Even in relatively sophisticated industries there is a growing tendency to sub-contract part of the production process to developing countries. In the North, for example, emphasis is on design of semiconductors, while fabrication is carried out in the South. This is not true, however, for such products as telecommunications equipment, which involve extremely technology-intensive fabrication processes.

(e) In the South, industrialization is not spreading evenly, while in the North, structural changes are occurring. For example, the expanding importance of

Japan at the expense of the United States is increasingly evident, as illustrated by developments in the semiconductor and machine tool industries. Meanwhile, the performance of NICs such as the Republic of Korea continues to exceed the average of development in the South. The Asian region generally seems to be keeping up a strong pace of development, while growth elsewhere is stagnant or even falling back. In Latin America, for example, machine tool production fell badly in 1988, although the chemical industry sustained its pace.

(f) In international trade, the United States and East Asia are of growing importance as export markets for other countries, the former because of more favourable production costs overseas and exchange rate considerations, and the latter because demand has far outstripped the capacity of local suppliers. Machine tools and plastics provide two examples of that trend.

(g) With regard to *(d)*, international sourcing of parts and components, for example in the apparel and semiconductor industries, is becoming more important to industry in the North. However, such a trend has not emerged in more technology-intensive industries, such as telecommunications equipment.

(h) A growing trend towards less government involvement and more deregulation and privatization is discernible. The telecommunications industry provides an example of the former, while in the iron and steel and plastics industries privatization of government-owned companies is occurring increasingly in both North and South.

(i) Anticipation of increasing regulation of international trade is causing companies to relocate their manufacturing activities. For example, in all industries Japanese companies are attempting to build up positions in Europe to prepare themselves for the barrier-free Single European Market of 1992. By the same token, European brewing firms and other industries have been joining together in order to take advantage of the new situation.

(j) Despite the huge strides 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, in aluminium smelting, developed countries account for 80 per cent of primary production and 97 per cent of secondary production. In man-made fibres, however, over a half of production now comes from outside the major industrialized countries, and in plastics production the centre of gravity is shifting heavily towards the South.

A. Machine tool industry (ISIC 38)*

1. Development of international machine tool markets

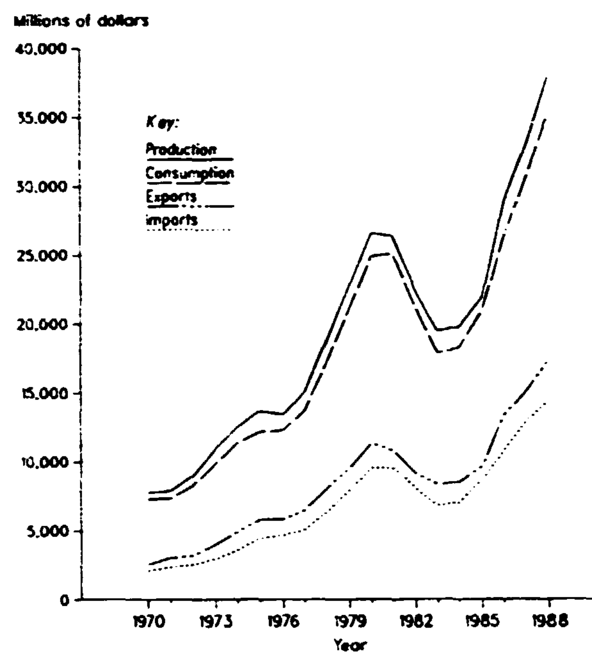
(a) *Introduction*

Machine tool consumption is frequently used as a measure of industrialization. The category includes tools used for the following purposes: cutting and forming metal; turning, boring, milling and grinding operations; and punching, pressing, bending or cutting with lasers and by electro-erosion.

The range of application extends from the manufacture of pencils and cameras to that of marine engines, cars and aeroplanes. Because of the strategic nature of the end-use industries, access to most modern machine tools is considered essential for national competitiveness.

During the past two decades world machine tool production has generally outpaced world economic growth (figure IV.1). In nominal United States dollars, production grew from 7.8 billion in 1972 to an estimated 38 billion in 1988, an average annual growth rate of 9.2 per cent.

Figure IV.1. World machine tool production, trade and consumption, 1970-1988



Source American Machinist

[a]Estimated

For a century, the United States dominated the world machine tool industry. As recently as 1967 it accounted for 34 per cent of world production and 31 per cent of consumption. The rise in importance of the USSR, Japan and the developing Asian countries has eroded this position, however, and today the United States produces only 6.4 per cent of world output and accounts for 11 per cent of consumption. Japan, by far, leads in production. Overall, developed countries still clearly dominate the industry, representing about 90 per cent of production and exports (with Eastern Europe and the USSR accounting for 20 per cent of production and 15 per cent of exports).

(b) *Production*

World production of machine tools grew in 1988 by 15 per cent, to $38 billion. As mentioned above and indicated in table IV.1, Japan is by far the world's leading producer, having overtaken the United States

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*UNIDO acknowledges the contribution of G. Habig, Verein Deutscher Werkzeugmaschinenfabriken, Frankfurt, Federal Republic of Germany, and the assistance of Joseph Jablonowski, editor of *American Machinist*, in providing valuable information and data.

Table IV.1. World production of machine tools, 1985–1988
(Millions of dollars)[a/], [b/]

Country, area or region	1988	1985	1986	1987	
1. Japan	8 643.3	5 316.7	6 872.2	6 419.4	(34.6)
2. Germany, Federal Republic of	6 833.3	3 168.6	5 185.4	6 402.6	(6.7)
3. USSR[c/]	4 500.0[d/]	3 035.8	3 672.0	3 976.3[e/]	(13.2)
4. Italy	2 803.6	1 115.5	1 623.3	2 235.2	(25.4)
5. United States	2 440.0	2 717.8	2 747.9	2 585.0	(-5.6)
6. Switzerland	1 913.6	955.2	1 423.6	1 652.4	(15.8)
7. German Dem. Republic[c/]	1 457.0	730.4	1 000.7	1 312.0	(11.0)
8. United Kingdom	1 349.3	550.1	915.4	1 058.4	(27.5)
9. France	805.8	499.3	657.2	766.1	(5.1)
10. China[c/]	731.6	341.2[d/]	363.7[e/]	632.5	(15.6)
11. Taiwan Province	695.2	278.2	366.6	577.8	(20.3)
12. Spain	673.6	252.9	396.3	575.0	(17.1)
13. Yugoslavia	671.7	239.2	390.4	515.0	(30.4)
14. Romania	657.5	324.1[e/]	307.0[e/]	617.8	(6.4)
15. Republic of Korea	597.1	175.0	333.5	530.9	(12.5)
16. Czechoslovakia[c/]	450.0[d/]	338.1	383.0[e/]	405.0[d/]	(11.1)
17. Brazil	448.9	265.0[d/]	370.0[e/]	575.5	(-22.0)
18. Poland[c/]	320.0[d/]	148.1[d/]	153.0[e/]	322.7	(-1.1)
19. Canada	290.2	199.0	209.5	244.1	(18.8)
20. Sweden	280.9	215.0	214.5	257.7	(9.0)
21. India	272.0[d/]	245.1	269.8	277.7[e/]	(-2.0)
22. Hungary[c/]	241.5	175.5	180.3	210.0	(-15.0)
23. Belgium	190.0[d/]	89.9	150.0	179.3[e/]	(6.0)
24. Austria	155.0[d/]	120.4	156.2[e/]	155.0[d/]	(0.0)
25. Bulgaria	150.0[d/]	132.6	143.2[e/]	140.0[d/]	(7.1)
26. Israel	135.0[d/]	96.0	130.0	130.0[d/]	(3.8)
27. Denmark	80.2	53.3	71.7	76.8	(4.4)
28. Australia	50.0[d/]	36.4	39.2	45.0[d/]	(11.1)
29. Netherlands	45.5	43.4	64.4	47.3	(-3.8)
30. Finland	42.7	20.0[d/]	24.5	35.3	(20.9)
31. Argentina	38.1	..	..	34.8	(9.4)
32. Singapore	37.0[d/]	34.1[e/]	34.4	35.0[e/]	(5.7)
33. Portugal	19.2[d/]	11.2	12.5	18.7[e/]	(2.7)
34. Mexico	18.0[d/]	18.0[d/]	16.5	21.4[e/]	(-15.8)
35. South Africa	9.7	28.5[e/]	11.0	12.3	(-21.1)
36. Hong Kong	1.5[d/]	1.3[d/]	1.3	1.4[e/]	(7.1)
Total	38 047.4	21 970.8	28 890.6	33 081.5	(15.0)
North America	2 730.2	2 916.8 (- 6.3)	2 957.4 (-7.6)	2 829.1	(-3.4)
Western Europe	15 327.7	7 190.8 (113.2)	11 024.9 (39.0)	13 589.8	(12.7)
Eastern Europe and USSR	8 447.7	5 123.8 (64.9)	6 230.1 (35.6)	7 498.8	(12.6)
Latin America	505.0	283.0 (78.4)	386.5 (30.6)	631.7	(-20.1)
Asia	10 977.7	6 391.6 (71.7)	8 241.5 (33.2)	8 474.7	(29.5)
Others	59.7	64.9 (-8.0)	50.2 (18.9)	57.3	(4.2)
Total North (excluding centrally planned economies)[c/]	26 625.9	15 393.2 (73.0)	20 774.5 (28)	22 765.6	(16.9)
Total South (excluding centrally planned economies)[c/]	2 242.8	1 112.7 (101.6)	1 522.1 (47)	2 184.5	(2.6)
Total world	38 047.4	21 970.8 (73.2)	28 890.6 (31.7)	33 081.5	(15.0)

Source: American Machinist.

Notes: Figures within parentheses represent percentage change between the production level in the year concerned and that of 1988. Whenever possible, data includes machine tools only; it does not include parts and attachments.

a/ Free market currencies have been converted at current rates for the period covered.

b/ Controlled currencies have been converted as follows: Eastern Europe and USSR, Bulgaria, Czechoslovakia, Poland and China at 70 per cent of the official rate; and German Democratic Republic at 65 per cent of the rate of the Federal Republic of Germany.

c/ Countries with controlled currency whose official rate may not represent real value.

d/ Rough estimate from fragmentary data.

e/ Unrevised.

in the early part of the decade. Japan reinforced its lead in 1988 with a 34.6 per cent increase in output to reach $8.6 billion. This represents 22.7 per cent of world production (table IV.2), showing a slight decline since 1985, when Japan held 24.2 per cent of overall output, but a strong advance overall since 1980, when it produced only 14.3 per cent of the world total. The Federal Republic of Germany maintained its second position, with output of $6.8 billion, showing 6.7 per cent production growth and recovering market share lost in the early 1980s. That country produces 18 per cent of world machine tool output.

The USSR remained the world's third largest producer, making machine tools to the value of $4.5 billion, a 13.2 per cent growth on the previous year and 11.8 per cent of the world total. Together, the USSR, Japan and Federal Republic of Germany, accounted for more than a half (52.4 per cent) of total world production of machine tools in 1988.

The United States slipped back into fifth place behind Italy, which showed a strong 25 per cent increase. Output in the United States declined by 5.6 per cent and that country, as already mentioned, now accounts for just 6.4 per cent of world production, a steady decline from 17.9 per cent at the beginning of the decade. Switzerland, the German Democratic Republic and the United Kingdom all showed strong growth in production of machine tools last year. Notably, output in the United Kingdom grew by 27.5 per cent. Production growth in France, at 5.1 per cent, was not as strong as consumption growth. China, which is the tenth-largest producer, showed an increase in output of 15.6 per cent in 1988, slightly increasing its share in world production from 1.5 per cent in 1985 to 1.9 per cent.

On a regional basis, both North America and Latin America showed an overall decline in machine tool production in 1988, although Western Europe and Eastern Europe and the USSR moved ahead strongly at a roughly equal pace of some 12 per cent. Asian machine tool output grew 29.5 per cent, largely helped by the increase in Japan (see figure IV.2). Western Europe was the largest producer, with 40 per cent of world output in 1988. Production in total grew by 12.7 per cent, with growth in all countries except the Netherlands. Countries outside the EEC were particularly successful. Italy and Switzerland were able to increase their market shares slightly, while the United Kingdom and particularly France lost ground during the 1980s. The development of the machine tool industry in Spain is worth noting, as the country increased its world market share from 1.1 per cent in 1970 to 1.3 per cent in 1980 and to 1.8 per cent in 1988.

In Eastern Europe and the USSR, production growth was strong in most countries, contributing to an overall increase of 12.6 per cent and a share in world production of 22.2 per cent. Poland, however, saw a decline of 1.1 per cent. Growth was strongest in Yugoslavia, where it rose by 30.4 per cent.

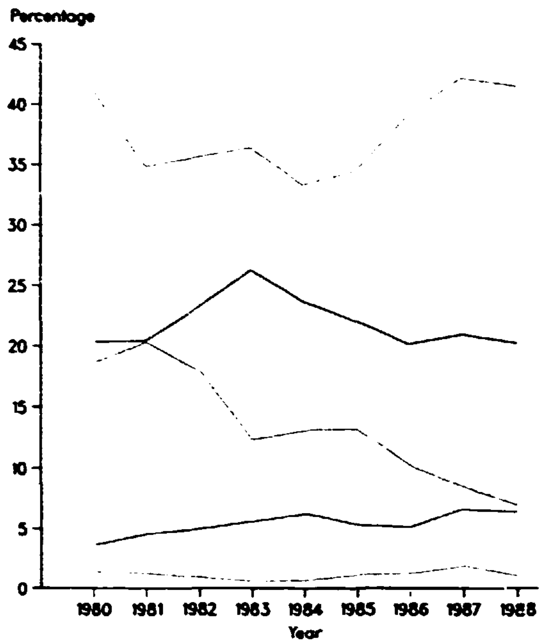
Output in Asia represented 28.8 per cent of world production, about 10 percentage points higher than in

Table IV.2. Country and regional production of machine tools, 1980, 1985 and 1988
(Millions of dollars)

Country or region	1988		1985		1980	
	Production	Percentage share	Production	Percentage share	Production	Percentage share
Japan	8 643.3	22.7	5 316.7	24.2	3 826.1	14.3
Germany, Federal Republic of	6 833.3	17.9	3 168.6	14.4	4 707.6	17.5
USSR	4 500.0	11.8	3 053.8	13.8	3 065	11.4
Italy	2 803.6	7.4	1 115.5	5.1	1 728.1	6.5
United States	2 440.0	6.4	2 717.8	12.3	4 812.3	17.9
Switzerland	1 913.6	3.8	955.2	4.3	994.1	3.7
German Dem Rep.	1 457.0	3.5	730.4	3.3	891.5	3.3
United Kingdom	1 349.3	2.1	550.1	2.3	1 395.8	3.5
France	805.8	1.9	499.3	1.5	953.9	1.3
China	731.6	1.9	341.2	1.55	420	1.55
North America	2 730.2	7.2	2 916.8	13.3	5 006.1	18.7
Western Europe	15 327.7	40.3	7 190.8	32.7	10 800.5	40.3
Eastern Europe and USSR	8 447.7	22.2	5 123.8	23.3	5 679.1	21.2
Latin America	505.0	1.3	283.0	1.3	386.4	1.4
Asia	10 977.7	28.8	6 391.6	29.1	4 828.4	18.3
Others	59.7	0.15	64.9	0.29	47.6	0.17
Total North a/	26 625.9	69.9	15 393.2	7.0	19 680.3	72.9
Total South a/	2 242.8	5.9	1 112.7	5.1	968.7	3.6
Total world	38 048.0	100	21 970.9	100	26 970.9	100

Source: American Machinist.
a/ Excluding centrally planned economies.

Figure IV.2. World machine tool production by region, 1980-1988.



Key:
Western Europe
EEC
CMEA
Other Western Europe
North America
Latin America
Japan
Other Asia

Source *American Machinist*
Note The 1988 figures are estimates

1980. This is largely due to the contribution of Japan, which, as mentioned above, saw a growth of 34.6 per cent. The share of other Asian countries, excluding Japan, has risen to 6.1 per cent of the world total, from 3.7 per cent at the beginning of the decade. The Republic of Korea increased production by 12.5 per cent to $597 million, but this represents a considerable slowing in production growth from 58 per cent and 90 per cent in the previous two years. In total, the Republic of Korea has increased production by 342 per cent since 1980 and 241 per cent since 1985. Taiwan Province saw production grow by 20.3 per cent to $695.2 million, but India saw a 2 per cent decline. Currently, Taiwan Province, the Republic of Korea and China each holds a world market share in the range of 1.6 to 1.9 per cent; this figure was under 0.5 per cent in the early 1970s.

Production overall declined for Latin America in 1988, down by 20 per cent from that of the previous year. This is in sharp contrast to an increase in earlier years, demonstrated by a 71.7 per cent overall rise in production between 1985 and 1988. Output in Brazil was down by 22 per cent to $448.9 million and in Mexico by 15.8 per cent to $18 million. In Argentina, output rose by 9.4 per cent to $38.1 million.

In total, the North saw a 16.9 per cent increase in production of machine tools in 1988, against just 2.6 per cent for the South, excluding centrally planned economies. The strong production growth in Taiwan Province (20.3 per cent) and more modest advance in the Republic of Korea (12.5 per cent) were the main factors in helping the South achieve a slight gain. The share of the North in production is 69.9 per cent and that of the South, 5.9 per cent, leaving the other 24.1 per cent to the centrally planned economies.

(c) *Consumption*

Total world consumption of machine tools in 1988 increased by 14 per cent to $35.2 billion (see table IV.3). The USSR continued to be the leading consumer, absorbing an estimated $5.99 billion, or some 17 per cent of the world total. Consumption increased by 13 per cent over that of 1987. This increase was dwarfed, however, by the 56 per cent rise in consumption in Japan, lifting it to a close second in the list of world machine tool users. In third place, the United States saw its consumption of machine tools decline by nearly 3 per cent to $3.85 billion. That country's share in world consumption has been steadily eroded, as mentioned above, having declined from 21 per cent in 1980 to 10.9 per cent in 1988. In fourth place, the Federal Republic of Germany saw its consumption decline by 4 per cent to $3.84 billion. That country's share in world consumption is similar in size to that of the United States and has remained constant during the decade.

In contrast to its European neighbours, Italy's consumption of machine tools jumped by 24 per cent to $2.2 billion, taking it above that of the United Kingdom, even though the latter rose by a similarly large magnitude, up 31 per cent to $1.42 billion. As table IV.3 shows, these countries lie fifth and sixth in world machine tool consumption.

Moving down the list, France, China and the Republic of Korea all saw increases in consumption of between 11 and 13 per cent. The latter two have shown strong growth throughout the 1980s, with China increasing consumption by 170 per cent since 1980 and the Republic of Korea by 145 per cent. Canada lies tenth in the list of world consumers of machine tools, increasing use by 33 per cent in 1988, in stark contrast to its neighbour, the United States. This is in line with the steady growth shown by Canada throughout the decade. Consumption has increased by 74 per cent since 1980. Spain and Switzerland both achieved growth in consumption of 20 per cent in 1988. Romania's output was steady, pushing it back two places in the production league behind Spain and Switzerland.

Taiwan Province saw a 43 per cent rise in consumption of machine tools, lifting it well up the table of consumers. Brazil, on the other hand, experienced a sharp decline of 24 per cent. This was the steepest drop in any country for which statistics are available. The German Democratic Republic helped offset some consumption declines in other Eastern European countries, turning in a 44 per cent increase.

Argentina, Belgium, Denmark, Finland, Hungary, India, Mexico, the Netherlands, Poland and Yugoslavia

Table IV.3. World machine tool consumption, 1980, 1987 and 1988
(Millions of dollars)

Country, area or region	1988	1987	Percentage change 1987-1988	1980	Percentage change 1980-1988
1. USSR	5 990	5 303.2	13.0	3 751	59.7
2. Japan	5 686.8	3 64[illegible].1	55.8	2 532.7	124.5
3. United States	3 850	3 967.2	-3.0	5 325.9	-27.7
4. Germany, Federal Republic of	3 843.7	4 001.4	-3.9	2 545	51.0
5. Italy	2 181.5	1 753	24.4	1 260.1	73.1
6. United Kingdom	1 420.4	1 087.1	30.7	1 344.6	5.6
7. France	1 376.6	1 219.9	12.8	992	38.7
8. China	1 151.6	1 033.5	11.7	532	169.6
9. Republic of Korea	1 109.1	979.5	13.2	452.8	144.9
10. Canada	944.7	708.4	33.4	541.6	74.4
11. Spain	726.8	606.9	19.8	227.8	219.1
12. Switzerland	690.2	576.7	19.7	349.3	97.5
13. Romania	621.4	619.4	0.3	762.1	-18.5
14. Taiwan Province	589.9	412.7	42.9	191.9	207.4
15. Brazil	453	601.5	-24.7	418.9	8.1
16. German Democratic Republic	443.6	308.5	43.8	453.7	-2.2
17. Poland	420	428.5	-2.0	535	-2.1
18. Sweden	414.4	377.3	9.8	235.7	75.6
19. Bulgaria	400	391	2.3	45	78.8
20. Yugoslavia	398.1	356.6	11.6	335.2	18.8
21. India	383	389.6	-1.7	216.2	77.2
22. Mexico	255.5	247.4	3.3	327.9	-22.1
23. Belgium	220	206.1	6.7	136.8	60.8
24. Netherlands	209.8	229	-8.3	132.1	58.8
25. Australia	185	177.3	4.3	172.3	7.3
26. Israel	175	168	4.2	..	..
27. Czechoslovakia	170	160	6.3	221.8	-23.3
28. Austria	161	159	1.3	200.7	-19.7
29. Hungary	156.3	164	-4.6	166.7	-6.2
30. Denmark	129.2	133.8	-3.4	64.9	99.1
31. Finland	114.1	120.9	-5.6	..	..
32. South Africa	97.5	73.7	32.3	230.2	-57.6
33. Singapore	97	95	2.1	101.9	-4.8
34. Hong Kong	75	70.4	6.5	..	..
35. Argentina	50.2	57.1	-12.1	117.7	-57.5
36. Portugal	43.6	42.3	3.1	50	-12.8
North America	4 794.7	4 675.6	2.5	5 867.5	-18.3
Western Europe	11 706.3	10 681.4	9.5	7 539	55.3
Eastern Europe and USSR	8 599.4	7 731.2	11.2	6 270.5	37.1
Latin America	758.7	926	-18.1	864.5	-12.2
Asia	9 092.4	6 629.8	37.1	4 027.5	125.7
Others	282.5	251	12.5	402.5	-29.8
Total North a/	22 295.3	19 089.1	16.8	16 341.7	36.4
Total South a/	3 187.7	3 041.2	4.8	1 827.3	74.4
Total world	35 234.0	30 895.0	14.0	24 971.5	41.1

Source: American Machinist.
a/ Excluding centrally planned economies.

all saw declines in consumption of machine tools in 1988. The growth displayed by Singapore and Hong Kong, at 2 per cent and 6.5 per cent respectively, was lower than might have been expected from general economic activity. South Africa, meanwhile, showed an exceptionally high growth in consumption of 32 per cent.

On a regional basis, Western Europe has continued to erode the share of world consumption held by North America, owing to the decline in consumption in the United States. Canada has shown a steady growth and the region as a whole accounts for 13.6 per cent of the total (see table IV.4). Western Europe now accounts for one third of world machine tool consumption, having witnessed a growth in 1988 of 9.5 per cent and a total of 55 per cent since 1980. Strong growth in 1988 by France, Italy, Spain, Sweden, Switzerland and the United Kingdom was offset by declines in consumption in Belgium, Denmark, Finland, Federal Republic of Germany and Netherlands.

Eastern Europe and the USSR's consumption of machine tools grew by 11.2 per cent in 1988 and by 37 per cent during the decade, mainly owing to advances in the USSR, Bulgaria, German Democratic Republic and Yugoslavia. The region accounts for 24.4 per cent of world consumption, down slightly from 25 per cent in 1980. During the decade,

Table IV.4. Share in world machine tool consumption, 1980 and 1988

Country, area or region	Percentage share 1988	Percentage share 1980
1. USSR	17.0	15.0
2. Japan	16.1	10.1
3. United States	10.9	21.3
4. Germany, Federal Republic of	10.9	10.2
5. Italy	6.2	5.0
6. United Kingdom	4.0	5.3
7. France	3.9	3.9
8. China	3.3	2.1
9. Republic of Korea	3.1	1.8
10. Canada	2.7	2.1
11. Spain	2.1	0.9
12. Switzerland	1.9	1.4
13. Romania	1.7	3.1
14. Taiwan Province	1.7	0.76
15. Brazil	1.3	1.7
16. German Democratic Republic	1.2	1.8
17. Poland	1.2	2.1
18. Sweden	1.2	0.9
19. Bulgaria	1.1	0.1
20. Yugoslavia	1.1	1.3
21. India	1.1	0.9
22. Mexico	0.7	1.3
23. Belgium	0.6	1.5
24. Netherlands	0.6	0.5
25. Australia	0.5	0.7
26. Israel	0.5	..
27. Czechoslovakia	0.5	0.9
28. Austria	0.5	0.8
34. Hungary	0.4	0.66
29. Denmark	0.4	0.3
30. Finland	0.3	..
31. South Africa	0.3	0.9
32. Singapore	0.3	0.4
33. Hong Kong	0.2	..
35. Argentina	0.1	0.5
36. Portugal	0.1	0.2
North America	13.6	23.5
Western Europe	33.2	30.2
Eastern Europe and USSR	24.4	25.1
Latin America	2.15	3.5
Asia	25.8	16.1
Others	0.8	1.6
Total North a/	63.2	65.4
Total South a/	9.0	7.3
Total world	100.0	100.0

Source: American Machinist.
a/ Excluding centrally planned economies.

consumption by the USSR has advanced by 59 per cent, but that of Czechoslovakia, German Democratic Republic, Hungary, Poland and Romania has fallen.

Latin America was the only region in 1988 to show an overall decline in consumption of machine tools. Figures are only available, however, for Argentina, Brazil and Mexico. All countries showed a decline in consumption of between 4 and 24 per cent. Argentina and Mexico registered a sharp decline in consumption for the decade of 22 per cent and 57.5 per cent, respectively. Brazil has shown slight growth, however, of 8.1 per cent since 1980. The region's share in world consumption of machine tools has slipped since 1980 from 3.5 per cent to 2.15 per cent.

Growth in Asia, on the other hand, has been consistently strong, mainly because of advances in Japan. The region showed 37 per cent growth in 1988 and 125.7 per cent for the decade up to that time. China, the Republic of Korea, Taiwan Province and India have all shown a steady advance, although consumption was down in India in 1988. Overall, Asia's share in world consumption has grown from 16 per cent in 1980 to 25.8 per cent in 1988.

Excluding the centrally planned economies, the share of the South in world machine tool consumption has inched forward during the decade from 7.3 per cent to 9 per cent. The share of the North (excluding centrally planned economies) has declined slightly, but dominates overwhelmingly at 63.2 per cent.

(d) *Factors accounting for 1988 growth patterns in selected countries and areas*

As can be noted already, the overall pattern of production and consumption was remarkably varied, with some countries recording large decreases in activity. Others, notably Japan and Italy, reported outstanding gains, while yet others, particularly the United States and to some extent the Republic of Korea, saw surprisingly disappointing advances in a year of such strong general economic growth.

In the United States, consumption was down by 3 per cent and production by 5.6 per cent. Imports rose by about 2 per cent, indicating a continued preference by the United States for foreign machine tools. This trend has slowed, however. Despite the impression given by the statistics, 1988 is reported as a good year for machine tool manufacturers. According to the Association for Manufacturing Technology, towards the end of the year orders for new machine tools were running at 103 per cent of the 1987 figure. These could not be fully met, however, as capacity had been reduced under the influence of poor industry performance and increasing penetration of imports.

The huge 56 per cent increase in consumption of machine tools in 1988 by Japan left manufacturers struggling to keep pace. Even though production was up 35 per cent in dollar terms, the backlog of unfilled orders grew. According to the Machine Tool Builders Association, whose members make machine cutting tools, the reasons were twofold. First, Japanese manufacturers in general, concerned about their exports after the reversal in the yen-dollar rate, had delayed making capital investments. Demand had therefore become pent up before 1988 and machine tool orders surged when reinvestments began. Secondly, efforts to cut costs and rationalize in the face of an appreciating yen had borne fruit by 1988, and enough funds were accumulated to facilitate heavy investment.

So far as metal-forming tools are concerned, according to the Japan Forming Machine Association, huge orders placed by General Motors in 1984-1985 (totalling 100 billion yen over the two-year period) had boosted order books in 1986-1987. By contrast, 1988 showed virtually zero growth. An increase in imports of machine tools was also evident in 1988. A study by the Ministry of International Trade and Industry (MITI) showed that the majority of imports were from Japanese companies overseas. The increasing rate of imports partially offset rises in the value of the yen, but Japan's surplus in machine tools trade still grew by 6 per cent to nearly $3 billion. The country exported 39 per cent of production in 1988.

The Federal Republic of Germany saw a slight increase in production and exports of machine tools, although consumption fell. An increase in production is predicted for 1989, when the country was to host the European world machine tool show at Hanover in September. Exports to the USSR and Eastern Europe, a major market, reached $320 million at the end of 1988, representing 8 per cent of overseas sales. Another 11 per cent went to the United States while Austria, France, Italy, Switzerland and the United Kingdom each took shares of between 5 and 8 per cent. Order books were strong for 1989, and production was expected to rise by 5 per cent. Further ahead, the Single European Market after 1992 is expected to boost demand and reduce imports from Japan.

Eastern Europe and the USSR have had limited success in trying to revive their machine tool industry. In 1987, more than 60 per cent of the enterprises were failing to reach their targets. New accounting laws mean that Stankoimport, which has been an autonomous State trading company for 60 years, is now part of the machine-tool-building ministry. Its import monopoly has been broken and several factories now have the right to deal directly with foreign customers. In 1989, the State was expected to control only 20 per cent of machine tool output, mainly the heavy-duty metal-cutting machines and presses. Increased competition for customers among the rest is expected to boost quality and sales know-how. Stankoimport has participated in machine tools trade fairs in the United States to help boost exports. However, a 40 per cent United States tax on USSR machinery exports has curbed potential in that market.

Several successful United States-USSR joint ventures sell some 15 per cent of USSR machine tool exports. Another venture involves a new turning centre in the Federal Republic of Germany to install Siemens control panels on Soviet products for developed market economies. The 1989 Metal Working Exhibition in Moscow should boost imports, and the use of profits for investment should liberate larger funds for purchases.

Investments in machine tool production are up 25 per cent, mainly in factories producing advanced equipment. Examples include the Savelov Amalgamation in Minaviaprom, which builds lathes and milling machines, and Srednvevolzhks machine tool plant which specializes in chuckers and machining centres. Metal-forming equipment development is also receiving high priority. Official estimates say 10,000 numerically controlled machine tools were produced in 1987, although other estimates say it was closer to 20,000. One explanation offered for the difference is that products held by the military may not be reported through trade channels.

The German Democratic Republic is continuing its emphasis on flexible manufacturing systems and computer-integrated manufacturing. By far the largest share of the country's huge exports goes to the USSR. The 43 per cent surge in imports in 1988 reflects continued efforts by the State machine tool trading company, WMW Import-Export, to focus on hard-currency imports of key technology from the West, in an effort to modernize key industries such as textiles, food and beverages, as well as machine tool and factory automation industries.

China's machine tool production capability has grown, although performance has been patchy. The recently-formed Chinese machine tool builders association reported a nearly 40 per cent gain in exports, while imports rose by 11 per cent. In 1989 the organization is sponsoring the country's first international machine tool show.

Export growth for Taiwan Province was fairly flat in 1988. The sharp increase of the new Taiwan dollar against the United States dollar spurred imports by 33 per cent. Meanwhile, the agreement on the voluntary restraint of exports to the United States, currently being renegotiated for another term, has held down exports. It has particularly affected sales of machining centres and lathes to customers in the United States. Taiwan Province considers the restraint to be unfair, as not every country complied with the request from Washington. Export-oriented products were to be highlighted at the metalworking machinery show at Taipei in April 1989.

Most of the substantial 31 per cent increase in machine tool consumption in the United Kingdom in 1988 arose because the gains were posted against a weak market in 1987. The rise in domestic consumption of 27 per cent was partly based on an 8 per cent appreciation in the pound sterling against the dollar. The year 1987 had seen the final phase in the reduction of first year capital allowance against taxation, after significant investment had been made in previous years to take advantage of tax breaks while they existed. This, combined with sharp falls in investment by the motor vehicles and mechanical engineering industries in the United Kingdom, had made 1987 a poor year for the machine tools industry. A slow-down is expected in manufacturing output in 1989, which will affect production of machine tools. The United Kingdom imports more than half its machine tool consumption and exports slightly less than half its production.

The 25 per cent increase in consumption in Italy in 1988 was fed through production and import rises. The drop in exports seen in 1987 seems to have been temporary, and in 1988 they climbed back to 47 per cent of production. The rebound was in all areas, Italy being one of the few developed market economies that actively courts machine tool customers in developing countries. Ucimu-Sistemi per Produrre, the association of producers of machine tools and related factory equipment, forecast an 18 per cent increase in production of metal-cutting machine tools in 1989, and a 21 per cent increase in metal-forming machines. Robots amounted to a $275 million industry for Italy in 1988, accounting for about 10 per cent of machine tool exports, although the figures are not included in the data given in tables IV.1 and IV.3. The producers' association projected a 25 per cent growth in robot shipments in 1989, with one third of production to be exported.

Hungary saw a decline in volume of machine tool exports in 1988, although exports increased in value, indicating that more costly machines are taking a growing share. The most important outlets are Eastern European countries, Austria, China, Federal Republic of Germany, and Switzerland. The austerity policy in Hungary and other Eastern European countries means that efforts will be concentrated on developed market economies and overseas markets in 1989.

The machine tool industry in Poland is beginning to age and the number of machines over five years old has grown to 23 per cent. It was thought that attempts might be made to reduce exports in 1989 in order to meet growing internal demand, although this would exacerbate the industry's depletion of hard currency. A deal was agreed upon in 1988 with Scharmann of the Federal Republic of Germany concerning the production of machines of that country in Polish plants. It is not yet clear whether that is the beginning of a trend.

In line with other Pacific rim countries, the Republic of Korea is experiencing an increase in home demand. For machine tools, labour problems in the industry, liberalization of policy on imports, and a further strengthening of the won against the dollar are among factors which allowed much of the increased demand to be fulfilled by imports in 1988. The machine tools manufacturers association in the Republic of Korea expected production, imports and exports to remain at similar levels to those in 1988. A major problem arises for domestic manufacturers lacking local supplies of key parts such as servomotors.

Spain had a good year for machine tool consumption in 1988, which rose nearly 20 per cent in dollar terms and 13 per cent in pesetas. There was a trend towards more shipments equipped with higher-quality controls. Spanish trade increased. Imports gained 21 per cent, the main suppliers being Federal Republic of Germany, Italy, Japan, United Kingdom, Switzerland, United States and France. Exports gained 14 per cent, with most going to Western Europe (68 per cent), especially the Federal Republic of Germany. Other buyers include France, United States, United Kingdom, Portugal and Italy. In total, three quarters of Spain's exports are to countries that are considered highly developed.

The Swedish machine tool industry, which grew by 9 per cent in 1988 in line with a general economic boom, is not feeling the benefits in terms of profitability. However, restructuring is largely completed, and the companies that remain in the business are expected to show greater stability of financial performance in future. Large metalworking companies in Sweden have been investing heavily in the past few years, particularly Volvo and Saab-Scania. Both have new production plants coming on stream in 1989. A serious labour shortage in the country will result in demand for robotics and automation equipment and manufacturers are expecting good order books. Many major companies in Sweden have been investing heavily in the EEC, but machine tool manufacturers have made no significant acquisitions. It is considered that the creation of the Single European Market after 1992 will not seriously affect exports from Sweden. The country is a net importer of machine toois and Italian companies are increasing their share of the market, while high-quality Japanese goods are becoming more in evidence.

The dramatic 22 per cent fall in production in Brazil is attributed to high inflation in the country deriving from the reflationary effects of the 1986 Cruzado plan. Forecasts for 1989 were bleak, on the basis of the high level of inventories at the start of the year. Wide-ranging lay-offs were predicted in the capital goods industry as stocks carried over for the year totalled nearly half the orders.

In South Africa, where production was down by 21.1 per cent in 1988, although consumption was up by 32 per cent, many manufacturers have quit the business. A reluctance by industrialists to spend money on capital goods has left the machine tool industry unprofitable. In 1984 there were 24 domestic manufacturers whereas in 1989 there were just nine. Ironically, spending on machinery rose in the second half of 1988 following a period of artificially low interest rates and as industry caught up with aging equipment. The increased demand was met through imports. With an expected rise in interest rates to cool the economy and curb imports, demand was flattening at the beginning of 1989. It is reported that fixed capital investment is running below the level of plant and equipment depreciation, suggesting that the country's stock is aging. The concern within the economy to repay foreign loans will keep a lid on little domestic booms such as those experienced in 1988.

Triple-digit inflation in Argentina has had the same effect on demand as in Brazil. Consumption of machine tools was down by 12 per cent in 1988, although production held up well, showing a 9.4 per cent increase, largely going to exports, which were up by 64 per cent.

2. *Trade*

In 1970, just over a third of world production was traded. This has risen to nearly 46 per cent in 1988, underlining the increasing importance of international trade and competition between countries. However, only 7.4 per cent of world production in 1988 left the circle of the 36 machine-tool-producing countries and was exported to the non-producing countries of the South.

Figure IV.3 provides some idea of the directions of trade, particularly showing vigorous trade within Western Europe and with CMEA countries. The United States as a market for external suppliers plays a much greater role than Western Europe, while Japan offers hardly any sales potential for foreign suppliers. Western Europe and Japan tend to place a greater part of their exports outside the large country groupings.

Although, on the whole, the trade structure is largely unchanged from previous years, the emphasis has shifted in certain areas. Among Western developed countries, for example, the following aspects are noteworthy (see table IV.5):

(a) Supplies from Western developed countries to the United States have increased considerably, from 5.2 per cent in 1972 to 13 per cent in 1980 and almost 20 per cent in 1986, falling to about 15 per cent in 1987;

(b) Similarly, Asia took only 10 per cent of Western developed countries' exports in 1972, but by 1987 the percentage had risen to 19 per cent. This trend was driven primarily by China;

(c) In comparison, Africa and Central and South America have slipped in importance especially during the 1980s, and currently together they take up less than 6 per cent of Western developed countries' exports;

Figure IV.3. Currents in international machine tool trading, 1987

(Billions of DM)

Source: National Statistics, German Machine Tool Builders' Association (VDW)

Notes: Values within circles: market volume. Values within arrows: internal trade

*Estimated

Table IV.5. Destinations of machine tool exports of 15 Western developed countries, 1972-1987
(Percentage)

Importing region or country	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Asia	10.1	10.8	12.5	12.3	13.8	14.9	16.6	16.5	13.1	13.2	15.2	19.1	19.9	10.7	18.7	19.0
CMEA	15.9	18.6	17.6	19.0	21.8	22.4	20.7	16.7	13.8	10.3	11.8	15.4	10.8	9.6	9.3	11.6
Africa	3.6	3.6	4.3	5.0	4.9	4.9	4.4	4.1	5.2	6.3	6.0	5.6	4.4	3.6	2.7	2.0
Europe (excluding CMEA)	52.2	47.8	44.3	42.1	38.8	37.9	36.4	39.8	41.3	39.0	39.1	38.6	36.1	37.1	41.0	43.8
Central and South America	7.7	8.2	9.2	10.3	9.9	8.1	8.1	7.1	8.5	9.0	8.4	5.1	4.4	4.1	3.6	3.7
North America	8.5	9.5	10.3	9.6	9.6	10.6	12.2	14.8	16.5	20.4	17.7	15.0	22.8	22.9	23.2	18.6
United States	5.2	6.3	7.2	6.6	6.7	12.1	9.9	12.2	13.0	14.6	14.9	12.7	19.6	19.6	19.7	15.4

Source: American Machinist.
Note: Western developed countries include Austria, Belgium, Canada, Denmark, Finland, France, Federal Republic of Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom and United States.

(d) CMEA imports from Western developed countries have been replaced increasingly by intra-CMEA trade. Exports to CMEA countries in 1977 reached almost 22 per cent, and in 1982 still amounted to 15.4 per cent, whereas 1987 saw a reduction to 11.6 per cent, far less than exports to East Asia for example. Intra-CMEA trade in machine tools has increased to about 50 per cent;

(e) Western Europe has lost none of its significance as a sales area for machine tools. Today, approximately 44 per cent of the exports of Western developed countries is sold within Western Europe.

In summary, the United States and East Asia have gained considerably as machine-tools sales areas, whereas CMEA trade is more and more internal. Africa, Central and South America and Western Asia have continued to decline so far as international machine tool trading is concerned. All this makes it likely that in future there will be an even more strongly linked and significant machine tool trade between Western developed countries, although Taiwan Province and the Republic of Korea will gain in significance in international machine tool trading.

There are not only structural shifts on the demand side. Structural changes on the supply side also clearly indicate that competition is becoming even more intense. The Japanese machine tool industry is particularly dynamic. Its percentage share of exports increased from 3.5 per cent in 1970 to 13.1 per cent in 1980 and to approximately 19.4 per cent in 1988. These gains correspond with losses for all other important supplier countries. Italy and Switzerland alone have held steady, or increased their shares in world exports. The Federal Republic of Germany had to pay tribute to the export power of Japan, but was able to stabilize its percentage and work its way up to 23.8 per cent of world exports in 1988. The country is thus once again the world's largest machine tool exporter. The United Kingdom, and even more so the United States, where export percentages in 1972 were still above those of Switzerland and Italy, have since had to report losses in world market shares of nearly 37 per cent in the case of the United Kingdom, and about 66 per cent in the case of the United States.

With regard to geographical trading links, Japan's trade focused in the Pacific area, and the United States is its largest single customer. Approximately three quarters of all Japanese machine tool exports is sent to that area. Japanese export concentration has increased by a total of 7 per cent since 1980. The United States alone absorbed almost 36 per cent of Japanese exports in 1987.

The strong export performance of Taiwan Province is also worth noting. About 33 per cent of its sales go to the United States. Exports, however, are now being restricted under a voluntary restraint agreement.

3. *Restructuring and redeployment*

(a) *Size of the industry*

The machine tool industry comes under the category of small- and medium-scale enterprise (table IV.6) for both technical and historical reasons. There are about 30 broad categories of machine tools, with largely varying dimensions within each category, and a series of subcategories related to specific processes. The bulk of production is for relatively small batches of diverse products. In 1987, the European machine tool industry comprised about 1,400 companies. In the United States there was a similar number in 1982 (no actual figures are available for 1987), of which about two thirds had less than 20 employees. Today, however, the United States machine tool industry is probably smaller.

According to a MITI survey, the machine tool industry of Japan consists of about 170 companies with 50 or more employees. Many produce accessories (dies, tools, gigs and fixtures) rather than machine tools. The average number of employees engaged in machine tool manufacturing for the 110 member companies of the Japan Machine Tool Builders' Association is 304 per company. But 70 per cent of these firms have fewer than 300 employees. Even though the largest enterprise employs about 3,000, it can generally be said that this industry is made up mainly of small- and medium-scale enterprises.

Detailed figures are not available for most developing countries, NICs and CMEA. It can be said,

Table IV.6. Structure of the machine tool industry in selected developed countries, 1987

Country	Number of companies	Number of employees	Average employment per company
France	148	10 025	68
Germany, Fed. Rep. of	390	93 500	240
Italy	430	30 500	71
Japan	1 600	32 700	20
Spain	144	7 734	55
Switzerland	119	13 800	116
United Kingdom	200	23 400	117
United States	455a/	62 300	137

Source: German Machine Tool Makers' Association.
a/ Number of companies in 1982, with more than 20 employees.

however, that with the exceptions of CMEA firms and some in China, the machine tool industry in these countries generally consists of smaller companies than in developed countries.

In the 1980s, about 100 European machine tool companies disappeared through bankruptcy or closure, take-overs and, especially in the United States and the United Kingdom, management buy-outs. All this has led to significant changes in the structure of the industry.

(b) *Co-operation and foreign direct investment*

Companies from the United States, Asia and European countries outside the EEC own machine tool plants within the EEC. The estimated production share held is about 10 per cent. Figures are not available for the United States, but the share of foreign-owned machine tool production is probably much higher.

A list of the 25 largest machine tool companies in developed countries (table IV.7) includes Japanese, American and European companies. Data for other machine-tool-producing countries and areas are scarce, but the available figures for the Republic of Korea and Taiwan Province show that machine tool companies in developing countries or NICs are comparatively much smaller.

Within the context of the foreign ownership of domestic machine tool production, certain structural changes have a permanent effect on the international machine tool business. The regional targeting strategy under which Japan has built up a powerful position in the past 15 years is meeting resistance. The United States has made access more difficult through voluntary restraint agreements with Japan and Taiwan Province. Europeans are highly sensitive about this question and developing countries have come to question their dependence on their mighty neighbour. The consequences were predictable. By building up wholly or partly Japanese-owned production facilities in the United States and Europe, it is hoped that trading problems will be avoided and markets secured. This approach is also now being taken up by machine tool manufacturers in Europe. Such action is being helped along by the fact that for most countries in the South, and recently through *perestroika* or restructuring, in the USSR, pure export business is becoming increasingly difficult. Co-operation arrangements or joint ventures are thus essential to securing market shares in the long term, introducing a new structural aspect regarding internationalization of production and sales.

As no country aiming at competitiveness can afford not to use the most modern machine tools even if it means buying them from abroad, it is likely that trade will expand for this as much as any other reason. The relative role of trade, investment and licensing agreements will change.

As discussed in detail in a UNIDO report*, several factors will encourage production links in one form or another, including the following:

(a) The imposition of trade barriers in one or more markets. Such obstacles could lead to foreign direct investment in the countries imposing them, in other major markets to pre-empt similar moves there, or in locations that, while not important in themselves, might offer cost or other advantages. This would render them suitable sites from which to export to the original market;

(b) The need to remain close to good customers at home who, through foreign direct investment, are relocating a large part of their production abroad;

(c) The prospect of obtaining easier access to key production components, human or material, whose use could improve real productivity and product quality;

(d) The opportunity to reinforce control over relevant parts of the international production network by building up a local presence in those locations.

Information on foreign direct investment in the machine tool industry is sketchy. The presence of Japanese machine tool companies in the United States is well known, however. Yamazaki-Mazak, Hitachi-Seiki, Okuma, Makino, Amada and Toyoda, to name a few, produce machine tools in the United States. Only a few companies of the Federal Republic of Germany such as Trumpf, Klingelnberg or Hüller-Hille, have set up there. Others like Deckel have

*"Recent developments in the machine tool industry: the prospects for foreign direct investment with particular reference to Asian developing countries" (PPD.53)

Table IV.7. World's 25 biggest machine tool companies, 1987 (Millions of dollars)

	Company	Country	Machine tool turnover	Number of employees
1.	Yamazaki-Mazak	Japan	675.0	3 000
2.	Fanuc Ltd.	Japan	650.9	1 700
3.	Litton Industries	United States	556.7	54 200
4.	Amada Co.	Japan	523.0	1 560
5.	Cross & Trecker Corp.	United States	422.2	4 100
6.	Comau	Italy	400.0	4 971
7.	Okuma Machine Works	Japan	388.1	1 782
8.	Cincinnati Milacron	United States	374.0	9 153
9.	Gildemeister	Germany, Fed. Rep. of	326.1	2 082
10.	Mori S-ki	Japan	320.2	1 537
11.	Toyoda Machine works	Japan	315.3	4 367
12.	Ingersoll Milling	United States	310.0	4 500
13.	Deckel	Germany, Fed. Rep. of	302.0	2 400
14.	Komatsu	Japan	298.1	15 801
15.	Trumpf	Germany, Fed. Rep. of	255.0	2 122
16.	Makino	Japan	242.7	951
17.	Aida Engineering Ltd.	Japan	211.3	684
18.	Maho	Germany, Fed. Rep. of	210.2	2 088
19.	Sonoike	Japan	202.0	537
20.	Traub	Germany, Fed. Rep. of	196.4	1 641
21.	Hüller-Hille	Germany, Fed. Rep. of	193.5	2 007
22.	Müller Weingarten	Germany, Fed. Rep. of	184.9	2 441
23.	Hitachi-Seiki	Japan	178.5	1 237
24.	Index	Germany, Fed. Rep. of	161.3	1 940
25.	Heller	Germany, Fed. Rep. of	115.1	1 704

Source: American Machinist and German Machine Tool Maker's Association.

bought United States companies and some have established their own subsidiaries.

Investments in Europe have been mainly by United States and Japanese companies in the United Kingdom and France, plus a few other isolated examples. Figures on foreign direct investment in Asia or Latin America are not available, but with the exception of a very few investments in Latin America, India and Singapore, the amount of direct investment in those regions is probably extremely limited. In contrast to foreign direct investment, there have been numerous co-operation agreements between companies of the North and South. This holds particularly true for machine tool companies of the Federal Republic of Germany. Japanese companies have entered co-operation agreements mainly with partners in Asia, while deals between United States and other European companies and the South have been less common.

Co-operation agreements are sought, particularly by the biggest Asian countries which aim at expanding their machine tool output, to meet growing domestic demand, promote industrialization and acquire know-how. Smaller countries—particularly those whose industrial sector is small—may try to obtain at least a marginal linkage with some machine tool suppliers.

(c) *World-wide machine tool companies*

Comparison of financial performance of machine tool companies around the world is difficult because of different reporting periods and methods and currency fluctuations. The study by *American Machinist* for 1987 shows the Japanese company, Yamazaki Mazak, as the largest company in terms of sales. Its turnover figure reached $675 million as its new plant in the United Kingdom dramatically increased company capacity. The second-placed company is another Japanese firm, Fanuc Ltd. Its sales are highly concentrated in numerical controls (NC) equipment (see table IV.7).

The acquisition in 1986 of Lamb Technicon placed the United States firm Litton in third position, ahead of Amada of Japan, whose $523 million machine tool business includes sales of Sonoike and Wasino. Fourth is Cross & Trecker of the United States, whose sales include those of Alliance Tool, acquired from Gleason in 1987. Italy's Comau is next, with sales of $400 million, ahead of Japan's Okuma and Cincinnati Milacron, where emphasis has been on diversification.

4. *New competitors*

As already mentioned, Taiwan Province and the Republic of Korea, in particular, have recently built up large machine tool capacities and play an important role in the international machine tool business. Their industry structure, however, is quite different from the more established producers in the North.

In the case of the Republic of Korea, production stems from more than 100 registered companies. Most, however, are very small and a large share of the total comes from a handful of firms such as Dae Woo Heavy Industries, Tongil and Swachon. Most of the major companies belong to a larger conglomerate and produce machine tools for their respective parent companies. Their level of technological development in global terms is only moderate, but they are expanding continuously to more advanced items, using a mix of foreign and locally developed know-how. Key components and designs come from abroad and a characteristic of the industry is its low export share.

In contrast, the machine tool industry of Taiwan Province seems to be technically more advanced and much more export-oriented. This mainly stems from the fact that most machine tool companies of Taiwan Province are independently run and not part of major industrial conglomerates. Another reason is that the domestic market is much smaller than in the Republic of Korea, and as the preferred destination has been the United States, Taiwan Province producers have sought to improve both knowledge about, and trade relations with, that country.

5. *Technological change*

Technological advances have provided an impetus to structural change in the industry. The most important development in the 1970s was the proliferation of NC machine tools. The aerospace and automobile industries led the field, but development was initially hampered by high capital costs and reliability problems with the early models. As the cost of control units fell with the more widespread distribution of components in the early 1970s and microprocessors in the late 1970s, machine tools fitted with computer NC (CNC) units increased in number. The growing use of machining centres, lasers and electron discharge machining has vastly improved quality and productivity, favouring those producers which had the financial resources to invest in such technologies (table IV.8).

Table IV.8. Share of numerical control machine tools in total production of selected countries, 1978 and 1987

Country	1978	1987
China	..	19.8
Germany, Fed. Rep. of	10.1	42.6
India	..	21.7
Italy	9.3	30.9
Japan	22.7	52.4
Republic of Korea	..	30.2
Spain	..	37.4
United Kingdom	10.4	37.4
United States	9.2	20.6

Source: American Machinist.

The next technological step was the linking of CNC machine tools to central computers, thereby achieving greater flexibility and versatility and allowing a wider variety of tasks to be undertaken. The goal was to combine productivity and high flexibility. These developments are revolutionizing machine tools, introducing complete systems which incorporate controls, local testing and fault diagnosis. Flexible manufacturing systems and unmanned factories have been introduced in several plants world-wide. However, the task of acquiring and integrating mechanical engineering skills with electronic technologies, the pressure to invest in research and development activities and the enormous capital costs are barriers to the introduction of these complex, yet flexible, manufacturing systems. In recent years, development has concentrated on flexible manufacturing cells, which are less complex and have lower investment needs.

A new concept of flexible automation combining productivity and flexibility is derived by transferring highly automated large-scale batch manufacturing processes to small and medium batches. Computer-integrated manufacturing can secure competitiveness by making use of all aspects of modern information technology. In the long run, companies operating world-wide will have to face up to this, and access to the latest electronic hardware and software will be a key factor for the industry.

Because countries in the South will concentrate more on productivity than on planning and production flexibility, the cutting edge of technological development is likely to remain with developed countries.

6. *Perspectives*

The past 10 to 15 years have seen a period of upheaval in the machine tool industries, particularly with reference to the development of new technologies and products. New competitors have penetrated large market segments with both high technology products (Japan) and traditional machines (Republic of Korea, Taiwan Province). The machine-tool-producing countries have responded to these developments by offering their domestic machine tool industries various protection and assistance packages. So far as trade is concerned, tariffs have not been utilized as a major policy tool to protect domestic industries. It has been, rather, in the non-tariff field where protectionist and various other support measures, ranging from research and development aids to financial assistance, have been applied.

Structural adjustment processes will increasingly include the promotion of local direct investment and industrial co-operation arrangements in Europe, the United States and Asia, including CMEA countries. These will take place either through joint ventures or licensing agreements.

One of the most important events in this respect is the realization of the Single European Market scheduled for the end of 1992. The unified market will have a potential size of about $10 billion, compared with about $4 billion in the United States and about $3.5 billion in Japan. The increased size of the European market will put competition in a new dimension as the region will become a focal point for the rest of the world.

The expanding markets and production strength of the machine-tool-producing countries and areas in Asia will enhance the concept of internationalization and co-operation. The established machine-tool-producing countries will attempt to secure markets and developing countries and NICs will seek to acquire know-how through co-operation agreements.

Technological development is expected to lead to the manufacture and use of new materials to replace some metals. The increasing use of electronics will make some mechanical components obsolete, and some metal-cutting processes will be reduced by the increased use of other, for example laser-based, processes.

The concept of flexible automation will drive machine tool progress in developed countries, while the production and application of standard NC machine tools will be a feature of the capital goods industry in developing countries and NICs. In unit terms, the demand for machine tools will decrease, at least in developed countries, while their value will rise.

The introduction of new machining concepts and computer-integrated manufacturing will gradually be realized through close contact between machine tool producers and their customers as well as by high investments in research and development. Developing countries will continue to rely on the transfer of know-how from traditional industrialized machine tool producers through co-operation agreements.

The world machine tool industry will continue to change considerably over the next decade, and the accompanying structural changes may be expected to involve the issues of internationalization, co-operation and integration.

Appendix

Supplementary statistical data

Table IV.9. World production of cutting and forming tools, 1987 and 1988
(Millions of dollars)[a], [b]

Country, area or region	1988[c]		1987		1987-1988 percentage change		1388 percentage share	
	Cutting	Forming	Cutting	Forming	Cutting	Forming	Cutting	Forming
1. Japan	6 771.6	1 871.7	4 762.2	1 657.2	42.2	12.9	23.3	20.7
2. Germany, Federal Republic of	4 863.0	1 970.3	4 65[illegible]	1 749.7	4.5	12.6	16.8	21.8
3. USSR[d]	3 600.0[e]	900.0[e]	3 234.0[f]	742.3[f]	11.3	21.2	12.4	9.95
4. Italy	2 073.9	729.7	1 660.4	574.8	24.9	26.9	7.1	8.1
5. United States	1 565.0	875.0	1 778.4	806.6	-11.9	8.4	5.4	9.7
6. Switzerland	1 667.6	246.0	1 465.9	186.4	13.7	31.9	5.7	2.7
7. German Dem. Rep.[d]	1 170.7	286.3	1 054.2	257.8	11.1	11.[illegible]	4.0	3.2
8. United Kingdom	1 183.4	166.0	898.8	159.6	31.6	4 0	4.1	1.8
9. France	639.7	166.1	608.2	157.9	5.1	5.5	2.2	1.8
10. China[d]	532.1	199.5	493.1	139.3	7.9	43.2	1.8	2.2
11. Taiwan Province	533.7	161.6	482.6	95.2	10.6	69.6	1.8	1.8
12. Spain	510.6	163.0	437.7	137.3	16.6	18.7	1.7	1.8
13. Yugoslavia	498.3	173.3	382.1	132.9	30.4	30.4	1.7	1.9
14. Romania[d]	575.0	82.5	551.9	65.9	4.1	25.2	2.0	0.9
15. Republic of Korea	473.5	123.7	393.5	137.4	20.3	-10.0	1.6	1.4
16. Czechoslovakia[d]	400.0[e]	50.0[e]	360.0[e]	45.0[e]	11.1	11.1	1.4	0.5
17. Brazil	368.1	8[illegible].8	471.9	103.6	-22.0	-22.0	1.3	0.9
18. Poland[d]	265.0[e]	55.0[e]	266.0[e]	56.7[e]	-0.3	-3.0	0.9	0.6
19. Canada	173.9	116.3	143.6	100.5	21.1	15.7	0.6	1.3
20. Sweden	173.0	107.9	158.5	99.2	9.1	8.7	0.6	1.2
21. India	160.0[e]	112.0[e]	16[illegible].0[f]	115.7[f]	-1.2	-3.2	0.5	1.2
22. Hungary	210.0	31.5	108.6	29.4	16.2	7.1	0.7	0.3
23. Belgium	45.0[e]	145.0[e]	42.8[f]	136.5[f]	5.1	6.2	0.15	1.6
24. Austria	120.0[e]	35.0[e]	120.0[e]	35.0[e]	0.0	0.0	0.4	0.4
25. Bulgaria[d]	135.0[e]	15.0[e]	130.0[e]	10.0[e]	3.8	50.0	0.5	0.16
26. Israel	100.0[e]	35.0[e]	95.0[e]	35.0[e]	5.2	0.0	0.3	0.4
27. Denmark	56.4	23.8	52.6	24.1	7.2	-1.2	0.19	0.3
28. Australia	20.0[e]	30.0[e]	17.0[e]	28.0[e]	17.6	7.1	0.07	0.3
29. Netherlands	30.3	15.2	31.0	16.3	-2.2	-6.7	0.1	0.17
30. Finland	6.3	36.4	5.2	30.1	21.1	20.9	0.02	0.4
31. Argentina	27.1	11.0	26.4	8.4	2.6	30.9	0.09	0.12
32. Singapore	33.0[e]	4.0[e]	32.0[f]	3.5[f]	3.1	14.3	0.11	0.0[illegible]
33. Portugal	7.7[e]	11.5[e]	7.5[f]	11.2[f]	2.6	2.6	0.03	0.12
34. Mexico	15.0[e]	3.0[e]	17.8[f]	3.6[f]	-15.7	-16.6	0.05	0.03
35. South Africa	5.3	4.4	7.4	4.9	-28.4	-10.2	0.018	0.04
36. Hong Kong	0.2[e]	1.3[e]	0.2[f]	1.2[f]	0.0	8.3	-	0.054
North America	1 738.9	991.3	1 922	907.1	-9.5	9.3	5.9	10.9
Western Europe	11 476.9	3 850.9	10 236.4	3 353.1	12.1	14.8	39.5	42.6
Eastern Europe	6 854.0	1 593.6	6 158.8	1 340.0	11.3	18.9	23.6	17.6
Latin America	410.2	94.8	516.1	115.6	-20.5	-17.9	1.4	1.04

Table IV.9 (continued)

Country, area or region	1988 c/		1987		1987-1988 percentage change		1988 percentage share	
	Cutting	Forming	Cutting	Forming	Cutting	Forming	Cutting	Forming
Asia	8 504.1	2 473.8	6 325.6	2 149.5	34.4	15.1	29.3	27.4
Others	25.3	34.4	24.4	32.9	3.6	4.5	0.08	0.38
Total North (excluding centrally planned economies) d/	19 912.7	6 713.8	16 850	5 915.3	18.1	13.4	68.6	72.3
Total South (excluding centrally planned economies) d/	1 710.6	532.4	1 681.4	503.6	1.7	5.7	5.9	5.9
Total world	29 009.4	9 338.8	25 183.3	7 898.2	15.2	14.4	100	100

Source: American Machinist, February 1989.

Note: Whenever possible, data includes machine tools only; it does not include parts and attachments.

a/ Free market currencies have been converted at current rates for the period covered.

b/ Controlled currencies have been converted as follows: Bulgaria, Czechoslovakia, Poland, USSR and China at 70 per cent of the official rate; and German Democratic Republic at 65 per cent of the rate of the Federal Republic of Germany.

c/ Estimates.

d/ Countries with controlled currency whose official rate may not represent real value.

e/ Rough estimate from fragmentary data.

f/ Unrevised.

Table IV.10. World trade in machine tools, 1987-1988 (Millions of dollars) a/, b/

Country, area or region	1988		1987		1987-1988 percentage change	
	Export	Import	Export	Import	Export	Import
1. Germany, Federal Republic of	4 128.5	1 138.9	3 654.7	1 253.5	13.0	-9.1
2. Japan	3 360.5	404.0	3 035.1	26 3	10.7	52.6
3. Switzerland	1 626.6	403.2	1 435.8	360.1	13.3	12.0
4. Italy	1 328.8	706.7	1 048.5	566.3	26.7	24.8
5. German Dem. Rep. c/	1 298.4	285.0	1 202.4	198.9	8.0	43.3
6. United Kingdom	666.7	737.8	501.0	529.7	33.1	39.3
7. United States	602.2	2 012.0	586.7	1 968.9	2.6	21.9
8. Yugoslavia	445.5	171.9	303.4	145.0	46.8	18.5
9. Taiwan Province	421.6	316.3	379.9	214.8	11.0	47.25
10. Czechoslovakia c/	375.0 d/	95.0 d/	330.0 d/	85.0 d/	13.6	11.8
11. USSR c/	360.0 d/	1 850.0 d/	312.3 e/	1 639.2 e/	15.3	12.8
12. France	335.7	906.5	284.3	738.1	18.1	22.8
13. Belgium	315.0 d/	345.0 d/	294.3 e/	321.1 e/	7.0	7.4
14. Spain	249.7	302.9	218.8	250.7	14.2	20.8
15. Sweden	211.8	345.3	192.7	312.3	9.9	10.6
16. Hungary	191.0	105.8	170.5	124.5	12.0	15.0
17. Netherlands	179.5	343.8	179.5	361.2	0.0	-4.8
18. Austria	169.0 d/	175.0 d/	169.7 e/	173.7 e/	-0.4	0.74
19. Romania c/	163.0	126.9	132.9	134.5	22.6	-5.6
20. China c/	130.0	500.0	93.0	494.0	39.8	11.3
21. Israel	115.0 d/	155.0 d/	115.0 e/	153.0 e/	0.0	1.3
22. Poland c/	100.0 d/	200.0 d/	98.1	203.9	1.9	-1.9
23. Bulgaria c/	100.0 d/	350.0 d/	85.0 d/	336.0	17.6	4.2
24. Canada	94.1	748.6	63.7	528.0	47.7	41.8
25. Singapore	90.0 d/	150.0 d/	85.0 e/	145.0 e/	5.9	3.4
26. Denmark	62.4	111.4	58.5	115.5	6.7	-3.5
27. Republic of Korea	48.0	560.0	37.5	486.1	28.0	19.6
28. Finland	39.9	111.3	29.3	114.9	36.2	-3.1
29. Brazil	35.9	40.0	23.0	49.0	56.1	-18.4
30. India	34.0 d/	145.0 d/	34.7 e/	146.6 e/	-2.0	-1.09
31. Argentina	26.3	38.4	16.0	38.3 e/	64.4	0.26
32. Portugal	9.6 d/	34.0 d/	9.4 e/	33.0 e/	2.1	3.0
33. Hong Kong	6.5 d/	80.0 e/	6.0 e/	75.0 e/	8.3	6.7
34. Australia	5.0 d/	140.0 d/	4.9 e/	137.2 e/	2.0	2.04
35. Mexico	2.5 d/	240.0 d/	2.7 e/	248.7 e/	-7.4	-3.2
36. South Africa	0.2	88.0	2.5	63.9	-92.0	37.7

Country, area or region	1988 Export	1988 Import	1987 Export	1987 Import	1987-1988 percentage change Export	1987-1988 percentage change Import
North America	696.3	2 760.6	650.4	2 496.9	7.1	10.6
Western Europe	9 438.2	5 816.8	8 191.5	5 283.1	15.2	10.1
Eastern Europe	3 032.9	3 184.6	2 634.6	2 967	15.1	7.3
Latin America	64.7	318.4	41.7	336	55.2	-5.2
Asia	4 090.6	2 205.3	3 671.2	1 826.3	11.4	20.7
Others	5.2	228	7.4	201.1	29.7	13.4
Total North (excluding centrally planned economies c/)	13 385.2	9 054.4	11 769.4	8 092.9	13.7	11.9
Total South (excluding centrally planned economies c/)	779.8	1 724.7	699.8	1 556.5	11.4	10.8
Total world	17 328	14 513.7	15 196.8	13 010.4	14.0	11.5

Source: American Machinist, February 1989.
Notes: Whenever possible, data includes machine tools only; it does not include parts and attachments.
a/ Free-mark currencies have been converted at current rates for the period covered. A complete list of the actual exchange rates used is available on request. For 1987, the rate is that reported as the average daily market rate by the IMF. For 1988, the IMF rate is used for the first three quarters, and bank transfer rates for the final quarter.
b/ Controlled currencies have been converted as follows: USSR, Bulgaria, Czechoslovakia, Poland and China at 70 per cent of the official rate; German Democratic Republic at 65 per cent of the Federal Republic of Germany rate.
c/ Countries with controlled currency whose official rate may not represent real value.
d/ Rough estimate from fragmentary data.
e/ Unrevised.

B. Semiconductor Industry (ISIC 383228)*

1. Recent trends and the current situation

(a) Global production and consumption

The world-wide semiconductor industry has always been extremely cyclical in nature. In the past, demand surges were followed by lulls which, in turn, were inevitably followed by renewed surges. As a result, world-wide semiconductor production has been erratic. Figure IV.4 shows that in 1984, world-wide semiconductor production grew by 47 per cent to $32.75 billion. One year later, production fell by 12 per cent. Such is the nature of the global semiconductor industry.

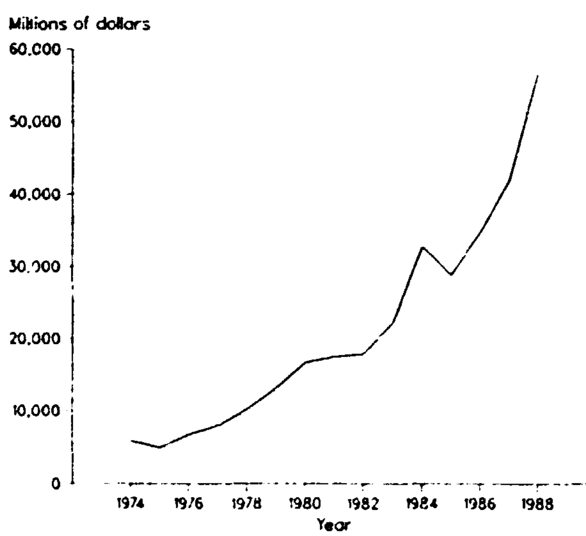
There are many reasons why the semiconductor industry routinely undergoes such erratic business fluctuations. The industry, though more than two decades old, is still far from achieving maturity. In addition, many of the major customers of semiconductors—in particular, computer companies—are far from being mature themselves. During the personal computer boom of 1984, computer manufacturers doubled and tripled orders of semiconductors, just to assure themselves of a continuous supply of the vital components. This multiple ordering caused semiconductor-makers to overestimate the market, pushing up production excessively, which ultimately led to the severe semiconductor recession of 1985.

To complicate matters, government meddling also wreaked havoc with demand and supply. Many industry analysts blame the 1986 United States-Japan semiconductor trade agreement, which set arbitrary price floors on certain chips that were exported from Japan by the United States, for the severe memory chip shortage in 1988.

Thus, forecasting semiconductor demand is an inexact science at best. None the less, several signs indicating an imminent slow-down have recently

*UNIDO acknowledges the contribution of Alden M. Hayashi, former Senior Editor, Electronic Business.

Figure IV.4. World production of semiconductors, 1974-1988



Source: Integrated Circuit Engineering Corporation arisen. Many market researchers fear that the global semiconductor industry, after growing by more than 30 per cent in 1988, may enter into a mild recession by the end of 1990.

One of the most important economic indicators in the semiconductor industry is the so-called book-to-bill ratio, considered by many to be the best bellwether of the industry. The book-to-bill ratio measures orders booked versus orders shipped. Thus, a ratio below 1.00 usually indicates industry contraction while a ratio above unity indicates expansion. In September 1988, the United States ratio fell below unity for the first time in 22 months, and remained below or at unity into early 1989 (see table IV.11), a fact which many industry analysts regarded as portending a recession in 1989.

Table IV.11. Book-to-bill ratio for the United States semiconductor market, 1988 and January 1989

Month	Book-to-bill ratio
January 1988	1.15
February	1.17
March	1.15
April	1.18
May	1.18
June	1.16
July	1.09
August	1.02
September	0.99
October	0.94
November	0.95a/
December	0.93a/
January 1989	1.00a/

Source: Semiconductor Industry Association, World Semiconductor Trade Statistics (Cupertino, California, 1989).
a/ Preliminary data.

There were several reasons for the slip in demand. Perhaps most importantly, the markets for many end-products that use semiconductors had declined. For example, sales of personal computers, which had grown from 20 per cent to 30 per cent annually in the past, was expected to slow to only 13 per cent in 1989, according to the market researcher International Data Corporation of Framingham, Massachusetts.

In addition, much of the demand surge in 1988 was due to nervous customers who were worried about being able to obtain a continued supply of semiconductors. Memory chips, in particular, were in short supply during most of 1988. Consequently, as prices soared for certain types of scarce semiconductors, many customers stocked up inventories. In 1989, however, semiconductor-makers began to build larger quantities of chips in either new facilities or facilities that were recently expanded to meet the 1988 demand surge. Customers were therefore no longer worried about a shortage in 1989 and stopped stockpiling semiconductors. In fact, some customers burnt off excess inventories, leading to a book-to-bill ratio of less than one in early 1989. Semiconductor manufacturers are now aware of the demand lull, and many will begin cautiously cutting back on capital expansions.

As a result, world-wide semiconductor production was forecast to grow by only 3.1 per cent to $58.5 billion in 1989 (see table IV.12). In 1988, world-wide production grew by 35.3 per cent. Production may actually decrease in 1990 by 3.3 per cent to $56.5 billion. But Integrated Circuit Engineering Corporation predicts that world-wide production will recover in 1991. Table IV.12 includes a breakdown of semiconductors into two major categories: discrete semiconductors (simple semiconductors like rectifiers and thyristors that perform just one function); and integrated circuits (semiconductors like microprocessors that perform multiple functions). Integrated circuits are commonly called chips.

As demand and supply have fluctuated, prices have also vacillated. The average selling price of a semiconductor was forecast to fall by 4.2 per cent to $0.39 in 1989. In 1988, the average selling price increased by 18.6 per cent as a result of the shortage mentioned earlier (see table IV.13).

There are four main geographical regions of semiconductor consumption and production: Japan, the United States, Western Europe and the rest of world. Among the countries or areas in the rest-of-the-world region most active in consuming or producing semiconductors are Australia, Brazil, China, Hong Kong, India, Malaysia, Republic of Korea, Singapore and Taiwan Province.

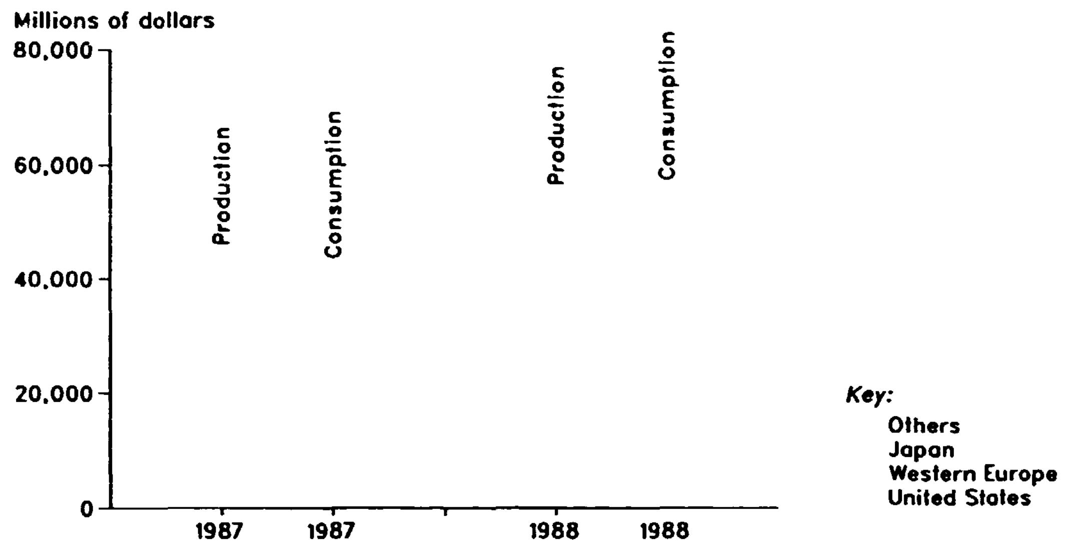
Figure IV.5 shows that Japan leads the world in semiconductor production, with the United States a close second. In terms of semiconductor consumption, the United States leads the world, with Japan a close second. It is interesting to note, however, that the

Table IV.12. World production of semiconductors, 1986-1991 (Millions of dollars)

Item	1986	1987	1988	1989	1990	1991
Discrete semiconductors	7 190	8 085	10 420	10 620	10 725	11 260
Integrated circuits	27 570	33 815	46 290	47 850	45 800	50 600
Total	34 760	41 900	56 710	58 470	56 525	61 860
(percentage growth over previous year)	(20.4)	(20.5)	(35.3)	(3.1)	(-3.3)	(9.4)

Source: Integrated Circuit Engineering Corporation.

Figure IV.5. World production and consumption of semiconductors, 1987 and 1988



Source: Dataquest Incorporated, and Integrated Circuit Engineering Corporation.

Table IV.13. Average semiconductor selling prices (Dollars)

Year	Average selling price	Percentage increase over previous year
1983	0.28	0.7
1984	0.332	14.9
1985	0.289	-13.0
1986	0.322	11.4
1987	0.343	6.5
1988a/	0.407	18.6
1989b/	0.390	-4.2

Source: Integrated Circuit Engineering Corporation.
a/ Estimated.
b/ Forecast.

Table IV.14. Semiconductor consumption of Western Europe (Total 1988 = $8.50 billion)

Country or country grouping	Consumption (percentage of total)
Germany, Federal Republic of	27.6
United Kingdom	21.7
France	15.2
Italy	12.5
Scandinavia	7.2
Others	15.8

Source: Motorola Incorporated; and Dataquest Incorporated.

fastest growth in terms of both production and consumption is in the rest of the world.

Within Western Europe, the Federal Republic of Germany leads in semiconductor consumption (see table IV.14). In 1988, that country purchased $2.35 billion worth of semiconductors, accounting for 27.6 per cent of the total market in Western Europe. The United Kingdom was second with a consumption of $1.84 billion, representing 21.7 per cent of Western Europe's total market.

In 1987, for the first time, the semiconductor production of countries in the rest of the world topped the $1 billion mark (see table IV.15). In 1988 production in that region surged to $2.3 billion. Its strong growth is mainly due to the Republic of Korea, which accounted for 65 per cent of the region's total production in 1988. In fact, next to Japan, the

Table IV.15. Semiconductor production in the rest of the world a/, 1986-1988 (Millions of dollars)

Country or area	Production 1986	1987	1988
Republic of Korea	335	577	1 475
Taiwan Province	155	265	400
China	122	145	165
Others b/	133	183	235
Total	745	1 170	2 275

Source: Integrated Circuit Engineering Corporated.
a/ Region excluding Japan, the United Stat-s and Western Europe.
b/ Includes Australia, Brazil, Hong Kong, India etc.

Republic of Korea has become the semiconductor success story of Asia. As a result of government policy stressing the development of certain industries, the Republic of Korea has recently emerged as a significant player in the world-wide electronics industry. In particular, the country has targeted semiconductors, because chips are the foundation of electronics products.

From 1986 to 1987, the Republic of Korea's semiconductor production grew by more than 70 per cent from $335 million to $577 million. In 1988, the country's production grew by an astonishing 156 per cent to $1,475 million.

Semiconductor consumption in the rest-of-the-world grouping is also led by the Republic of Korea, whose purchases totalled $1,590 million in 1988, an increase of 44 per cent from the year before (see table IV.16). The country was expected to consume nearly $2 billion worth of semiconductors in 1989. Taiwan Province is a close second to the Republic of Korea. Owing to its extensive production of personal computers, in 1988 Taiwan Province consumed $1,480 million of semiconductors, up 41 per cent from 1987. It was forecast to purchase $1,810 million worth of semiconductors in 1989.

Table IV.16. Semiconductor consumption in the rest of the world[a], 1987-1989 (Millions of dollars)

Country or area	Production 1987	Production 1988	Production 1989
Republic of Korea	1 100	1 590	1 970
Taiwan Province	1 050	1 480	1 810
Hong Kong	590	810	980
Singapore	510	700	840
China	340	450	540

Source: Dataquest Incorporated.
a/ Region excluding Japan, the United States and Western Europe.

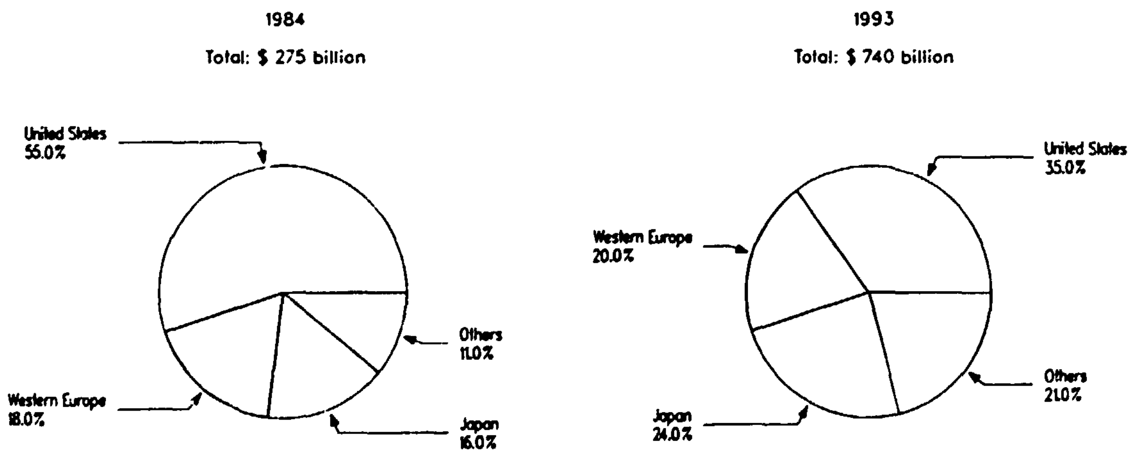
The main reason why countries in the rest of the world are consuming an increasing number of semiconductors is that they are producing more and more electronics end-products, such as television sets, video recorders and personal computers, that use semiconductors. Figure IV.6 shows how electronics equipment production in countries in the rest of the world has increased dramatically during the 1980s. This region accounted for 11 per cent of the world's total electronics equipment production in 1984. In 1988, the figure grew to 17 per cent, and Integrated Circuit Engineering Corporation predicts the figure will rise to 21 per cent in 1993.

The gain will be at the expense of the United States. The United States produced 55 per cent of the world's total electronics output in 1984, but is forecast to account for only 35 per cent in 1993. Western Europe's electronics output has held steady at around 20 per cent of world-wide production. Meanwhile, Japan's growth has somewhat slowed down. In 1984, Japan accounted for 16 per cent of total world-wide production, and that figure grew to 23 per cent in 1988. However, it is expected to increase its percentage to only 24 per cent in 1993, in part, owing to the negative effects of the high-valued yen.

Several recent trends and events promise to have a serious impact on the semiconductor production of various regions. First of all, several countries or areas in the rest-of-the-world grouping—in particular, Hong Kong, Republic of Korea, Singapore and Taiwan Province—have targeted electronics as key a industry. As a result, their Governments have nurtured and supported the local development of that targeted industry. The Government of the Republic of Korea, for example, has helped fund a number of semiconductor research and development projects (discussed in more detail later).

Furthermore, several countries in the rest-of-the-world grouping have been trying to induce Japanese,

Figure IV.6. World production of electronic equipment by region, 1984 and 1993



Source: Integrated Circuit Engineering Corporation

United States and Western European companies to relocate their manufacturing operations. Malaysia has been particularly active. That South-East Asian country gives various tax breaks to foreign corporations, and it also allows manufacturing equipment and many materials to be imported duty-free. Consequently, many United States corporations have been expanding their manufacturing operations there. Previously, Malaysia was used as a manufacturing site for only assembly and test work, the so-called back-end of manufacturing. Recently, however, National Semiconductor, Motorola and Fujitsu announced that they would augment their Malaysian operations by adding wafer fabrication, the so-called front-end of manufacturing in which electronic circuitry is etched on to silicon wafers that are then sawed into individual semiconductor dies.

Fujitsu's expansion in Malaysia is also due to the soaring value of the yen, which makes overseas manufacturing investments comparatively cheaper. Although the high yen value has not yet forced Japanese companies substantially to relocate their manufacturing to offshore sites, any further appreciation of the currency's value would increase the already strong pressure to do so.

Another factor pushing Japan offshore is the growing protectionist sentiment in the United States and Western Europe. Indeed, after the 1986 United States-Japan semiconductor trade agreement, by which the United States imposed price floors on imported memory chips from Japan, virtually every major Japanese semiconductor-maker increased manufacturing operations in the United States (see table IV.17).

The European single market of 1992 has also given Japanese as well as United States companies reason to worry. In early 1989, the EEC Commission announced tough local content rules which stated that for a chip to achieve "European" status—and thus be free from any import duties—it would need to be built virtually from scratch within EEC borders. Previously, foreigners could get away with just assembling their semiconductors in EEC countries.

Many United States companies are already preparing for Europe 1992. For example, Motorola recently invested $70 million to expand its manufacturing operations in West Kilbride, Scotland. Even the smaller United States chip-makers are beginning to act. MIPS Computer Systems, developer of an innovative microprocessor using reduced-instruction-set computer technology, announced in January 1989 that it would grant Siemens of the Federal Republic of Germany the right to manufacture MIPS's microprocessors.

The Governments of Western Europe and the United States have also taken steps to bolster local semiconductor manufacturing by supporting a number of research consortia. After years of declining semiconductor prominence, Western Europe, in particular, appears to be making a final stand by raising huge sums of money. Two projects of special note are ESPRIT, with a total budget of more than $750 million, and the Megaproject, with a budget of close to $2 billion (further details on Western Europe's research and development drive given later).

The United States Government has also taken steps to protect local industry. In 1987, the Government helped fund Sematech, a six-year consortium established to restore United States leadership in semiconductor manufacturing technology. Roughly half of the consortium's $200 million annual budget is being paid from taxpayer dollars. Whether Sematech will actually stoke semiconductor manufacturing in the United States has yet to be seen.

(b) *Trade*

Because of the dollar devaluation since 1985, many United States semiconductor companies are beginning to realize that their products have become price-competitive in overseas markets. In particular, the dollar dropped in value from 240 yen in 1985 to 130 yen in 1989, but only recently have United States semiconductor companies taken advantage of this by increasing their efforts to export to Japan. One reason for the delay is that many United States semiconductor companies had long written off Japan as a closed market, and the stigma led many of them to remain leery of that market even after the dollar plummeted in value *vis-à-vis* the yen. However, several United States companies are renewing their efforts in Japan. A few companies, like Intel Corp. and Texas Instruments Inc., have even begun to win sales among Japan's consumer electronics giants. Previously, winning orders for Japanese consumer electronics products like television sets was virtually impossible for foreign companies.

The rise in value of the yen, however, seems to have had little effect on Japan's export prowess. By whittling down manufacturing costs at every corner, Japanese companies have kept prices in check and exports have remained robust. Indeed, Japan's semiconductor exports soared from $2.4 billion in 1984 to

Table IV.17. Major Japanese semiconductor firms in the United States and Europe

Firm	Location
Fujitsu	San Diego, California; Gresham, Oregon; Tallaght, Ireland
Hitachi	Irving, Texas; Landshut, Federal Republic of Germany
Mitsubishi	Durham, North Carolina
NEC	Roseville, California; Mountain View, California; Livingston, Scotland; Vallivor, Ireland
Toshiba	Sunnyvale, California; Braunschweig, Federal Republic of Germany

Source: Integrated Circuit Engineering Corporation.

$6.2 billion just four years later (see figure IV.7). Figure IV.7 also shows the current magnitude of Japan's semiconductor trade surplus, at $4 'lion in 1988.

The rest-of-the-world grouping achieve. .e most dramatic increase in exports, from $70 million in 1984 to $700 million in 1988. Meanwhile, imports for this group increased from $1,050 million to $3,950 million during the same time period.

Since 1980, the United States has had a deficit in its trade in integrated circuits with Japan (see table IV.18). Thus far, the depreciated dollar has had little effect on reversing that trend. Prior to 1980, the United States exported more chips to Japan than it imported.

Table IV.19 lists the United States' imports and exports of electronic components and devices in 1988 (the United States Department of Commerce lists semiconductors under the broad category "Electronic components and devices", which includes resistors, capacitors, connectors, switches and other products).

Table IV.18. Japan's integrated circuits trade surplus with the United States[a]

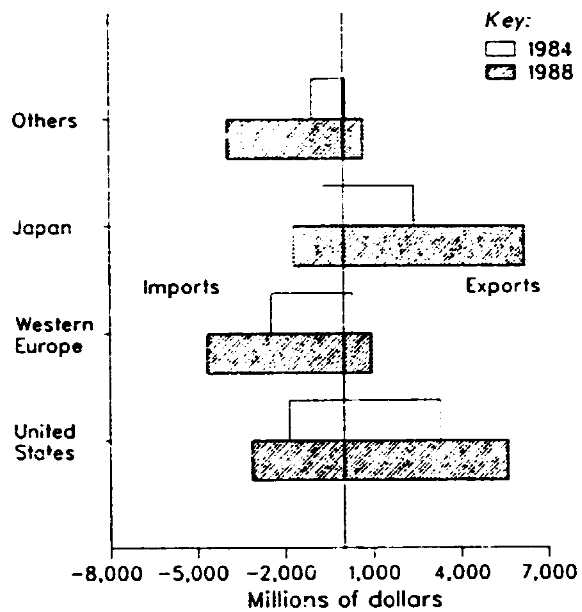
Year	Millions of dollars
1975	- 64
1976	-131
1977	-101
1978	- 93
1979	-130
1980	11
1981	3
1982	133
1983	307
1984	834
1985	376
1986	250
1987	525
1988	750[b]

Source: Electronics Industries Association of Japan, Facts and Figures on the Japanese Electronics Industry (Tokyo, 1988), pp. 107-108.

a/ A positive number indicates Japan had a trade surplus with the United States. A negative number indicates the United States had a trade surplus with Japan.

b/ Estimated.

Figure IV.7. International semiconductor trade, 1984 and 1988



Source: Integrated Circuit Engineering Corporation

Malaysia was the main destination for United States exports of electronic components and devices in that year, and it was number two, behind Japan, for exporting those products to the United States. The figures, however, are misleading. Much of the $1.2 billion worth of United States exports into Malaysia were unfinished products that needed to be assembled and tested there (Malaysia is one of the world's most active sites for semiconductor assembly and testing). After the work was done, Malaysia shipped the finished products back into the United States, which accounted for much of the $1.6 billion in imports that year. The same can be said of Singapore, which bought $670 million worth of United States electronic components and devices in 1988 and exported $990 million worth back to the United States. In contrast, the electronic components and devices shipped to and from Japan and Western Europe are, generally speaking, finished products ready for use in electronics end-products.

Table IV.19. United States' imports and exports of electronic components and devices (including semiconductors), 1988 (Millions of dollars)

Imports from		Exports to	
Japan	3 200	Malaysia	1 200
Malaysia	1 600	European Community	1 170
Singapore	990	Canada	760
European Community	760	Japan	680
Canada	730	Singapore	670
Other	3 680	Other	3 540
Total	10 960	Total	8 020

Source: United States Department of Commerce.

2. *Major companies in the global industry*

It is interesting to note that the top 10 largest companies in the North (which also happen to be the top 10 largest companies in the world) accounted for sales worth $30.65 billion in 1988, roughly 54 per cent of total world-wide production (see table IV.20).*

United States companies are losing their dominance in semiconductors. Six years ago, Texas Instruments and Motorola were the two largest semiconductor companies in the world (see table IV.21). In 1988, the three largest semiconductor companies were all Japanese; Texas Instruments and Motorola fell to numbers five and four, respectively. In fact, of the total world-wide $56.7 billion worth of semiconductor production in 1988, Japanese companies accounted for 45 per cent, United States companies 42 per cent, Western European companies 9 per cent, and companies in the rest of the world 4 per cent.

Table IV.22 shows one market researcher's prediction of the largest semiconductor companies in the world in 1993. Several points are worth noting about the prediction. United States companies, which held five of the top 10 spots in 1983, is forecast to hold only three spots 10 years later. On the other hand, Japan is expected to increase its dominance from four spots to six, during the same time period. According to the forecast, Europe will claim no company in the top 10 in 1993, while Samsung of the Republic of

*Tables for pretax profit and profit margins are difficult to come by because most of the major semiconductor companies are part of larger corporations that do not, in general, break down their profit numbers for each of their divisions. For example, Japan's Matsushita Electric Industrial Company Ltd. is an extremely diversified electronics manufacturer whose total sales in 1988 exceeded $38 billion. In addition to semiconductors, the company makes, among other products, consumer electronics equipment such as television sets, video cassette recorders and stereo equipment. In fact, of the company's total sales in 1988, semiconductors accounted for only $2 billion, and the company does not release information on the profitability of that division.

Table IV.20. The largest semiconductor companies in the world, 1988
(Millions of dollars)

Rank	Company	Country	Sales 1988	Percentage change from 1987
1	NEC	Japan	4 650	44
2	Toshiba	Japan	4 545	52
3	Hitachi	Japan	3 610	43
4	Motorola	United States	2 900	22
5	Texas Instruments	United States	2 750	28
6	Intel	United States	2 330	37
7	Matsushita	Japan	2 080	40
8	Fujitsu	Japan	2 075	51
9	Philips	Netherlands	2 010	25
10	Mitsubishi	Japan	1 940	48

Source: Integrated Circuits Engineering Corporation.
Note: "Captive" producers, companies that manufacture semiconductors for internal consumption only, have been excluded. Thus, IBM, which produced $3.7 billions' worth of semiconductors last year, has been omitted because the company does not sell its semiconductors in the open market.

Table IV.21. The largest semiconductor companies in the world, 1983
(Millions of dollars)

Rank	Company	Country	1983 Sales
1	Texas Instruments	United States	2 350
2	Motorola	United States	1 255
3	NEC	Japan	1 985
4	Hitachi	Japan	1 690
5	Toshiba	Japan	1 460
6	National Semiconductor	United States	1 270
7	Intel	United States	1 170
8	Philips	Netherlands	1 150
9	Advanced Micro Devices	United States	935
10	Fujitsu	Japan	815

Source: Integrated Circuits Engineering Corporation.
Note: "Captive" producers, companies that manufacture semiconductors for internal consumption only, have been excluded.

Table IV.22. The largest semiconductor companies in the world, 1993
(Millions of dollars)

Rank	Company	Country	1993 Sales (projected)
1	Toshiba	Japan	7 400
2	NEC	Japan	7 300
3	Hitachi	Japan	5 700
4	Texas Instruments	United States	4 100
5	Motorola	United States	3 900
6	Mitsubishi	Japan	3 700
7	Fujitsu	Japan	3 600
8	Intel	United States	3 400
9	Matsushita	Japan	3 300
10	Samsung	Republic of Korea	3 200

Source: Integrated Circuits Engineering Corporation.
Note: "Captive" producers, companies that manufacture semiconductors for internal consumption only, have been excluded.

Table IV.23. The South's largest companies
(Millions of dollars)

Rank	Company	Country	1988 Sales	Percentage change from year before	Products
1	Samsung	Republic of Korea	955	192	Discrete semiconductors, CMOS logic, EEPROMs, SRAMs, DRAMs, MPUs
2	Hyundai	Republic of Korea	200	400	DRAMs, SRAMs, EPROMs
3	Goldstar	Republic of Korea	190	58	Discrete semiconductors, Linear ICs, TTL logic, Zilog 80 (Z80) MPUs, CMOS gate arrays, ROMs, SRAMs, DRAMs

Source: Integrated Circuit Engineering Corporation.
Note: CMOS = complementary metal oxide semiconductor; DRAM = dynamic random access memory; EPROM = programmable read-only memory; EEPROM = erasable programmable read-only memory; IC = integrated circuit; MPU = multiprocessor unit; ROM = read-only memory; SRAM = static random access memory; TTL = transistor-transistor logic.

Korea, the first company from the South, will join the list in the number 10 spot.

The South's largest semiconductor companies are all from the Republic of Korea (see table IV.23). Samsung, in particular, has made tremendous progress in a relatively short period of time. The company's sales in 1989 should top $1 billion, and many analysts believe that Samsung will one day emerge as one of the world's largest semiconductor companies. Samsung's success, however, has thus far been based on either older or commodity-like products such as dynamic random access memories. It remains to be seen whether the Republic of Korea will be able to continue their success as they move up-market to more state-of-the-art, value-added semiconductors such as microprocessors and application-specific integrated circuits.

None the less, the Republic of Korea shows little sign of letting up. Goldstar recently began construction of a $2.22 billion semiconductor fabrication facility at Chongju. Hyundai has announced that it will spend $1.15 billion in electronics over the next five years.

There has recently been considerable consolidation among the world's major semiconductor companies. During the past few years, several mergers and acquisitions have occurred, particularly among the major semiconductor companies in the United States. National Semiconductor purchased Fairchild Semiconductor after Fujitsu's unsuccessful attempt. Harris acquired the combined semiconductor operations of General Electric and RCA in 1988. (General Electric had purchased RCA in 1986). Advanced Micro Devices, which recently acquired Monolithic Memories Inc., was itself a take-over candidate in early 1989. Siemens of the Federal Republic of Germany was said to be interested in the purchase.

Much of the consolidation is a reflection of the merger mania that has recently swept the United States. However, the consolidation is also an indication of something else. Less than three decades old, the semiconductor industry is maturing out of the infancy stage, and companies are now realizing that, to succeed in the future, they need a certain critical mass because research and development and capital expansion is becoming prohibitively expensive.

There is a large handful of companies with sales past the $1 billion mark and a host of companies with sales below the $200 million mark. However, very few companies fall between those two sales volumes. Many analysts feel that because of the industry's maturation, very few small- and medium-sized companies will be able to join the major players. There seems to be some sort of barrier at the $1 billion mark, which is why Advanced Micro Devices said it had to purchase Monolithic Memories Inc. Industry analysts have speculated that without the acquisition, it would have taken Advanced Micro Devices considerable time to grow from being a mid-sized company to a major player with sales past $1 billion.

Western Europe's chip-makers also appear to be going through some sort of consolidation process. In early 1989 General Electric of the United Kingdom and Siemens of the Federal Republic of Germany (Europe's number three semiconductor company) were attempting to buy Plessey Semiconductor Ltd. of the United Kingdom (Europe's number four semiconductor company) for $3 billion. Plessey's plight is ironic in that the company acquired Ferranti Electronics Ltd., another major player in the European semiconductor industry, in 1987. Moreover, in late 1988 the United Kingdom's Inmos signed a preliminary agreement to be acquired by SGS-Thomson.

Table IV.24 shows the consolidation that has taken place in Western Europe's semiconductor industry over the past five years. In 1983, the top integrated circuit (IC) companies in Western Europe were all in approximately the same size class. However, the 1988 figures show that two companies—Philips and SGS-Thomson—have broken away from the pack, thanks to major acquisitions. Several years ago, Philips acquired the United States' Signetics, and Italy's SGS-ATES Componenti Elettronici and France's Thomson Semiconductors merged. Some industry analysts believe that the only way in which Western Europe's chip-makers will be able to compete with those from the United States, Japan, and the developing Asian countries is by combining forces. In fact, some pundits believe Western Europe's semiconductor industry will consolidate into just two or three companies within the next decade.

In addition to mergers and acquisitions, companies are also partnering more and more with their competitors, particularly as the cost of manufacturing and research and development for each new generation of semiconductors skyrockets. The market research firm, Dataquest Incorporated, has noted that the number of co-operative ventures among semiconductor companies has soared from a handful in 1980 to 93 in 1987. Many of the alliances are East-West arrangements. For example, Motorola and Toshiba announced, late in 1986, that they would establish a joint venture. Through the partnership, Toshiba is obtaining Motorola's coveted microprocessor technology. In return, Motorola is receiving Toshiba's memory chip know-how. Both companies are also jointly making semiconductors in Japan. Texas Instruments and Hitachi recently announced that they would pool research and development resources. Industry analysts assert that the trend of East-West partnerships will continue in the future.

3. *Manufacturing capacity of developing countries*

Manufacturing in developing countries, with the Republic of Korea the notable exception, has generally been limited to the "back-end", or assembly, packaging and test steps. Wafer fabrication—the complex "front-end" where electronic circuitry is etched on to silicon wafers—is generally done in Japan, the United States and Western Europe. The entire manufacture of semiconductors in developing countries has been limited to low-end semiconductors because manufacturing processes in those countries are below the levels in the North. For example, in China and India, wafer fabrication is done using 2-micron geometries; that is, the smallest width of the etched electronic circuitry is 2 microns, whereas in Japan, the United States and Western Europe, capabilities of 1 micron and below are emerging.

As discussed earlier, the Republic of Korea is the dominant producer of semiconductors in the rest-of-the-world grouping. That country's production is

Table IV.24. The consolidation of Western Europe's semiconductor industry, 1983 and 1988

Rank	Top European IC companies in 1983	Millions of dollars	Rank	Top European IC companies in 1988	Millions of dollars
1	Siemens	200	1	Philips	905
2	Philips	200	2	SGS-Thomson	820
3	SGS-ATES	170	3	Siemens	440
4	Thomson	100	4	Plessey-Ferranti	305
5	ITT	100	5	ITT	200
6	Ferranti	75	6	Inmos	125
7	Inmos	57	7	Telefunken	100
8	Plessey	50	8	Matra Harris	55
9	Telefunken	40	9	Marconi	30
10	Others	48	10	Asea Hafo	30
			11	Others	190
	Total	1 040		Total	3 200

Source: Integrated Circuit Engineering Corporation.

Table IV.25. Production and exports of the Republic of Korea's major semiconductor producers
(January 1989)

Company	Production per month	Percentage of exports	Destination of exports
Samsung	7 million DRAMs a/	40	United States
	400,000 SRAMs b/	30	Western Europe
		20	South-East Asia
		10	Others (including Argentina, Brazil and Japan)
Goldstar	450,000 SRAMs	80	United States
Hyundai	".7 million SRAMs c/	47	Asia
		29	United States
		24	Western Europe
	6 million DRAMs	90	United States
		10	Western Europe

Source: Integrated Circuit Engineering Corporation.
a/ 65 per cent of DRAMs exported.
b/ 70 per cent of SRAMs exported.
c/ 85 per cent of SRAMs exported.

geared towards overseas markets. Table IV.25 shows how the major companies in the Republic of Korea have structured their production.

4. *Capacity utilization and expansion plans, 1988*

During 1983-1984, capacity utilization was extremely high as a result of the personal computer boom. Manufacturers of personal computers could not secure enough chips to meet their demand. Semiconductor manufacturers around the world geared up for the market explosion. Then the personal computer market stalled, leading to serious overcapacity in the semiconductor industry in 1985-1986 (see table IV.26). Demand caught up with supply in 1987-1988 and, in fact, there was a shortage of many types of chips—most notably dynamic random-access memory (DRAM) chips—in 1988. However, some industry anlaysts expect a drop in capacity utilization in 1989 and 1990, owing to a further slackening of demand for personal computers and other electronics products that use semiconductors. World-wide capacity utilization should then recover in 1991-1992, according to many analysts.

Table IV.26 shows that the capacity utilization of the rest-of-the-world grouping increased from 2.1 per cent of total world-wide capacity in 1982 to 5.8 per cent in 1989. The capacity utilization of that region should continue increasing to 7.3 per cent in 1992, according to the market research firm Dataquest Inc. Meanwhile, capacity utilization, as a percentage of total world-wide capacity, has decreased for the United States from 39.5 per cent in 1982 to 25.3 per cent in 1989.

Table IV.27 gives a more detailed view of capacity utilization in semiconductor plants in Japan and the United States, and reveals that Japanese plants generally operate at a higher capacity utilization rate than their counterparts in the United States. Indeed, during 1986, the tail end of the last semiconductor recession, Japanese plants were running at 74 per cent of capacity, as compared with only 59 per cent for those of the United States.

However, not all plants are created equal. In fact, how busy a plant was in 1988 depended very much on the type of technology that facility could handle (see

Table IV.26. Estimated semiconductor capacity utilization, 1982-1992
(As percentage of total world-wide capacity)

Country or country grouping	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
United States	39.5	43.3	42.8	20.3	19.3	24.9	27.4	25.3	25.8	27.4	27.5
Japan	21.9	32.7	40.0	30.0	30.5	38.7	42.1	39.0	36.1	31.0	36.6
Western Europe	8.5	8.6	9.7	7.6	8.2	9.9	10.7	10.4	10.2	10.6	11.0
Other	2.1	2.7	3.1	2.2	3.0	4.6	5.6	5.8	5.4	6.6	7.3
Total world	72.0	86.2	95.6	60.1	61.0	78.1	85.8	80.5	77.5	81.6	82.4

Source: Dataquest Inc.

Table IV.27. Capacity utilization of chip plants in Japan and the United States, 1984-1990
(Percentage)

Country	1984	1986	1988	1990
Japan	90	74	90	80
United States	94	59	88	75

Source: Integrated Circuit Engineering Corporation.
Note: Figures based on five-day working week, two shifts per day.

Table IV.28. Capacity utilization in 1988
(Percentage)

Technology	Capacity utilization
Less than 1.00 micron	105
1.00 to 1.49 micron	95
1.50 to 3.00 micron	90
Greater than 3.00 micron	60

Source: Integrated Circuit Engineering Corporation.
Note: Figures based on five-day working weeks, two shifts per day.

Table IV.29. Estimated semiconductor capital spending
(Millions of dollars)

Country or economic grouping	1984	1985	1986	1987	1988	1989	1990	1991	1992
Japan	3 900	3 336	1 850	2 439	3 796	4 044	3 919	5 238	7 056
United States	3 661	2 629	2 066	2 474	3 332	3 654	3 729	4 640	6 056
Western Europe	843	803	823	843	923	1 061	1 135	1 402	1 706
Others	434	463	299	380	468	545	655	900	1 096

Source: Dataquest Inc.

table IV.28). State-of-the-art plants that could manufacture chips with circuitry of less than 1-micron line widths were running at 105 per cent capacity during the same time period.

Although capacity utilization is expected to drop in the near future, semiconductor capital spending was forecast to rise by 9.2 per cent to $9.30 billion in 1989 (table IV.29), according to Dataquest Inc. But Dataquest predicts that capital spending will increase by only 1.4 per cent in 1990. In fact, Japan is expected to decrease its capital spending by 3.1 per cent to $3.92 billion in 1990. Spending by the rest of the world ("Others" in table IV.29) should, however, remain strong. Countries in that group were spending $545 million on capital expansion in 1989, up 16.4 per cent from 1988, and their spending should rise by another 20.2 per cent in 1990, according to Dataquest.

In particular, the Republic of Korea has been very aggressively increasing its capital expenditure. Table IV.30 shows the individual investments of the major semiconductor manufacturers in the Republic of Korea, the leading industry being Lucky Goldstar, which spent nearly $200 million on capital expansion in 1988.

5. *Restructuring and redeployment*

(a) *Cost of production*

The cost of materials in the semiconductor industry is not, relatively speaking, that significant a portion of the total cost of production. Table IV.31 shows that both research and development expenses and equipment costs outweigh the cost of materials. Labour costs are also significantly less than either research and development or equipment expenses. This is one reason why the bulk of semiconductor production has remained in Japan, the United States and Western Europe.

Analysts do not expect any major changes in the manufacturing cost structure in the foreseeable future. In fact, research and development and equipment costs will probably only increase in proportion to materials and labour costs. Research and development costs are soaring because of the increasing complexity of chip designs. The latest microprocessor from Intel Corporation contains more than one million transistors and the company spent four years and $300 million to develop it. The equipment required to build such a semiconductor is extremely complex and expensive. The price tag for a state-of-the-art photolithography system, used to etch electrical circuitry on to silicon wafers, currently tops the $4 million mark.

Table IV.30. Semiconductor capital expenditures in the Republic of Korea, 1988
(Millions of dollars)

Company	Semiconductor capital expenditures 1988
Goldstar	194
Samsung	107
Hyundai	16
Daewoo	7

Source: Korea Economic Daily, 1988.

Table IV.31. Cost of production in the semiconductor industry
(Percentage)

Item	Total production cost
General and administrative	28.9
Research and development	19.8
Equipment	14.7
Wafer fabrication equipment	10.0
Assembly equipment	1.5
Automatic testing equipment	3.2
Materials	14.1
General materials and chemicals	2.1
Packaging materials	5.3
Silicon wafers	3.8
Masks and service	2.9
Facility construction	5.6
Labour	8.9
Utilities	2.4
Contractors for assembly work	2.1
Miscellaneous	3.5
Total	100.0

Source: Integrated Circuit Engineering Corporation.
Note: Costs are based on 1986 figures for the world-wide semiconductor industry.

(b) *Wage rates in the North and the South*

Although the cost of labour is only 8.9 per cent of the total cost of production (table IV.31), large differences in wage rates still make manufacturing attractive in certain countries in the rest-of-the-world grouping. Table IV.32 clearly shows that wages in the United States are markedly above wages in those countries*.

Wage rates notwithstanding, semiconductor manufacturers from Japan, the United States and Western Europe will generally make only their older products among the rest-of-the-world grouping. In other words, this group is used only for back-end manufacturing processes; in particular, assembly, packaging and test work. The main reason for this is quality control. Manufacturing a state-of-the-art semiconductor is a very intense and complicated process. Electronic circuitry of 1-micron width—roughly 1 per cent of the diameter of a human hair—has to be etched on to 6-inch (15.24 centimetres)-round silicon wafers. The circuitry is so complex that it is equivalent to drawing a road map containing every side street of the entire United States, according to one semiconductor scientist. Because of the microscopic scale used, an extremely clean facility is required for the wafer fabrication process because even a tiny dust particle can spoil the electronic circuitry. In the most advanced wafer fabrication facilities today, one cubic foot (28,300 cubic centimetres) of air contains at most one 0.2-micron particle and nothing larger.**

Table IV.32. Hourly wages for equipment operators, 1987

Country or area	Dollars
United States	10.70
Singapore	3.00
Republic of Korea	2.50
Hong Kong	2.50
Taiwan Province	2.00
Thailand	1.15
Malaysia	0.80
Philippines	0.60
India	0.60

Source: United States Bureau of Labor Statistics; Integrated Circuit Engineering Corporation.

(c) *Adjustments to overcapacity (or undercapacity)*

Detailed employment figures for the world-wide semiconductor industry are difficult to obtain. Individual countries, in general, do not track employment specifically for the semiconductor industry, and neither do industry trade organizations such as the Semiconductor Industry Association of Cupertino, California. The United States, however, is one country that does keep detailed employment figures. Table IV.33 shows that United States employment in the semiconductor industry increased from 223,400 workers in 1980 to 279,100 in 1985. However, employment fell to 247,300 in 1987, the last year for which statistics are available. The decrease was mainly due to the severe recession in 1985-1986, which forced most United States semiconductor companies to cut back their staff. Massive lay-offs during that time were extremely common in Silicon Valley.

Detailed figures for the Japanese semiconductor industry are not easy to obtain. However, table IV.34 shows the total employment of the country's electronics industry, which includes the semiconductor segment.

*Comparable figures could not be obtained for Japan and Western Europe. However, due to the highly appreciated yen, analysts estimate that the cost of production in Japan and the United States is now roughly equal.

**At this manufacturing level, even a flu virus can cause defects.

Table IV.33. United States semiconductor industry employment, 1980-1987

Year	Total number employed
1980	223 400
1981	223 700
1982	225 700
1983	235 000
1984	237 800
1985	279 100
1986	261 200
1987	247 300

Source: United States Bureau of Labor Statistics.

Table IV.34. Total employment of Japan's electronics industry, 1982-1986

Year	Total number employed
1982	947 780
1983	1 044 729
1984	1 189 363
1985	1 201 342
1986	1 211 767

Source: Ministry of International Trade and Industry; and Electronics Industries Association, Facts and Figures on the Japanese Electronics Industry (Tokyo, 1988), p. 29.

(d) *Sourcing of materials and equipment*

Semiconductor materials are not, relatively speaking, that costly a component of the semiconductor manufacturing process (see table IV.31). The major material involved is silicon wafers, which, because of the difficulty in manufacturing them, are made predominantly by Japanese and Western European companies.

There has recently been much concern in the United States because of the country's lack of local silicon wafer suppliers. With the sale of the silicon wafer business of the United States Monsanto Company to Huels of the Federal Republic of Germany, there exists no remaining major domestic supplier of silicon wafers in the United States. In fact, the top seven silicon wafer suppliers—SEH, Osaka Titanium, Wacker, Japan Silicon (owned by Mitsubishi), Komatsu Electronic Metals, Monsanto (now owned by Huels) and Toshiba Ceramics—are all based in Japan or Western Europe. Those seven together controlled about 90 per cent of the $2 billion market in 1988.

As stated earlier, capital equipment is a larger cost component than materials in the semiconductor manufacturing process. In fact, the price tag of a new wafer fabrication facility stocked with state-of-the-art equipment now runs at about $200 million. Within a decade, the cost is expected to reach the $1 billion mark as each succeeding generation of semiconductor products becomes increasingly difficult to manufacture. Today, just one piece of photolithography equipment can top $4 million.

Virtually all semiconductor production equipment comes from the North. Of the top 10 semiconductor production equipment companies in 1987, six were United States-based and the remaining four were Japanese (see table IV.35). The presence of local equipment companies is a major advantage for the United States and Japanese semiconductor-makers. Particularly in Japan, the chip-makers and equipment companies work closely together to develop the equipment needed to manufacture the next-generation semiconductors. By doing so, manufacturing problems can be ironed out at an earlier and less-expensive stage. Also, when a United States or Japanese chip-maker runs into any manufacturing problems, the equipment companies are always nearby to help.

On the other hand, the lack of a semiconductor infrastructure in the Republic of Korea places the country at a significant disadvantage. The Republic of Korea often does not get the latest production equipment, and because the local market there is not yet very substantial, many Japanese and United States equipment companies have no subsidiaries that can adequately service the equipment in the Republic of Korea. The country is currently trying to build up its infrastructure by encouraging indigenous companies to make silicon wafers and production equipment. None the less, it will be some time before the Republic of Korea has a sufficient infrastructure in place.

During the past few years, the high cost of building a fabrication facility and stocking it with the necessary

Table IV.35. Top 10 semiconductor production equipment companies (Millions of dollars)

Rank	Company	Country	Fiscal 1987 sales	Fiscal year ending
1	Nikon	Japan	242	March 1988
2	Perkin-Elmer	United States	212	July 1987
3	General Signal	United States	208	December 1987
4	Advantest	Japan	205	March 1988
5	Applied Materials	United States	174	October 1987
6	Tokyo Electron	Japan	173	September 1987
7	Canon	Japan	151	March 1988
8	Teradyne	United States	130	December 1987
9	Varian	United States	125	September 1987
10	LTX	United States	120	July 1987

Source: VLSI Research Inc.

state-of-the-art equipment has given rise to a new phenomenon in the United States: the semiconductor company without a wafer fabrication facility. Because manufacturing has become prohibitively expensive for many small United States companies, they have chosen an alternative strategy: sub-contracting their manufacturing out to Asian foundries. Innovative Silicon Valley companies like Altera Corp., Chips and Technologies Inc. and Xilinx Inc. decided to concentrate on chip design, leaving their manufacturing for others to do. For various reasons, larger United States companies like Texas Instruments and Intel have also begun to sub-contract out their manufacturing. In fact, one United States market analyst estimates that the world-wide foundry business topped $1 billion in 1988.

So far, companies in Japan and the Republic of Korea have benefited from the windfall. Indeed, Hyundai of the Republic of Korea started in the semiconductor business by making chips for semiconductor companies in the United States. By doing foundry work for others, Hyundai was able to fine-tune its manufacturing processes and the company is now trying to sell on its own the chips that it makes. Several years ago, 80 per cent of Hyundai's production was foundry work, but the figure has since fallen to below 50 per cent and, as Hyundai reaps greater success in selling semiconductors directly to customers, company officials aim at driving the foundry percentage down further, to below 30 per cent.

(e) *Research and development expenditures*

Research and development expenditures on a country basis are difficult to obtain. For the United States, however, rather detailed figures are available. Table IV.36 shows research and development expenditures for the United States semiconductor industry. Although the overall industry average of research and development expenditures as a percentage of sales is 9.5 per cent, many United States companies are spending considerably more than that. For example, Advanced Micro Devices routinely spends in excess of 20 per cent. However, the company, as well as other big spenders in research and development, has lately been under pressure from Wall Street and stock investors to cut back. In fact, many United States corporations are paring their research and development budgets, in part as a defence against hostile take-over attempts, which have reached near epidemic proportions in the United States. Consequently, the relative level of research and development spending in the United States semiconductor industry decreased in 1987, even though the absolute level increased by 12.7 per cent over that of 1986. In other words, research and development as a percentage of sales fell from 10.6 per cent in 1986 to 9.5 per cent in 1987.

On the other hand, the Republic of Korea is dramatically increasing its research and development budget. The country is quickly losing its low-cost labour advantage because the won is rapidly appreciating. It is thus trying to move up-market with higher value-added products.

However, United States and Japanese semiconductor companies have recently become more proprietary with their technology. For example, Intel has steadfastly refused to license the technology for its 32-bit microprocessor, the 80386. In the past, such second-sourcing agreements were commonplace. Moreover, when companies do license their technology, they are now asking for more money. Texas Instruments recently took nine East Asian chip-makers to court in order to collect five to 10 times more in royalties for the dynamic random-access memory (DRAM) technology the company had licensed. Texas Instruments won the legal battle and, as a result, the company could collect more than $250 million by 1990.

Semiconductor companies in the Republic of Korea thus realize that they will probably have to develop their own technology in order to remain competitive. Hyundai spent 25 per cent of its sales on research and development in 1988 and the company was planning to increase such expenditures dramatically in 1989. Hyundai planned to enlarge its research and development staff from 250 in 1988 to 400 workers in 1989. In addition, the Republic of Korea has instituted a series of research co-operatives, many of which have been sponsored by the Government. Table IV.37 summarizes the 18 joint development projects that have been established since 1986. These projects were supported by the Government at a total investment of $226 million. The projects cover a wide range of technologies and involve the country's major electronics manufacturers. They span a short time period, at most three years, which reflects the country's strong desire to catch up with semiconductor technologies in Japan and the United States. All the projects have short-term commercial orientations and, consequently, should have an impact on the global semiconductor industry some time in the early 1990s, according to Dataquest Inc.

One of the reasons for forming consortia is that semiconductor research and development is becoming increasingly expensive. As stated earlier, Intel has reported that the research and development cost of its most recent microprocessor reached $300 million—

Table IV.36. United States semiconductor industry research and development expenditures, 1986 and 1987
(Millions of dollars)

1986	1987	Percentage increase	1986 R+D as percentage of sales	1987 R+D as percentage of sales
1 820	2 052	12.7	10.6	9.5

Source: Electronic Business, 1 September 1988, p. 74.

Table IV.37. The Republic of Korea joint semiconductor development projects, 1986-1990
(Millions of dollars)

Project name	Time period	Participants[a/]	Investment[b/]
Sub-micron Technology	Oct. 1986 - Mar. 1989	ETRI, SST, GSS, HEI	109.8
ETS Standard Cell ICs	Jan. 1987 - Dec. 1989	DTI, GS	4.2
300V Power MOS FET	Jan. 1987 - Dec. 1988	KEC, DTI	4.1
CDP IC	Jan. 1987 - Dec. 1988	GS, DTI	4.9
GaAs Semiconductor Materials	Jan. 1987 - June 1989	GSC, SCC	6.9
High Lead-type Leadframe	Jan. 1987 - Dec. 1989	Pungsan, Anam	47.0
VLSI Level EMC	Oct. 1986 - Dec. 1988	Dongyan Chemical, Anam	1.8
Automotive ICs	July 1987 - June 1989	DEP, KEC, DTI	4.9
GaAs Photo Cell	Oct. 1986 - Sept. 1989	KEC, GS	3.8
Thin-film Transistor	July 1987 - June 1989	GS, DEP	4.9
Digital Video IC	Oct. 1987 - Sept. 1989	GS, DTI	5.0
High-power Transistors	Jan. 1988 - Dec. 1990	KEC, HEI, SST	2.0
32-bit PC ICs	Jan. 1988 - Dec. 1990	DTI, HEI, KEC, SST	5.0
CCD Camera Manufacturing	Jan. 1988 - June 1990	SED, SST	4.5
CCD Image Sensor	Jan. 1988 - Dec. 1990	SED, SST	5.0
DAT IC	Jan. 1988 - Dec. 1989	SEC, SST	5.6
Power Transistor Package	Jan. 1988 - Dec. 1988	Samsung Aerospace, SST	3.9
GaAs Epitaxial Wafer	Jan. 1988 - Dec. 1989	GSC, GS	3.0
		Total	226.3

Source: Dataquest Inc.

a/ Key: DEP = Daewoo Electronic Parts
DTI = Daewoo Telecommunications
ETRI = Electronics Technology Research Institute
GS = Goldstar Company
GSC = Goldstar Cable
GSS = Goldstar Semiconductor
GST = Goldstar Telecommunications
HEI = Hyundai Electronics Industry
KEC = Korea Electronics Company
SEC = Samsung Electronics
SED = Samsung Electron Device
SSC = Samsung Corning Company
SST = Samsung Semiconductor and Telecommunications

b/ Converted at a constant rate of $1 = 800 won.

more than $250 billion just to develop one semiconductor. Consequently, many companies have found that it has become too expensive to conduct certain research and development programmes alone.

In that connection, Texas Instruments, which had previously shunned partnering with its Japanese competitors, has formed an intriguing alliance with rival Hitachi. The partnership concerns 16-megabyte DRAMs—future memory chips that will be able to store 16 times the amount of memory as the latest commercial DRAMs. Texas Instruments and Hitachi are gambling separately on different technologies in developing the 16-megabyte DRAM, and neither company is sure whether it has chosen the right approach. Both companies have therefore agreed to pool their results, thereby lessening the potential risks, estimated at hundreds of millions of dollars. In today's world of staggering research and development costs, such partnerships will most likely continue.

Western Europeans have also set up various consortia. For years the Western European semiconductor industry has been in serious decline. Many analysts believe that the recent flurry of Western European research and development consortia is the region's last chance to re-emerge as a major player in the global semiconductor market. In order to return into the memory-chip market, Philips of the Netherlands and Siemens of the Federal Republic of Germany established their "Megaproject" in 1984. Philips will invest a total of $1 billion, Siemens will invest $600 million, and the two companies' respective Governments have agreed to invest a total of $270 million. So far, Philips has developed a 1-megabyte static random-access memory (SRAM) chip and Siemens has succeeded in developing a 4-megabyte DRAM chip. Both companies are hoping to catch up with the Japanese.

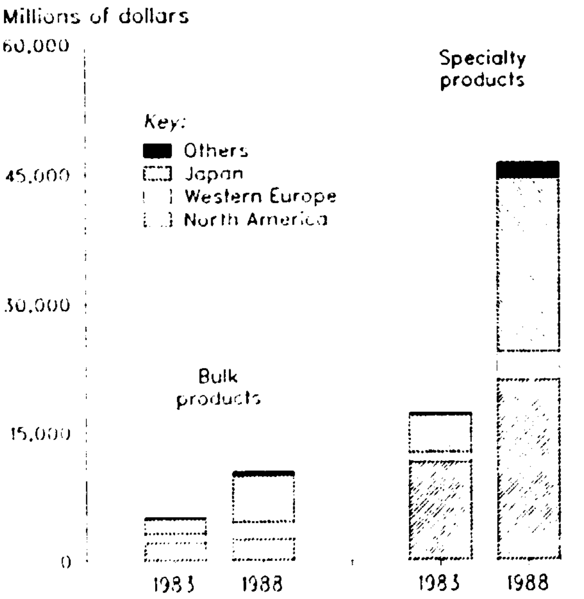
Other Western European consortia include ESPRIT, a $750 million research and development co-operative for micro-electronics, software technology and advanced information processing; and JESSI (Joint European Silicon Submicron Initiative), a $3.3 billion project involving Siemens, SGS-Thomson, Plessey and Philips. JESSI's goal is to develop 0.3-micron chip technology by the mid-1990s.

The United States, which previously shunned such consortia, has recently joined the bandwagon. Various United States chip makers banded together in 1987 to form Sematech, a consortium whose aim is to develop advanced semiconductor manufacturing processes. Sematech's annual budget is roughly $200 million, of which about half will come from the United States Government. So far, 14 United States chip-makers—including major manufacturers like Advanced Micro Devices, Intel, Motorola, National Semiconductor and Texas Instruments—have joined. Sematech's minimum lifetime has been set at five years.

(f) *Shift in production*

One way to measure the shift in production from bulk commodity products to higher-value-added ones is to separate semiconductor production into discrete semiconductors versus the more advanced integrated circuits, which are commonly called chips. Discrete semiconductors such as rectifiers and thyristors are, compared to integrated circuits, relatively primitive, since they are only able to perform one function. Integrated circuits, on the other hand, are much more complex. For example, a microprocessor chip today contains all the brainpower of yesterday's large computers. Comparing discrete semiconductor production versus integrated circuits production gives a general, although admittedly crude, measure of a country's semiconductor manufacturing prowess. Figure IV.8 (and appendix table IV.45) shows that for the "others" country grouping, IC production as a percentage of overall semiconductor production grew from 53.5 per cent in 1983 to 77.6 per cent in 1988. Those countries are clearly shifting their production to higher-value-added products at a rapid pace.

Figure IV.8. World shift in production from traditional semiconductor bulk products to higher value-added products, 1983 and 1988



Source: Integrated Circuit Engineering Corporation

The integrated circuit category can further be broken down into commodity products and high-value-added ones. At the high end of the spectrum, application-specific integrated circuits (ASIC), which are integrated circuits customized to meet a customer's specific requirements, are among the most sophisticated and complicated of semiconductors. Table IV.38 shows that United States companies control the

Table IV.38. World-wide ASIC sales, 1988 (Total = $4.945 billion)

Company origin	Percentage share of total
United States	54
Japan	38
Western European	8
Others	–

Source: Integrated Circuit Engineering Corporation.

world-wide ASIC market. The "others" group has yet to penetrate this market segment.

In contrast to ASICs, metal-oxide semiconductor (MOS) memory integrated circuits are more like commodities, since they can, in general, be used by a wide range of customers. Table IV.39 gives a breakdown of the major MOS memory suppliers in the world. The market is clearly dominated by the Japanese, who commanded a 71 per cent share in 1988. United States firms were a distant second with 19 per cent.

More than a decade ago United States firms were the dominant suppliers of MOS memory chips. However, many of those firms were forced out of the market in the 1980s by severe Japanese price-cutting. In particular, Intel, which founded the DRAM market, was driven out, and, in a somewhat humiliating turn of events, Intel now resells DRAMs that it buys from Samsung of the Republic of Korea. There are currently only two United States manufacturers of DRAMs left—Micron Technology and Texas Instruments.

The DRAM episode reflects a fundamental weakness of the United States semiconductor industry. United States chip companies are quick to develop innovative products. However, the companies often are unable to reap the full benefits of their inventiveness once the products become commodities. Industry analysts cite a lack of competitive manufacturing as the culprit.

(g) *Foreign direct investments*

United States companies are continuing to expand their manufacturing in Asia. Motorola, for example, has announced that it would spend $300 million on a semiconductor and telecommunications factory in

Table IV.39. 1988 world-wide MOS memory-chip market (Total = $11.0 billion) (Percentage)

Supplier	Percentage of market in 1988
Japan	71
United States	19
Western Europe	3
Others	7

Source: Integrated Circuit Engineering Corporation.

China. The company also stated that it would build a $47 million wafer fabrication facility in Malaysia by 1991.

Because of the high-valued yen, the Japanese, too, are doing more manufacturing offshore (see table IV.40). Sony is building its first overseas wafer fabrication facility, which was scheduled for start-up in Thailand in 1989.

Table IV.40. Overseas electronic component and device production facilities[a/] of Japanese corporations, 1986

Country or area	Number of facilities
North America	33
United States	31
Canada	2
Western Europe	21
Germany, Federal Republic of	7
United Kingdom	6
Spain	2
Ireland	2
Belgium	2
France	1
Italy	1
Others	183
Taiwan Province	62
Republic of Korea	42
Singapore	30
Malaysia	14
Brazil	13
Hong Kong	7
Mexico	7
China	3
Thailand	2
Philippines	2
Indonesia	1

Source: Electronic Industries Association of Japan, Facts and Figures on the Japanese Electronics Industry, (Tokyo, 1988), p. 25.
a/ Including semiconductor facilities.

(h) *The role of Governments*

Various Governments are playing a major role in industrial restructuring. As mentioned earlier, a growing mood of protectionism—in the United States and Western Europe (through the single European market of 1992)—is already affecting the investment decisions of many semiconductor companies.

In addition, most Governments of the North and many of the South have decreed semiconductors to be a national priority. Thus, financial subsidies, often in the form of government-assisted consortia, are common. As discussed earlier, the Governments of the Republic of Korea, Japan, the United States and Western Europe have all helped to fund various research and development projects. In Japan, MITI takes an active role in planning the future of the semiconductor industry. For example, during the latest memory-chip glut, MITI strongly suggested to the various semiconductor companies in Japan that they cut down their production of such chips by a specified amount.

For South-East Asian countries, government help comes in the form of certain incentives for foreigners to manufacture there. For example, as discussed earlier, the Government of Malaysia gives tax breaks to foreign companies to induce them to manufacture semiconductors in Malaysia.

(i) *Major bottle-necks*

For countries of the North, the pace of expansion is usually held back by limited capital. As was discussed earlier, building a wafer fabrication facility currently costs more than $200 million. Very few companies can afford that kind of expenditure without incurring some financial hardship.

The problem of limited capital pertains to countries of the South as well. Those countries also face other limiting factors. The Republic of Korea's predicament is a case in point. Several years ago, the country's chaebol, or industrial conglomerates, targeted electronics as a lucrative and important market. Money was no object. To date, Hyundai—a shipbuilder, car-maker and construction engineering power-house—has spent more than $300 million to break into the electronics market. Samsung, Lucky Goldstar and Daewoo have similarly spent hundreds of millions of dollars. However, progress has been slower than expected owing to a lack of technical know-how and experienced engineers in the country. In fact, Hyundai executives admitted that the Republic of Korea's lack of technical talent is currently one of Hyundai Electronics' most crucial problems.

6. *Technological trends, new products development and new processes*

(a) *Future technologies*

Technology is important in any industry, but it is crucially important in the semiconductor industry because of short product life-spans. Time-to-market is a critical concept. Getting to the market six months earlier than a competitor can mean a difference of millions of dollars of sales. A new memory chip, when first introduced in the market-place, can command a price of above $100. Three or four years later that same memory chip might sell for under $5, particularly if the next-generation memory chips have already arrived in the market-place.

The technology having the most impact on shortening the time-to-market of semiconductor products is computer-aided engineering (CAE), CAD and CAM, which involve the use of a computer to design and manufacture a chip. In fact, many complex chips today are too complicated for engineers to design manually. Computer tools are essential to design and lay out the hundreds of thousands of transistors that need to be placed on a thumb-nail sized area. The widespread use of computer-aided tools has given rise to a $5 billion industry in the United States, according to the market researcher Datatech Inc.

In terms of new products, different materials are always being studied as possible replacements for the ubiquitous silicon. One material that has been investigated for years is gallium arsenide, which conducts electricity roughly five times faster than silicon. Thus, gallium arsenide chips, and the computers made from them, will be able to process information that many times faster. However, gallium arsenide is a costly and difficult material to work with. Nevertheless, a number of United States firms are pioneering the market for this material, which reached around $130 million in 1988. In addition, various Japanese conglomerates such as Fujitsu, Hitachi and NEC are conducting research on the material.

In the process-technology area, the BiCMOS process—a hybrid of the bipolar and complementary metal-oxide semiconductor (CMOS) processes—holds much promise. BiCMOS combines the speed advantage of the bipolar process with the low-power and density—the ability to pack more circuitry into a given area—advantages of CMOS. Integrated Circuit Engineering Corporation predicts that the market for BiCMOS chips will soar from $50 million in 1988 to $1.5 billion in 1993.

Another important technology is that of semiconductor production equipment. Etching electronic circuitry less than 1.0 micron wide on a wafer of silicon is a demanding process that taxes the capabilities of photolithography. Up to now, optical lithography has been used with great success. However, it becomes unwieldy below 0.5 microns because, at that scale, the wavelength of light is too large to etch the circuitry. Consequently, equipment producers are investigating equipment that uses either X-rays or electron beams. The Japanese, in particular, are concentrating on X-ray lithography research.

(b) *Research and development in the South*

The United States, Japan and Western Europe lead the world in semiconductor research and development. However, a country of the South—the Republic of Korea—is making rapid progress in this field. The International Solid State Circuits Conference, held annually in the United States, gives a good indication of where the latest semiconductor technologies are being developed. At the Conference held in New York in February 1989, 39 of the technical papers presented were from the United States, 35 from Japan, 14 from Western Europe and one—on a gallium arsenide semiconductor—from the Republic of Korea. Less than two decades ago the bulk of the Conference papers were from the United States and Western Europe; Japan was a minor participant then.

(c) *North versus South*

As stated earlier, labour and material costs are not a very large percentage of overall production costs. For that reason, it is unclear whether the North will ever use the South for much more than back-end manufacturing or low-end production. It appears that for other countries to become major players in the global semiconductor industry, they will have to develop their own indigenous industry, as the Republic of Korea is currently trying to do by supporting local companies like Hyundai, Samsung, Lucky Goldstar and Daewoo.

The intrinsic technology content of CAE systems for micro-electronic components opens up promising avenues for the development of ASIC and user-specific integrated circuits in developing countries. Possibilities for multi-source prototyping and siliconization make this option particularly attractive for developing countries.

7. *Short- and medium-term outlook*

Most industry analysts expect countries other than Japan, the United States and those of Western Europe to play an increasingly large role in the global semiconductor industry. Integrated Circuit Engineering Corporation predicts that the semiconductor market of those countries will grow from 13 per cent of the total world-wide market in 1988 to 20 per cent in 1993. Those figures are based on the fact that production of electronics equipment—end-products like personal computers, video cassette recorders and telecommunications gear that use semiconductors—is rapidly moving to Asian countries and areas such as Hong Kong, the Republic of Korea, Singapore and Taiwan Province.

A shift in semiconductor production is expected to follow the market shift. Production is already increasing dramatically in certain countries. The increase, however, has been more the result of a concentrated domestic effort, as in the case of the Republic of Korea, than a concerted effort by foreign manufacturers from Japan, the United States and Western Europe. Nevertheless, companies from those countries of the North currently do a significant part of their manufacturing in the rest of the world and will continue to do so in the near future.

Manufacturing by Northern countries in the rest of the world has been so far mainly limited to low-end products or, if high-end products are involved, only the back-end of manufacturing through such operations as assembly and packaging. This situation will probably not change in the near future for several reasons. First, to manufacture state-of-the-art semiconductors, a high degree of manufacturing expertise is needed, expertise that countries in the rest of the world generally lack. In fact, many United States companies have great difficulties making such chips in the United States, even with trained personnel and advanced production equipment. Secondly, labour and material costs are not, comparatively, a major percentage of overall production cost. Thirdly, many countries in the rest of the world lack the necessary infrastructure, such as reliable power and water supplies, adequate telecommunications and local production equipment support.

Appendix

World-wide semiconductor industry statistics

Table IV.41. World semiconductor production, 1974-1988
(Billions of dollars)

Year	Production	Percentage increase
1974	5 905	14
1975	4 890	-17
1976	6 655	36
1977	7 935	19
1978	10 160	28
1979	13 015	28
1980	16 645	28
1981	17 445	5
1982	17 805	2
1983	22 235	25
1984	32 750	47
1985	28 855	-12
1986	34 760	21
1987	41 900	21
1988	56 710	35

Source: Integrated Circuit Engineering Corporation.

Table IV.42. World semiconductor production and consumption 1987 and 1988
(Millions of dollars)

Country or region	Production		Consumption	
	1988	1987	1988	1987
United States	22 200	18 500	21 100	16 500
Western Europe	6 100	5 200	8 500 a/	6 400
Japan	23 500	18 700	19 100	14 300
Other	2 300	1 200	3 900	6 100
Total world	54 100	43 600	41 100	54 800

Sources: Dataquest Inc.; and Integrated Circuit Engineering Corporation.

a/ Including the world's third, fourth and fifth largest consumers in 1988:

Germany, Federal Republic of	2 346
United Kingdom	1 844
France	1 292

Table IV.43. Electronic equipment production
(Percentage shares)

Country or region	1984	1988	1993
United States	55	40	35
Western Europe	18	20	20
Japan	16	23	24
Others	11	17	21
Total world (billions of dollars)	275	490	740

Source: Integrated Circuit Engineering Corporation.

Table IV.44. International semiconductor trade, 1984 and 1988
(Millions of dollars)

Country or region	Imports from 1984	Imports from 1988	Exports to 1984	Exports to 1988
United States				
Japan	1 585	2 200	700	1 400
Western Europe	200	450	2 000[a]	3 200[a]
Others	70	500	600	1 000
Total	1 855	3 150	3 300[a]	5 600[a]
Japan				
United States	700	1 400	1 585	2 200
Western Europe	..	200	465	1 350
Others	..	100	350	2 650
Total	700	1 700	2 400	6 200
Western Europe				
United States	2 000[a]	3 200[a]	200	450
Japan	465	1 350	..	200
Others	..	100	100	300
Total	2 465	4 650[a]	300	950
Others				
United States	600	1 000	70	500
Japan	350	2 650	..	100
Western Europe	100	300	..	100
Total	1 050	3 950	70	700

Source: Integrated Circuit Engineering Corporation.
a/ Including production of United-States-owned plants in Western Europe.

Table IV.45. World-wide shift in production from traditional semiconductor bulk products to higher-value-added products, 1983 and 1988

Country or region	Traditional bulk products: discrete semiconductors 1983 (millions of dollars)	1988	Speciality products: integrated circuits 1983 (millions of dollars)	1988
North America	2 145	2 530	11 475	21 025
	(15.7)	(10.7)	(84.2)	(89.2)
Western Europe	935	1 880	1 040	3 200
	(47.3)	(37.0)	(52.6)	(63.0)
Japan	1 790	5 500	4 420	20 300
	(28.8)	(21.3)	(71.2)	(78.7)
Others[a]	200	510	230	1 765
	(46.5)	(22.4)	(53.5)	(77.6)
Total world	5 070	10 420	17 165	46 290
	(22.8)	(18.4)	(77.2)	(81.6)

Source: Integrated Circuit Engineering Corporation.
Note: Figures in parentheses indicate percentage of production.
a/ Excluding CMEA countries, but including China.

C. Telecommunications equipment industry (ISIC 3832)*

1. *Present situation*

The world's telecommunications industry is currently enjoying a period of dynamic growth which looks set to go on for at least another decade. During the 1980s, the market for telecommunications equipment has expanded rapidly, and the rate of growth has recently accelerated. In 1986, the total world-wide market for telecommunications equipment is estimated to have been around $81 billion. This figure rose to about $98 billion in 1988, and is set to increase to $113 billion in 1989. Forecasts suggest that it could jump to $180 billion by the end of the century, with growth rates slowing down in the first five years of the decade, and speeding up in the last five (see figure IV.9).

There are three main factors behind the boom in sales. First, there have been a series of technological breakthroughs that have put pressure on telephone operating companies to modernize their networks. These technology changes revolve around the shift from analogue to digital signalling—handling telephone calls as a series of electronic digits rather than sound waves. New telephone exchanges are being installed to replace the current generation of mechanical switches. This is being accompanied by big investments in fibre-optic cables, which have a much greater capacity than the present generation of copper cabling.

Second is the issue of deregulation. In all developed countries, Governments have been following the lead of the United States, Japan and the United Kingdom in opening up the telephone industry to new competition. This has meant reducing the monopoly powers of the big telephone companies, which are usually State-owned, and have traditionally had the right to control virtually every aspect of telecommunications. In some countries, new operators owning their own telephone cables are entering the market. In many others, the handling of data traffic—as opposed to normal voice conversations—can be done by private operators over lines leased from the telephone companies. Elsewhere, value-added services, in which some form of unique information is added to the standard call, are springing up. All of these demand additional investment.

Deregulation is also opening up the exciting new area of mobile communications. This is a market with great potential for the last decade of the century, with big new investments already afoot in Europe and the United States, and likely to spread rapidly to East Asia as well. The ramifications of growth in mobile communications are by no means clear as yet, because of the mix of technologies that can be used, and the different markets that can be tackled. But equipment manufacturers undoubtedly see this area as a major target for expansion.

Finally, equipment sales are also being driven by economic considerations. The development of the use of computers, the growth of transnational business, and the market advantages yielded by swift exchanges of information have all led to an increasing need for efficient communications. In recent years, the integration of financial markets, particularly the stock and money markets in London, New York and Tokyo, have also demanded big investments in telecommunications.

At the same time, telecommunications investments are increasing in both developing countries and the centrally planned economies of Eastern Europe, the USSR and China. Expenditure in some developing countries, where there is an acute shortage of both investment capital and skilled workers, is being helped by World Bank financing.

(a) *Market trends*

The manufacturing side of the telecommunications industry is part of the rapidly expanding information technology sector. This can be seen as including telecommunications services, computer equipment and computer services as well. In its entirety, the information technology industry amounted to sales of around $500 billion in 1985, and is expected to reach almost $890 billion in 1990, with by far the biggest volume of sales being generated in telecommunications services at about $290 billion in 1985 and an estimated $450 billion in 1990.

This growth in the volume of telephone traffic lies behind the increasing demand for equipment. Old systems are being replaced by the latest technology, and new markets are being opened up geographically. The balance of these different markets can be judged fairly accurately by the installed base of main telephone lines, which is now approaching 40 per cent of the population in developed countries. The United States, for example, has around 122 million installed lines, followed by Japan with 46 million and the USSR with 29 million. The Federal Republic of Germany, where telecommunications policy has been directed since the late nineteenth century towards making a reasonably priced telephone available in every household, now has 26 million lines, and France 24 million. The United Kingdom follows with 22 million and Italy with 18 million.

Given these figures on telephone installations, it is no surprise that the biggest single market for telecommunications equipment is the United States, which, in the early 1980s, accounted for about 40 per cent of world sales. In 1982, out of a total market of $46.9 billion, measured in constant 1979 dollars, sales in North America (including Canada) accounted for $19.9 billion, or about 42 per cent. Europe generated $12.5 billion of equipment sales (25 per cent). The rest of the world lagged far behind these three large developed zones, with Latin America spending only $1.4 billion, Africa $0.4 billion, and other areas $0.9 billion.

The United States remains in the dominant position, although Europe is currently going through a spurt of investment that is giving it a greater share of total sales. In 1986, the United States accounted for sales of $24 billion, well ahead of Japan with $7.1 billion and the Federal Republic of Germany with $5.9 billion. The USSR, however, was the second largest spender in the world, with sales of $8.4 billion, although most of the equipment was supplied from within Eastern Europe, with very few orders percolating through to

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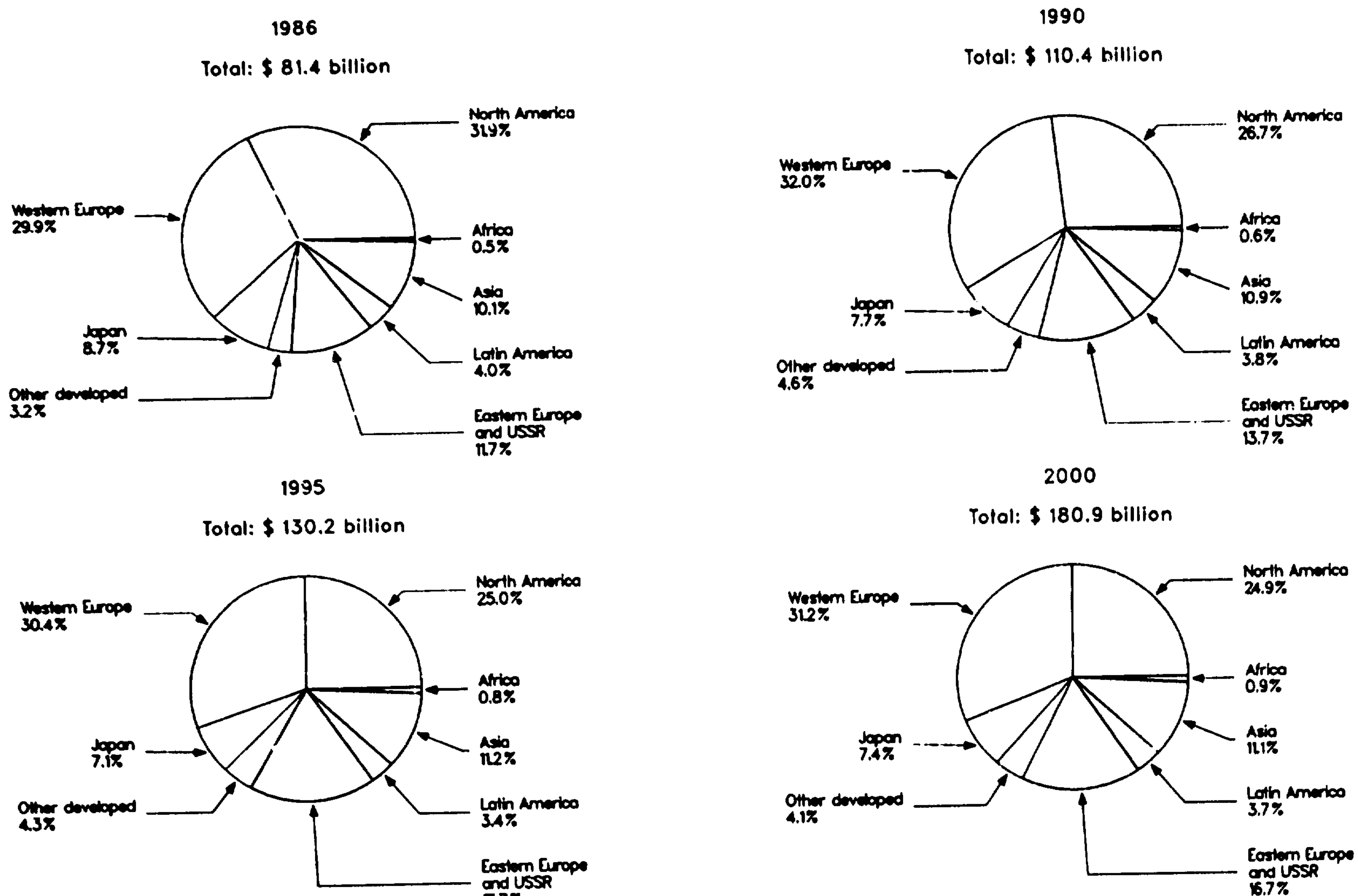
*UNIDO acknowledges the contribution made by Terry Dodsworth, Industrial Editor, *Financial Times*

Figure IV.9. Telecommunication markets, 1986-2000



Source Telecommunications Research Centre and United States Government statistics the developed market economies. France's spending amounted to $4.5 billion, followed by Italy ($3.9 billion) and the United Kingdom ($3.1 billion).

(b) *Production*

Output has responded to increased demand by leaping ahead. Telecommunications manufacturing facilities are concentrated, like the industry's markets, in developed countries, though within these, Japan has steadily been capturing an increasingly large market share.

Like all areas of the telecommunications industry, the statistics are open to considerable distortion because of the problem of drawing a clear distinction between telephone equipment and other electronics products. But an indication of the growth is given in figures published by Benn Electronics on output in 14 European countries—Austria, Belgium, Denmark, Finland, France, Federal Republic of Germany, Ireland, Italy, Netherlands, Norway, Spain, Sweden, Switzerland and United Kingdom. Production in those countries amounted to $14.1 billion in 1985. In constant dollars, after adjusting for inflation, output rose in the following year to $17.8 billion, reaching $18.8 billion in 1987, and $19.3 billion in 1988.

In the United States, where the manufacturing industry has been under great pressure from imports over the past few years, the market has nevertheless been strong enough to support strong advances in production. Output grew to $34 billion in 1988 from $31 billion in the previous year, and is set to expand to $37.5 billion in 1990. Japan, the second largest national producer in the world, with four strong companies in Hitachi, NEC, Toshiba and Fujitsu, has an industry about half the size of that of the United States, with output in 1987 of approximately $15.4 billion. This is forecast to rise to around $18 billion by 1991.

(c) *Trade*

Trade in telecommunications products has become a significant issue over the past few years because of the sudden surge in Japanese exports and the comparative imperviousness of the Japanese market to imports. The main target in this process has been the United States, which has seen its trade deficit in telecommunications rise to well over $1 billion a year. Foreign companies have flooded into the market in the wake of deregulation, taking the lion's share of sales for low-cost items such as telephone handsets, where there has been a distinct manufacturing advantage in the cheap-wage countries of South-East Asia. Japanese producers have also had a big impact in other specialized areas such as land-based satellite equipment.

To a certain degree, Europe has also been hit by a similar drive from overseas, with the United Kingdom's deregulated markets coming under particular attack. Like the United States, the United Kingdom has also slipped into a deficit on its telecommunications products, moving from a small surplus in 1983 to a deficit of about $200 million by 1986. Other countries in Europe have also been affected, so that the region overall has seen a fall in its surplus on telecommunications trade. But most of the leading producer countries are still generating more than enough exports to cover the inflow of products. In the Federal Republic of Germany, for example, telecommunications exports rose from $747 million in 1985 to $937 million in 1986, but at the same time imports were held down to only $163 million and $235 million (see table IV.46).

In France, imports rose from $87 million to $102 million in the same period, but exports advanced from $462 million to $482 million. Sweden has also maintained an exceptionally strong position: its imports jumped from $150 million to $200 million between 1985 and 1986, while its exports in the same period

Table IV.46. European trade in telecommunications equipment
(Millions of dollars)

Country	Telecommunications Exports 1985	Exports 1986	Imports 1985	Imports 1986
Austria	30	43	54	83
Belgium	191	336	106	143
Denmark	48	68	70	110
Finland	69	97	65	81
France	462	482	87	102
Germany, Federal Republic of	747	937	163	235
Ireland	113	141	81	83
Italy	168	219	192	235
Netherlands	145	172	188	278
Norway	52	72	116	184
Spain	25	36	72	128
Sweden	962	986	150	200
Switzerland	82	114	70	118
United Kingdom	310	321	413	534
Total	3 404	4 005	1 827	2 512

Source: Benn Electronics, Yearbook of World Electronics, 1988.

stood at $962 million and $986 million, in 1985 and 1986, respectively. Belgium has similarly maintained a strong export record, helped by foreign producers who use it as a convenient base. Its overseas sales jumped from $191 million to $336 million between 1985 and 1986, while its imports rose from $106 million to only $143 million.

The United Kingdom was the main deficit country, partly because of its failure to generate exports as strong as those of the Federal Republic of Germany and France. The United Kingdom industry's overseas sales in 1985 amounted to only $310 million, rising to $321 million in the following year, but in the same period its imports jumped from $413 million to $534 million. Italy, similarly, had imports of $192 million in 1985, increasing to $235 million in 1986, a period in which its exports increased from $168 million to $219 million. Spain, which is in the process of aggressively expanding its telecommunications sector, was also in deficit, with imports rising from $72 million to $128 million, while exports rose from only $25 million to $36 million.

As can be seen, both the Federal Republic of Germany and Sweden are among the largest world telecommunications equipment exporting countries. But Japan is by far the biggest, with overseas sales of about $2.9 billion in 1987, on an actual, rather than inflation-adjusted, basis. The United States had exports in the same year of just under $1 billion, while the fastest growth was concentrated on one country and one area in South-East Asia—the Republic of Korea, whose exports reached $460 million in 1987, and Taiwan Province, which registered $400 million worth of overseas sales (see figure IV.10).

Because telecommunications is such a large industry, the sudden strength of Japanese exports, combined with the problem that the United States and the United Kingdom have had in containing imports, has led to increasing sensitivity over trade imbalances. The problem has been partly caused by the moves to market liberalization, which have made it possible to attach more and more products to the public telephone network without the direct intervention of the telephone authorities—traditionally, many of the public telephone groups had a monopoly on installations, and frequently on the equipment supplied as well. When these controls were abolished in the United States and the United Kingdom, the way was open for battle, based essentially on prices.

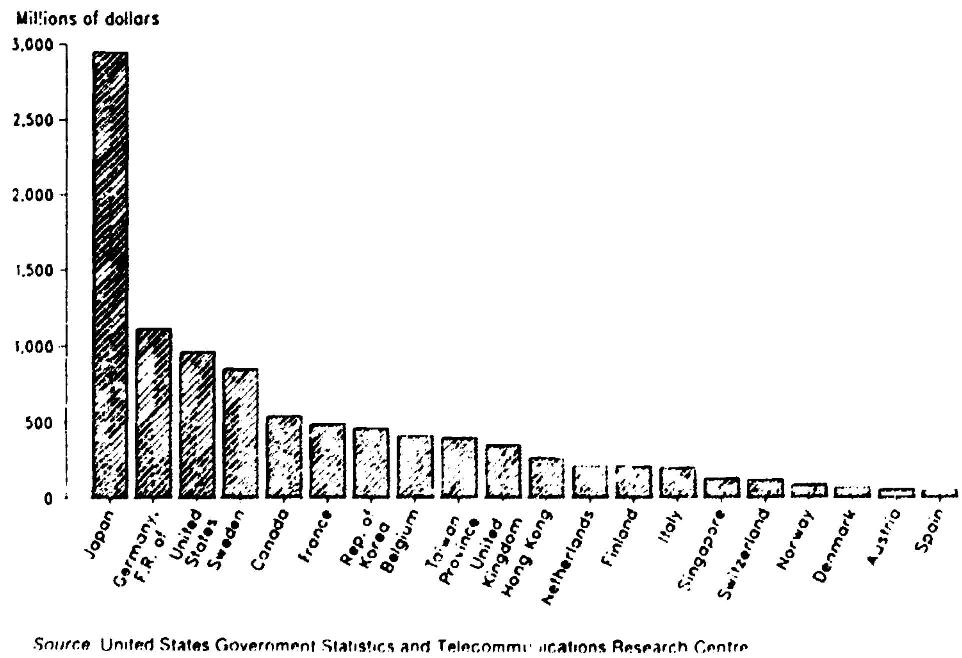
Similar shifts could occur elsewhere if some of the liberalization plans being hatched by Governments all over the world come to fruition. The EEC Commission, for example, has driven through a new rule saying that small attachments to the network will be opened to the competitive market place. It is also moving towards a more open policy on procurement for the large exchanges and other infrastructure equipment which control the telephone system.

These trends will give opportunities to new competitors, just as they already have in the United States, but both the United States Government and the European Economic Commission have made it clear that if the trade balance swings too far in the disfavour of domestic companies, there could be retaliatory action against the overseas companies benefiting from the policies of liberalization. Hence, the situation is delicately balanced between further opening of markets and retaliatory protectionism.

(d) *Product sectors*

One of the statistical problems in dealing with the telecommunications industry is the wide variety of equipment that goes into the make-up of a telephone network. In calculating trade flows, for example, it is

Figure IV.10. Top 20 telecommunication equipment exporters in 1987



Source: United States Government Statistics and Telecommunications Research Centre difficult for reporting agencies to know how to treat semiconductors, which move relatively freely across trading barriers today, and which now form a crucial element in switching equipment. Even without problems of this sort, the industry is complex, and it is becoming increasingly complicated as new technologies develop. Today, for instance, the world is in the middle of an explosion in mobile telephone technology, which is spawning new products virtually every day.

The largest single area of sales is in the public switching market—the large telephone exchanges which lie at the heart of telephone networks. Expenditure on this equipment has been strong since the early 1980s, as the telephone companies swung into a period of modernization with the advent of digital switches. In the world's 50 largest markets, which account for about 97 per cent of the world's total investments in telecommunications, spending on this sort of equipment amounted to $22 billion in 1986, or some 27 per cent of total capital expenditure on telephone equipment in the countries concerned.

Transmission products which handle the signalling in the network are the next largest area of sales, accounting for $18.9 billion worth of manufacturers' revenues in 1986, or just over 23 per cent of the largest 50 markets. Spending on cables amounted to $7.4 billion, or 9 per cent, a testimony to the rapid acceleration in the installation of new fibre-optic cables throughout the world. The strength of revenues in this branch underscores the importance now attached to new cabling, because the dramatic fall in fibre-optic cable prices is forcing the industry to run much harder to stay still in financial terms.

Customer premises equipment (CPE)—telephone handsets, telexes and facsimile machines—also accounts for a large slice of the industry sales, generating revenues of $7.5 billion, or 9.2 per cent of the overall market. Particularly, customer premises equipment plays a dominant role in the development of United States imports. Telephone sets are by far the largest import product category and five of the major nine import products definitely belong to customer premises equipment. Assuming that telephone sets, telephone answering machines and facsimile belong to line equipment, at least two thirds of United States imports of line equipment consisted of customer premises equipment in 1986 (see table IV.47).

At the same time, Europe has now reached lift-off point, and is planning the development of a new digital pan-European system that will allow conversations from mobile handsets throughout the region. Several producers are investing heavily in research and development expenditure to break into this promising new area. Another inducement to join the mobile bandwagon is the buoyancy of demand for this type of equipment in East Asia. Indeed, United Kingdom executives working on the proposed new "telepoint" system in the United Kingdom—a mobile system which allows customers to make calls connected by radio link to the public telephone systems—believe that the next major market for the product may be in East Asia.

Some forecasts suggest that sales in the mobile industry will shoot up by around 80 per cent—admittedly from a low base—by 1990. Data communication is likely to be the next fastest area of expansion, growing at a rate of about 14 per cent a year, and moving sales up to $9.8 billion by 1990. Growth in this branch is being headed by the United States, where the liberalized market has encouraged the development of large corporate data communications networks. Japanese spending is also increasing rapidly under the influence of similar deregulation policies, and is expected to reach $930 million by 1990 from $637 million in 1986.

Table IV.47. Key United States import product categories (Millions of dollars)

	Category	1986
1	Telephone sets	963
2	Telephone answering machines	278
3	Cordless telephones	229
4	Cellular telephones	104
5	Facsimile	212
6	Telephone switching apparatus	408
7	Radio apparatus/parts	567
8	Telephonic apparatus	253
9	Transceivers	212
1-5	Customer premises equipment	1 786

Sources: *Financial Times* and United Kingdom Government statistics.

Office exchanges fill the number three position in terms of expansion, with a forecast average annual growth rate from 1986 to 1990 of 7.6 per cent. Spending in this branch reached $6 billion in the 50 largest world markets in 1986, and is undergoing a cyclical upswing as companies increasingly take advantage of the latest digital technology.

2. *The world's leading companies*

The world telecommunications industry is dominated by 10 major suppliers, all of which are located in the three main developed areas of the United States, Europe and Japan. Although there is some manufacturing outside those areas, much of it is under licence from the leading companies, or under a joint venture arrangement. The main exception to this rule is Eastern Europe and the USSR, which meet a large part of internal consumption with local production. But China, for example, is now beginning to expand its telecommunications industry very much in co-operation with companies from developed market economies willing to invest in the country in joint projects.

The relative strength of the big 10 companies is not easy to gauge. They come from countries with widely different industrial and financing traditions, so that their financial results are not strictly comparable. Companies from Japan and continental Europe, for example, normally carry much more debt in their balance sheets than United Kingdom and North American groups, which are more reliant on equity funding.

Profits also tend to be understated in the continental European and Japanese companies compared to their

Anglo-Saxon rivals. The continentals and the Japanese run a negligible risk of take-over on grounds of low profitability, and their funding is more dependent on understanding banks than critical shareholders.

The most commonly used measure of size and market position is the position of the different companies in the public switching market for large telephone exchanges. This equipment is the most crucial part of any telephone network, and the companies that have a strong position in this branch tend to have a firm base for growth because of the long-term nature of the investments involved—once a telephone company has decided on a particular technology it cannot easily change for many years.

This part of the market accounted for about $19 billion of sales in 1986, with American Telegraph and Telephone of the United States showing a clear lead over the rest of the industry with a 25 per cent market share. The French company Alcatel, was the next largest, with 18.5 per cent, followed by Siemens of the Federal Republic of Germany with 13.2 per cent and Northern Telecom of Canada with 10.5 per cent. The other six were Ericsson of Sweden (8.3 per cent), NEC of Japan (8.3 per cent) GEC-Plessey Telecommunications of the United Kingdom (5.1 per cent), Fujitsu of Japan (4.6 per cent), Telettra/Italtel of Italy (3.9 per cent) and GTE of the United States (2.3 per cent).

Many of those companies are not only producers of switching equipment. They also manufacture other key items that go into telephone networks, such as transmission equipment which sends signals along the telephone lines, and the cables themselves. Some also produce radio equipment, which is increasingly being linked into telephone networks. This comprises transmission and reception products, microwave items and both satellites and satellite earth stations. About 90 per cent of the total market in all of these products is provided by 27 companies, most of them transnational corporations with interests in a diverse number of countries.

Of those corporations, nine groups are based in the United States, one in Canada, 13 in Western Europe and five in Japan. Apart from the big switch producers mentioned above, the most important groups are IBM, the United States computer producer which also has extensive telecommunications interests, Motorola of the United States, which has become one of the most important suppliers of mobile equipment, Nokia of Finland, which is another big mobile communications company, and three Japanese companies—Hitachi, Toshiba and Fujitsu. Standard Telephones and Cables, the United Kingdom group, has also established itself as one of the leading cable and transmission companies, and is the world's leader in the developing market of underwater cables. In addition, Philips, the Netherlands-based group, is a strong player in Europe with its office systems.

Taking telecommunications products as a whole, not just switching systems, the two world market leaders are still unquestionably AT&T and Alcatel—the latter having jumped to its present place in the world league by purchasing the telecommunications interests of ITT of the United States in early 1986. It is difficult to index precisely the level of telecommunications activities in their production divisions, because both make other equipment—Alcatel, for example, makes check-outs for subway systems, and AT&T produces computers. But after allowing for this ancillary equipment, AT&T's sales amount to around $13.5 billion and Alcatel's to $13 billion.

Hitachi of Japan is the next largest, with sales of $6.6 billion, followed by Siemens of the Federal Republic of Germany, with $6.3 billion, and NEC of Japan with $5.8 billion. Toshiba, the Japanese group, has sales of $3.4 billion, just ahead of Ericsson of Sweden and Northern Telecom, the Canadian group, both of which have sales of about $2.9 billion. GPT is next with sales of $2 billion, followed by Philips of the Netherlands, which has sales of about $1.7 billion. Both GTE of the United States and Italtel of Italy have about $1 billion of revenues. Motorola, which is one of the world's leading semiconductor companies, also has sales of about $2.9 billion in telecommunications, although it has concentrated on radio and mobile technology rather than public switching.

Given the enthusiasm with which companies have pursued this market in recent years, it is surprising that profits are not much higher than they are at present. Alcatel, for example, made a return of only 3.1 per cent on sales in 1988, with net profits of $400 million. Alcatel's excuse was that it had considerable reorganization costs to absorb after the acquisition of the ITT activities. Similarly, AT&T, which is also going through a restructuring phase, actually lost money in 1988, declaring net losses of $1.7 billion on total sales of $35 billion, after a big write-down for modernization.

3. *Restructuring*

The main reason for depressed profits at present lies in the bout of restructuring that is now sweeping through the industry. This is leading to costly write-offs, plant closures and disruptions as new enterprises are formed or old ones merge. It is also forcing many companies into a costly effort to break into new markets.

One factor pushing the industry towards greater concentration of resources has been the escalating cost of research and development. In the past decade or so, telecommunications has become one of the industries most deeply affected by the revolution in microelectronics and data processing. It has moved from the mechanical age to the era of electronics, and with this shift has come a big escalation in the costs of research to keep up with the constant evolution of this new technology. As networks are digitized, switching systems are becoming highly dependent on software. This means that products are changing rapidly and that life cycles are shortening dramatically. Consequently, the cost of revisions and changes is mounting all the time.

Coinciding with this shift to a software-based industry is the beginning of work on the next generation of switches. Most research work at present is being directed towards a revolutionary system of using light to conduct messages within the switching system, an idea which is also being examined by the computer and semiconductor industries. Costs of developing this technology are being estimated in the range of $2 billion, against the $1 billion or so which most companies spent on the move into digital switching. This is a further argument for manufacturers to try and offset their costs against larger markets.

These pressures have coincided with the wave of deregulation and internationalization of markets in such a way that it has been much easier than in the past for companies to cross boundaries and reach agreement with foreign groups. Traditionally, transactions of this kind have been difficult within developed countries because telecommunications manufacturers have been regarded as national industrial champions that need to be protected by government policies. This mode of thinking has not disappeared, but it is crumbling, and has led to several significant deals and market changes, some of which include:

(a) Northern Telecom, the Canadian group, has managed to enter the United States market and build a strong position in the digital exchange sector;

(b) Alcatel's purchase of ITT's telecommunications activities in Europe allowed it to expand out of France into the Federal Republic of Germany, Spain and other European markets;

(c) Ericsson's purchase of Compagnie Générale des Constructions Téléphoniques (CGCT) in France, along with its move into the United Kingdom, where it now has about one third of the market, has allowed it to become a major Europe-wide supplier;

(d) The merger of the telecommunications activities of Plessey and the General Electric Company (GEC) has allowed rationalization of manufacturing in the United Kingdom with the formation of GEC-Plessey Telecommunications (GPT);

(e) The proposed merger of GEC-Plessey Telecommunications with Siemens of the Federal Republic of Germany could create the third largest telecommunications manufacturer in the world;

(f) Northern Telecom has established a foothold in Europe with a share of 28 per cent in STC of the United Kingdom.

(g) AT&T has moved into Western Europe through a collaboration agreement with Philips and a deal to develop manufacturing in Italy in partnership with Italtel, the leading Italian switch producer;

(h) AT&T has also concluded an agreement to absorb GTE in the United States over a period of several years;

(i) The Europeans have begun to move into the United States. Ericsson has established a strong position in mobile switching, while Siemens has begun to sell its public switches, and GPT has control of Stromberg-Carlson, a Florida-based producer;

(j) Motorola has moved strongly into Western Europe with its mobile communications manufacturing operations.

This wave of amalgamations may be followed by a period of consolidation. Companies will need time to adapt themselves to transnational operations. Nevertheless, some industrialists argue that there will have to be still more mergers over the next decade to create companies with sufficient size to weather the economic conditions created by the new switching technology. Producers will need to be able to market to a much larger number of telephone companies to spread their costs, it is argued, in the way that is common today in the computer industry. The industry could well slim down to around half a dozen world-class players, similar in structure to the mainframe computer industry following the flood of mergers that has engulfed it over the past decade.

4. Telecommunications investments in developing economies

The spread of telecommunications is a crucial issue in the growth of developing countries. It is important because of the role of communications in the supporting infrastructure for industry, and it could also have a direct impact on industrial activity if countries could establish telecommunications manufacturing industries.

Studies of the growth of telecommunications networks have indicated that they have a major impact on the economic activities of countries at the stage of increasing industrialization. At this point, effective telephone communications replace other and slower forms of communications such as postal services or travel. This allows increasingly efficient commerce and industrial transactions because of the availability of up-to-date information. Markets become more efficient because they can no longer be skewed to the interests of a few information-rich individuals.

The role of telecommunications in development is underscored by the example of the fast-developing South-East Asian economies of the Republic of Korea, Taiwan Province and Singapore. In 1986, the Republic of Korea was the world's tenth largest investor in telecommunications systems, with a budget of $1.4 billion. This put its investment only just behind that of China, despite the immense difference in the size of the two countries and their populations. Taiwan Province, similarly, was the twentieth largest investor, spending $685 million, while Singapore was thirty-first with $313 million (see table IV.48).

The Republic of Korea has developed its telephone networks with a deliberate, government-led policy of expansion through two State-owned authorities, one of which competes in data transmission. The country already has 7.7 million lines (not far behind Spain's 9.8 million), and has an aggressive plan for a further 5.6 million over the next five years. It intends to replace its present system with a digital network by the year 2000. It is notable that the Republic of Korea has managed to break into the telecommunications manufacturing business while in the process of this expansion, partly because of its creation of an electronics industry through big investments in semiconductors. In 1987, the Republic of Korea's exports totalled $460 million, largely built on sales to the United States for low-cost telephone handsets (see figure IV.10).

Taiwan Province has also developed rapidly from 1 million lines in 1975 to 5 million in 1985 and plans for 10 million digital lines by the turn of the century. Along with the Republic of Korea it is the only economy, outside the established post-war industrial world, that has managed to break into the list of the top 10 exporters, with sales overseas in 1987 of $398 million.

Table IV.48. Major world telecommunications markets, 1986-2000
(Millions of dollars)

Country or area	1986	1990	Percentage change 1986-1990	1995	Percentage change 1990-1995	2000	Percentage change 1995-2000
United States	24 099.00	27 191.30	13.25	29 900.00	9.96	41 800.00	39.80
USSR	8 400.00	13 402.00	59.55	20 300.00	51.47	26 400.00	30.05
Japan	7 080.00	8 456.00	19.44	9 200.00	8.80	13 300.00	44.57
Germany, Fed.Rep.of	5 888.00	7 684.00	30.50	8 600.00	11.92	12 900.00	50.00
France	4 482.00	6 161.00	37.46	6 800.00	10.37	9 600.00	41.18
Italy	3 915.00	6 734.00	71.96	7 400.00	9.89	9 500.00	28.38
United Kingdom	3 146.00	4 718.00	49.97	5 100.00	8.10	6 500.00	27.45
Canada	1 885.00	2 321.00	23.13	2 600.00	12.02	3 200.00	23.08
China	1 448.00	2 050.00	41.57	2 900.00	41.46	3 600.00	24.14
Republic of Korea	1 422.00	1 919.00	34.95	2 100.00	9.43	3 100.00	47.62
Spain	1 403.00	3 000.00	113.82	3 300.00	10.00	5 200.00	57.58
Switzerland	1 360.00	1 393.00	2.43	1 600.00	14.8[illegible]	2 400.00	50.00
India	1 308.00	2 282.00	74.46	2 700.00	18.3[illegible]	3 300.00	22.22
Australia	1 204.00	3 000.00	43.85	3 300.00	9.70	4 100.00	24.24
South Africa	964.00	1 511.00	56.74	1 600.00	5.89	2 200.00	37.50
Brazil	872.00	1 024.00	17.43	1 100.00	7.42	1 800.00	63.64
Mexico	851.00	1 307.00	53.58	1 500.00	14.77	2 300.00	53.33
Sweden	845.00	1 144.00	35.58	1 300.00	13.64	1 900.00	46.15
Austria	786.00	1 080.00	37.40	1 200.00	11.11	1 700.00	41.67
Taiwan Province	685.00	913.00	33.28	1 000.00	9.53	1 500.00	50.00
Indonesia	640.90	875.70	36.64	889.00	1.52	1 100.00	23.73
Argentina	632.00	772.00	22.15	795.00	2.98	1 100.00	38.36
Saudi Arabia	550.80	770.20	39.83	885.00	14.91	1 400.00	58.19
Netherlands	544.70	786.50	44.39	840.00	6.80	1 300.00	54.76
Hong Kong	521.40	705.40	35.29	745.00	5.61	1 200.00	61.07
Norway	499.00	643.00	28.86	702.00	9.18	1 100.00	56.70
Belgium	468.00	519.00	10.90	628.00	21.00	990.00	57.64
Colombia	460.00	649.00	41.09	387.00	-40.37	640.00	65.54
German Dem. Rep.	426.40	601.90	41.16	710.00	17.96	900.00	26.76
Venezuela	416.40	481.90	15.73	676.00	40.28	900.00	33.14
Singapore	313.20	427.70	36.56	625.00	46.13	900.00	44.00
Finland	302.10	363.60	20.36	465.00	27.89	720.00	54.84
Pakistan	296.50	529.60	81.99	651.00	20.64	830.00	25.50
Greece	286.50	502.90	75.53	692.00	37.60	1 100.00	58.96
Turkey	268.70	402.80	49.91	592.00	46.97	970.00	63.85
Denmark	259.80	370.40	42.57	547.00	47.68	850.00	55.39
New Zealand	241.10	367.50	52.43	497.00	35.24	820.00	64.99
Iran (Islamic Rep.of)	234.00	410.00	75.21	587.00	43.17	850.00	44.80
Poland	227.50	304.90	34.02	538.00	76.45	710.00	31.97
Bangladesh	211.60	317.30	49.95	386.00	21.65	480.00	24.35
Egypt	210.40	280.00	33.08	521.00	86.07	750.00	43.95
Hungary	197.50	252.30	27.75	528.00	109.27	750.00	42.05
Israel	197.00	215.00	9.14	255.00	18.60	370.00	45.10
Iraq	178.60	283.00	58.45	339.00	19.79	550.00	62.24
Yugoslavia	161.40	249.60	54.65	467.00	87.10	625.00	33.83
Czechoslovakia	144.70	273.90	89.29	572.00	108.84	790.00	38.11
Portugal	121.40	227.90	87.73	429.00	88.24	720.00	67.83
Algeria	109.40	203.00	85.56	375.00	84.73	590.00	57.33
Syrian Arab Republic	104.20	158.30	51.92	211.00	33.29	300.00	42.18
United Arab Emirates	102.40	152.30	48.73	202.00	32.63	307.00	51.98

Source: United Kingdom Telecommunciations Research Centre and statistics from public telephone companies.

Elsewhere, developing countries are plagued by a lack of resources in the development of their telecommunications networks and manufacturing industries. The problem is deeply entrenched. At the financial level, it is hard for the over-stretched Governments running the telecommunications system to find additional funds for expansion. It is equally difficult to find the skills needed for what is increasingly becoming a high-technology industry, requiring software development as much as hardware. There are also institutional blockages because of the way network provision is tied up in government agencies and frequently involved in political decisions.

In trying to break through some of these problems there has been an increasing emphasis in aid policies in recent years on more flexible structures. This trend reflects the movement towards market deregulation in the main industrialized markets of the United States, Japan and Europe. At the same time it echoes current thinking on the importance of bringing private capital into growth industries in developing economies.

Several developing countries are now at an interesting stage of development. India, for example, recently formed two new corporations to handle domestic and overseas telecommunications. It also proposed a development plan to modernize and expand its basic network, while privatizing the country's terminal equipment manufacturers. The country is negotiating a contract for the supply of main telephone exchange technology. Alcatel of France was hoping to win the contract, although it is now facing potential competition from a local production consortium.

Brazil, which has a network of around 7.2 million telephone circuits, has also recently pledged to develop its highly congested system with the addition of a further 1 million lines. The country spent $1.3 billion on equipment in 1986, and produces around 300,000 terminals a year. It has put a great deal of effort into the development of its telex network of 1,800 connections.

Mexico, with 3.8 million lines, has a $6.5 billion development programme designed to expand the network under way at present. It aims at spending $1.3 billion by 1990 compared to $850 million in 1986, and wants to have 28 telephones available per 100 people by the year 2000, against 8 per 100 in 1986. Telmex, which runs the telephone service and supplies equipment, manufactures all the key electronic components needed for the system.

Indonesia is aiming to increase its investment programme from $640 million in 1986 to $876 million in 1990 so as to extend the telephone service to rural areas, while installing new telexes and data switching systems. Siemens of the Federal Republic of Germany is involved in manufacturing in the region, and is producing equipment for large-scale expansion programmes in some of the main population centres.

Argentina has around 2.8 million lines at present, and is aiming at expanding at about 8 per cent a year. Spending in 1986 amounted to $630 million, and future investment is earmarked for a variety of new areas, including rural centres not yet connected with the main network, satellite services, and a microwave network.

Colombia, with 1.8 million lines, is also trying to improve its rural connections—at present well over 90 per cent of the country's telephone network is concentrated on 40 cities. Jeumont Schneider of France is closely involved in the development of the system.

Venezuela is intending to lift expenditure from $416 million in 1986 to $482 million by 1990, increasing the number of lines from 1.3 million to around 2.2 million. Ericsson of Sweden has a close relationship with Venezuela, where the telephone operating company also manufactures some of its own equipment.

Pakistan is in the middle of a $1 billion development programme, as the country mobilizes to expand from almost 500,000 lines in 1986 to 1.2 million in 1990. The country is heavily reliant on imported equipment, but is intending to establish indigenous manufacturing for switches, cables and some spare parts. It wants to establish more comprehensive dialling facilities within the country, while improving the telex and data transmission services.

Egypt is the largest telecommunications user in Africa (excepting South Africa), but still has only a little more than 1 million lines in service. Spending is running at over $200 million a year, financed by debt, bilateral aid and suppliers' loans. The country is building new microwave transmission links, but is barely keeping pace with the demand for new telephone and telex services.

There are a large number of developing countries whose investments in telecommunications infrastructure are relatively small and their expenditure amounts to less than $100 million per year as shown in table IV.49.

Many smaller countries, particularly island countries in the Caribbean and Pacific, have opted to use outside contractors to run their telecommunications systems. In the West Indies, for example, Cable and Wireless of the United Kingdom has several operating

Table IV.49. Telecommunications equipment expenditure by selected countries and areas, 1986

Country or area	Expenditure (millions of dollars)
Bulgaria	108.90
Libyan Arab Jamahiriya	106.10
Malaysia	99.80
Philippines	98.00
Romania	91.90
Viet Nam	89.10
Thailand	88.90
Kuwait	80.80
Ireland	74.70
Peru	71.80
Chile	59.40
Kenya	58.10
Qatar	54.10
Puerto Rico	53.10
Ecuador	48.10
Costa Rica	42.30
Zimbabwe	41.70
Cuba	37.30
Nigeria	37.00
Morocco	34.70
Côte d'Ivoire	33.90
Tunisia	30.20
Bahrain	30.10
Panama	27.60
Lebanon	27.00
Dominican Republic	25.20
United Republic of Tanzania	21.90
Nicaragua	21.30
Bolivia	20.90
Cyprus	17.90
El Salvador	17.90
Jordan	17.80
Guatemala	15.60
Virgin Islands	15.40
Afghanistan	14.80
Ethiopia	14.60
Zambia	13.20
Bahamas	12.80
Reunion	12.10
Uruguay	12.00
Jamaica	11.90
Paraguay	11.80
Uganda	11.50
Sudan	11.20
Ghana	10.80
Mozambique	10.30
Myanmar, Union of	10.10
Luxembourg	9.90
Sri Lanka	9.50
Namibia	9.00
Democratic Yemen	8.90
Cameroon	8.00
Senegal	7.90

Source: United Kingdom Telecommunications Research Centre.

contracts. It is shortly planning to run a new fibre-optic cable down to the region to connect it with the transatlantic cabling system.

Several common features run through most of these investment projects. Many of the countries concerned are still heavily dependent on agriculture, with large rural populations where the telephone service is sparse or non-existent. Connecting these areas is therefore one priority. Another is to create genuinely national systems that can be accessed throughout by direct dialling rather than through operators.

At the same time, developing countries are struggling with the issue of integrating themselves more closely into the international system. This is also a key issue because of the need to attract international investment and trade in international markets. Hence the desire to install international direct dialling and sophisticated data transmission networks, systems which are dependent on the latest technology if they are to be fitted efficiently into the overall international telecommunications network.

In addition, developing countries are looking at novel ways of solving some of their problems. Mobile telephone technology, for example, has changed so rapidly in recent years that it has become flexible and cheap enough to present alternative ways of connecting outlying areas to the fixed backbone system. Microwave communications are also being used increasingly. Thailand, for example, has recently reached an agreement with Cable and Wireless of the United Kingdom on a microwave system linking major buildings to run a data transmission service around the country separate from the public telephone network.

5. *Involvement of transnational corporations in developing countries*

The current round of restructuring in industrialized countries may be followed over the next few years by renewed attention to telecommunications in developing countries. In the past few years, there is no doubt that the large manufacturing companies have concentrated their attention on their domestic markets and the possibilities of expanding elsewhere in the liberalizing markets of the United States and Western Europe. Most of the new technology they were developing was also aimed initially at those countries. With the new technology established, however, and the initial reorganization wave complete, companies are beginning to turn their attention towards developing countries.

The potential in these developing markets is enormous. Five years ago, for example, the number of telephones per 100 inhabitants was estimated at just less than 70 in North America and almost 40 in Western Europe. But in Central and South America, the figure stood at only 7, and in Africa at less than 2. The problems in selling in these markets are well known, ranging from foreign currency shortages and payments problems, to shortages of skilled resources and restrictive attitudes to foreign investment.

Some countries and areas in East Asia have made progress by a mixture of indigenous development and co-operation in the most technology-intensive area of large public switches. In the Republic of Korea, for example, Samsung, a large industrial conglomerate, has an agreement with Alcatel (inherited from the days before the French group took over ITT's telephone operations) to make large switches in the country. But at the same time, in the Republic of Korea, the industry has expanded rapidly into telephone handset manufacturing, where it has established a strong niche position in export markets as well as at home.

Alcatel is also present in Taiwan Province, where its System 12 digital switch is again made under licence. Taiwan Province is another area which has developed its telecommunications manufacturing in other fields, becoming in the process one of the world's largest exporters of this equipment.

In addition, Mexico has developed manufacturing on the basis of the Alcatel System 12 technology. The group's Indetel plant, in which Alcatel has a 40 per cent direct stake and other indirect shareholdings, also makes transmission equipment. In Turkey, the Teletas group, 40 per cent owned by Alcatel, makes System 12 along with a variety of telexes, handsets and multiplexers.

Alcatel's other main link with the developing world is in India, where the company's E10 digital switch is made under licence. Attempts to develop further contacts through an additional deal, however, have recently run into problems, highlighting the issue of the dependence of countries like India on foreign technology. Local industrialists have claimed that they could develop and market a switch more cheaply than that which Alcatel has on offer, and the Government is currently considering this proposed alternative. Whichever way the decision goes, it is clearly important to the country's future, because the ambitious plans to develop the telephone infrastructure depend upon effective switching technology. If local industry is developed successfully, there are healthy prospects of exports.

Siemens is another company with a strong position in the developing world, despite the main focus of its expansion in recent years on North America. The company has a plant in Indonesia, where it is currently involved in an ambitious expansion programme for the local telephone system. Siemens is also well-entrenched in South Africa, where it installed one of the first digital networks in the world, and has links with South America. The company has sold its EWSD digital switch in well over 20 countries and areas throughout the world, including Argentina, Brazil, Chile, China, Colombia, Libyan Arab Jamahiriya, Oman, Paraguay and Taiwan Province.

Ericsson has also developed a large overseas business, largely because the Swedish market is too small to support a major manufacturing group. A great deal of this growth has been through foreign manufacturing plants to provide employment, or joint ventures and licensing agreements. It has established a particularly strong position in Central and South America, where it has a total of 9,000 employees and links with Brazil, Colombia and Mexico; overall, it has production facilities in 35 countries.

Ericsson has its largest Latin American operation in Mexico, where its Mexico City production facility has a 60 per cent share of the public telephone exchange market. The group is the majority shareholder in this business, which is quoted on the local stock exchange. In Brazil, Ericsson claims about 35 per cent of the market through its local factories in Manaus and São Paulo, which also export elsewhere in Latin America. Its main competitors are NEC of Japan and Siemens, which both have around 30 per cent, and Alcatel with 10 per cent.

The group makes a variety of equipment in Brazil, including switches and telephone terminals. In addition, it manufactures cable, which it also produces in Argentina and Colombia.

In Africa, Ericsson's only facility is at Algiers, but the company is better represented throughout the East and Western Asia. In Malaysia, where it has its own production plant, it has about 40 per cent of the market in competition with NEC, which has the rest. In India it has a licensing operation to make telephone handsets, while in the Republic of Korea it has a joint venture manufacturing plant—Otelto—with about 14 per cent of the market. Alcatel has 34 per cent and AT&T of the United States 26 per cent.

Ericsson also has plants in New Zealand and Australia—where its AXE exchange dominates the market—and is currently setting up a facility in China to make its large office telephone exchange.

The European companies have a lead over producers from other countries because they have been active overseas for longer. AT&T was confined to the United States market under the terms of the break-up of the industry which allowed ITT to operate overseas; hence AT&T is only beginning to break out overseas in the wake of deregulation. Japanese companies, however, have been advancing fast in the Pacific region and South America. NEC has been the most aggressive, establishing a strong position in several of the smaller markets, and muscling into the larger ones like Brazil alongside the Europeans.

6. *Component supplies*

Unlike basic industries such as steel, or intermediate technology sectors like motor components, telecommunications equipment manufacturing is becoming an increasingly high-technology business. For this reason, it is not an industry which lends itself to outsourcing of components in areas of low-cost labour. Hence established manufacturers in developed countries are unlikely to invest very much in supplies of parts from developing countries on economic grounds alone.

On the other hand, penetration of many of these markets is conditional on establishing production facilities, and often tied to aid packages to help in establishing plants. Companies like Alcatel, for example, find it convenient that they have tentacles throughout Western Europe, because each of their national businesses can pursue sales opportunities overseas with the backing of aid from their local Governments. This process of tying orders to local production financed by aid is helping manufacturers win orders, and developing countries to build up their manufacturing base to some degree. But at the same time there is an economic cost, because many of the plants are much smaller than producers would ideally like to install to achieve the most efficient scale.

For this reason, some manufacturers are seeking ways of achieving economies of scale by developing interdependent plants in different countries. Ericsson, for example, has been pursuing the idea of modular product development, so that each factory makes a unit that can be used in the local system, but which can also be exported to other plants for assembly into their networks. This approach is easier with the new digital technology than in the past, because modern switches are constantly being expanded, adapted and refined. But there could be a long-term disadvantage for the country in which the component units are made to the extent that this type of technology transfer would not give them a base for establishing a full-scale switch manufacturing industry.

In the semiconductor area, however, there is now exceedingly buoyant trade in special integrated chips for the telecommunications industry. This interchange involves the big industrialized countries—Japan above all, but also some of the newly industrializing countries of East Asia—which have the engineering facilities and human skills to develop chip manufacturing.

7. *New technology*

One telecommunications issue which is of great concern for both developed and developing countries is the relative importance of the switch manufacturing branch in the next generation of equipment. Telecommunications is now advancing so fast that new niche markets are springing up every day, allowing smaller producers a role outside the ambit of the big switch manufacturers. Indeed, the industry is beginning to move towards the structure of the computer business. A decreasing number of established, traditional companies exist that are capable of bringing the capital to bear for the big mass-market infrastructure projects, while a large number of smaller producers are developing specialist products. Some of these newer technologies may provide an opening for developing countries' producers.

The problem for developing countries is that many of these products are mixtures of hardware and software. Some of them are highly technical, and most demand a fairly high level of available skills in electronics engineering. It will, therefore, take time to build up the expertise necessary to exploit these areas, although some countries such as India, which produce significant numbers of electronics experts, have the foundations for launching development programmes. Some of the developing product lines are described below:

Multiplexers. Multiplexers are units which fit to the end of telephone lines, controlling the traffic over the lines in a way that allows the capacity to be used to the optimum degree. They are capable, for example, of judging traffic so that a line that has been used for voice conversations during the day can be converted to data transmissions during the evening.

There is one school of thought in the industry which argues that devices such as multiplexers will steadily eat into the traditional switch market, because they allow intelligence in the telephone network to be located close to the end-user. In other words, users—particularly large businesses—can thereby exert more control over their telecommunications operations and expenditure. Specialists in this technology include STC, a United Kingdom group which dropped out of the new generation of switch manufacturing in the early 1980s, but which has since become a pioneer in multiplex techniques. AT&T in the United States is also a leading manufacturer, but there are several other smaller manufacturers in the United States as well.

ISDN. The most vaunted new technology is integrated systems digital networks (ISDN), a switching device which allows the public telephone network to treat voice and data traffic without distinction. Data networks tend today to be separate from voice systems, and where they are not, data transmission requires elaborate conversion techniques. ISDN would allow the same plug to be used for any type of message.

It is still not clear whether ISDN will make the impact which has been predicted, because installation of the system will be highly expensive. Moreover, many large businesses have already invested in systems for handling both their voice and data traffic. Since this is a technology which would help public telephone operators to retain control of their systems, it is being promoted by them.

VANS. Value-added network services (VANS) are characteristic of the trend towards new telecommunications products which depend on software as much as hardware. VANS are essentially information services carried over the telephone system, helping customers with advice, or giving them data of various kinds. They require sophisticated computers and switches to handle the transmission of the information, and this is often provided through private lines leased from the telephone companies.

One of the most effective value added services launched up to now is electronic data interchange (EDI), a method used by some big companies to order products and then invoice them electronically. Under these systems, no paper changes hands. Orders are made out on a computer screen and then dispatched using special coding devices to the supplier over the telephone wires. They are received by one computer and can then be processed on another computer screen. Later, the supplier can dispatch bills using the same electronic process in reverse.

EDI has required an enormous amount of work to set up because it demands the use of standard systems between different companies. Ordering and billing formats have to be put in a common language for the computers to deal with them. But the advantages in terms of reduced paperwork, greater accuracy and lower costs—electronic messages cost a fraction of a letter and stamp—are such that the technology is beginning to take off. So far, the main growth has been in national markets, with the United States and the United Kingdom the most advanced, possibly because of the deregulated telecommunications environment. But the approach is steadily being adopted more widely, and EDI is beginning to be used internationally. As it becomes more common between transnational corporations, it is one technique which is likely to make an impact on developing countries.

Mobile communications. Telephone sets that can be carried around with subscribers, whether in their car or on their person, have been dreamed about for decades. But they are now becoming a reality for more and more people, establishing the area of mobile communications as the most exciting field for telecommunications development in the last decade of the century.

The mobile sector depends upon radio technology which is usually blended into the wired telephone network in some way. It has come of age mainly because of developments in semiconductor technology which allow increasing sophistication in the way that signals are handled. The reduction in size and increasing efficiency of semiconductors has also enabled manufacturers to shrink products and make them genuinely portable.

The industry is developing fast and new approaches to mobility are being adopted. Several technologies, including those described below, have already established themselves.

(a) Radio paging. This technology allows subscribers to carry a small device that makes an audible signal when someone is trying to contact them. Used initially in small enclosed environments such as hospitals and building sites, radio paging has since expanded to cover regional areas and countries. Even broader coverage is being developed, such as Europe-wide systems.

(b) Radio telephones. These devices, used by taxis, the police and large fleet organizations, have been around for many years. But the latest technology allows the limited number of channels released for radio telephone use to be much more efficiently used and re-used. This is leading to a big expansion of the systems.

(c) Cellular mobile telephones. The big explosion in the use of car phones has occurred because advances in technology have made it possible to bring together radio and fixed-link telephone technology in an affordable manner. Cellular phones work by dividing areas into cells. Within these cells, people can make and receive calls carried over a radio link to the centre of the local cell, where the signals are linked into the normal telephone system. The system is capable of carrying a large number of subscribers with a relatively limited radio wave spectrum because each cell can use the same wavelengths, which are tailored so that they do not interfere with each other.

This process depends upon computers which are powerful enough to track the car-born handsets wherever they are, so that calls can be linked through to them. The system then has to be capable of handing over the radio signals from one cell to another if the car-driver passes between cells.

Introduced initially in populous areas to be used by business people, cellular mobile telephone systems have been one of the fastest-growing branches of industry. Usage has quickly expanded from senior directors to sales-persons in many companies, and in some markets subscriber lists are doubling every year. Expansion is being boosted by the falling price of joining the system—handsets have dropped to as low as $200 a unit for some models in the United States, a fifth of the price five years ago. As of the end of December 1988, the number of mobile telephone subscribers, world-wide, was put at slighty over 4 million (see table IV.50), and total demand for add-on cellular telephones was estimated to be nearly 2 million units in 1989/90 (see table IV.51).

The industry is in such a state of flux that a number of new producers are throwing their hats into the ring to become involved in the next phase of the cellular revolution, when digital systems are introduced. The idea behind digital technology is that it will give much greater capacity to cellular systems—the present analogue networks are due to begin running out of space in about two years' time in densely populated areas. Digital will also provide the opportunity for new co-operative ventures, such as a decision by Western European telephone administrations to opt for a pan-European network that will allow the same mobile phones to be used throughout the region.

In developing countries struggling to establish a basic telephone service, cellular telephones may seem like an expensive diversion. But the technology can have some significance in rural areas, where large cells can be created to cover outlying areas. In some cases, this can be a viable alternative to investment in a fully-wired system, relatively quick to install and maintain. Few countries, on the other hand, could justify manufacturing such equipment.

Meanwhile, mobile telephones are set to move into other new fields as well. These involve techniques which are similar to the car-phone system, but which would either be cheaper, or more adapted to genuine mass markets because of the greater capacity. The first of this new generation of technologies is being launched in 1989 in the United Kingdom. Known as telepoint, it will allow users to make outgoing calls from selected places, but not receive them.

The idea of telepoint is to create certain points in open, public places, where people can make calls with extremely light pocket phones that transmit over a distance of about 200 metres to a black box in a wall. The phones could be employed, for example, in railway stations, or certain stores and petrol forecourts. As in cellular phones, the signals will be carried over a radio link and then sent into the public telephone network. Billing will be to a registered home telephone number.

Even before telepoint has started, however, Governments and technologists are talking about a more flexible form of personal communications which could bring portable telephones within the reach of anyone who wants one. By selecting very high frequencies for the proposed system, engineers believe that they can make very large quantities of capacity available to the public. It will also be possible to put cells very close together so that callers can make—and probably

Table IV.50. World summary of cellular subscribers (End December 1988)

Cellular protocol	Subscribers	Percentage of total
AMPS	2 273 350	56.0
NMT 450	656 510	16.2
TACS	551 800	13.6
NTT	208 350	5.1
NMT 900	155 800	3.8
C450	101 600	2.5
R2000	97 500	2.4
CVK	17 950	0.4
Total	4 062 860	100.0

Source: Technophone and United Kingdom Cellular Mobile Phone Company.

Table IV.51. Estimated world cellular market, 1989/90 (Millions of units)

Cellular protocol	Add-on portables	Add-on mobiles	Total add-on
AMPS	179 550	807 200	986 750
NMT 450	18 600	137 350	155 950
TACS	117 950	209 850	327 800
NTT	15 000	60 900	75 900
NMT 900	59 575	142 925	202 500
C450	25 200	56 800	82 000
R2000	6 500	58 000	65 000
CVK	0	1 800	1 800
Total	422 375	1 475 325	1 897 700

Source: Technophone and United Kingdom Cellular Mobile Phone Company.

receive—calls wherever they are. A great deal of work still has to be done on semiconductor and radio technology to make such a system viable, but there is some confidence that it will be practicable by the end of the century.

8. *Future prospects*

Over the medium-term, telecommunications manufacturing faces the prospect of more of the change that has begun to sweep through the industry in the past decade or so. This will probably mean further consolidation in some parts of the industry, particularly the traditional business of switch production, where there will be a continuing need to achieve more effective economies of scale.

At the same time, this branch of the industry is likely to see a slackening of activity from growth rates of over 7 per cent at present to about 4 per cent up to 1995. Producers are currently enjoying the peak of the replacement cycle as telephone operating companies modernize their networks, but the most urgent part of this work may be completed in large areas of developed countries by the early 1990s. In the final five years of the century, however, spending is likely to pick up to around 8 per cent a year again as investment accelerates in new data services, ISDN and the expansion of the mobile telephone industry world-wide.

A further question could be raised by a general downturn in economic activity if the developed market economies slip back into recession induced by high interest rates. Indeed, it is notable that the fast-developing cellular mobile industry has never had to cope with a downturn in economic activity—it has expanded in a period of general economic growth when businesses have been willing to invest in new ideas for sustaining their market share.

The telecommunications industry, however, ought to be able to weather any general economic problems better than most. Telephone operating companies are highly cash-generative, typically earning good returns on sales. In the 1980s they have been regularly enjoying growth rates of 8 to 10 per cent a year in call volumes, a level of activity that has given them reserves that should enable them to maintain a steady rate of investment.

The burst of new technology that has engulfed the industry in recent years is also going to open up fresh markets. With the real cost of a great deal of equipment declining, and likely to continue in a downward direction because of improvements in semiconductor technology, more sophisticated products are coming into the range of a greater number of people. Small businesses should be helped by the advent of ISDN, which will make it much easier for them to contemplate elaborate data links as well as voice communications, while the general public will be able to afford mobile telephones with the introduction of pocket handsets.

One of the major questions for the industry will be how effectively developing countries manage to increase their spending on telecommunications. Many of those countries have ambitious plans to install new systems. But it is not clear whether they will be able to find the finance to meet their targets, how far they will be able to encourage investment in domestic industry.

What is clear is that actual and latent demand for telephones will not be met in the immediate future. Large parts of the world have only a minimal telephone infrastructure at present, and to construct an adequate system would probably require tripling expenditure in developing countries. Given the importance of telecommunications in economic development, this shortfall may well become a focus of attention in the next few years.

D. Aluminium industry (ISIC 372022-372034)

1. *Recent trends and current conditions*

The largest and yet the youngest of the non-ferrous metal industries, aluminium smelting began just 100 years ago. Certain properties of the metal—its lightness and durability, corrosion resistance and good electricity and heat conductivity has encouraged its use in all sectors of the economy. Its good appearance and recycling capability have added to the appeal.

Total world output of aluminium has reached 365 million tonnes to date, of which 70 per cent was produced in the 1970s and 1980s. The metal can be cast, rolled or mixed with other metals, such as copper, zinc or magnesium, to give additional properties [63].

In the period following the Second World War, demand for aluminium grew at an average annual rate of 8-9 per cent, inspiring a rapid expansion of primary production capacity that eventually led to supply being in excess of market demand [64]. The energy crisis of 1973 and the international recession that followed exacerbated the situation. Demand for aluminium products collapsed and prices plummeted. Despite new energy price pressures and growing capital costs, however, world demand continued to grow at a rate of 4.3 per cent per year and production of primary aluminium grew in line with this ([65], p. 23).

By the 1980s a four-year "growth-recession" cycle had developed. The boom periods of 1980 and 1984 arose from rapidly increasing demand, spurred by general economic growth rates. The current boom in aluminium markets, however, seems to have been mainly inspired by the extremely low aluminium prices of the past three years. The availability of cheap material has restrained the development of substitutes while at the same time opening new fields of application ([66], p. 600).

Generally, the boom periods have been brought to an end by excessive reopening of moth-balled capacity generating a market demand-and-supply imbalance. The surplus output, after a while, encourages the next downturn. The response by the aluminium industry was extensive restructuring, involving capacity trimming, modernization of existing plants, diversification, forward integration and other shifts in the pattern of production.

In the recent cycle, the first fruits of those steps were noticeable by 1986. In 1987 aluminium prices recovered, despite the world stock-market collapse. The upswing continued into 1988, reflected in the levels of aluminium production, consumption and trade. Despite the recommissioning of almost all available capacity, demand has continued to exceed supply throughout 1988.

(a) *Production of primary aluminium*

World production of primary aluminium increased by nearly 4.7 per cent in 1987 on the previous year, reaching 16.2 million tonnes. The figure is slightly higher than the 1980 output, indicating a steady recovery by the aluminium industry from the slump in the early 1980s. Table IV.52 and figure IV.11 show the major primary-aluminium-producing countries in the world.

As reflected in table IV.52, the increase has been more pronounced in developed countries, where producers have begun cautiously reopening moth-balled plants. However, the combined output of developed countries in 1987 was still more than 10 per cent lower than in 1980. The slump was most distinct in Japan, which had been the world's third largest producer country in 1980. Since then, Japanese production capacity has been severely cut back with output of primary aluminium falling by 96 per cent to less than 41 million tonnes between 1980 and 1987.

In the United States, the world's largest producer, output fell by 34.7 per cent between 1980 and 1986. In 1987, however, production was up 10 per cent, reflecting the upswing in the industry.

In Western Europe, the decline from 1980 to 1986 was not so pronounced (5.4 per cent) owing to the sharp rise in Norwegian production (10.2 per cent) and the more moderate increase in the Federal Republic of Germany (4.5 per cent). Norway became the biggest producer in Western Europe in 1987,

Table IV.52. World production of primary aluminium, 1980 and 1987

Rank in 1987	Country, region or economic grouping	1987 production (thousands of tonnes)	Percentage change		Percentage share	
			1987-1986	1980-1987	1987	1980
1	United States	3 342.90	10.09	-28.17	20.58	29.03
2	USSR	2 354.80 [a]	386.03	-1.88	14.50	14.97
3	Canada	1 548.40	14.26	44.10	9.53	6.70
4	Australia	1 024.20	17.05	237.45	6.31	1.89
5	Brazil	843.50	11.37	223.68	5.19	1.63
6	Norway	797.80	9.42	20.57	4.91	4.13
7	Germany, Federal Rep. of	737.70	-3.40	0.96	4.54	4.56
8	Venezuela	439.60	3.[illegible]2	35.18	2.71	2.03
9	China	420.00 [b]	-14.28	17.32	..	2.23
10	Spain	341.00	-3.86	-11.77	2.10	2.41
11	France	322.50	0.22	-25.33	1.99	2.69
12	United Kingdom	294.40	6.71	-21.37	1.81	2.34
13	Neth[illegible]nds	268.70	4.15	4.07	1.65	1.61
14	[illegible]	265.[illegible]0	3.19	43.48	1.63	1.15
15	New Zealand	249.00	5.42	59.41	1.53	0.97
16	Yugoslavia	245.90	-9.99	52.35	1.51	1.01
17	Italy	232.60	-4.12	-14.23	1.43	1.69
18	Indonesia	201.40	-7.95	201.40	1.24	0.00
19	Bahrain	180.30	1.18	43.10	1.1[illegible]	0.79
20	Egypt	179.20	1.30	49.33	1.10	0.75
21	South Africa	170.60	0.59	97.00	1.05	0.54
22	United Arab Emirates	155.90	0.71	345.43	0.96	0.22
23	Argentina	155.10	2.99	16.53	0.96	0.83
24	Ghana	150.30	20.63	-19.93	0.93	1.17
25	Cameroon	71.50	-11.84	66.28	0.44	0.27
	North America	4 891.30	11.38	-14.61	30.12	35.73
	Western Europe	3 453.70	1.57	-3.93	21.27	22.42
	Other developed [c]	1 484.40	4.46	-9.37	9.14	10.22
	Latin America	1 500.30	7.42	83.77	9.24	5.09
	Asia (excluding China)	901.40	-2.68	89.49	5.55	2.97
	Africa	401.00	4.81	14.34	2.47	2.19
	Total North [c]	9 829.40	6.69	-10.32	77.81	86.97
	Total South [c]	2 802.70	3.59	70.61	22.19	13.03
	Total world [c]	12 632.10	5.99	0.23	..	..
	Total North	..	..	..	..	87.52
	Total South	..	..	..	..	12.48
	Total world	16 240.00 [d]	4.66	1.29		

Source: [67] and [68].

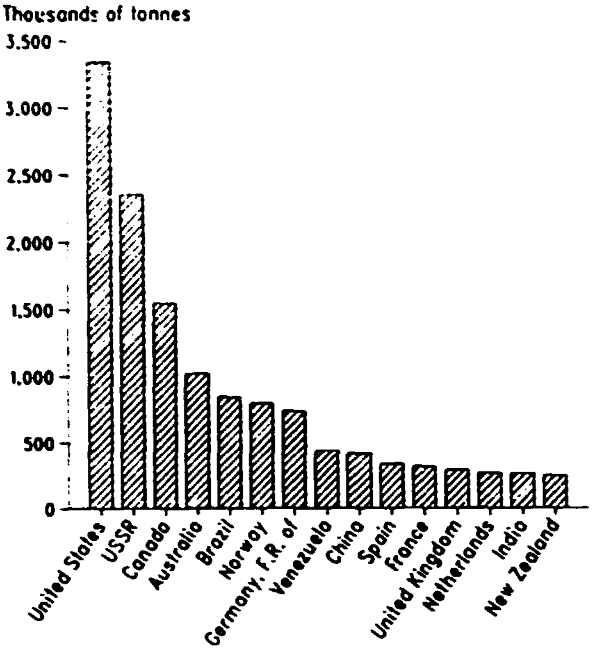
a/ Estimated.

b/ Estimated production of China, see Journal of Metals, April 1988, p. 54.

c/ Excluding centrally planned economies.

d/ See [63].

Figure IV.11. World production of primary aluminium, 1987



Source: [68].

ahead of the Federal Republic of Germany. But the output of all other major Western European producers fell considerably. Slumps of 26.3 per cent in the United Kingdom, 25.5 per cent in France, 10.5 per cent in Italy and 8.2 per cent in Spain were recorded during the period 1980-1986.

In other developed countries there were remarkable upturns. Between 1980 and 1987 South Africa and New Zealand increased production by 97 and 60 per cent respectively. Growth was pronounced in Australia, where output rose by 237 per cent, representing the second largest growth rate during the period. In 1987, the United States was the largest producer country, with almost 21 per cent of the total world output ahead of the USSR with 15 per cent, Canada with 9.5 per cent, Australia with 6.3 per cent, Brazil with 5.2 per cent and Norway with 4.9 per cent.

Turning to developing countries, Latin America was the largest producer region of primary aluminium in 1986, with a share of 9 per cent of production, ahead of Asia with 6 per cent and Africa with 2.5 per cent.

On a country-by-country basis, Brazil, the top developing country producer, with a growth of 11.4 per cent between 1986 and 1987, exceeded the output of the major Western European producers and moved to fifth place in 1987. The Brazilian Aluminium Producers' Association estimated that the country's output should reach 871,000 tonnes in 1988 ([69], p. 11). The second largest manufacturer among developing countries was Venezuela, with half of the Brazilian output in 1987. This was followed by India, Indonesia, Bahrain and Egypt. The United Arab Emirates, Brazil, Indonesia and Islamic Republic of Iran experienced the highest growth rates (345, 224, 201 and 152 per cent respectively) between 1980 and 1987. The only major producer country where output declined was Ghana, producing nearly 34 per cent less in 1986 than in 1980. But between 1986 and 1987 production recovered by some 21 per cent. This represents the second largest growth rate, outstripped only by Mexico which pushed up production by 63 per cent. Other developing countries in which output declined in 1987 were Turkey, experiencing a fall of over 30 per cent, China, with a 14 per cent decline, Cameroon down by 12 per cent, and Indonesia down by 8 per cent.

Despite the smelting boom among developing countries in the 1980s, however, developed countries still dominate world production. Their combined share amounts to almost 80 per cent, mainly due to high levels of production in the traditional producer countries and sharp rises in Australia, Canada and Norway.

(b) *Production of secondary aluminium*

During the 1980s manufacturing of secondary aluminium rose sharply. The trend strengthened during 1987 when the whole industry experienced a considerable upswing. In Western Europe, for instance, 1987 production increased by 5 per cent on the 1986 output and reached a level of 1.3 million tonnes ([70], p. 610). During the period from 1984 to 1986, however, prices fell.

As may be seen from table IV.53, world secondary aluminium production increased its share in total aluminium production to 27 per cent, up from 21 per cent in 1980. This remarkable growth is attributable to various factors. The main impetus certainly came from the sky-rocketing energy prices of the 1980s. In contrast to primary smelting which is very energy-intensive, secondary production is economical, requiring just 5 per cent of the energy consumption of primary smelting. Moreover, consumer durables and capital goods containing aluminium are about to enter the recycling stage, providing increased primary raw material for secondary use. The quality of secondary aluminium is not inferior to primary metal, although this situation might alter slightly as more aluminium alloys with low aluminium grades are incorporated into the recycling process ([71], p. 487).

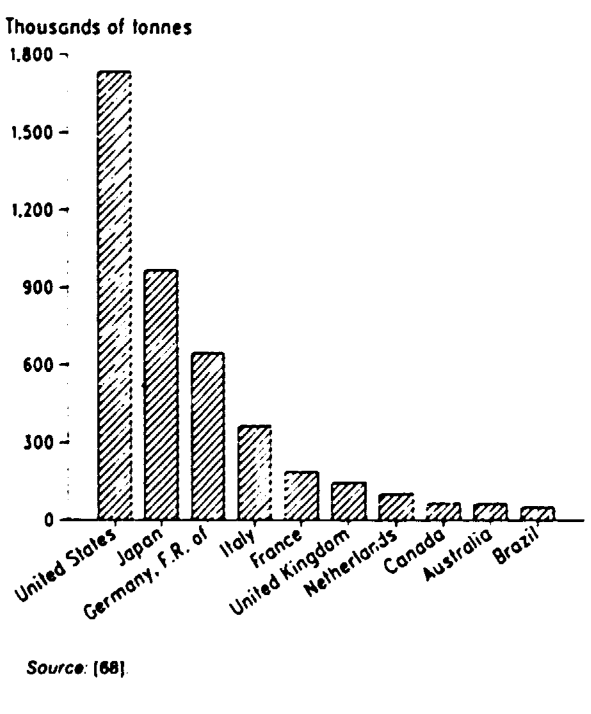
As reflected in table IV.53, primary aluminium production accounts for a much higher share of total output in those countries that have recently erected new primary smelters. Therefore, in Australia, Brazil, Canada, Norway and Venezuela, primary aluminium production accounts for more than 90 per cent of total output. In traditional producer countries like the United States, the Federal Republic of Germany and most of the other major Western European manufacturers, the share of primary metal has been decreasing significantly during the 1980s, and now ranges between 53 and 72 per cent. The change never quite reached the extent of that in Japan, however, where the share of primary in total production decreased from 60 per cent to just 4 per cent between 1980 and 1987. Figure IV.12 represents the 10 largest producer countries of secondary aluminium. The top producer country in 1987, accounting for nearly 38 per cent of world production, was the United States, showing an increase of 39 per cent on the 1980 figure. Japan, where secondary aluminium manufactures accounted for 96 per cent of total aluminium output in 1987, ranked second, representing 21 per

Table IV.53. Percentage share of primary and secondary aluminium in total aluminium production at country and regional levels, 1980 and 1987

Country or region	1987 Percentage share of aluminium in the country or regional total		1980 Percentage share of aluminium in the country or regional total	
	Primary	Secondary	Primary	Secondary
Canada	95.97	4.03	94.29	5.71
United States	65.86	34.14	78.84	21.16
France	63.31	36.69	71.76	28.24
Germany, Federal Republic of	53.31	46.69	63.23	36.77
Italy	39.05	60.95	47.15	52.85
Netherlands	72.60	27.40	82.52	17.48
Norway	99.75	0.25	99.40	0.60
Spain	87.62	12.38	90.94	9.06
United Kingdom	67.17	32.83	67.72	32.28
Australia	94.12	5.88	88.87	11.13
Japan	4.04	95.96	60.16	39.84
Argentina	97.73	2.27	95.00	5.00
Brazil	94.37	5.63	84.97	15.03
Mexico	79.21	20.79	71.36	28.64
Venezuela	97.78	2.22	97.02	2.98
North America	73.12	26.88	81.34	18.66
Western Europe	68.11	31.89	76.05	23.95
Latin America	94.88	5.12	90.90	9.10
Asia a/	94.45	5.55	95.73	4.27
Total North b/	68.86	31.14	77.36	22.64
Total South b/	95.44	4.56	94.11	5.89
Total world	73.40	26.60	79.20	20.80

Source: [67] and [68].
a/ Excluding China.
b/ Excluding centrally planned economies.

Figure IV.12. World production of secondary aluminium, 1987



Source: [68].

cent of world production, followed by the Federal Republic of Germany (14 per cent) and Italy (8 per cent). Data on production in centrally planned economies are not available.

The only major producer countries where production declined in the 1980s were the United Kingdom (19.4 per cent) and Canada (0.15 per cent). All the others showed significant growth of, for example, 85 per cent in the Netherlands, 68 per cent in Australia, 52 per cent in the Federal Republic of Germany, 39 per cent in the United States and 34 per cent in Japan.

The only significant producer in the developing world is Brazil, where output is expected to rise by over 9 per cent between 1980 and 1987. Nevertheless, its share in total world production is still very low, accounting for 1.1 per cent in 1987. Elsewhere in Latin America, production of secondary aluminium decreased. In Mexico, the second largest Latin American manufacturer, output declined 7.6 per cent between 1980 and 1987 and Argentina's output was nearly halved during this period. The only developing countries and areas to show significant increases were Taiwan Province (98 per cent) and the Islamic Republic of Iran (90 per cent). Asia's share in the world total amounts to only 1.16 per cent.

Thus, with an output of some 4.4 million tonnes, developed countries are playing an even more important role in world markets for secondary aluminium than primary aluminium. Their share of total world output is over 97 per cent.

While the developed countries' output of primary aluminium decreased by over 10 per cent between 1980 and 1987, developing countries pushed up production of secondary aluminium by 39 per cent. Between 1986 and 1987 the growth amounted to 7.8 per cent, and this trend is forecast to become even stronger. It should be remembered, however, that the level of secondary aluminium production is dependent on the availability of waste and scrap. Thus, countries with considerable primary production and buoyant consumption—mainly developed countries—enjoy notable advantages. Trade in waste and scrap has become ever more important. This is mainly because Japan, which, it may be remembered, shut down most of its primary production, remains an important producer of secondary aluminium and therefore had to provide raw materials for itself in foreign markets.

(c) *Production of aluminium casting*

Owing to the lack of comparable data for 1987, the world market for aluminium casting can be analysed only for 1986. Table IV.54 shows the level of production of castings in countries and regions and their percentage share in the world total. The combined share of developed countries in world production accounted for almost 82 per cent, and their output grew by 40 per cent over the 1982 level. The situation is similar to that on the secondary aluminium markets, the difference being that the developing countries experienced a boom period between 1982 and 1986, pushing up production by over 56 per cent. The growth rates were especially notable in Asia, where the increase reached over 127 per cent. The Philippines, in particular, pushed up output, becoming the sixth largest producer in the world, and the largest among developing countries. Taiwan Province and the Republic of Korea have also been experiencing a boom, showing rises in output of 409 and 65 per cent, respectively. All this helped lift Asia's share in world

Table IV.54. World production of aluminium castings, 1982 and 1986

Rank in 1986	Country, area or economic grouping	1986 (thousands of tonnes)	Percentage change from 1982	Percentage share 1986
1	United States	1 032.20	74.21	27.83
2	Japan	792.90	24.12	21.38
3	Germany, Federal Republic of	426.60	42.63	11.50
4	Italy	305.00	24.49a/	8.22
5	France	187.30b/	-1.27	5.05
6	Philippines	183.00c/	18 200.00d/	4.93
7	USSR	141.50e,f/	..	3.82
8	United Kingdom	99.50b/	27.08	2.68
9	Taiwan Province	81.00g/	409.43	2.18
10	Spain	54.40e/	0.74	1.47
11	Brazil	33.60e,f/	-39.68	0.91
12	Sweden	30.20	39.17	0.81
13	Australia	28.10e/	..	0.76
14	Austria	26.50e/	..	..
15	Republic of Korea	18.50	65.18	0.50
	North America	1 032.20	74.21	27.83
	Western Europe	1 165.00	27.00	31.41
	Eastern Europe and the USSR	87.70e,f/	44.96	2.36
	Latin America	59.90	..	1.62
	Asia	384.30	..	10.36
	Total Northh/	3 024.60	40.09	81.55
	Total Southh/	357.10	56.14	9.63
	Total worldh/	3 381.70	41.63	
	Total North	3 264.70	47.09	88.02
	Total South	444.20	94.23	11.98
	Total world	3 708.90	51.49	

Source: Modern Casting, December 1987, p. 25.
a/ Percentage change from 1981.
b/ Including magnesium castings.
c/ Castings only from Victorias Milling Corporation.
d/ Percentage change from 1983.
e/ Die-castings only.
f/ Forecast tonnages.
g/ Including aluminium wheels for automobiles.
h/ Excluding centrally planned economies.

output to over 8 per cent in 1986, while Latin America's contribution amounted to only 1.6 per cent.

In the developed regions, Western Europe's share in world production accounted for over 31 per cent in 1986, followed by the United States with almost 28 per cent (making it the largest producer country in the world), Japan with 21 per cent and the centrally planned economies with 8.9 per cent. The increase between 1982 and 1986 was most marked in the United States, which registered an increase of 74 per cent, ahead of the Federal Republic of Germany (43 per cent), Sweden (39 per cent), and the United Kingdom (27 per cent). The only major producer among developed countries experiencing a decline was France (1.3 per cent).

(d) *Production of semi-manufactures*

Production of semi-manufactures, including plates, sheets, strips, foils, bars, rods, sections, tubes, wires and forgings, is concentrated in three main regions—North America, Western Europe and Japan. Owing to a lack of data for centrally planned Europe and most developing countries, the amount of world production cannot be stated. Table IV.55, therefore, shows the level of output in 1987 in major producer countries and the percentage change from that of 1986 and 1980.

Throughout the 1980s the output of most countries and areas increased with the exception of Spain, Taiwan Province and Yugoslavia. During this period the biggest expansions occurred in Denmark (117 per cent), Netherlands (54 per cent), Japan (49 per cent), Austria (41 per cent) and Switzerland (36 per cent). The other countries showed moderate growth rates, ranging between 4 per cent for Sweden and 20 per cent for Norway. In all countries for which data were available, except Denmark, the 1987 output was below the 1986 level.

In the United States, which is by far the world's largest producer of aluminium semi-manufactures, production decreased by nearly 7 per cent between 1986 and 1987. Japan, ranking second with less than half the output of the United States, reported a level of production that was nearly 10 per cent lower than that of 1986. The Federal Republic of Germany was listed in third position ahead of France, Italy and the United Kingdom. The only major producer among developing countries is Brazil. In 1986 output reached 362,000 tonnes, 27.7 per cent above the 1980 level.

(e) *Trade in unwrought aluminium*

Recent instability in the exchange rates of trading partners has not yet been clearly reflected in trade statistics for unwrought aluminium, although the dollar-priced exports of the United States rose sharply between 1986 and 1987. The increase amounted to 37 per cent, but 1987 shipments were still much lower than in 1980, showing a decline of over 55 per cent during the period (see table IV.56). In Canada, the world's biggest exporter, shipments have been climbing continuously, showing a growth rate of almost 50 per cent between 1980 and 1987. In the same period

Table IV.55. World production of semi-manufactures, 1980, 1986 and 1987

Rank in 1987	Country or region	1987 (thousands of tonnes)	Percentage change from 1986	Percentage change from 1980
1	United States	5 507.40	-6.77	17.44
2	Japan	2 126.50	-9.80	48.84
3	Germany, Federal Republic of a/	1 172.90	-1.22	15.20
4	France	612.20	-7.48	14.88
5	Italy	560.80	-9.77	19.70
6	United Kingdom	417.10	-6.07	8.14
7	Brazil	362.60 b/		27.7 b/
8	Belgium	310.60	-12.04	32.91
9	Australia c/	273.00	-5.42	19.06
10	Spain	231.10	-5.97	-4.23
11	Yugoslavia	204.50	-4.40	-10.82
12	Switzerland	163.40	-2.82	35.83
13	Norway	142.40	-6.67	20.17
14	Netherlands	130.90	-4.28	54.36
15	Austria	124.20	0.24	40.82
16	Sweden	105.30	-3.80	3.95
17	Greece	84.30 b/		..
18	Finland	25.90	-1.54	16.67
19	Denmark	17.40	15.52	117.50
North America		5 507.40	-6.77	17.44
Western Europe		4 014.20	-3.21	17.25

Source: [67] and [68].
a/ Excluding forgings.
b/ Data referring to 1986.
c/ Excluding tubes.

Table IV.56. World exports of unwrought aluminium, 1980 and 1987

Rank in 1987	Country, area or region	1987 (thousands of tonnes)	Percentage change 1986-1987	Percentage change 1980-1987	Percentage share 1987	Percentage share 1980
1	Canada	1 171.80	0.70	49.33	18.93	18.63
2	Norway	754.20	16.66	44.70	12.18	12.37
3	Australia	707.30	22.05	1 564.24	11.42	1.01
4	Brazil	430.90	33.12	..	6.96	0.00
5	Germany, Federal Republic of	333.60	10.57	49.13	5.39	5.31
6	Netherlands	314.40	4.35	-13.93	5.08	8.67
7	Venezuela	302.80	9.91	32.98	4.89	5.41
8	United States	288.30	36.57	-55.58	4.66	15.41
9	New Zealand	243.00	32.21	90.59	3.92	3.03
10	Indonesia	179.70	0.00	100.00	2.90	0.00
11	Yugoslavia	157.20	8.94	181.22	2.54	1.33
12	Bahrain	146.10	6.80	88.52	2.36	1.84
13	United Arab Emirates	146.00	-6.17	2 181.25	2.36	0.15
14	United Kingdom	133.69	14.38	-31.17	2.16	4.61
15	France	119.30	-16.75	-32.75	1.93	4.21
16	Spain	106.90	-26.98	0.09	1.73	2.54
17	South Africa	93.80	1.52	644.44	1.52	0.30
18	Iceland	89.10	14.97	32.39	1.44	1.60
19	Hungary	63.40	3.59	-24.70	1.02	2.00
20	Switzerland a/	61.00	11.72	35.56	0.99	1.07
21	Greece	59.70	30.07	-0.83	0.96	1.43
22	Italy	51.60	50.44	337.29	0.83	0.28
23	Cameroon	47.40	-10.57	256.39	0.77	0.32
24	Sweden	43.60	10.66	146.33	0.70	0.42
25	Austria	39.40	25.88	302.04	0.64	0.23
26	Hong Kong	36.20	38.70	248.08	0.58	0.25
27	Belgium	27.60	10.84	40.82	0.45	0.47
28	Finland	24.30	42.94	523.08	0.39	0.09
29	Taiwan Province	17.30	38.40	..	0.28	0.00
30	Argentina	13.80	-60.35	-75.18	0.22	1.32
	North America	1 460.10	6.20	-4.11	23.58	34.04
	Western Europe	2 172.50	9.03	18.52	35.09	43.51
	Latin America	753.80	13.54	123.35	12.17	8.01
	Asia	538.40	4.12	446.60	8.70	2.34
	Africa	..	..	..	4.26 b/	
	Total world	6 191.40	5.21	46.97		

Sources: [67], [68] and [72].
a/ Including waste and scrap.
b/ 1986.

imports have been increasing markedly, both in the United States (136 per cent) and Canada (439 per cent). But this trend was reversed in 1987 when imports declined sharply in both countries. The drop in the value of the dollar might be one reason, but certainly the world-wide upswing in the aluminium industry was another. The rise in prices induced producers world-wide to bring back on stream moth-balled capacities, and as a consequence, demand for imported material weakened.

In Western Europe almost all countries, excluding Spain and France, increased exports between 1980 and 1987. The largest growth rates can be observed in Italy (50 per cent), Finland (43 per cent) and Greece (30 per cent). But also Norway, ranking second in the list of top exporters, and the Federal Republic of Germany, Europe's second largest exporter, pushed up exports by 17 and 11 per cent, respectively. Even the sharp decline in the value of the dollar against most Western European currencies has not affected the volume of exports from the region. One reason for this is the low aluminium price on world markets. In Japan, for instance, average domestic aluminium prices in the first quarter of 1988 were 43 per cent lower than in the same period of 1984 ([63], p. 604). Moreover, stocks have declined sharply, falling from 17 weeks to four weeks, adding impetus to demand, which still exceeds supply.

In Western Europe, changes to the unwrought aluminium import picture can be noticed in the early 1980s Between 1980 and 1987 nearly all countries except the Netherlands, Finland and Ireland increased imports, with the combined growth rate amounting to 20.8 per cent (see table IV.57). But with the upswing in the aluminium industry, Western European producers brought shut-down capacities back on line. Demand for imported material weakened in most of the major producer countries and contributed to an overall decline in imports of 2 per cent between 1986 and 1987. Nevertheless, considering the regional distri-

Table IV.57. World imports of unwrought aluminium, 1980 and 1987

Rank in 1987	Country, area or region	1987 (thousands of tonnes)	Percentage change		Percentage share	
			1986-1987	1980-1987	1987	1980
1	Japan	1 835.30	34.36	101.66	28.19	21.17
2	United States	1 241.50	-7.66	135.67	19.07	12.25
3	Germany, Federal Republic of	734.00	-6.34	20.57	11.28	14.16
4	France	407.10	-4.88	22.44	6.25	7.73
5	Italy	376.90	8.40	27.85	5.79	6.86
6	Belgium	315.50	2.64	24.95	4.85	5.87
7	Republic of Korea	200.20	8.51	171.27	3.08	1.72
8	Taiwan Province	195.10	25.06	234.65	3.00	1.36
9	United Kingdom	175.80	-3.51	3.78	2.70	3.94
10	Netherlands	145.50	-3.71	-32.61	2.24	5.02
11	Turkey	94.00 a/	144.79	..	1.44	..
12	Switzerland a/	90.20	2.15	66.42	1.39	1.26
13	Austria	81.10	-13.17	130.40	1.25	0.82
14	Hong Kong	70.50	50.32	74.07	1.08	0.94
15	Norway	57.10	62.68	248.17	0.88	0.38
16	India	55.80 b/	-13.08	13.65	0.86	1.14
17	Canada	53.40	-17.21	439.39	0.82	0.23
18	Portugal	43.50	11.83	84.32	0.67	0.55
19	Sweden	43.10	-20.63	16.80	0.66	0.86
20	Singapore	40.60	158.60	351.11	0.62	0.21
21	Yugoslavia	32.60	-5.23	-48.09	0.52	1.46
22	Denmark	27.80	-18.95	26.94	0.43	0.51
23	Finland	23.50	8.80	-11.99	0.36	0.62
24	Spain	13.40	-38.53	318.75	0.21	0.07
25	Ireland	2.30	-39.47	-58.18	0.04	0.13
	North America	1 294.90	-8.10	162.53	19.89	12.48
	Western Europe	2 536.80	-2.17	20.82	38.97	48.84
	Latin America	5.40	-28.95	-95.10	0.08	2.56
	Asia (including China)	804.30	-2.74	111.38	12.36	8.85
	Total world	6 509.80	1.03	51.41		

Sources: [67], [68] and [72].
a/ Including waste and scrap.
b/ January to November.

bution of imports, Western Europe still ranks in first place, holding a share of 39 per cent in total world imports, ahead of Japan.

In Japan, the need to replace closed domestic capacity by imported material has been growing since 1980, making the country the largest importer of unwrought aluminium in 1987. North America's share of total world imports amounts to 20 per cent, followed by Asia with 12 per cent.

So far as overseas sales are concerned, Western Europe is still the largest exporter, although its share in world exports has been declining from 43.5 per cent in 1980 to 34.8 per cent in 1987. North America's stake, too, has been falling during the 1980s from 34 per cent in 1980 to 2[illegible].4 per cent in 1987. Regions which increased their share markedly during this period included Latin America, Australia and Asia. Australia, which has built up huge capacities for aluminium smelting, has also increased exports, raising its share in the world total from 1 per cent in 1980 to 11.4 per cent in 1987.

In Latin America shipments from the two major exporters, Brazil and Venezuela, have shot up in the 1980s, contributing to the region's increase in world total exports from 8 per cent in 1980 to 12 per cent in 1987. According to the Brazilian Aluminium Association, Brazil earned about $1 billion from aluminium exports in 1987—an absolute record since 1981 ([73], p. 212). Brazil's 1988 exports were expected to outstrip the 1987 level, reaching 527,000 tonnes ([69], p. 11).

In Asia, all major exporters increased shipments continuously during the 1980s, pushing up Asia's share in the world total from 2.3 per cent in 1980 to 8.7 per cent in 1987. The region's top exporters in 1987 were Indonesia, Bahrain and the United Arab Emirates, ranking tenth, twelfth and thirteenth in the list of the world's top exporters. Africa held a 4.6 per cent share in world total exports in 1986, representing a slight increase over the 1980 figure. Data for 1987 are scarce.

Turning to imports by developing countries, the only region showing a significant position is Asia, with a rise in its share of the world total from 8.9 per cent in 1980 to 12.4 per cent in 1987 (see table IV.57). Countries with no primary smelting capacities account for the major part of the region's increase. The biggest importers in 1987, the Republic of Korea and Taiwan Province, experienced hikes of 171 and 235 per cent respectively. Together, they account for 6 per cent of total world imports.

(f) *Trade in aluminium waste and scrap*

In 1987, important changes occurred in the pattern of aluminium waste and scrap trade. Exports and imports reached an all-time high, mainly because of the demand of Japanese manufacturers. Some 612,000 tonnes were transported from North America, the centrally planned economies and other countries into the EEC and Japan. The latter, in particular, increased imports by 20 per cent on 1986, to reach 430,642 tonnes ([74], p. 17). Japan, unable to increase imports from the United States and Canada, attempted to meet its requirements with supplies from Western European countries. Exports from the EEC thus more than doubled between 1986 and 1987, resulting in serious internal supply problems ([70], p. 610).

(g) *Consumption of primary aluminium*

World consumption of primary aluminium has been increasing throughout the 1980s, growing from almost 16 million tonnes in 1980 to 17.1 million tonnes in 1986, a growth rate of 7.6 per cent. For 1987, consumption is believed to have grown at about 4 per cent ([63], p. 604).

While the combined increase in consumption of developed countries amounted to only 1.9 per cent between 1980 and 1986, developing countries raised usage by 38 per cent. The main reason was the backlog of demand in those countries, caused by widening fields of application, the substitution of aluminium for other materials and the growth in primary smelting capacities in developing countries.

Figure IV.13 shows consumption by countries and regions in 1987. Table IV.58 shows the percentage change between 1987 and 1980 by major producer countries, areas and regions. Changes in the countries' share in world consumption during the 1980s can also be seen.

The highest growth rates were experienced by Asian countries and areas, where India, the Republic of Korea, Taiwan Province and Turkey raised consumption at rates of between 40 and 208 per cent from 1980 to 1987. Asia's overall share in world total consumption rose from 4.5 per cent in 1980 to 9.6 per cent in 1987.

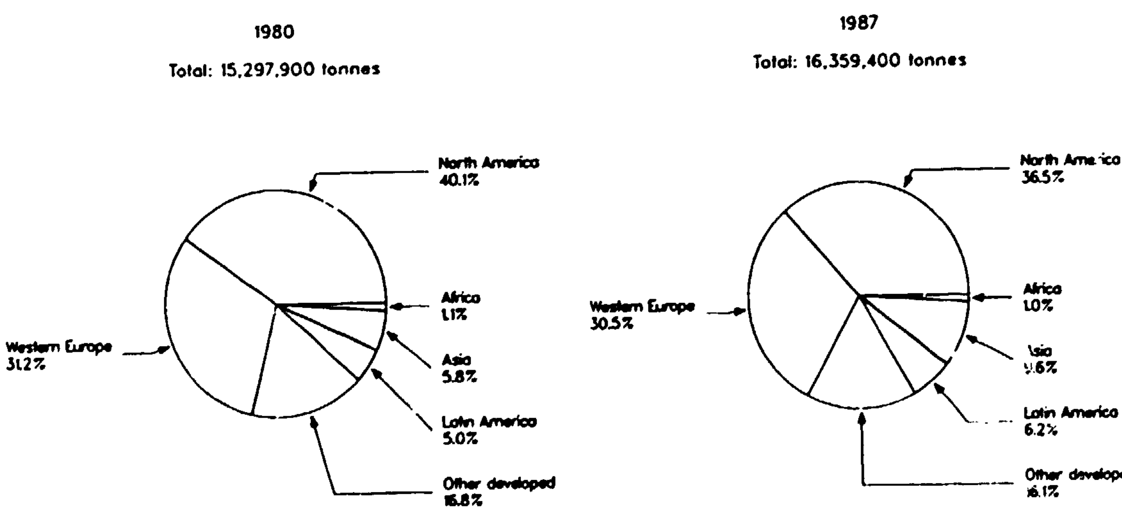
Demand in Latin America reached just 4.8 per cent in 1986, with Brazil's consumption proving quite volatile. Between 1970 and 1980 demand in Brazil increased at an average annual rate of 12.8 per cent. It subsequently suffered the effects of the recession in Brazil from 1981 to 1984, but underwent an extraordinary boom period between 1985 and 1986. In 1987, it suffered a new slump and overall demand was only 14.8 per cent higher than in 1980. This corresponded to a per capita consumption of 2.9 kilograms per year ([75], p. 204).

African consumption is still very low at less than 1 per cent of the world total.

Among developed countries, the United States ranks first with a share of 34 per cent in world total consumption in 1987, ahead of Japan (13 per cent) and followed by a number of Western European countries led by the Federal Republic of Germany with 9.3 per cent. Despite the record prices prevailing on the London Metal Exchange, the average price in Japan for the first quarter of 1988 was 43 per cent lower than in the same period in 1984 ([63], p. 604).

In Australia, Belgium, Federal Republic of Germany, Italy and South Africa, increases in consumption between 1980 and 1987 were considerable, with growth rates of between 14 and 35 per cent. In other major consumer countries increases were much lower, and the United Kingdom and Spain even saw a decline of 6.3 and 1.6 per cent, respectively. Nevertheless, developed countries remain the major users of primary

Figure IV.13. World consumption of primary aluminium by region, 1980 and 1987



Sources [67], [68] and [72]

Table IV.58. World consumption of primary aluminium, 1980 and 1987

Rank in 1987	Country, area or region	1987 (thousands of tonnes)	Percentage change 1986-1987	Percentage change 1980-1986	Percentage share 1987	Percentage share 1980
1	United States	4 536.00	5.08	1.85	34.11	29.00
2	Japan	1 696.80	4.47	3.53	12.76	10.67
3	Germany, Federal Republic of	1 185.70	-0.05	13.76	8.92	6.79
4	France	615.60	3.88	2.45	4.63	3.91
5	Italy	548.00	7.45	19.65	4.12	2.98
6	Brazil	431.80	1.91	45.68	3.25	1.93
7	United Kingdom	383.60	-1.41	-6.28	2.88	2.67
8	India	326.30	5.26	39.56	2.45	1.52
9	Canada	322.40	0.00	3.37	2.42	2.03
10	Australia	318.70	8.55	27.28	2.40	1.63
11	Belgium	284.90	0.81	22.33	2.14	1.52
12	Spain	259.20	6.23	-1.59	1.95	1.72
13	Republic of Korea	207.90	5.64	208.00	1.56	0.44
14	Taiwan Province	177.80	18.22	93.47	1.34	0.60
15	Argentina	142.00	17.07	138.66	1.07	0.39
16	Venezuela	135.00	0.00	40.33	1.02	0.63
17	Turkey	131.00	34.22	191.11	0.99	0.29
18	South Africa	92.20	22.28	18.66	0.69	0.51
19	Egypt	77.10	32.93	92.75	0.58	0.26
20	Mexico	68.10	30.96	-35.51	0.51	0.69
	North America	4 858.40	4.72	1.95	36.54	31.03
	Western Europe	4 059.10	1.30	9.43	30.53	24.16
	Other developed	2 141.50	5.86	7.50	16.11	12.97
	Latin America	830.50	5.93	39.21	6.25	3.89
	Asia a/	1 278.50	17.84	85.29	9.62	4.49
	Africa	128.80	24.20	-5.01	0.97	0.88
	Total North a/	11 059.00	3.66	5.66	83.17	68.16
	Total South a/	2 237.8	13.44	57.35	16.83	11.99
	Total world a/	13 296.80	5.18	11.84		
	Total North	13 636.80 b/		1.89 c/	83.36 b/	87.16
	Total South	2 722.60 b/		38.05 c/	16.64 b/	12.84
	Total world	16 359.40 b/		6.53 c/		

Sources: [67], [68] and [72].
a/ Excluding centrally planned economies.
b/ 1986 data.
c/ Percentage change 1980-1986.

aluminium, their consumption having accounted for 83 per cent of the world total in 1986.

By mid-1988, world-wide aluminium consumption growth was halted by the tight situation on the alumina markets. Although customers were willing to pay ever higher prices, no additional alumina, the base material for primary aluminium smelting, was available. China, Islamic Republic of Iran and USSR have reported shortages; the latter two may even have been forced to cut production ([76], p. 6).

(h) *Consumption of semi-manufactures by different industries in major consumer countries*

Both production and consumption are still concentrated in highly industrialized countries, indicating a correlation between aluminium per capita consumption and per capita income. Moreover, as can be seen from table IV.59, the increase and degree of aluminium consumption by the automotive, construction and packaging industries varies remarkably. This is due to differences in industrial structure and manufacturing practices as well as other factors such as climatic differences. Remarkable interregional differences in the structure of aluminium consumption can also be observed.

In the United States packaging ranked first in 1987 with a share of 28.6 per cent, coming before the building industry (22.4 per cent) and automotive applications (21.7 per cent).

In Japan, aluminium consumption concentrated on the automotive and construction industries. Packaging took only 8.1 per cent, with most of the growth in the industry being apparent in recent years.

In Western European countries with significant automobile industries, including France, Federal Republic of Germany, Italy and Spain, this industry ranks first in the consumption of aluminium. In the Federal Republic of Germany and France, automobile use

Table IV.59. Aluminium consumption by industry in major consumer countries, 1987
(Percentage)

Industry	United States	Japan	Germany, Federal Republic of	Italy	France	United Kingdom	Spain
Automotive applications	21.7	31.5	35.6	29.0	34.9	13.8	27.3
Construction	22.4	29.6	15.4	23.9	12.1	20.2	28.9
Packaging	28.6	8.1	10.3	10.6	8.8	15.4	16.1
Mechanical engineering	5.9	4.7	8.6	10.3	3.6	8.7	2.1
Electrical engineering	9.5	6.6	5.2	7.7	15.9	8.8	13.6
Household supplies	8.0	5.0	5.9	9.4	4.5	5.7	7.0
Others	3.9	14.5	19.0	9.1	20.2	27.4	5.0
Total (thousands of tonnes)	6 635.0	2 489.9	1 089.9	752.7	521.0	381.3	254.2

Source: [63], p. 603.

accounts for more than a third of the total. In Italy and Spain the industry accounts for 29 and 27.3 per cent, respectively.

While the construction industry dominated aluminium applications in Spain and the United Kingdom, this use lagged behind in France and the Federal Republic of Germany. In some countries the construction industry in particular has proved slow in switching to new building materials. As a result it has turned out to be unrealistic to expect the duplication of United States performance in Western European markets.

Turning to the pattern of consumption of aluminium in Western Europe, as can be seen in table IV.59 the packaging industry has yet to reach the importance of the automotive industry. Shares for packaging have varied from 8.8 per cent in France to 16.1 per cent in Spain. The next section will give some insight into the structure of one segment of the packaging industry, namely beverage cans, a market that has been aggressively solicited by producers of aluminium semi-manufactures in most countries in recent years.

(i) *The beverage-can market*

The recent success of aluminium beverage cans has been facilitated by the development and implementation of cost-effective recycling methods, impressive productivity advances and tremendous design innovations. These have led to dramatic decreases in the weight of the aluminium can. By 1987 aluminium had eliminated steel in the 12-ounce United States beer-can market and achieved a share of over 90 per cent in the soft-drink can market. In Australia the share has been equally high, while Canada and Japan show penetration rates of 84 per cent and growth continues [77].

In Japan the proportion of aluminium in non-pressure-filled health-drink cans rose by 88 per cent in 1988 compared to 1987, while the share of the fruit juice market rose by 12 per cent ([78], p. 5).

In Western Europe, market penetration has been only about 40 per cent, with significantly higher rates in Greece and Sweden (both 100 per cent), Austria, Ireland and Switzerland (between 80 and 90 per cent) and Italy (70 per cent). In the Federal Republic of Germany only 15 per cent of the cans are made of aluminium, while in Belgium, France, Spain and the Netherlands the use of tin plate still prevails. The remarkable differences are mainly dictated by the presence or absence of effective collecting systems for used cans. Recycling, however, is a must if aluminium is to have a chance of replacing other materials in packaging as, for the time being, the metal is much more expensive than steel or tin plate ([79], p. 613). On the other hand, the production of one steel can consumes over 10 per cent more energy than required by an aluminium can. Moreover, recycling steel cans is not cost-effective.

Plastic bottles, having been quite successful in displacing glass bottles, still present a recycling problem. Environmental concerns are also beginning to raise barriers to their expanded use. Ultimately, the plastic bottle is inferior to the aluminium can in terms of production speed, shelf-life and carbonation loss.

2. *Net profits and sales*

(a) *The North's largest companies*

The aluminium and aluminium products markets can be described as oligopolistic, with capacity concentrated among a few large, vertically integrated, transnational corporations. Seven companies represent about 44 per cent of the total smelting capacity and 50 per cent of capacity in developed market economies ([80], p. 596). Although their share has been decreasing slightly in recent years and will continue to do so, they will remain the dominant producers and price leaders. Their operations are highly integrated, from bauxite mining to production and sale of fabricated and semi-fabricated products ([65], p. 24). The markets are based on the co-existence of those large firms with some 50 more specialized companies that hold another 22 per cent of the total smelting capacity ([63], p. 604).

Generally, 1987 was the year when aluminium companies began recovering from the slack period.

Many factors contributed to the improved performance of most of the top six, including increasing demand for aluminium. This was accompanied by rising prices and pay-offs from the earlier restructuring and rationalization of the industry. The trend continued in 1988, when Alcan, Alcoa and Reynolds all posted their best ever annual earnings.

The Aluminium Corporation of America or Alcoa, the world's top aluminium company, enjoyed a strong performance in 1987, with sales rising 66 per cent over the 1986 result (see table IV.60). However, extraordinary charges for capacity write-downs and debt reductions cut its net earning to $200 million compared with $254 million in 1986 ([81], p. 7).

In the second quarter of 1988, Alcoa reported $238 million in net earnings, versus a $67 million loss in the same period of 1987. Net income also recovered considerably, reaching $416 million in the first half of 1988 compared with the net loss of $42 million in the first half of 1987 ([84], p. 7). For the full year 1988, Alcoa reported a net income of $861.4 million on a revenue of $9,940 million. This means that sales were up 28 per cent and net income more than quadrupled during the period ([85], p. 7).

Alcan, the big Canadian producer, reported a consolidated net income of $931 million in 1988, more than double the $433 million posted in 1987. The company was expecting a similar result for 1989. The successful strategy applied by the company during recent years and the strong price situation both contributed to the improved performance. The emphasis of the programme is on modernization and low-cost excellence rather than on expansion ([86], p. 9).

Reynolds Metals, the second largest aluminium manufacturer in the United States, reported record sales in 1987 and 1988. Sales reached $4,284 million in 1987, being 18 per cent above the 1986 level, and shot up by a further 31 per cent in 1988, to $5,618 million. Net income more than doubled between 1987 and 1988 and the profit margin rose to 8.6 per cent ([85], p. 7). A number of factors are said to have contributed to the company's improved performance, including strong world-wide demand, improved prices and increased packaging, can and consumer product sales.

Amax, which acquired Alumax in November 1986, became the third largest aluminium manufacturer in the United States in 1987, with sales amounting to $3.4 billion. For the second quarter of 1988, the company reported operating earnings of $180 million, up from $78 million in the same period of the previous year ([87], p. 2).

As part of its long-running restructuring programme, Kaiser Aluminium & Chemical sold parts of its businesses in order to lower its debts. Moreover, the name of the company, which at the end of 1987 held 80 per cent of its former assets has been changed to KaiserTech. In 1987, KaiserTech was the only firm of the United States' big four to experience a startling net loss, amounting to $362 million. Excluding restructuring provisions of $366.1 million, the company's operating loss was $4.6 million compared with $94.2 million in 1986. The company was expecting to lower its total debt by $415 million to $940 million by the end of 1987 ([88], p. 7).

In 1988 the company's operations improved markedly. The company posted a net income of $51.6 million in the second quarter, including an estimated gain of $14 million from the sale of most of its chemical businesses. Total debt amounted to $857 million then and the debt-to-capital ratio dropped from 57 to 45 per cent ([89], p. 7). Data on the overall performance of the company in 1988 has not been made available, as Kaiser is not obliged to report for some time in line with its newly established private status ([90], p. 1).

Moving to Western Europe, data on the performance of aluminium-producing companies are scarce. Data on the 1987 results of France's Péchiney-Ugine Kuhlmann could not be found. Alusuisse, the Swiss aluminium manufacturer reported sales of $3.5 billion in 1987, a decrease of 10 per cent. However, for the first time since 1984, the company posted a net profit, earning 259 million Swiss francs (about $174 million) compared with a loss of 688 million Swiss francs ($461 million) in 1986. The turnaround has been attributed to rising world aluminium prices, a favourable economic climate in major markets and increased concentration on high-value-added products ([91], p. 2).

VIAG, the diversified parent company of the aluminium producer VAW of the Federal Republic of Germany, reported sales of $4.8 billion in 1987, thus

Table IV.60. The North's largest companies in 1987

Rank in 1987	1987 sales (millions of dollars)	Percentage change 1986-1987	Company	Country	Net profit (millions of dollars)	Profit margin (percentage)	Employees	Sales per employee
1	7 767	66.0	Aluminium Corp. of America	United States	200.0	3.0	55 000	141 218
2	6 797	14.1	Alcan	Canada	433.0	6.3	..	..
3	4 806	-2.7	Viag (diversified parent company of VAW)	Germany, Federal Republic of	318.7	6.6	32 733	146 818
4	4 284	18.0	Reynolds Metals	United States	220.0	5.0	27 300	156 923
5	3 469	-10.2	Alusuisse	Switzerland	177.2	5.1	23 497	147 627
6	3 434	138.0	Amax	United States	51.0	1.0	19 856	172 945
7	2 227	-	Kaisertech	United States	-362.0	-	12 500	178 160
8	1 681	28.0	Hydro Aluminium	Norway	209.4	12.5	7 600	221 184

Sources: [81], p. 7; [82], p. 8; [83], p.9; Financial Times, 21 November 1988; and Fortune, 25 April 1988.

representing a decline of 2.7 per cent on the 1986 result. Nevertheless, the profit margin was high, at 6.6 per cent of sales. In the first nine months of 1988, the newly privatized VIAG saw net profits rise significantly on an 11 per cent sales gain. In its interim report the company said that profits increased in all divisions and total sales in 1988 were expected to rise by about 7 per cent. Nevertheless, results of the performance of the single divisions could not be obtained ([92], p. 21).

Hydro Aluminium, an expanding Norwegian producer, showed an increase in turnover of 28 per cent on the 1986 value. The remarkable profit margin of 12.5 per cent is attributed to the high prices for primary metals in the second half of 1987. Company officials state that they will build up a financial position strong enough to carry out plans regardless of economic fluctuations ([83], p. 9).

(b) *The South's largest companies*

All big aluminium manufacturers in developing countries and areas, with the exception of China Rebar of Taiwan Province, are located in countries with substantial primary aluminium production. As data on the performance of companies in the South are scarce and often not available for two consecutive years, a ranking of firms can not easily be undertaken. Therefore, table IV.61 shows listings for 1986 and 1987. The percentage change in turnover on the previous year refers to the 1987 figure in cases where data have been available for both years. Furthermore, as modifications in turnover of one year on the previous are often quite substantial, forecasts are difficult to set up. The increase in sales of Asahan Aluminium Corp. of Indonesia, the largest company in the South in 1987, amounted to 40 per cent. This was primarily due to the surge in ingot prices. Gross operating profit was expected to reach $40 million. Nevertheless, net profits should be considerably lower partly because of exchange rate losses [93].

CBA of Brazil, the company reporting the highest turnover in 1986, experienced a rise of 79 per cent over 1985. The profit margin accounted for 11.4 per cent. Output of primary metals was 158,830 tonnes in 1986 and could be raised to 168,982 tonnes in 1987 [73].

Profit margins, in general, rose significantly between 1986 and 1987, thanks to the world-wide boom in the aluminium industry. Only the African companies, Alucam in Cameroon and Friguia in Guinea, experienced losses in 1987. For Venalum in Venezuela, the second largest producer in 1986, sales went up only slightly in 1987. The other large Venezuelan manufacturer, Alcasa, saw its turnover increase between 1986 and 1987 by a remarkable 19 per cent.

The largest company in the Middle East in 1987, Alba in Bahrain, reported estimated sales of $257 million, thus ranking second, followed by Dubal in the United Arab Emirates. The Indian manufacturer, Hindustan Aluminium Corporation, showed an increase in its 1986 turnover of 7.4 per cent on the previous year. Another big Indian manufacturer of primary aluminium, Nalco, restarted idle capacity in 1988 and hoped to produce 550,000 tonnes for that year against some 167,000 tonnes in 1987 ([89], p. 5).

3. *Structure of the cost of production*

As figure IV.14 shows, the major components of the production costs of primary aluminium are alumina,

Table IV.61. The South's largest companies by sales, 1987

(Millions of dollars)

Company	Country or area	1987 sales	Percentage change over previous year	Net profit	Profit margin (percentage)	Net assets
Asahan Aluminium Company	Indonesia	350	40.0	40.0 a/	11.4	..
CBA-Brasiliera De Aluminio	Brazil	321 b/	79.3	36.6	11.4	261
Venalum	Venezuela	271	0.3	..	..	..
Alba-Aluminium Bahrain	Bahrain	257 c/	..	..	..	..
Hindustan Aluminium Corp.	India	246 b/	7.4	12.3	5.0	..
Dubal	United Arab Emirates	221 c/	..	..	..	..
Al Ghuhair Group	United Arab Emirates	218	..	..	..	..
Balco	Bahrain	216	-6.9	60.3	27.9	..
Alcasa-Aluminio del Caroni	Venezuela	191	19.3	33.3	17.4	..
Indian Aluminium Corp.	India	184 b/	-10.5	13.1	7.1	..
China Rebar	Taiwan Province	150 b/	..	2.5	1.7	201
Aluar Aluminio Argentino	Argentina	141 b/	-39.5	-2.2	-	355
Alucam	Cameroon	138	22.1	-1.1	-	71
Etibank Seydisehir Aluminyim	Turkey	118	..	10.1	8.6	147
Friguia	Guinea	88	..	-3.7	-	20
Aluminium Products Company	Saudi Arabia	60	..	..	..	100

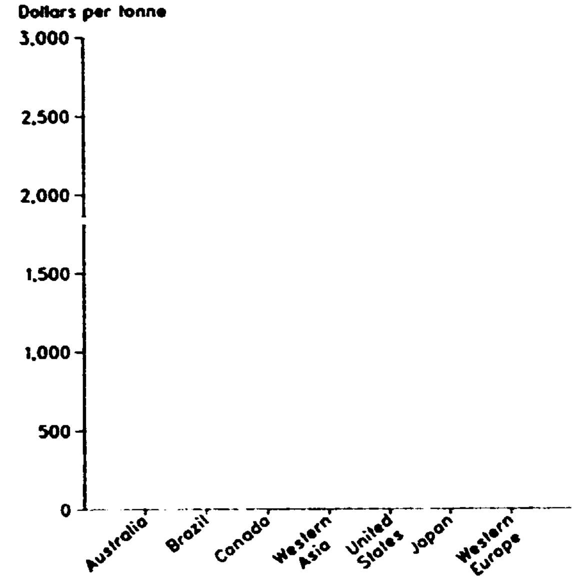
Sources: [93]; South, April 1987, July 1987, May 1988, July 1988 and September 1988.

a/ Expected gross operating profit.

b/ Figures for 1986.

c/ Estimated.

Figure IV.14. Aluminium smelting costs at selected sites, 1985/86



Key:
Alumina
Power
Capital charges
Labour
Other

Source: [65]

electricity and capital charges. Average values of these components and total costs measured in 1984 dollars are stated for a plant newly erected in 1985/86 in various locations. Considering the costs of alumina, interregional differences in its importance as a factor of production are not very striking, the percentage share in total smelting costs ranging between 21.7 and 24.6 per cent. In absolute terms, Canada and traditional producers like Western Europe, the United States and Japan have to face alumina costs of over $600 per tonne, whereas the average costs for Australia, Brazil and Western Asia amount to $560, $575 and $580 per tonne, respectively. Nevertheless, it should be noted that in some locations smelters are at a particular alumina cost disadvantage because of high freight costs.

Labour costs account for a very small share of total production costs in all regions observed, the lowest running at 2.1 per cent for Brazil and the highest being Australia with 4 per cent. Moreover, the figures indicate that labour costs have become secondary, because of high levels of automation in smelter facilities.

Power costs have always been an important factor in smelter competitivity, and since the second oil shock, in particular, they have become the dominant factor. Energy-rich countries or regions like Australia, Brazil and Western Asia are generally in more favourable positions than the traditional producer regions of Western Europe, the United States and Japan. Figure IV.14 shows remarkable differences in power costs in absolute terms and as a percentage of total production costs in the various locations. Moreover, the ownership of power sources can heavily influence power prices. Self-generated electricity is generally priced at average production cost, whereas purchased electricity is frequently priced according to other principles, mostly marginal cost ([94], p. 31).

Government policy on electricity pricing for industrial users thus often plays an important role. In many countries, particularly in those with high power prices, special agreements exist between aluminium producers and the power industry usually linking the cost of energy to the price of the aluminium ingot. Today, however, the advantage arising from linking costs to the price of the end-product has disappeared because of the high aluminium prices of recent years. Some smelters have suffered greatly inflated costs. In general, production costs rose by nearly 16 per cent during 1987 and 1988, reversing the 1982 to 1986 trend of plunging costs ([95], p. 13).

Furthermore, power prices paid by smelters may differ according to energy sources. Oil-based plants, for instance, are at a disadvantage against company-owned hydroelectric facilities that have already been amortized. The fact that manufacturers in traditional producer countries have to spend an increasingly higher portion of total costs on energy provisions encourages them more and more to shift to secondary aluminium production. This needs only 5 per cent of the energy requirements of the primary industry.

Because smelting facilities are capital-intensive, capital charges are another major factor in total production costs. As economies of scale have grown more important, thus encouraging larger plants, it has become more difficult to assess average capital costs per tonne of output in the various regions. Data given in figure IV.14 apply to a 200,000-tonne-per-year greenfield smelter. The figures show that capital charges account for a bigger share of total production costs in countries with newly erected capacities, ranging from 33.7 per cent in Canada to 40.9 per cent in Western Asia. The traditional producer countries represent a lower percentage share, amounting to less than 31 per cent in all regions. Furthermore, estimates indicate that current costs of producing aluminium ingots from a newly integrated plant would require an aluminium price of around $2,400 per tonne to provide an adequate return on investment ([65], p. 32). Other current cost items, including materials, particularly petroleum coke, maintenance and overheads, take a similar share in total production costs in every region observed, ranging between 20 and 23 per cent.

Considering direct operating costs, presented in table IV.62, interregional differences are even more obvious. In 1987, Canada held the most favourable position, with direct operating costs amounting to $746 per tonne. Latin America ranked second, facing costs that were 4.3 per cent higher than in Canada. Oceania, listed in third place, 8.7 per cent behind Canada, stays within the 10 per cent range. All other regions are above 10 per cent. Africa and Western Asia, in fourth place, had to take direct operating costs that were 13.5 per cent above the Canadian figure. The least favoured region was Asia, showing a disadvantage of 88 per cent against the Canadian average direct operating costs. But producers in the

Table IV.62. Comparison of direct operating costs for primary aluminium smelting in various regions, 1987

Country or region	Direct operating costs (dollars per tonne)	Disadvantage in comparison with the most cost-effective region (percentage)
Canada	746	
Latin America	778	4.3
Oceania	811	8.7
Africa and Western Asia	847	13.5
Northern Europe	946	26.8
Southern Europe	1043	39.8
United States	1054	41.3
Central Europe	1173	57.2
Asia	1401	87.8

Source: [96], p. 609.

United States and in the various regions of Western Europe also had to face costs that were between 26.8 and 57.2 per cent higher than those of Canadian manufacturers.

Bearing in mind these big regional differences, international division of labour and specialization will continue. Additional capacities and replacement facilities are therefore most likely to be erected in areas with the lowest direct operating costs. Energy and alumina costs will be decisive for future expansion and construction plans. It may be noted that Latin America and Oceania have at their disposal almost 43 per cent of the world's reserves of bauxite, the base material which is converted first into alumina and then into aluminium ([96], p. 609).

4. *Technological change and industrial restructuring*

At the beginning of the 1980s the aluminium industry experienced the longest downturn in its history. After a 4 per cent drop in 1980, consumption in developed market economies fell by a further 6 per cent in 1981 and by 2.8 per cent in 1982 ([65], p. 12). At the end of 1982 world-wide capacity utilization had fallen to 72 per cent from 96 per cent in 1980. This was the lowest rate ever experienced.

During the first phase of the downturn the industry reacted by adjusting inventory and adopting stand-by measures such as the freezing of excess capacities or postponement of investment decisions. But when demand did not pick up as expected, and prices stagnated at low levels, it became clear that the industry had to undergo structural changes. The measures taken included reduction in production costs. In the United States, the number of employees shrank considerably between 1983 and 1987, with job losses amounting to 19 per cent for primary, and 10 per cent for secondary smelting ([97], p. 54).

In addition to these changes, computerization and automation of plants has created a new aluminium industry. Facilities can be operated permanently, pot condition can be observed thoroughly and labour productivity has become high [98]. The adoption of rationalization schemes has allowed production costs to be cut by about 20 per cent between 1982 and 1986 ([63], p. 602).

After the end of the short-term boom in 1984 many inefficient plants had to be closed down. Between 1984 and 1985, 400,000 tonnes of capacity were shut down, the major part permanently. In Japan, the shut-down was most remarkable. Primary aluminium output fell by 96 per cent between 1980 and 1987, making Japan the world's largest importer of primary metal. In the United States, plants have also been written off, shifting manufacturers' balance sheets into the red. In contrast to the situation in Japan, however, these capacities remained on a stand-by basis, partly through management buy-out ([66], p. 600).

In Western Europe tougher employment laws are making temporary shut-downs more costly. Many national companies have a high degree of government involvement, and this has frequently hampered the closure of uneconomic plants. In one development, however, Alusuisse, has started considering whether some of its primary facilities could be changed into swing producers. These plants would only be activated during the summer months when energy is cheaper ([99], p. 542).

Hand-in-hand with the shut-down of capacity in traditional producer countries has come the erection of new plants in bauxite- and energy-rich regions. The main countries and regions to benefit have been Australia, Brazil, Canada and, increasingly, Venezuela and Western Asia. In many cases, existing facilities in these countries needed to be improved in order to remain competitive. Brazil, for instance, has been anxious to cut energy requirements for primary smelters. Furthermore, important technology developments, such as computerized process control, electrolyte control and decrease of current density, have emerged in recent years ([100], p. 120).

The recycling of scrap has been encouraged, particularly in traditional producer countries. As may be seen from table IV.53, the share of secondary aluminium production in total world aluminium output has increased from 21 per cent in 1980 to 27 per cent in 1987. Moreover, greater emphasis has been placed on fabricating stages and new fields of application. Increased effort has been put into the development of new and improved products. The key areas for increased use of aluminium semi-manufactures have been the construction, automotive and packaging industries. The next section covers the recent changes in the latter two key areas.

(a) *Packaging*

Technological trends in packaging include moves towards thinner foils and their increased use in more sophisticated, laminated, multi-material structures. Today, 18 to 30 per cent more packaging (by area) can be made per unit weight of aluminium than a decade ago [77]. These improvements have been made possible through advances in high-speed rolling technology, including computerized shape and gauge control of foil, and improved metal quality and alloys. Metal packages are increasingly used in areas where a cosmetic surface appearance is required or a modest level of barrier effectiveness is needed.

(b) *Automotive industry*

The surge in fuel prices after the last oil price rise forced the automobile industry to take steps to reduce the weight of cars. Other measures, for example, to lower air resistance and improve the efficiency of motors were also undertaken. Moreover, regulatory measures on safety and pollution control needed to be observed. As a result, performance of automobiles has already improved, but other measures still await implementation. One of these is the increased use of aluminium to help reduce car weight further. Currently, the share of aluminium in total material amounts to only 3 to 4 per cent, while that of cast iron and steel accounts for 74 per cent ([101], p. 210).

On a life-cycle energy consumption basis, including manufacturing and direct and indirect fuel operating costs, aluminium typically requires between 25 and 50 per cent of the energy demanded by steel and cast-iron parts ([77], p. 47). Other advantages, such as corrosion resistance, aesthetics and ease of fabrication, have also contributed to the growth in aluminium use in automobiles.

(c) *Restructuring at the firm level*

All of the world's major transnational aluminium companies have been rethinking their strategies. Primary material facilities have been closed down in countries with high energy prices, and big firms have directed their attention to semi-manufactures markets, often selling other parts of their businesses. As a result of mergers and acquisitions, new companies have been created. Hydro Aluminium, for instance, developed from the merger of ASV (Ardal og Sunndal Verk a.s.) and the aluminium division of Norsk Hydro, the largest Norwegian company. Created in 1986, Hydro Aluminium has become the largest Western European manufacturer of primary aluminium, with an annual capacity of 600,000 tonnes. Furthermore, with the acquisition of five Alcan plants in Western Europe, Hydro Aluminium holds the largest network of extrusion plants in the region ([102], p. 558).

Alusuisse, the Swiss company, has been cutting loose from primary smelting while at the same time forward-integrating into specialized, high-value-added products and developing its chemical businesses. Its primary capacity has been halved to about 400,000 tonnes per year, and many of its United States' operations have been shed ([103], p. 57).

KaiserTech of the United States has sold its industrial and speciality chemicals businesses and its Western European aluminium operations. The restructuring measures at Alcan included the sales of five extrusion plants to Hydro Aluminium. Moreover, in 1987 the company spent $95 million on research and development, excluding costs for new products and processes that have been directly developed in the plants. These expenditures have accounted for up to 6 per cent of turnover ([80], p. 599). Alcan is currently halfway through a programme to expand and modernize its aluminium casting business in order to improve its capacity to supply North American value-added ingot customers. The company has committed $100 million to the programme during 1988 and 1989 ([104], p. 9).

The French company Péchiney also stresses its downstream activities. The acquisition of the United States can manufacturer ANC (American National Can) boosted it to the number one position in packaging and gave it over 25 per cent of the United States can market ([105], p. 7; [106], p. 1). Downstream activities currently account for over 50 per cent of the company's sales, while primary aluminium is 27 per cent. Péchiney is said to have pursued a strategy of maintaining its level of smelting capacity, but raising productivity. This has been done by allowing its share in large smelters with advantageous power supply contracts to diminish as the smelters expand ([107], p. 2).

5. *Indigenous manufacture in developing countries*

The remarkable rise in energy prices during the past 15 years has encouraged aluminium production to move to energy-rich countries, which often also have huge bauxite reserves. As the construction of these mainly export-oriented primary aluminium plants is capital-intensive, ventures between local, in many cases State-controlled, firms and foreign partners have been set up. The arrangements are mostly debt-to-equity conversions, and often involve agreements in which partners have to take a certain amount of the output, usually correlating to their share in equity. Japanese firms, in particular, have been trying hard in recent years to establish a foothold in promising markets, such as those of Brazil, Indonesia, Thailand and Venezuela, in order to secure aluminium requirements.

Measures taken by Governments anxious to attract foreign investors include tax cuts, favourable exchange rate conversions and provision of power at a price considerably lower than the local market price. On the other hand, Governments strictly control the domestic price of aluminium and fix it at a level below world market prices. As a result companies have been eager to export most of their output, leading to lack of supply in those countries. Furthermore, during recent years aluminium production has been affected by power shortages in many developing countries. Domestic downstream facilities have been particularly hit by lower primary metal output, as most of the companies have to meet their foreign obligations first of all.

The following sections will cover recent developments, the current situation and the outlook for aluminium production in major producer countries of the developing world.

(a) *Venezuela*

Venezuela has the most ambitious plans for construction and expansion of aluminium plants. Between 1987 and 1988, output of primary aluminium should have increased by 66 per cent to 700,000 tonnes. The 1988-1989 growth rate should amount to 28 per cent, and that for 1990 is projected at 29.7 per cent. As may be seen from table IV.63, output should reach almost 1.5 million tonnes in 1992 and for 1996 the goal is 2 million tonnes. If all these plans are carried out on schedule, Venezuela will be the world's largest producer of primary aluminium by the year 2000.

The use of debt-to-equity swaps has ensured that financing of the ambitious export-oriented projects has met little trouble so far. In particular, Japanese aluminium semi-manufacturers, anxious to secure their aluminium provisions, are financing expansions as part of arrangements that guarantee certain levels of output over a number of years. Overall, however, the programme represents $6.5 billion of a broader five-year scheme that calls for investments of around $25 billion between 1988 and 1993. This sum is three times bigger than the total invested in basic industries at the height of Venezuela's oil boom in the mid-1970s. Critics thus state that the programme is not economically viable, and that falling revenues from oil sales and depleted foreign exchange reserves will force the Government to call for a new round of debt restructuring talks ([87], p. 1).

As the major part of the aluminium industry is owned by the State, the Government lays down guidelines for the whole industry. The priority is to achieve vertical integration. Thus, investments are not only made in the construction and expansion of primary smelter capacity, but also in upstream facilities comprising bauxite mining and the production of alumina. Bauxiven, the State-owned bauxite producer, for instance, is going to invest $195 million in the Los Pijguaos mine, where large deposits of high-grade ore have recently been found. The Government hopes to push the 1988 output of 700,000 tonnes to 3 million tonnes by 1990. At the end of the century, production is projected to reach 8 million tonnes per year ([104], p. 7).

At the beginning of 1988, Venezuela inaugurated its first fully integrated aluminium operation with the production of the first alumina refined from Venezuelan bauxite. The Bauxiven mining operation has thus joined Interalumina, Venalum and Alcasa in creating a large, low-cost integrated aluminium production facility. Prior to this, all bauxite for the industry was imported ([82], p. 8).

The Government's short-term expansion projects include the increase of Venalum's primary aluminium capacity from 280,000 tonnes to 456,000 tonnes by 1990. By the beginning of 1989, technology upgrading had added 58,000 tonnes of capacity, and the last tranche of financing was secured. Japan's Marubeni Corp. agreed to finance $100 million of the total $600 million expansion as part of a contract that will give the Japanese company 400,000 tonnes of the smelter's output over eight years. Moreover, Marubeni plans to ship 60 to 70 per cent of Venalum's metal to Japan, and to sell the rest on the South-East Asian market ([108], p. 7).

At Venezuela's second largest smelter, Alcasa, primary aluminium output will also be raised significantly. Between 1988 and 1990, capacity will be more than doubled, reaching a level of 384,000 tonnes ([109], p. 122). In addition to the Alcasa and Venalum expansion, the short-term Government plan includes the build-up of a 180,000-tonnes-per-year smelter which is scheduled to operate at 70 per cent of capacity by 1990. The project is a joint venture named Aluminio Alam S.A. or Almasa, formed by Alcasa (30 per cent), Austria Metall (40 per cent) and Péchiney (30 per cent). Debt-to-equity conversion will finance around $280 million of the total $660 million investment. The Almasa partners' metal take will match their equity, with Alcasa expecting to place its share in downstream joint ventures in Europe ([91], p. 1).

Another joint venture grouping State interests, Italimpianti, Techint and a private Venezuelan com-

Table IV.63. Expansion plans of primary aluminium capacity in Venezuela and Brazil, 1987-2000

Year	Primary aluminium capacity, Venezuela (tonnes)	Percentage increase	Primary aluminium capacity, Brazil (tonnes)	Percentage increase
1987	420 000	..	..	..
1988	700 000	66.0	869 000	..
1989	898 000	28.0	..	..
1990	1 165 000	29.7	899 000	3.5
1992	1 494 000	28.2	1 214 000	35.0
1994	1 607 000	7.6	1 244 000	2.5
1996	2 000 000	24.5	1 254 000	0.8
2000	..	..	1 430 000	14.0

Sources: "Aluminium rides the bull into the New Year", Metal Bulletin, 31 December 1987, p. 9.; "Venezuela accelerates expansion again, but corruption allegations rock industry", [91], p. 1; and [73], p. 205.

pany, is to build a 360,000-tonnes-per-year smelter in two 180,000-tonnes-per-year stages. The first will come on stream in 1991 and the second in 1992. Called Aluyana, the complex is said to carry a $1.4 billion price tag spread over five years. Venalum may take an interest of 40 to 45 per cent, and Italimpianti and Techint might share around 50 per cent with the private Venezuelan company. Another venture, a 180,000 tonne-per-year smelter, might involve Alumax and Alusuisse ([110], p. 6).

If all these expansion and building plans are carried out, the Government will have to increase production of bauxite and alumina in order to maintain its target of reducing dependence on imports of these raw materials. The Government plan, therefore, includes projects to increase the output of Bauxiven to 6 million tonnes per year by 1990 ([109], p. 122). Moreover, Interalumina's capacity will be increased from 1.4 million tonnes in 1988 to 2 million tonnes in 1990. But the company is arguing for a further increase to 3 million tonnes in view of the huge expansions in the country's primary smelting capacity. Venezuela will be forced to import alumina by mid-1991 if the additional capacity is not approved, company officials state ([76], p. 6).

Although the country is currently busy raising its primary smelting capacity, it is also trying to establish a foothold in downstream manufacturing. At the beginning of August 1988, Venalum agreed to buy a 20 per cent stake in United States extruder Wells Aluminium. The undisclosed purchase price will be paid in metal units. Venalum will supply metal at a volume ranging between 40 and 60 per cent of Wells' needs ([111], p. 7). Foreign master alloy producers are also trying to secure a foothold in the very promising Venezuelan market.

In another example, Metallurg formed a venture with the local special steels producer Acerex. The company, called Aleaciones Metalúrgicas Venezolanas or AMV, wants to start production of master alloys and manganese briquettes in the third quarter of 1989. Close to AMV is the Kawecki-Billiton venture with CVG, the Venezuelan State holding concern, and Aleaciones No Ferrosas. The company will be called Alloyven and will have an initial capacity of 15,000 tonnes. Start-up is projected for late 1989 ([112], p. 15).

(b) *Brazil*

Brazil currently holds fifth place in world primary aluminium production, and stands fourth in world exports of unwrought aluminium. That makes it the biggest developing country producer and exporter of this metal. Backed up by 20 per cent of the world's bauxite reserves, Brazil has expansion plans similar to those of Venezuela; namely, increasing primary smelting capacity and strengthening the vertical integration of the aluminium industry.

Until 1990, primary production capacity will be increased only moderately, but growth should reach 35 per cent between 1990 and 1992. Up to the year 2000, primary smelting capacity is forecast to reach 1,430,000 tonnes per year, some 600,000 tonnes less than that of Venezuela (see table IV.63).

In contrast to Venezuela, Brazil's aluminium industry is not dominated by State interests. However, State officials strictly control domestic prices, which are kept at a level below world market prices. Companies do have some advantage in selling to the local market, however, as they are allowed exemption of up to 30 per cent from increases in electricity prices ([113], p. 5). Moreover, the country's biggest company by turnover, CBA-Brasiliera De Aluminio, is privately owned. The company wants to push its smelting capacity from the current 170,000 tonnes per year to 240,000 tonnes per year ([114], p. 3).

The most ambitious Brazilian project under construction is the Albras primary smelter. Phase I currently allows production of 166,000 tonnes per year, but when phase II is finished in 1991 capacity will amount to 340,000 tonnes per year. For the time being, nearly all of Albras' output is exported through its shareholders, and a similar arrangement is expected to come into operation upon completion of phase II. Brazil's State mining concern, CVRD, at present sells its metal take of 51 per cent mainly to Japan, with some sales going to the EEC. The Japanese shareholder Nippon Amazon Co., or NAAC, a consortium of 33 Japanese companies, takes 49 per cent of the output for sale in Japan.

Alumina, the base material for primary aluminium smelting at Albras, has been imported until recently. Depressed prices in recent years made this a cheaper solution than new investments in an alumina facility. Construction of an alumina refinery, the Alunorte complex, was halted in 1986, after Japanese shareholders in the NAAC consortium voted to stop funding the project. With the recent hike in alumina prices, this project has become economically viable again. It is understood that Japanese shareholders are discussing a resumption of the project with CVRD, and that a partnership with the Mineracao Rio do Norte or MRN, a bauxite mining company, is being discussed. Plans have been laid for MRN, where bauxite output is currently being expanded to 6.5 million tonnes per year, to provide Alunorte with their bauxite requirements. Alunorte will ship its alumina to Albras' pot-lines, thus creating a fully integrated aluminium operation in the Amazon ([112], p. 11).

Moreover, a decision has been made to increase output at the Alumar smelter from the current 245,000 to 328,000 tonnes per year. A third phase scheduled for start-up in November 1990 will be added. Full production has been proposed for March 1991. Billiton will provide the necessary investment of $270 million and will take all of the new output. A further expansion to 380,000 tonnes per year could be effected if Billiton's partner in Alumar, Alcoa, decides to go ahead with its share of phase III ([115], p. 1).

As in Venezuela, however, efforts are being made in Brazil to erect downstream facilities. Reynolds Internacional do Brasil is constructing a 700-million-units-per-year aluminium can plant which is due to come on-stream in late 1989. Some 20,000 tonnes per year of aluminium sheet is supposed to be supplied by Alcan Alumínio do Brasil ([116], p. 32).

(c) *China*

China, with an estimated output of 420,000 tonnes of primary aluminium in 1987, is the third largest producer among developing countries, just behind Venezuela. Like the big Latin American producer countries. China has ambitious expansion plans, including the construction of primary aluminium smelters and alumina refineries and the improvement and expansion of downstream facilities. The Qinghai smelter, having an annual capacity of some 100,000 tonnes, started production at the beginning of 1988 and is part of a larger plan to make China self-sufficient in aluminium by 1990 [93].

China's semi-manufactures have been seriously affected by a lack of ingots. Production fell to 36 per cent of aluminium fabrication capacity after the primary metal was diverted to experts to support bank debt repayments ([117], p. 6). The targeted doubling of alumina and aluminium output by 1990 is thus essential for downstream manufacturing. The Pingguo aluminium smelter in Guangxi is expected to produce 100,000 tonnes per year by 1990. At the same time the Zhengzhou aluminium smelter at Jiaozuo should reach an output of 200,000 tonnes and the Shanxi alumina refinery in Hejin county is projected to produce 500,000 tonnes of alumina ([83], p. 13).

In order to improve operating efficiency at the Southwest Aluminium Fabrication Plant or SAFP, a consortium of three Japanese companies signed a contract with China. For 1,500 million yen the Japanese firms will raise the rolling mill's production rate from 30,000 tonnes per year to between 130,000 and 150,000 tonnes per year by late 1990 ([118], p. 13). Upgrading will soon also be effected at North China Aluminium where capacity will be raised from the current 5,000 to 10,000 tonnes per year. The improvement involves the installation of new equipment worth $8 million bought by Zhoushenco, a joint venture company between Kobe Steel and China's non-ferrous metal organization CNNC. When the new equipment comes on-stream, North China will be the country's largest foil-maker ([119], p. 7).

(d) *Western Asia*

The region's huge oil and gas reserves have allowed some countries, notably Bahrain and United Arab Emirates, to set up primary aluminium production. The oldest of these facilities, at Alba in Bahrain, where production started in 1971, is currently being revamped with capacity being raised from 180,000 to 225,000 tonnes per year. Péchiney and Hydro Aluminium are candidates to provide smelting technology for this expansion, which is said to involve an investment of around $1.1 billion, plus $400 million for a new power plant ([120], p. 9).

In the United Arab Emirates, Dubai, where manufacturing came on stream at the beginning of the 1980s, produced almost 156,000 tonnes in 1987 ([99], p. 540). The Umm al-Qaiwain Emirate has approved the construction of an aluminium smelter with a capacity of 240,000 tonnes per year. The $1.2 billion project called Umalco, where production is projected to start up in 1990, will be financed by the Emirate and the International Engineering Consultants of Dubai to the extent of 51 per cent. A further 10 per cent will be held by China National Metals and Minerals Import and Export Corp. (China) and China Everbright Holdings Co. (Hong Kong), which will take 78,000 tonnes of the output every year. Furthermore, Amari declared its interest in the project ([99], p. 540; [121], p. 12).

The construction of another smelter to be located in Qatar is currently under study. The Gulf Organization for Industrial Consulting has completed a pre-feasibility study on the construction of a $1 billion, 200,000-tonnes-per-year smelter and is seeking partners for the project ([122], p. 6). Qatar, with one of the world's largest gas reserves, is also to be the location for a second new aluminium smelter, which will be built by a consortium of investors from China, the United Kingdom and the United States. The 240,000-tonnes-per-year project called Doha Aluminium Company, or Dohal, is projected to come on stream in 1991. Taking advantage of the cheap energy sources available, the facility will have its own power plant ([123], p. 11).

The Government of Saudi Arabia approved the construction of a 220,000-tonnes-per-year smelter which will be located at Yanbu ([124], p. 7). About 60,000 tonnes per year from the $640 million aluminium smelter will be consumed domestically. A group of Saudi Arabian and Gulf State companies are partners in the venture ([125], p. 9).

(e) *India*

India, Asia's second largest producer of primary aluminium, has also been trying to raise its primary smelting capacity, preferably within integrated projects. Aluminium output is forecast to reach 450,000 tonnes between March 1988 and March 1989, which means an increase of nearly 62 per cent over the corresponding period of the year before ([126], p. 6). This significant upturn will be due to improved operating rates and capacity expansions. At the beginning of 1988, the second phase of the alumina plant of India's National Aluminium Company was commissioned. Some 400,000 tonnes, from a total 800,000 tonnes of alumina produced there, will be shipped to the company's own smelter to produce 20,000 tonnes of aluminium. In order to avoid production disruptions from power shortages, Nalco has set up a 600 megawatt power plant. Meanwhile, the Bharat Aluminium Co., or Balco, another government-backed project with USSR co-operation, reported a much improved output of 92,000 tonnes in 1987 ([127], p. 7).

A 200,000-tonnes-per-year aluminium smelter is planned for Sindri in the bauxite-rich region of Bihar. The project, valued at 1 billion rupees (about $77 million), would be dependent on the downstream development of the Mukunda coal fields and power-stations ([128], p. 13).

6. *Medium term outlook*

(a) *Consumption*

Aluminium will continue to play a major role in the materials market-place, but its applications will probably shift from use as an independent material to incorporation as a component of highly engineered materials. In developed countries, aluminium might lose its market share to plastics and advanced composites in its current key areas of construction, electrical transmission, transport and packaging, although predictions are difficult as aspects of recycling have gained importance and, therefore, strongly reflect construction design and material selection. New and stricter waste disposal laws will shift the responsibility for waste disposal to producers.

Faced with these developments, manufacturers will have to decide whether or not to expand utilization of plastics, bearing in mind that recycling of this material is still in its infancy. Even if the application of aluminium does shrink in some industries in developed countries, it will certainly gain importance in the materials consumption of developing countries as domestic demand for key applications increases. Unlike developed countries, developing countries will select traditional materials, such as aluminium, well into the twenty-first century. In particular, countries that produce aluminium in big quantities, like Brazil and Venezuela, will raise their level of aluminium consumption [129].

(b) *Technological trends and new product development*

In developed countries major threats to the utilization of aluminium will come from plastics and advanced composites. In Western Europe, for instance, the share of aluminium in middle-range automobiles will increase to 6.5 per cent by 1995, while that of plastics will rise from 10 per cent in 1985 to 13 per cent during the same period ([130], p. 270). By the year 2000, aluminium components will represent 9 per cent of the vehicle, while plastics will constitute 15 per cent. The increasing use of these two materials will be at the expense of cast-iron and steel, the share of which will have decreased to 60 per cent by the year 2000 ([131], p. 170).

For some car components, aluminium is the preferred material, and its use will increase even more during the next few years. In Western Europe, for instance, more than 70 per cent of radiators are made of aluminium. In the United States this share is rapidly growing, and in Japan a start has been made [132]. The largest single opportunity for near-term weight reduction is the replacement of cast-iron engine blocks with those of aluminium alloy. But also radiators, bumpers and various body and drive train components will be made increasingly of aluminium, as there is hardly another material that matches its recyclability.

As new materials and manufacturing methods are developed by the aluminium industry to reduce weight and combat high fuel costs, light aluminium alloys might re-establish the importance aluminium once had in aerospace applications [133]. The emergence of super-purity aluminium is also a notable development.

In packaging, the most serious competitive threats come from sophisticated multilayer coextruded products with special incorporated barrier films such as ethylene vinyl alcohol or polyvinylidene chloride. In this market, however, the recyclability of aluminium again gives it a competitive edge. As the industry continues to develop new manufacturing techniques and new materials containing aluminium, prospects for continuing new applications seem to be bright.

One example lies in the field of energy conservation, leading to the development of the continuous cast system. New flexible packaging structures also receiving increased attention include hot-fill and asceptic packages and new systems for atmosphere packaging of food products. The pharmaceutical industry is also providing substantial growth in uses such as tamper-evident seals. Packaging applications for juices, syrups and wine, using foil or metallized plastic laminate structures, also promise increasing utilization of aluminium. The growing use of microwave ovens has led to several new innovative aluminium-containing packaging systems. Moreover, packaging technology is extended into non-conventional fields. In the United States, large-scale flexible solar collectors, based on laminate packaging technology, are currently being developed [77].

In general, downstream production will be computerized from the drawing office, using CAD/CAM, to the manufacturing process. Here, computerized robot monitoring and control will increasingly be used, leading to completely computerized design and production processes.

(c) *Aluminium recycling*

Metal recycling, in general, has been pursued for more than a thousand years, thanks to the ability to reproduce stable quality. The aluminium industry will process ever-growing volumes of aluminium waste and scrap in order to save energy and raw materials and to release waste deposits. Overall, aluminium recycling reached a level of 34 per cent in 1986 ([134], p. 487). The recycling rate is calculated by dividing the amount of scrap used by the current level of aluminium consumption. The rate looks rather low, but it is actually distorted by the fact that while consumption has been rising rapidly, reuse is still relatively low because most output has gone into producing consumer durables with a relatively long life-span. The recycling rate figure will thus be adjusted in years to come, when aluminium scrap from capital and consumer durables enters the recycling stage. For some consumer goods recycling rates reach 90 per cent. Aluminium scrap from motor vehicles, for instance, is recycled at this level ([128], p. 17). Another sector where recycling has been growing recently is the beverage can market. Energy requirements for secondary production amount to only 5 per cent of those necessary to make the same can from bauxite ([135], p. 17).

The world-wide recycling rate for beverage cans is currently 48 per cent, with significant differences between countries, as reflected in table IV.64. The major problems occur in setting up efficient collection schemes. Aluminium market penetration is already well developed in the United States, Canada, Japan and Australia. In Western Europe, aluminium's share varies greatly between countries, ranging from 15 per cent for the Federal Republic of Germany to 100 per cent for Sweden and Greece. Across Western Europe, however, efforts are being made to improve recycling rates by installing economically viable collection schemes. The measures, taken partly by industry and partly by Governments, reflect the growing awareness of the need to conserve natural resources. It has become obvious that only good recycling rates coupled with efficient collection schemes will prevent Governments from imposing heavy taxes or mandatory deposits.

Table IV.64. World production of secondary aluminium, 1980 and 1987

Rank in 1987	Country or region	1987 (thousands of tonnes)	Percentage change 1986-1987	Percentage change 1980-1987	Percentage share 1987	Percentage share 1980
1	United States	1 733.20	4.93	38.74	37.85	37.74
2	Japan	965.50	20.93	33.60	21.09	21.83
3	Germany, Federal Republic of	646.00	3.36	52.00	14.11	12.84
4	Italy	363.00	0.00	19.41	7.93	9.18
5	France	186.90	4.76	9.94	4.08	5.14
6	United Kingdom	143.90	1.48	-19.38	3.14	5.39
7	Netherlands	101.40	44.86	85.37	2.21	1.65
8	Canada	65.00	0.00	-0.15	1.42	1.97
9	Australia	64.00	16.35	68.42	1.40	1.15
10	Brazil	50.30	4.79	9.11	1.10	1.39
	North America	1 798.20	4.74	36.82	39.27	39.71
	Western Europe	1 617.00	4.05	42.82	35.32	34.20
	Other developed a/					
	Latin America	80.90	2.93	-0.98	1.77	2.47
	Asia b/	53.00	0.00	150.60	1.16	0.64
	Total North a/	4 444.70	7.77	38.59	97.08	96.89
	Total South b/	133.90	1.75	30.13	2.92	3.11
	Total world a/	4 578.60	7.58	38.32		

Sources: [67] and [68].
a/ Excluding centrally planned economies.
b/ Excluding China.

E. Wearing apparel (ISIC 322)*

1. Global consumption

In 1986 the estimated retail value of apparel sales on a global basis was $433 billion, compared with estimated sales of $396 billion in 1982, an increase of 2.25 per cent per year. The apparel consumption rate was slightly higher than the total population growth rate of 1.73 per cent. The estimated breakdown of retail sales between developed and developing countries was, respectively, 62 per cent and 38 per cent, in 1986, and 64 per cent and 36 per cent in 1982. The dominant apparel retail centre of the world is the United States, which, with only 5 per cent of the world's population, accounts for a disproportionate share of world apparel retail sales, estimated at 30 per cent in 1986 and 26 per cent in 1982. This is also why the United States is the single most important apparel export destination in the world. When all developed countries are taken together, apparel fibre consumption, expressed on a per capita basis, is usually more than 3.5 times the consumption rate of the developing countries. Table IV.65, which presents consumption data in aggregate and on a per capita basis, shows that apparel consumption is increasing. Table IV.66 shows that developed countries have larger absolute and per capita apparel consumption rates.

*UNIDO acknowledges the contribution of Jordan P. Yale, President of the Statistikon Corporation, East Norwich, New York.

Table IV.65. World apparel fibre consumption, 1975-1986

Year	Developed countries: Consumption (10^3 tonnes)	Developed countries: Population (millions)	Developed countries: Kilograms per capita	Developing countries: Consumption (10^3 tonnes)	Developing countries: Population (millions)	Developing countries: Kilograms per capita	World: Consumption (10^3 tonnes)	World: Population (millions)	World: Kilograms per capita
1975	16 076	1 127	14.26	9 542	2 911	3.28	25 618	4 338	6.34
1980	17 876	1 173	15.24	12 637	3 229	3.91	30 513	4 402	6.93
1981	17 320	1 181	14.66	13 305	3 296	4.04	30 625	4 477	6.84
1982	16 526	1 190	13.89	13 507	3 381	3.99	30 033	4 571	6.57
1983	17 502	1 198	14.61	13 916	3 450	4.03	31 419	4 648	6.76
1984	17 919	1 207	14.85	14 721	3 510	4.18	32 639	4 726	6.91
1985	18 965	1 215	15.61	15 145	3 603	4.20	34 111	4 813	7.09
1986	19 963	1 230	16.23	15 685	3 692	4.25	35 648	4 897	7.28

Sources: Food and Agriculture Organization of the United Nations, World Apparel Fibre Survey 1985 (Rome, 1985); and Statistikon Corporation.

Table IV.66. World apparel fibre consumption and population patterns, 1975–1986
(Percentage distribution)

Year	Developed countries		Developing countries	
	Consumption	Population	Consumption	Population
1975	62.75	25.98	37.25	74.02
1980	58.58	26.65	41.42	73.35
1981	56.55	26.38	43.45	73.62
1982	55.03	26.03	44.97	73.97
1983	55.71	25.77	44.29	74.23
1984	54.90	25.54	45.10	74.46
1985	55.60	25.24	44.40	74.76
1986	56.00	25.12	44.00	74.88

Source: Statistikon Corporation.

2. *Global production*

(a) *Production capacity and employment*

The employment level in the apparel industry could be taken as a basic indicator of capacity. Table IV.67 shows the apparel work-force in selected countries around the world for the years 1980 to 1987. Generally, there has been a decline in the apparel work-force in developed countries. In some cases the decrease has been significant (as in France, the Federal Republic of Germany, Italy and United States), while in other cases the decline has been modest (such as in Japan). In a few cases, there has been some increase in the size of the apparel work-force, as in Denmark, Greece, and South Africa.

Apparel employment and capacity in developing countries have increased, while in developed countries, they have declined. However, that decline was offset in the United States by productivity increases of 4.7 per cent per year from 1980 to 1987 (see table IV.68). The growth rate is higher than the average for manufacturing industry in general. Productivity rates for a few other key apparel-producing countries and areas indicate mixed trends. While the Republic of Korea and Taiwan Province experienced a 5.4 per cent productivity improvement in 1985, Hong Kong had a reversal of −3.4 per cent during the same period.

Table IV.69 shows that apparel employment in the South surpasses that of the North. This is due to the

Table IV.67. Employment in the apparel industry, 1980–1987
(Thousands)

Country or area	1980	1981	1982	1983	1984	1985	1986	1987
EEC								
Belgium	..	..	..	32.8	31.8	30.4	30.6	..
Denmark	16.1	15.3	16.2	16.4	17.1	17.9	18.0	..
France	251.3	237.1	237.2	226.2	215.4	207.0	200.0	196.0
Germany, Federal Republic of	248.8	230.0	209.7	193.9	191.1	188.4	185.5	177.5
Greece	..	..	..	..	..	69.0	..	69.5
Ireland	..	..	..	16.0	..	17.7	17.0	..
Italy	213.0	207.0	202.0	194.0	183.0	179.0	174.0	170.0
Netherlands	17.1	14.0	12.6	11.8	10.5	10.5	10.5	9.7
Portugal	73.0	69.5	66.9	66.5	67.1	67.1	67.1	..
United Kingdom	241.8	217.5	210.3	227.0	226.0	232.0	235.0	225.0
Other Europe								
Austria	33.2	31.9	30.3	29.2	29.0	28.6	27.8	27.0
Finland	34.6	32.0	32.0	30.8	30.6	29.4	28.5	..
Norway	7.1	6.4	5.7	5.2	4.6	4.7	4.3	..
Sweden	..	13.2	..	12.1	11.2	11.3	10.2	10.1
Switzerland	17.6	16.4	15.2	15.0	15.0	15.5	15.5	14.9
Asia and Oceania								
Australia	71.0	..	..	..	..	67.0	..	71.6
China	..	..	..	..	..		3 000.0 a/	..
Hong Kong	..	..	..	..	..	276.3	..	..
Japan	399.3	387.3	398.8	415.9	418.1	417.2	418.0	398.0
Republic of Korea	368.0	382.1	383.4	384.4	383.9	393.6	397.1	..
Taiwan Province	..	..	128.6	132.3	145.0	158.1	157.4	..
Turkey	..	..	..	..	..	..	..	535.0
North America								
United States	1 079.0	1 060.0	981.0	984.0	1 003.0	945.0	931.0	935.0
Africa								
South Africa	..	..	..	..	..	..	150.0	155.0

Sources: International Apparel Federation; Taiwan Textile Federation; Hong Kong Census and Statistics Department; Korea Federation of Textile Industries; United States Bureau of Labor Statistics; British Clothing Industry Association; and Statistikon Corporation.
a/ Estimated.

Table IV.68. The Statistikon United States apparel productivity index (1980=100)

Year	Productivity
1980	100
1981	105
1982	115
1983	119
1984	123
1985	131
1986	135
1987	138

Note: The Statistikon productivity index measures the value of apparel goods shipped, on a per-employee basis, by the garment industry. The value of shipments are expressed in constant 1982 dollars.

labour-intensive nature of the manufacturing process and to the fact that the industry, in most cases, is export-oriented and thus a hard-currency earner.

(b) *Capacity utilization and expansion plans in selected countries and areas*

Statistical data on capacity utilization rates for sewing machines or other equipment and on expansion plans in the apparel industry are difficult to compile. Some trends can be extrapolated, however. In the United States, for example, increased domestic production is mainly attributable to the quicker response of the manufacturer to market trends. The creation of private labels provides added impetus to the production increase. Capacity utilization rates appear to have increased, and capital expenditure on new plant and equipment is being maintained at higher levels than in previous years. For example, capital investment increased from $391 million in 1974 to $608 million in 1980 and $697 million in 1985.

China. In the past, the Government of China decided not to support the expansion of the domestic apparel industry as it was internally oriented and therefore not a hard-currency earner. In addition, since many consumers patronized their own tailors, there was no need for formal large apparel organizations. That situation is expected to change in the coming years, with the Government supporting the expansion of the apparel industry in order to provide the clothing needed for an expanding population.

Japan. Both the domestic apparel and textile industries of Japan are facing increased competition from nearby developing countries and areas such as Hong Kong, Republic of Korea, and Taiwan Province. A relatively recent problem has been the increased value of the yen, which has made Japanese apparel products more expensive in the international market and imports more attractive. The Japanese apparel industry seems to have excess capacity at present, and there are limited plans for expansion.

Hong Kong. In recent years the domestic apparel industry in Hong Kong has been losing personnel to higher-paying domestic industries and operating, and as a result, below capacity levels, unable to fill its export quotas. New investments are targeted towards improvements rather than capacity expansion.

Republic of Korea. The domestic apparel industry is fragmented, with many small family-owned firms working on a contractual basis for larger firms. In an attempt to cope with wage increases, apparel management is investing in the upgrading of equipment.

Table IV.69. Apparel employment changes, 1980-1987 (Thousands)

Country or area	1980	1987
North		
France	251.3	196.0
Germany, Federal Republic of	248.8	177.5
Japan	399.3	935.0
United Kingdom	241.8	224.0
United States	1 079.0	935.0
South		
China	..	3 000.0 a/
Hong Kong	..	276.3 b/
Republic of Korea	368.0	397.1
Taiwan Province	..	157.4 c/
Turkey	..	535.0

Sources: International Apparel Federation; Taiwan Textile Federation; Hong Kong Census and Statistics Department; Korea Federation of Textile Industries; United States Bureau of Labor Statistics; British Clothing Industry Association; and Statistikon Corporation.

Note: Apparel employment figures for Brazil, India, Pakistan, USSR and some other countries, believed to be high, are not available.

a/ Estimated.

b/ 1985 figure.

c/ 1986 figure.

Taiwan Province. Traditionally, the apparel industry of Taiwan Province has produced on a contractual basis; that is, an overseas firm would provide the design specifications and a domestic firm would produce the goods. In recent years, attempts have been made by the local industry to develop its own designs and produce higher-value-added garments. The industry is believed to have a strong capacity utilization rate.

(c) *Production trends*

Domestic apparel production trends in selected countries (subject to availability of data) are reflected in table IV.70, which shows that production has declined in most of the smaller European countries and increased in a number of large countries such as Canada, France, Federal Republic of Germany, United Kingdom and United States. Apparel production in Japan seems to have been declining, while it has been increasing in developing countries and areas such as Hong Kong, Republic of Korea, Taiwan Province and Turkey. In monetary terms, in almost every case (with the exception of Norway) the dollar value of the most recent production is higher than in earlier years. Certain countries, such as Japan, are producing higher value-added apparel, and the same trends seem to have emerged in many developing countries.

Table IV.71 shows estimated wholesale values of apparel shipments in the global market in selected years.

Table IV.70. Index of apparel production trends in selected countries and areas, 1985–1988 (1980=100)

Country or area	1985	1986	1987	1988
Austria	94	95	93	89
Belgium	92 (1.1)	97 (1.5)	92	100
Denmark	126 (0.7)	119 (0.9)	102 (1.0)	88
France	.. (7.1)	.. (9.0)	.. (11.0)	..
Finland	106 (0.9)	102 (1.1)	94	88
Germany, Federal Republic of	82 (8.9)	82 (11.8)	77 (14.5)	72
Greece	88 (6.0)	77	71	80
Ireland	96 (0.4)	104 (0.5)	96	96
Italy	96 (6.6)	99 (9.2)	97 (12.0)	..
Netherlands	78 (0.5)	77 (0.7)	76 (0.8)	77
Norway	80 (0.2)	82 (0.2)	72 (0.2)	63
Spain	88	85	84	84
Sweden	75	74	71	69
United Kingdom	110 (5.6)	112 (6.3)	110 (8.4)	113
Turkey			(1.9)	
Canada	100	101	103	103
United States	100 (32.0)	103 (32.5)	107 (34.0)	109
Republic of Korea	118	..	..	..
Japan	111 (20.0)	109 (25.5)	(31.4)	..
Taiwan Province	..	(3.9)	(5.9)	..
Hong Kong (1982=100)	105	124	..	..

Sources: OECD indicators of industrial activity; data in parentheses from International Apparel Federation, Yearbook 1988; data for 1988 estimated by Statistikon Corporation.
Note: Figures in parentheses indicate production in billions of dollars.

Table IV.71. Wholesale value of apparel shipments, 1982 and 1986

Region	1982		1986	
	(billions of dollars)	(percentage)	(billions of dollars)	(percentage)
North	135.7	60.2	144.4	58.0
South	89.9	39.8	104.7	42.0
Total	225.6	100.0	249.1	100.0

Source: Statistikon Corporation.

While still much greater than that of the South, the share of the North is declining, and the South is expected to continue to expand its production and distribution. For instance, according to a statement by the Ministry of Textile Industry of China "... At present, the average Chinese person consumes 3.7 kilograms of textile goods a year ... China aims to increase the figure to about 5 kilograms per person by the year 2000."([136], p. 1). If that goal is achieved, it will represent a net consumption increase of 1.3 kilograms per person. For an estimated 1.4 billion people, the net increment will amount to 1.82 million tonnes.

Table IV.72 list the world's 10 largest producer countries and shows how developed countries dominate world apparel production, largely thanks to captive markets and availability of resources.

3. *Comparative apparel production costs*

(a) *Wages and comparative cost of apparel manufacture*

Comparative hourly wage rates for a selected group of developed and developing countries or areas, are shown in table IV.73. Among developing countries, China had the lowest rate at $0.29 (including fringe benefits), and Taiwan Province the highest at $3.23. The wage rates of China and Taiwan Province were, respectively, 4.04 per cent and 45.5 per cent of that of United States. In all cases, the leading developing countries had hourly wage rates which were less than half that of the United States.

Labour-cost advantages are offset, however, by other elements of the final garment cost, such as material supplies, overheads, distribution and other costs, which cause the major direct labour-cost benefit of developing countries to decrease. The final cost of a garment will include fibre raw materials, yarn, fabric, dyeing and finishing, garment-cutting and sewing, trimming, shipping, tariff, wholesaling and retailing costs, as reflected in table IV.74, which shows the cost of manufacture of trousers in the United States and the Republic of Korea. Table IV.75 compares costs in the two countries given in table IV.74, on an aggregate basis. The comparison assumes United States costs to represent the base value of 100, with reference to which the deviation of costs in the Republic of Korea is measured. Table IV.75 shows that the net overall yarn cost favours the Republic of Korea because of the advantage of that country in the two specific areas of labour and depreciation costs. Those same advantages combined with that of yarn cost mean that the total grey fabric cost of $0.757 also favours the Republic of Korea.

The cost of converting the fabric into women's trousers in the Republic of Korea is $8.3, compared

Table IV.72. World's top 10 apparel producers, 1987

Country or area	Estimated production (billions of dollars)
United States	34.0
Japan	31.4
China	..
USSR	..
India	..
Germany, Federal Republic of	14.5
Italy	12.0
France	11.0
United Kingdom	8.4
Taiwan Province	5.9

Sources: International Apparel Federation; and Statistikon Corporation.

Table IV.73. Hourly wages in the apparel industry of selected countries and areas, 1987

Country or area	Basic wages (dollars)	Fringe benefits and other costs as percentage of basic rate	Effective wages (dollars)
China	0.23	25	0.29
Hong Kong	1.65	14	1.88
Republic of Korea	1.78	45	2.58
Taiwan Province	2.20	47	3.23
United States	5.47	31	7.17

Source: Statistikon Corporation.

Table IV.74. Comparative manufacturing costs of women's trousers in the United States and the Republic of Korea (Dollars)

Item	United States (base value)	Republic of Korea
A. Yarn cost (dollars per kilogram)		
Waste	0.097	0.114
Labour	0.337	0.091
Power	0.099	0.156
Supplies	0.036	0.036
Depreciation and interest	0.357	0.256
Raw materials (cotton)	1.345	1.555
Total	2.270	2.209
B. Grey (unfinished) fabric cost (dollars per yard[a/])		
Waste	0.018	0.021
Labour	0.197	0.046
Power	0.047	0.071
Supplies	0.042	0.056
Depreciation and interest	0.200	0.151
Yarn manufacturing	0.172	0.122
Raw materials (cotton)	0.251	0.290
Total	0.927	0.757
C. Apparel cost		
Basic fabric cost of 2 yards[a/] per garment	1.85[b/]	1.51[c/]
Lining	0.70	0.57
Dyeing and finish	1.00	1.10
Trimming, zipper, buttons, pleating, elastic and bindings	1.50	1.60
Labour	4.20	3.15
Cutting	3.00	2.25
Sewing	1.20	0.90
Overheads	0.93	0.40
Total	14.38	11.48
D. Wholesaling		
Gross profit	2.04	0.83
Import expenses		
Shipping	..	25 per cent
Quota	..	2.29
Tariffs, charges and commission	..	..
Total	12.22	11.46
E. Retailing		
Mark-up at 45 per cent of retail price	10.00	..
Mark-up at 38 per cent of retail price	..	7.02
Retail price	22.22	18.48
Total	32.22	25.50

Source: Statistikon Corporation.

Notes: In addition to the cost of the imported apparel, the following cost factors should be included: foreign shopping trips; cost of intermediaries; tying monies for an extensive period of time; logistical costs (warehousing, shipping, inventory, packaging and tickets); and greater mark-downs on imported merchandise due to the inflexibility or slow turnaround of merchandise orders.

a/ 1 yard = 0.91 metres.

b/ 2 x 0.927 = 1.854.

c/ 2 x 0.757 = 1.514.

Table IV.75. Comparison of cost estimates for the manufacture of women's trousers in the United States and the Republic of Korea

Item	Country	
	United States (base value)	Republic of Korea
Direct wages	100	0.36
Total yarn cost per yard[a] of fabric	100	0.71
Total grey fabric cost per yard[a] of fabric	100	0.82
Total garment cost (including finished fabric, trimmings, cutting, sewing and overhead costs)	100	0.82
Wholesale price (including United States import tariffs, shipping costs etc.)	100	0.94
Theoretical retail price	100	0.83

Source: Statistikon Corporation.
a/ 1 yard = 0.91 metres.

with $10.2 in the United States. The next major cost item is distribution, including wholesale and retail mark-ups. On the basis of those two costs, trousers produced in the United States will be retailed at $22.22 and those in the Republic of Korea at $18.48, approximately 17 per cent less. Table IV.75 reveals that the major competitive advantage of the apparel industry in the Republic of Korea—its lower wages—dissipates as the conversion process moves from the raw materials to the garment stage, and then to the final retail price. From a wage level equal to only 36 per cent of that of United States, the total cost of producing a pair of women's trousers in the Republic of Korea rises to 82 per cent of that of the United States. At the wholesale level, the garment delivered at a United States port will include expenses such as transport, insurance and tariffs. At that point the Republic of Korea's total manufacturing cost climbs to 94 per cent of that of the United States, representing only a 6 per cent cost advantage over a similar garment manufactured in the United States. At the final retail level, the cost advantage of the imports increase to 17 per cent. However, the saving might not be realized by the consumer, since the retailer might choose to take greater mark-ups or profitability.

(b) *Hidden manufacturing costs*

Developed countries often bear costs arising from compliance with government regulations. Even that negligible amount has not yet been matched by developing countries, although most are expected in future to adopt similar pollution control legislation, thus increasing their costs. Table IV.76 lists investment and operating costs of pollution abatement in the textile mills in the United States, expenses which are estimated to add less than 0.5 per cent to textile costs.

(c) *The drive for lower costs—remote sourcing*

To gain competitive advantage, many firms in the North will combine the marketing expertise available

Table IV.76. Capital expenditure and operating costs for pollution abatement in United States textile mills

Year	Capital expenditure (millions of dollars)	Annual operating costs (millions of dollars)
1981	48.0	108.5
1982	22.0	74.1
1983	18.7	101.1
1984	20.9	122.2
1985	25.0	148.9
1986	25.0	162.0

Source: [137], pp.3-25.

in a given country with the labour cost advantage of another. The most important managerial decisions concerning, for instance, garment design, marketing, distribution, pricing and brand name are made by the firm in the North which often has captive manufacturing facilities or sub-contracts with firms in developing countries. Such a relationship deprives developing countries of the ability to design garments on their own, one of the most important ingredients in the commercial success of an apparel firm. The following legislation affects the textiles and apparel industries in the United States: Cotton Dust Standard (1980); Noise Abatement Standards (1983); Hazard Communication Standards (1985); Apparel Flammability Regulations; Hazardous Waste Rules (1980); Effluent Guidelines (1979); Air Pollution Regulations; Superfund (1986); Revised Formaldehyde Workplace Exposure Standard (1987); and New Source Performance Standards for Industrial Boilers (1987).

Sourcing is used extensively. Although statistical data are lacking in this field, it is possible to draw conclusions from the limited available evidence. A survey [138] of United States apparel companies revealed that 60 per cent of respondents were sourced only in the United States, and 40 per cent on a combination basis, that is, in the United States, under tariff item 807A, and abroad. The smaller group of respondents broke down into companies that combined sourcing in the United States with tariff item 807 (27 per cent), with foreign sources (38 per cent), or with both (35 per cent).

Section 807A of the United States Trade Law (1986) allows the importer to pay tariff only on the value added to apparel imported from a Caribbean country. Thus a domestic garment manufacturer would ship fabrics woven and cut in the United States to a Caribbean country (such as Bahamas, Dominican Republic, Haiti and Jamaica) for assembly, and then ship the goods back to the United States. An estimated 10 per cent of all United States clothing imports are tariff 807A items ([139], p. 120).

Other countries that use foreign sourcing are China (primarily in fabrics), Federal Republic of Germany, Japan, Italy and Netherlands. Quantitative data for these countries are not available.

(d) *Shifts in foreign direct investments*

In recent years, particularly since 1985, there has been a significant shift in the flow of foreign direct investment in the textiles and apparel industry. Basically the flow of such investment from developed to developing countries is being reversed. Total foreign investment in the textiles and apparel investment industry in the United States, which was $490 million in 1985, increased to an estimated $1 billion in 1987.

United States investment abroad may be declining for the following reasons: the quality of garments produced in developing countries is difficult to monitor; the benefit of low labour costs, the single most important advantage of developing countries, dissipates after transportation costs, tariffs, quotas and other factors are taken into account; and, given the current high interest rates, it is becoming less attractive to tie up capital overseas for long periods.

Significant changes are also taking place in Japan. Foreign investment by Japanese firms in the textiles and apparel industry is declining, and much of that investment has become counter-productive. Host countries in the developing world used joint ventures as stepping-stones to develop their own industries and eventually become export threats to Japan. A case in point is the Republic of Korea, which has increased its textiles and apparel exports to Japan. Some of the changes taking place in major apparel-manufacturing developing countries and areas are described below:

Taiwan Province. The liberalized foreign exchange policy of Taiwan Province has encouraged its firms to invest in overseas plants in both developing and developed countries. Investment in developing countries is designed to take advantage of lower costs and offset United States import quotas. Taiwan Province firms have also recently been investing in the United States. Management believes that whatever it loses in terms of labour-cost advantage will be offset by its proximity to market, local design and finishing facilities as well as by the elimination of tariffs and import quotas.

Hong Kong. In 1986 there were 123 foreign textile and apparel firms in Hong Kong, 56 of which were wholly foreign-owned subsidiaries, and 67 joint ventures. In recent years, however, there has been a shift to overseas investment by domestic firms in an attempt to avoid the increasing costs of local production, to circumvent and ultimately benefit by quotas imposed in the host countries, and to take advantage of investment incentives offered by those countries. Hong Kong firms have made investments in the following countries and areas: Canada, China, Jamaica, Malta, Malaysia, Mauritius, Nigeria, Republic of Korea, Spain, Taiwan Province, Thailand and United States. Along with overseas investments, Hong Kong brings with it good textile skills, particularly in the area of finishing.

Republic of Korea. In recent years, this country has accelerated its overseas investment, particularly in the Caribbean basin. The primary purpose of the investment has been to take advantage of Section 807A of the United States Trade Law. Some firms of the Republic of Korea are opening plants in the United States, basically for the same reason.

4. *Marketing perspectives*

Table IV.77 lists the 10 countries with the highest apparel consumption, seven of which are developed countries which have larger per capita apparel fibre consumption rates with absolute apparel expenditure disproportionate to their population size. Of the 10 listed countries, the United States has the highest apparel expenditure, amounting to $129 billion.

(a) *International trade*

The high level of demand combined with the need to contain costs has forced many developed countries to meet their apparel needs by imports from developing countries. Table IV.78 shows the overall flow of inter-

Table IV.77. Top 10 apparel-consuming countries, 1986
(Billions of dollars)

Country	Consumption
United States	129.0
China	26.9a/
USSR	24.3a/
Japan	21.1a/
India	18.5a/
Germany, Federal Republic of	13.3a/
France	8.6
United Kingdom	8.0
Italy	6.2
Canada	3.9

Source: International Apparel Federation.
a/ Estimated by Statistikon Corporation.

Table IV.78. International apparel trade, 1986

Country group	Exports		Imports	
	(millions of dollars)	Percentage	(millions of dollars)	Percentage
Developed	21 781	41.3	53 991	91.7
Developing	30 923	58.7	4 884	8.3
Total	52 704	100.0	58 875	100.0

Source: [137], pp. 2-23.

national apparel trade for the year 1986. Global apparel exports of developed countries were $21.8 billion or 41.3 per cent of the total, while apparel exports of developing countries were $30.9 billion or 58.7 per cent of the total. Developed countries imported $54 billion or 91.7 per cent of all apparel imports during 1986. Developing countries, which often have a stronger protective shield against imports, had the remaining $4.9 billion or 8.3 per cent of total imports.

Tariffs charged by various developed and developing countries are shown in tables IV.79 and IV.80. In general, developing countries have higher rates and, therefore, more protected domestic markets. Various instruments such as subsidies through favoured tax treatment, favourable financing terms, the imposition of tariffs, quotas and licensing requirements, provision of investment incentives and support of research and development programmes are shown in table IV.81.

Table IV.79. Weighted average tariff levels for clothing, *ad valorem*, developed countries

Country or area	Tariff (percentage)
Canada	24.0
Japan	14.0
United States	22.5
EEC	13.5

Source: General Agreement on Tariffs and Trade, "Textiles and clothing in the world economy".

Table IV.80. Average tariff levels for clothing, *ad valorem*, developing countries

Country or area	Tariff (percentage)
Argentina	36
Brazil	102
Colombia	96
Egypt	145
India	145
Malaysia	27
Mexico	86
Morocco	96
Nigeria	60
Pakistan	192
Peru	60
Philippines	69
Republic of Korea	50
Sri Lanka	96
Taiwan Province	131
Thailand	90
Tunisia	45

Source: General Agreement on Tariffs and Trade, "Textiles and clothing in the world economy".

Table IV.81. Subsidies and incentives in selected textiles - and apparel - exporting countries and areas

Item	Republic of Korea	Taiwan Province	Hong Kong	Brazil	Philippines	Thailand	China	Pakistan	Turkey	Japan	United States
Subsidies through favoured tax treatment	Certain tax free reserves or allowances	No trade tax for exports, certain tax-free expenses, some tax compensation of losses		Certain taxable profit reductions	Favourable tax credits	Favourable tax credits	Income-tax reduction	Certain tax reductions	Certain tax reductions		
Financing	Preferential loans	Protection from fluctuating exchange rates	Export Credit Insurance Corp. insures against risk of non-payment		Preferential access to foreign exchange	Allowances for purchasing raw materials, interest subsidies	Special exchange rates	Price reduc- for the purchase of cotton	Financing of exports	Special (favourable) financing	
Import tariffs, quotas, licences	Licensing of selected imports	Periodic import restrictions	No restriction	High tariffs, licensing	Custom duties allowances for imported goods	Certain exceptions custom duties	Regulated through the Foreign Trade Organization	Licensing required	Import restrictions	Voluntary restraint agreement	Quotas
Investments		Classification of industries as "strategic" for favourable investment			Favoured tax allowances	Investment incentives based on export-intensity		Duty-free import of plant and machinery		Government assistance through the Law on Extra-ordinary Measures for the structural improvement of the textile industry	
Research and development			Productivity Council and Centre							Automated sewing system technology development	Some support in research

Source: Statistikon Corporation.

Because the apparel industry is highly fragmented in developing countries, no single firm spearheads the research effort. There is, moreover, only limited scope for research and development work on the sewing-machine, the basic unit of production. Sewing-machine manufacturers traditionally incorporate the latest electromechanical innovations into the machine. Any garment manufacturer, in developing or developed countries, can therefore acquire the latest technology, often with government assistance.

(b) *The effects of foreign exchange rates*

During 1986, foreign apparel sales represented 2.9 per cent of world merchandise trade, with an annual compound growth rate of 6.5 per cent for the period 1980-1986. Exchange rate fluctuations had an impact on pricing, and thus on international competitiveness. The volatility of the exchange rate has been linked to the declining value of the dollar. During the 12-month period up to February 1988, the following exchange rate variations occurred in major developed apparel-trading countries: the dollar depreciated by 8.7 per cent; the deutsche mark fell by approximately 2.2 per cent; and the yen appreciated by 13.6 per cent ([140], p. 22). During the same time, among developing countries and areas, the currencies of Hong Kong and Singapore depreciated by 2 per cent and 4 per cent, and those of the Republic of Korea and Taiwan Province appreciated by 5.2 per cent and 6.5 per cent, respectively.

Trade flows for the countries listed in table IV.82 are not consistent with exchange rate movements. For instance, Japan had a stable level of imports and an increase in exports in 1987, during a period when the value of the yen rose significantly. The relative value of the currencies of Hong Kong and Singapore depreciated, but their imports grew. Exports from the Republic of Korea increased despite of the appreciation of the won. One explanation could be that the drop in the exchange rate was not big enough to overcome the production cost differential in favour of the developing countries. Another could be that the exchange rate dropped during a period of economic revival. As a result, the domestic economy was able to absorb greater volumes of merchandise, including imports. This is what happened in the United States.

Exports sometimes depend on imports, as in the case of transfers or contractual shipments. Both exports and imports are then increased, as reflected in the experience of Hong Kong and Singapore. The distribution system within a country, particularly developed countries, can occasionally make mark-up allowances to accommodate increases due to exchange rate fluctuations.

(c) *Leading apparel companies and trading countries*

The 15 leading apparel-importing and apparel-exporting countries are listed in tables IV.83 and IV.84, which show developed countries to be the major importers, with a few exceptions such as the Federal Republic of Germany, Italy and United Kingdom, and developing countries to be the major exporting countries.

The world's leading apparel companies, with some key measures of their financial performance, are shown in table IV.85. The table is based on company apparel sales and, where data are missing, on estimates. It shows that most of the world's leading apparel firms are United States firms with good profitability rates. Only two companies on the list were not profitable in 1987.

Table IV.86 lists the leading apparel companies in developing countries and areas, to some extent on the basis of an assessment of trends in the absence of comprehensive statistical data. The available data shows, however, that some firms in developing countries are also very profitable.

5. *Technological perspectives*

(a) *Research and development expenditures*

The apparel industry is frequently seen as a mature industry in both developed and developing countries. However, a case can be made that the apparel industry has not yet moved from its early stages of development.

Because of its high labour-intensity and fragmentation, the apparel process resembles a cottage industry, which explains why textiles firms have played an insignificant role in direct investment in textiles research and development. Table IV.87 shows that the most important source of such investment in the United States was the synthetic fibre industry, which contributed an estimated 59 per cent of total textiles research funds, while the apparel industry contributed only 1.7 per cent.

The textiles and apparel industry in OECD countries is estimated to have spent in a recent year $668 million on research and development ([141], p. 102). If that figure is used as the starting-point, then further expenditures by fibre producers, Governments and others can be added to bring the base up to $1 billion, representing the world's total annual textile research expenditure. A further calculation shows that 1.7 per cent of that sum is $17 million, an insignificant amount representing total estimated research spending by the apparel industry world-wide. In recent years, Governments have taken an unusual interest in the development of the apparel industry. In addition to

Table IV.82. World merchandise of trade selected apparel-trading countries, 1986 and 1987 (Percentage change from previous year)

Country or area	Imports 1986	Imports 1987	Exports 1986	Exports 1987
United States	13.5	6.0 (-)	6.0	15.0 (+)
Germany, Federal Republic of	9.5	5.5 (-)	1.5	3.0 (+)
Japan	9.5	9.5 (=)	-0.5	0.5 (+)
Hong Kong	13.0	32.0 (+)	14.5	32.0 (+)
Singapore	9.0	14.0 (+)	13.5	19.0 (+)
Republic of Korea	8.0	21.0 (+)	12.0	24.0 (+)
Taiwan Province	29.0	30.0 (+)	25.5	14.5 (-)

Source: [140], p. 14.
Note: Symbol within parentheses represents direction of change from 1986.

Table IV.83. World's top 15 apparel-importing countries, 1983 and 1986
(Millions of dollars)

Rank	Country or area	1983	1986
1	United States	10 421	18 704
2	Germany, Federal Republic of	6 734	10 429
3	France	2 543	4 163
4	United Kingdom	2 417	3 488
5	Japan	1 501	2 853
6	Hong Kong	1 166	2 528
7	Switzerland	1 394	2 128
8	Belgium and Luxembourg	1 371	1 948
9	Canada	1 026	1 534
10	Sweden	943	1 520
11	Austria	883	1 289
12	Italy	631	1 164
13	Australia	338	415
14	Singapore	298	364
15	China	90	140a/

Sources: [137], pp. 2-4; and Statistikon Corporation.
a/ Estimated.

Table IV.84. World's top 15 apparel-exporting countries, 1983 and 1986
(Millions of dollars)

Rank in 1986	Country or area	1983	1986
1	Italy	4 530	7 572
2	Hong Kong	4 681	6 670
3	Republic of Korea	3 701	5 478
4	China	2 738	5 300
5	Taiwan Province	2 983	4 259
6	Germany, Federal Republic of	2 556	4 199
7	France	1 743	2 556
8	Turkey	648	2 300
9	United Kingdom	1 310	1 798
10	Netherlands	670	1 109
11	Belgium and Luxembourg	745	1 046
12	India	667	1 023
13	United States	883	879
14	Japan	658	734
15	Philippines	535	726

Source: [137], pp. 2-23.

the $17 million in research spending by industry, annual government apparel research expenditure has been estimated as follows:

Country or group	Millions of dollars
United States	3.5
Japan	12.0
EEC	1.0
Republic of Korea	12.0 (lump sum)
Total	28.5

The apparent annual total of world apparel research expenditure is thus $45.5 million ($17 + $28.5), or only 0.018 per cent of wholesale turnover, a neglible rate.

(b) *Apparel manufacturing innovations*

Particular innovations that have had an effect on apparel manufacturing processes are indicated in table IV.88 (see pp. 220-1) and briefly described below.

CAD allows the operator to create original apparel formats, draw and determine their specifications, modify or change them as the need arises, develop different colour schemes and save the designs in memory. The CAD system is also used to grade (create different garment sizes for) the apparel design and to mark the fabrics (outline the various parts of the garment design on the fabrics) for cutting purposes. In this area, new cutting methodologies (lasers, plasma torch) have been tried with different degrees of success. CAD can also be used to minimize waste in fabric cutting. Investment in CAD and peripherals is

Table IV.85. World's top 15 apparel companies, 1987

Company	Country or area	Annual sales (thousands) of dollars)	Percentage change 1986-1987	Pretax profit (thousands) of dollars)	Pretax margin on sales percentage)	Margin percentage 1986-1987
Levi Strauss International	United States	..	..	..	..	..
VF Corp.	United States	2 573 762	..	313 745	12.19	-24.6
Hartmarx	United States	1 080 420	1.6	72 045	6.7	49.9
Liz Claireborne	United States	1 053 323	29.5	208 205	19.7	-5.3
Coats Vinyella Plc (apparel only)	United Kingdom	918 750 a/	..	95 366	10.38	17.7
Fruit of the Loom	United States	870 300	35.6	13 400 b/	..	..
Prouvost S.A.	France	..	..	-	-	-
Interco Inc.	United States	813 300	-0.6	61 721	7.59	-6.0
West Point-Pepperell (apparel only)	United States	784 200	36.6	54 619	7.3	22.9
Kellwood	United States	698 156	21.8	44 573	6.38	-5.0
Leslie Fay	United States	582 023	1.5	31 237	5.4	-18.1
Phillips-Van Heusen	United States	500 025	34.8	35 973	7.2	10.1
Russel Corp.	United States	479 880	9.7	80 145	16.7	-0.3
Genesco	United States	405 844	-4.1	7 281	1.8	-52.0
Palm Beach Inc.	United States	394 238 a/	-6.0	5 973 b/	..	..

Sources: Fairchild's Textile and Apparel Financial Directory 1988 (New York, N.Y., Fairchild, 1988); Chemiefasern - Textil-Industrie, February 1988; and Statistikon Corporation.

Note: State-owned companies, as in China and the USSR, are not included in this table.

a/ 1986 figure.

b/ Estimated.

Table IV.86. The South's biggest apparel companies, 1987

Company	Country or area	Annual sales (thousands) of dollars)	Percentage change 1986-1987	Pretax profit (thousands) of dollars)	Pretax margin on sales percentage)	Margin percentage 1986-1987
Lai Sun Garment Co. Ltd.	Hong Kong	105 568	23.6	30 202	28.6	65.9
South Sea Textile Mfg. Co. Ltd. (1986)	Hong Kong	89 810	24.1	15 243	17.0	70.2
Crocodile Garment Ltd.	Hong Kong	64 133	11.8	8 972	13.99	25.95
United Ltd.	Hong Kong	49 958	39.8	3 495	7.0	..
South Pacific Textile Inc.	Singapore	..	..	..	..	..
Dainong Co. Ltd.	Republic of Korea	..	..	..	..	..
Samsung	Republic of Korea	..	..	..	..	..
Far Easter Textiles	Taiwan Province	..	..	..	..	..
CIA Hering-Gruppa	Brazil	..	..	..	..	..
Hualon Corp.	Taiwan Province	..	..	..	..	..

Sources: Fairchild's Textile and Apparel Financial Directory 1988 (New York, N.Y., Fairchild 1988); Chemiefasern - Textile-Industrie, February 1988; and Statistikon Corporation.

Note: Statistical data for the above companies are incomplete. Data on firms in China are not available.

Table IV.87. Sources of textiles research and development funds, United States

Industry or other source	Percentage of total expenditure
Fibre producers	59.0
Textile mills	14.7
Textile machinery	10.7
Chemicals, dyestuff, finishing	7.1
Government	6.6
Apparel	1.7
Education	0.2

Source: J.P. Yale, "Innovation: its impact on man-made fibers", Modern Textiles, September 1986, p. 52.

between $250,000 and $500,000. However, recent efforts have been made to provide similar software for personal computer equipment, at an estimated reduced cost of $100,000. Complete CAM systems also include an automated conveyor component. In recent years, efforts have been made to develop fully automated CAM processes. Computer-integrated manufacture allows full automation of the sewing process, but major problems remain for handling limp fabric and for perfect matching of design weaves.

Attempts have recently been made to reduce the mechanical sewing process by using other joining techniques such as gluing, fusing or welding. Although only limited success has been achieved so far, in certain areas they could lead to potential savings.

The application of management science to apparel manufacture is reflected in the quick response system of production. Under this system, there is a close working relationship between the retailer, the apparel manufacturer, the textile mill and the fibre producer, which permits garment delivery within a shorter period of time, thus resulting in reduced inventory levels throughout the distribution pipeline. Financial modelling, spreadsheet analysis and forecasting help management make "what if" assumptions for improved decisions, and some apparel manufacturers have improved their logistics by building fully computerized wai ›using and distribution systems at a cost of $6 · 'lion.

Within the next ten years, most of the apparel-manufacturing process is expected to be automated. When this happens, the apparel industry will proceed into the next phase of its product life cycle—the growth stage.

6. *Global outlook*

(a) *Short-run*

Production through the year 1990 is expected to be weak. Projections for that year, as shown in table IV.89, indicate a drop in production for most of the listed countries. Even the few anticipated increases (in Canada, Netherlands, United Kingdom and United States) are expected to be modest.

In addition, problems arising from high tariffs and import trade barriers still divide exporting and importing countries. Through the General Agreement on

Table IV.89. International apparel production trends (Index 1980=100)

Country	Percentage change in production 1989-1990
North America	
Canada	+ 2.0
United States	+ 1.0
Europe	
Austria	- 5.0
Belgium	- 4.0
Finland	- 5.0
Germany, Federal Republic of	- 5.0
Greece	- 3.0
Ireland	- 1.0
Italy	- 4.0
Netherlands	+ 1.0
Norway	- 5.0
Spain	- 4.0
Sweden	- 6.0
United Kingdom	+ 1.0

Source: Statistikon Corporation.

Tariffs and Trade (GATT), some of those problems might be reduced or completely eliminated.

(b) *Long-run*

The long-run outlook seems to be more promising for the global apparel industry because of such factors as the introduction of new technology to help design better garments, reduce labour input costs, improve materials use, and help make the apparel industry respond more quickly to fashion needs. Those developments will tend to favour developed rather than developing countries, but some NICs might welcome the rising capital intensity of the manufacturing process as workers leave apparel manufacture to seek better working conditions and pay elsewhere.

The long-term growth potential of apparel demand seems to lie with developing countries where demand growth is fastest, as in China or India. Firms in developing countries need to exploit this opportunity, and in some ways they may be forced to do so. Structural changes in the global market-place, for instance as a result of the planned integration of the European Community in 1992, the trade agreement between the United States and Canada, and other large trading groups in Asia and possibly in South America, will force firms and countries to change their business strategies. Those large economic groups will look primarily after their own domestic markets, and the driving force for firms will be the desire to capture a share of a new, large market.

Firms outside the large economic spheres will also be forced to change their strategies. One approach will be for firms in developing countries to open up plants or facilities within the major sphere of influence of those large markets. This is already happening. Companies from developing countries are opening plants in the United States and Canada, as well as in Europe. The second approach will be for those firms to strengthen and concentrate on their own developing markets. A third option is for a firm to operate in both the world and domestic markets.

Innovation target	Computer/software		Fabric cutting tools			Fabric sewing and joining technologies				
						Sewing	Joining			
	CAD	CAM	Laser	Hydro	Plasma torch	Automated programmed	Glueing	Fusing	Welding	Conveyor systems
A. Conceptualization of garment idea										
A1. Style, garment idea	I									
A2. Prototype garment	I									
A3. Evaluation of garment style	I									
A4. Preparation of first pattern	I									
A5. Evaluation and approval of garment fit										
A6. Pattern grading/ marking			I							
B. Evaluation										
B1. Business analysis										
B2. Cost analysis										
B3. Scale up production costs										
B4. Price, sales estimates										
B5. Profitability										
C. Commercialization										
C1. Materials requisition	I									
C2. Fabric needs (fibre type, designs, colours, prints, finish										
C3. Trimmings										
C4. Develop production schedule										
C5. Develop delivery schedule										
C6. Garment production										
C7a. Spreading										
C7b. Cutting	I	I	I	I	I					
C8. Sewing, tasks:							I	I	I	I
C8a. Separation of fabric piles						I				
C8b. Fabric positioning and allignment										
C8c. Loading, guiding and sewing						I				I
C8d. Unload sewn pieces from machine and send to the next conversion step						I				I
C9. Finished garment										
C10. Marketing										
C10a. Sales										
C10b. Promotion										
C10c. Brand management										
C11. Logistical control										
C11a. Warehousing										
C11b. Shipping										
C11c. Customer billing										
C11d. Documentation control										
C11e. Inventory control										
C11f. Order turn around/delivery										
C11g. Quick response to information requests/ complaints										

Source: Statistikon Corporation.

manufacture innovation matrix

Sources of innovation											
Partial or fully computerized manufacturing system (CIM)					Management Science						
(TC) (USA)	Technology research association (Japan)	Melbo's apollo project (Japan)	Fully integrated garment manufacture (Sweden)	Robotics for integrated manufacture (UK)	Quick response	Perceptual mapping	Conjoint analysis	Financial modelling	Spread sheet analysis	Forecasting	Optimization
		I	I			I	I				
		I	I								
		I				I	I				
		I									
		I	I	I							
								I	I		
								I	I	I	
								I	I	I	I
								I	I	I	I
										I	
								I			
								I	I		
		I									
									I	I	I
		I	I	I							
			I	I							
I	I	I	I								
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					I						
					I						

Appendix

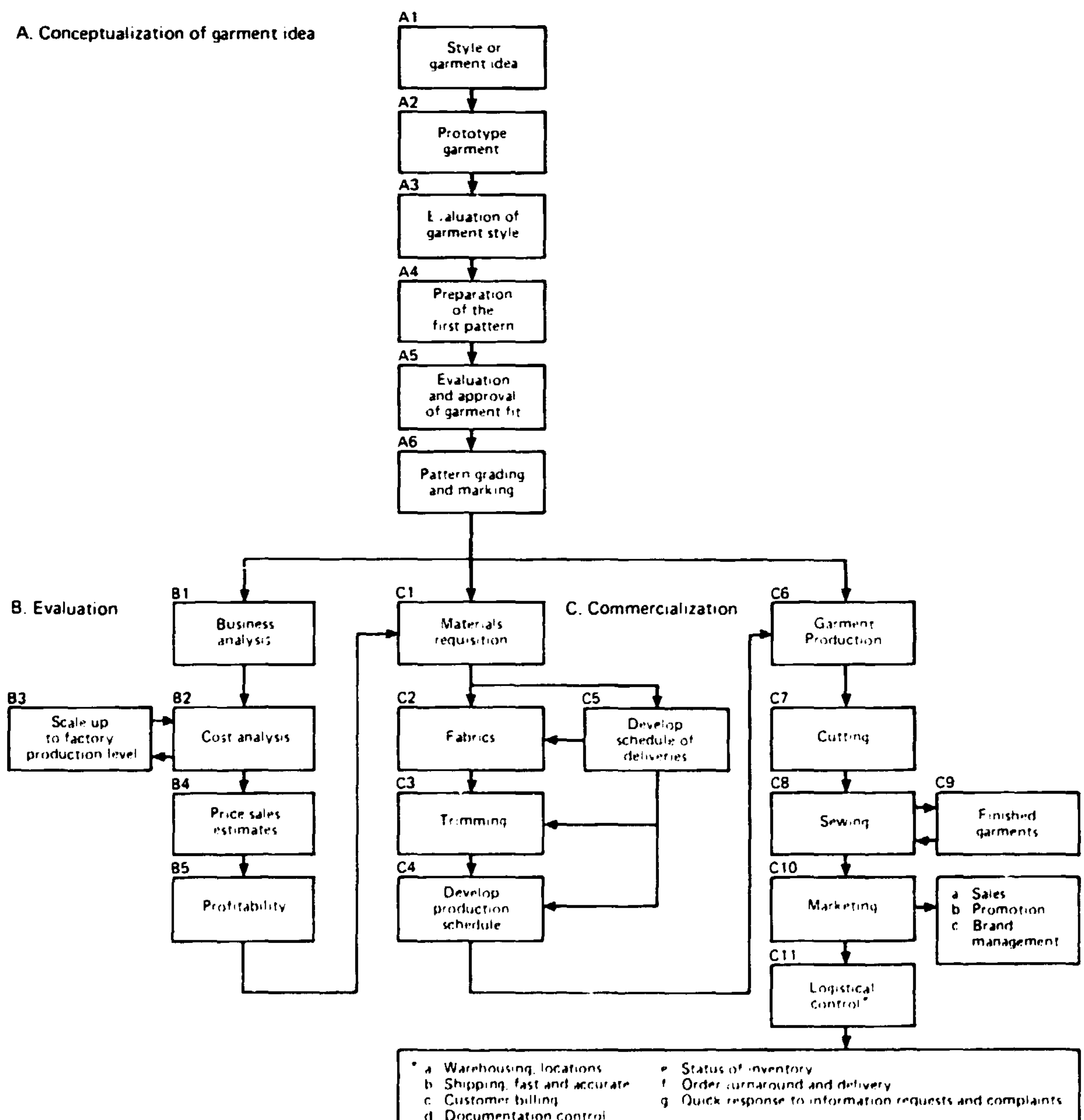
Process evaluation for apparel manufacturing

An examination of the nature of the apparel manufacturing process would provide a better understanding of the importance of the industry to developing countries and help identify areas where they have unique advantages. Figure IV.15 identifies the various steps in the apparel conversion process. The first group of activities, the conceptualization of the garment (A), serves to convert a concept or idea into a tangible form which could have market value. Apparel ideas come from many sources, such as the firm's own design, international trade or fashion shows, fashion magazines or trade papers, evaluating consumer trends and others. The dominant sources of styling ideas in developing countries are generally fashion publications or designs submitted by contracted parties in developed countries. The inability to create original garment designs for export markets poses a major obstacle for developing countries. Cultural barriers and timing are other problems, as it is imperative for the manufacturer to make goods available at the right time and place.

Traditionally, steps A1 to A6 deal with a labour-intensive process, but today, the use of computers provides a greater depth and facility of design options, as well as more accuracy and efficiency.

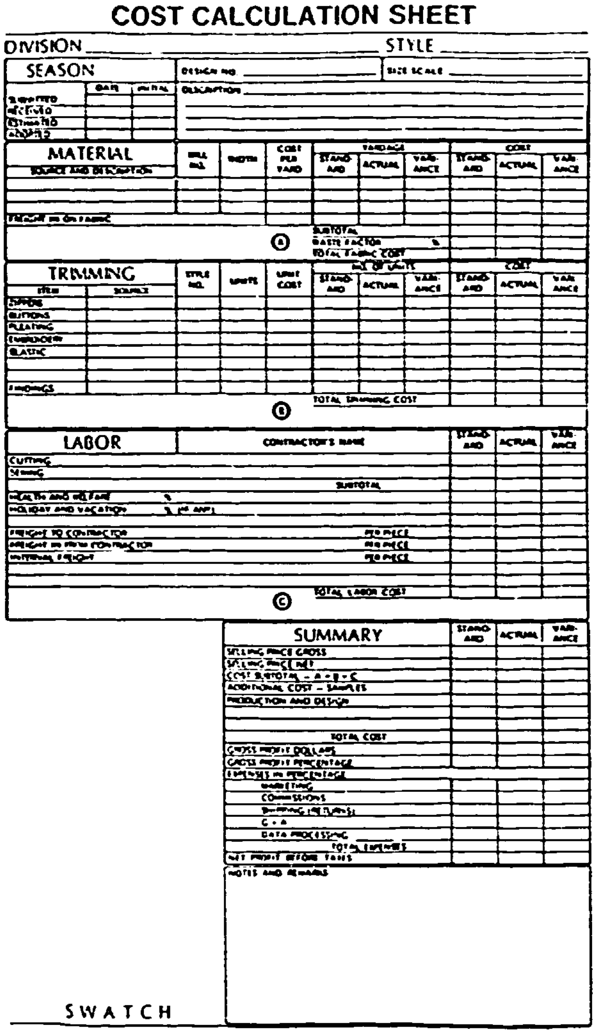
The three major variables that have an effect on profitability are cost, price and sales volume. The list of cost elements, in figure IV.16, show that the greatest saving could be made in the sewing cost, as this involves a manual operation. The process of sewing involves many short

Figure IV.15. Garment manufacturing sequence



Source J P Yale

Figure IV.16. Cost calculation sheet



Source: Statistikon Corporation

operations on the various parts of the garment. On a large-volume basis, many aspects of the sewing process can be automated, but since the apparel industry in developing countries consists of a multitude of small firms, many facets of automation or mechanization do not become practical for a small plant.

If management in developed countries had been aware of, and used, the improved managerial skills outlined in group B of figure IV.15, along with the improved techniques in group C, particularly items C10 and C11, they would have had a strong competitive advantage. Management in the United States has only recently exploited its potential strategic benefits through the "quick response programme", as discussed earlier.

The third group of activities, under item C, includes material sourcing (fabrics, trimming and other supplies), garment manufacture and managerial skills. Generally speaking, apparel firms in developed countries have access to fabrics of greater variety, with better dyeing, as well as improved printed and finished quality. Processing steps C7 and C8 are subject to newer cutting and sewing technologies that require a larger volume of production, on a limited garment style variation. Thus, it appears that developed countries have an advantage over developing countries in the use of technology.

F. Soap and detergents (ISIC 3523)

1. Present market situation

This section covers available data on detergent end-products in the form of cleaning agents for hard surfaces, fabrics and personal body care (skin, hair, teeth). It also includes data on detergent intermediates, which cover a range of materials produced by the chemical industry from commodity-type basic chemicals, which form the building-blocks for detergents, to chemically sophisticated additives such as enzymes and bleach activators.

There are various visible trends in the North and South for both these aspects of the detergents industry. In the North, the market for cleansing products is mature and likely to be extended significantly just by the introduction of new products or formulations or modifications in washing habits—such as a trend towards cold-water washing. In the South, the use of detergents is expanding rapidly, inspired by increasing industrialization and continued migration of population from rural areas to cities.

Product supply to the South remains dominated by a handful of Northern transnational corporations and their numerous subsidiary companies. More and more, however, production of basic chemical intermediates for detergents is becoming concentrated in the South, where hydrocarbon raw materials are more cheaply available, or where chemicals development is given priority in industrialization plans. An interesting trend towards the use of natural raw materials is also concentrating feedstock supply in the South, particularly in South-East Asia.

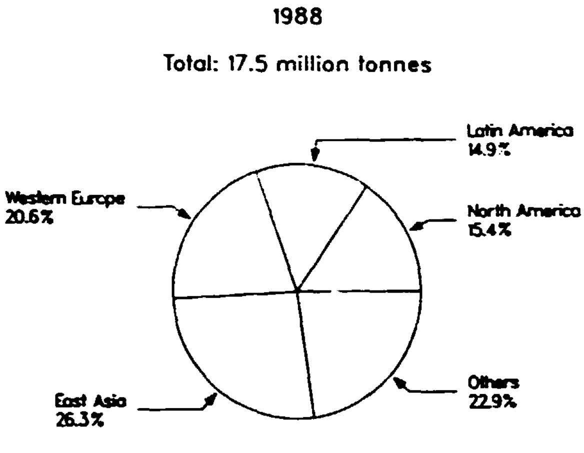
Environmental issues have arisen concerning the use of phosphates (the major water-softening agent) in detergents and the effect of effluent on waterways. The North is already legislating heavily, and phosphates are widely banned in parts of the United States and Europe. In the South, where waste-water treatment is likely to be generally less effective, particular problems could arise from a rapid increase in detergent usage. Phosphate products tend to be cheap and effective and thus suited to less developed markets.

(a) *Consumption*

Total world detergent production figures are not available, but in volume terms, world consumption of household detergents is estimated at roughly 17.5 million tonnes for 1988. A breakdown of consumption figures shows East Asia to be the major consumer region, using 4.6 million tonnes in 1988 (26.3 per cent). This is followed by Western Europe, where households consumed 3.6 million tonnes of soaps and detergents (20.6 per cent), North America, with 2.7 million tonnes (15.4 per cent) and the rest of the world accounting for the balance (see figure IV.17).

Total industry growth is steady and slightly ahead of world population growth. North American and Western European markets are generally regarded as mature. The fastest growth markets are in East Asia and less developed countries. The rate of growth of detergent consumption i[illegible]a and India is now running at from 8 to 10 p[illegible] a year as the use of synthetic powders replace t[illegible]nal use of soap.

Figure IV.17. World household laundry soap and detergent consumption, 1988



Source: Colin A. Houston and Associates.

Growth in detergents use in Latin American countries is about 3 to 4 per cent, compared with about 1 to 2 per cent in North America.

In terms of value, Western Europe has the largest market among the developed regions. The total market was worth $10 billion in 1988 (see table IV.90).

Table IV.90. Estimated detergent markets, 1988

Country or region	Market size (billions of dollars)
Western Europe	10
United States	9
Japan	3
Total	22

Source: Colin A. Houston and Associates.

This compares with a value of $9 billion for the United States (although governmment statistics put the figure at $10 billion) and $3 billion for Japan.

Detailed statistics were only obtainable for Western Europe (see appendix to this section). These indicate that apparent consumption of detergents by households and industry combined reached 8.7 million tonnes in 1987 (table IV.91). This total is derived from a production figure of 8.8 million tonnes, plus imports of 990,759 tonnes, minus exports of 1.19 million tonnes. The largest production and consumption groups are fabric washing powders and synthetic liquid products, each of which represent around

Table IV.91. Production and consumption of soaps and detergents in Western Europe, 1986 and 1987
(Tonnes)

Item	Production		Exports		Imports		Apparent consumption		Consumption per inhabitant (kilograms)	
	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987
Toilet Products										
Toilet soaps	334 352	337 716	110 113	116 924	56 216	[illegible] 671	280 455	279 463	0.790	0.784
Shaving products	25 974	27 064	4 883	5 714	5 383	7 949	26 474	29 299	0.076	0.082
Shampoos	230 050	242 662	28 378	31 888	25 968	35 036	227 640	245 810	0.641	0.690
Household and industrial soaps										
Household hard soaps	154 382	155 282	15 395	32 620	6 334	5 610	145 321	128 272	0.409	0.360
Other hard soaps	18 156	18 018	4 203	5 330	3 817	4 235	17 770	16 923	0.050	0.047
Industrial soaps	29 553	25 928	5 008	2 418	1 330	1 944	25 875	25 454	0.073	0.071
Fatty-acid liquid soaps	50 070	52 733	5 561	6 306	13 099	14 232	57 608	60 659	0.162	0.170
Special hand cleansers	53 117	62 529	1 612	1 627	1 848	3 598	53 353	64 500	0.150	0.181
Soft soaps	43 764	43 573	9 113	9 483	6 895	7 424	41 546	41 514	0.117	0.116
Washing products, surface cleaners and scourers										
Fabric washing-powders	3 610 132	3 564 723	438 897	462 410	273 636	335 716	3 444 871	3 438 029	9.701	9.650
Dishwashing powders	276 630	303 160	38 967	55 841	76 073	98 944	313 736	346 263	0.884	0.972
Powdered surface cleaners	84 950	80 007	2 403	2 808	8 515	12 287	91 062	89 486	0.256	0.244
Auxiliary washing-powders	3[illegible] 012	38 199	3 867	6 411	3 726	7 046	32 871	38 834	0.093	0.109
Synthetic liquid products	3 460 220	3 670 825	297 126	423 487	279 104	371 587	3 442 198	3 618 925	9.694	10.155
Scourers	258 723	257 904	31 306	30 861	28 269	26 480	255 686	253 523	0.720	0.711
Total	[illegible] 663 085	8 880 323	996 832	1 194 128	790 213	990 759	8 456 466	8 676 945	23.814	24.355

Source: Association internationale de la savonnerie et de la détergence.

40 per cent of total soaps and detergents output and consumption. Toilet soaps, shampoos, dishwashing powders and scourers are considerably less significant, in volume terms, but are the next largest groups, each representing about 2 to 3 per cent of total business. Table IV.91 also indicates the changing consumption pattern per inhabitant. The most significant development is the 4.7 per cent increase in synthetic liquid products consumption in just one year, from 9.69 kilograms per capita in 1986 to 10.155 kilograms per capita in 1987. In general, the trend of consumption in those two years showed that among toilet products, there was a decline in the use of toilet soaps, but an increase in shaving products and shampoos; in household and industrial soaps, there was a fall in consumption of household hard soaps, other hard soaps, industrial soaps and soft soaps, but an increase in the use of fatty acid liquid soaps and special hand cleaners. In the washing-products, surface-cleaners and scourers category, there was an increase in consumption of dishwashing powders, auxiliary washing powders and, as mentioned above, synthetic liquid products, while the per capita consumption of fabric washing powders, powdered surface cleaners and scourers declined. Total consumption of laundry detergents, per capita, in Western Europe is approximately 9.54 kilograms per year, with a range of from 5.6 to 12.8 kilograms per year.

(b) *Factors accounting for production and consumption trends*

Changing demographics, populations moving into cities, the growing use of automatic washing-machines and increased demand for washing liquids have spurred detergent demand. Many countries are motivated to start their own production of detergent intermediates such as linear alkyl benzene (LAB) to add value to raw materials from, for example, local oil refineries or to move away from imported products that may be less biodegradable. In China, for example, synthetic detergent production increased from 390,000 tonnes to over 1 million tonnes between 1980 and 1985. This was partly inspired by the increased production of washing-machines, output of which rose from 300,000 to more than 6 million during the period.

The single largest factor in detergent consumption trends in the North has been the shift in developed countries to the use of laundry liquids. This has been most rapid in the United States, where the use of liquids has escalated from 18 per cent of sales in 1980 to account for 40 per cent now.

A significant factor favouring liquids has also been the banning of phosphates in many states of the United States and certain countries on environmental grounds. These are used as "builders" in powder detergents to soften the water and allow better performance. Another reason for the growth has been the convenience of liquids plus significant improvement in packaging and formulation. Liquids now incorporate enzymes for better cleaning power and perform better than powders in cold water. They are regarded as easier to handle and dispense with. Furthermore, liquids do not present a caking problem in storage, as powders do.

It is interesting to note, however, that in Japan, where heavy duty liquids showed promising growth, market penetration has stopped completely and the use of liquids have been cut in half since the introduction of a highly concentrated powder product. One significant reason cited is that Japanese shoppers frequently carry purchases home from the supermarket and a box of light, compact powder has proved far more convenient than bulky, heavy liquid.

In Europe the switch to liquids has been slower, but it is catching up rapidly with the United States. One reason is the tendency to cooler washing temperatures. In European countries now the majority of laundry loads are washed at 60 degrees Celsius or lower, whereas 10 years ago the most popular wash was at 95 degrees. The move has been inspired both by the need to protect more delicate fabrics and the urge to save energy. It has been estimated that liquids now have 25 per cent of the laundry detergents market in the United Kingdom, 20 per cent in the Federal Republic of Germany and 10 per cent in France.

Components of detergents generally include surface active agents (surfactants) to remove dirt; builders (80 per cent of which are accounted for by sodium tripolyphosphate, or tetrasodium pyrophosphate) to soften the wash water; foam regulators; solubilizers to maintain solubility of ingredients in liquid detergents; antiredisposition agents to prevent dirt from re-entering the fabric; whiteners and brighteners; corrosion inhibitors to protect automatic washing machines; and enzymes for stain removal.

The highest volume ingredient consists of surfactants, which represent some 25 per cent of total detergent raw material volume. The traditional so-called "work-horse surfactants" have been the detergent alcohols derived from ethylene (a hydrocarbon derived from crude oil). Notably, ethylene oxide is used to produce alcohol ethoxylate. Shortages of ethylene in the past two years have led to a sharp escalation in price for these products and a shift in use to another raw material, LAB, in the form of its derivative, linear alkyl sulphonate.

Overall use of surfactants in detergents has increased, in some major products by up to 50 per cent, because of the increased use of liquids and run-down in use of phosphates. At a technical level, the trend has favoured the use of non-ionic materials (based on ethylene oxide). But this, coupled with the shortage of ethylene raw material, has caused prices to rise sharply and encouraged the greater consumption of anionic materials, such as linear alkyl sulphonate mentioned above.

A typical non-phosphate heavy-duty powder detergent now consists of 13 per cent surfactants, of which 7 per cent are the anionic linear alkyl sulphonate and 6 per cent non-ionic, based on ethylene glycol. In comparison, phosphate detergents contain 9 per cent linear alkyl sulphonate and 3 per cent non-ionic material ([142], p. 12).

(c) *Effects on trade*

Changes in raw material demand and prices have led to some dislocations in supply in the past couple of years. Notably, LAB has flowed into Europe in the form of cheap imports from Asia and Latin America. These are estimated to account for 20 per cent of the market in Western Europe and have helped increase overall demand.

It has been calculated that the number of new LAB plants in developing countries has increased the world's total by around 50 per cent in the past five years. Many new producers want to sell to Europe to earn hard currency. At the same time, European producers are losing export markets to new domestic plants in the South, many of which are protected by tariff barriers.

Another notable effect on trade flows has been inspired by the growing move to naturally derived feedstocks. These are mainly fatty alcohols derived from coconut and palm oils and tallow, the basis for the world's oleochemicals industry.

The United States is the world's largest producer of tallow, exporting major quantities to users in Europe and Japan. In the past, 70 per cent of the world's fatty-acid requirement has been met from tallow, but this is declining. Other oleochemicals, notably palm and coconut oils are increasing in importance, and the countries of South-East Asia have become the focus of the industry. They are expected to be supplying 25 per cent of the world requirement by the mid 1990s, with 15 per cent coming from Malaysia [143].

The local markets for oleochemicals remain generally underdeveloped in the ASEAN countries. Local schemes to develop the market are in hand in certain countries, however. For example in the Philippines, coconut is actively promoted as the raw material for sulphonated detergents.

The countries of the North are still considered the main markets, however. The complicated ASEAN tariff system, ironically, sometimes makes crude palm oil cheaper in Rotterdam than in other ASEAN countries. Simplified trading between those countries would promote usage. There are some worries over access to markets in the North. The United States has been campaigning against tropical fats and there have been duties applied on certain products in Europe.

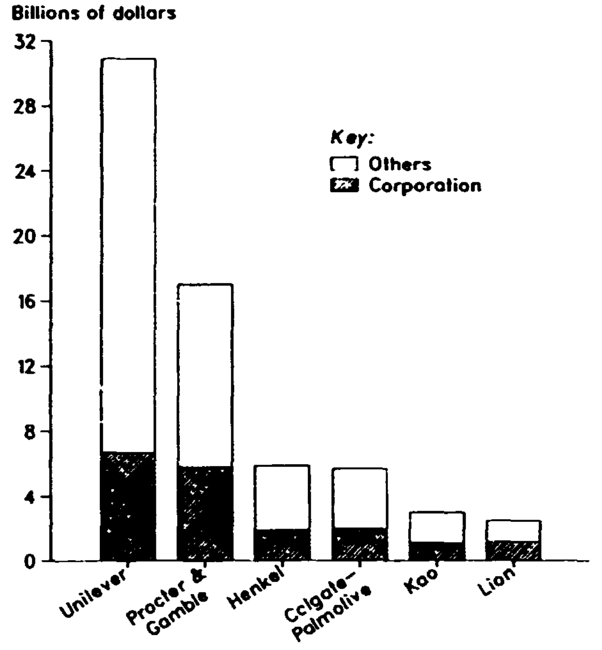
(d) *Major detergents companies*

The world market is dominated by six major transnational corporations. Between them, Unilever of the United Kingdom, Procter & Gamble of the United States, Henkel of the Federal Republic of Germany, Colgate-Palmolive, Kao of Japan and Lion had sales of $65 billion in 1987 (see figure IV.18) In general, detergent companies are relatively labour-intensive. The consumer-oriented detergent industry requires high investment in marketing strategies such as advertising. Advertising and promotion to introduce a new brand in the United States can cost up to $100 million.

For many years the detergent companies confined their efforts to within their national borders or general regions. Henkel was only active in Europe, and Lion and Kao in the East Asia. Now both Henkel and Kao are intensifying their efforts in the United States market. In early 1989, Henkel announced a major $480 million acquisition involving the fatty-acids division of Quantum Chemical company. This reinforces the position of the company from the Federal Republic of Germany in the United States' detergents intermediate industry.

Henkel already has a 26 per cent ownership in Clorox. Kao, meanwhile, has purchased the Andrew Jergens Company of Cincinnati. Many of the companies

Figure IV.18. Major players in the detergent industry, 1987



Source: Colin A. Houston and Associates.

are now experts in international markets, changing strategies widely to suit differing cultures and environmental legislation. As products are broadly similar, competition arises through different formulations, promotion or raw materials. Henkel is one company that is heavily involved in the use of natural raw materials. It has a stake in a Malaysian oleochemicals plant, as do other European companies, Akzo and Unichema. It may be noted that the Phillipines oleochemicals industry is largely controlled by Japanese interests, while in Indonesia, the United States firm, Vista, has formed a joint marketing venture with Sinar Mas Inti to sell the latter's fatty alcohols to be produced in Northern Sumatra. Kao has linked up with Malaysia's Palmco Holding to build a new $70 million fatty-alcohols complex in Malaysia.

Pushing further into the natural-oils-based business, Henkel's acquisition of the oleochemicals business of Quantum comes on top of plans to build a fatty-acids plant in the United States. Some of the output will be used to produce a new natural surfactant. Henkel has a turnover world-wide of $6 billion. Around $650 million of this is in the United States, where the company's presence dates back only to 1960. The company was in particular difficulty in the United States market in the early 1980s and underwent severe restructuring, closing down or selling businesses worth $140 million. Now much of its business is tied to low-growth industries, but Henkel is establishing a product line-up in niche markets such as that for natural-sourced vitamin E.

The Procter & Gamble Company increased sales by 13.7 per cent in 1988 to $19.3 billion, while its net earnings increased by 30 per cent to $1 billion. It sells more than 160 brands in 140 countries. The company uses innovative marketing techniques to win market shares. For example, in Europe it has captured half the liquid laundry detergent market through the introduction of a novel plastic sphere to apply the correct dose of liquid directly to a machine wash without using the usual machine dispenser. In Latin America, the company marketed toothpaste with the help of celebrities such as the opera singer Placido Domingo. Last year it signed a joint venture agreement to establish a business in China. Generally, in the Asia-Pacific region, it is tailoring products to local markets, for example, by developing a new shampoo to combat lice. In India it is researching and basing products on herbal medicine traditions. In total, Procter & Gamble spent $652 million on research and development in 1988.

Unilever, which is the largest consumer products company in the world, spent about $600 million in 1988 on research and development and on product development. Smaller companies could not hope to match those sums, making it unlikely that the world monopoly of the top detergent companies will be broken. In India, however, it should be noted that one local company, Nirma Chemical, has grown to hold 49 per cent of the Indian market, largely at the expense of Hindustan Lever, a Unilever subsidiary which now has a 20 per cent share. Nirma Chemical has 9,000 workers in four factories producing 500,000 tonnes per year of detergent. It is India's second largest privately-held group, and plans, revealed in 1989, to invest more than 2 billion rupees in five new projects will make it one of Asia's most integrated soap and detergent makers. It plans to manufacture 60,000 tonnes of LAB and is already constructing plants for 60,000 tonnes of fatty acid, 4,000 tonnes of glycerine, 100,000 tonnes of sulphuric acid and 15,000 tonnes of alpha olefin sulphate.

In Spain, a local family-owned detergent group, Camp, succesfully took on its transnational competitors and after a series of television advertisements won 25 per cent of the Spanish washing-powder market. In 1988, the United Kingdom company, BP Detergents International, bought world-wide rights to a Spanish brand of detergents in an effort to concentrate activities closer to the consumer end of the detergents business, which is more profitable than supplying unbranded products or intermediates.

2. *Manufacturing capacity for different raw materials*

(a) *Plant sources of oils and fats for oleochemicals*

In terms of competition with synthetic alcohols, coconut oil is the largest natural source. Coconut is a lauric oil, as is palm kernel and babassu, which is principally a product of Brazil. Some strains of the oil-seed crop, cuphea, are high in lauric oil content, but this is still undergoing developmental research. Palm kernel oil production has increased dramatically. Palm kernels are a by-product of palm oil production and this is one of the world's most prolific and economic oil crops. A tonne of palm fruit, known as fresh fruit bunches, can yield 200 kilograms of crude palm oil and 40 kilograms of palm kernels. In turn, these yield 50 per cent or 20 kilogrammes of palm kernel oil. A hectare of land can yield 20 to 24 tonnes per year of fresh fruit bunches. Thus annually, a hectare yields 4 to 5 tonnes of palm oil, and 400 to 500 kilograms of palm kernel oil.

In 1987, the ASEAN countries produced almost 6 million tonnes of palm oil, representing more than 60 per cent of world production. The region is also the world's largest producer of palm kernel and coconut oils, producing in 1987 almost 700,000 tonnes of the former and 2.2 million tonnes of the latter [144]. Current and proposed production of natural fatty acids and glycerine and other natural oils in the ASEAN region are shown in tables IV.92 and IV.93.

Table IV.92. Current and projected capacities of oleochemical plants in ASEAN countries, 1980, 1990 and 1996
(Thousands of tonnes per year)

Country and company	Current products	1980 total capacity	1990 projected capacity	1996 projected capacity
Malaysia		165 000	351 310	755 000
Acidchem	Fatty acids	30 000	60 000	..
	Glycerine	3 000	6 000	..
Fatty Chemicals Malaysia	Methyl esters	..	38 000	..
	Fatty alcohols	..	30 000	..
	Glycerine	..	8 200	..
Unichema	Fatty acids	30 000	30 000	..
	Glycerine	3 000	3 000	..
Southern Acids	Fatty acids	30 000	30 000	..
	Glycerine	3 000	3 000	..
Malayan Oleochemicals	Fatty acids	30 000	30 000	..
	Glycerine	3 000	3 000	..
Henkel Oleochemicals	Methyl esters	30 000	30 000	..
	Glycerine	3 000	3 000	..
Felda	Fatty acids	..	28 610	..
	Glycerine	..	2 600	..
Pan Century	Fatty acids	..	36 500	..
	Glycerine	..	9 400	..
Thailand		10 000	10 000	20 000
Imperial Chemical Industries	Fatty acids	10 000	10 000	20 000

Table IV.92. (continued)

Country and company	Current products	1980 total capacity	1990 projected capacity	1996 projected capacity
Philippines		128 200	128 200	250 000
United Coconut Chemicals	Fatty acids	30 000	..	..
	Glycerine	8 500	8 500	..
	Fatty alcohols	30 000	60 000	..
Pilipinas Kao	Methyl esters	22 000	22 000	..
	Glycerine	2 700	2 700	..
	Fatty alcohols	20 000	20 000	..
Colgate-Palmolive	Methyl esters	5 000	5 000	..
	Fatty alcohols	3 000	3 000	..
Proton Chemicals	Methyl esters	7 000	7 000	..
Indonesia		29 700	84 700	250 000
Cisadane	Fatty acids	12 000	12 000	..
	Glycerine	1 200	1 200	..
Sumi Asih	Fatty acids	15 000	15 000	..
	Glycerine	1 500	1 500	..
Presolene (Bekosi)	Fatty acids	..	..	40 000
	Glycerine	..	..	6 000
	Fatty alcohols	..	..	30 000
PT Sarimala Pereasa Sakyi	Fatty alcohols	..	..	15 000
Arib Awana Utama	Fatty alcohols	..	50 000	..
Sinar Mas	Glycerine	..	5 000	..
Golden Philchem	Fatty alcohols	..	..	
	Glycerine	..	..	2 300
Total ASEAN		322 900	564 210	1 275 000

Source: Performance Chemicals, April 1988.

Table IV.93. Production of palm, palm-kernel and coconut oils in the ASEAN countries, 1983-1992[a/]

(Thousand tonnes)

Item	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Palm oil										
Indonesia	983	1 278	1 216	1 148	1 339	1 727	1 970	2 217	2 458	2 707
Malaysia	3 018	3 830	4 133	4 544	4 598	4 953	5 229	5 475	5 720	5 973
Philippines	20	26	30	35	37	40	44	47	51	54
Thailand	56	81	89	94	115	125	140	160	170	180
Asean production	4 077	5 215	5 468	5 821	6 089	6 845	7 383	7 899	8 399	8 914
World production	5 417	6 347	6 925	7 505	8 176	..	..	..	..	..
ASEAN percentage of world production	75.3	82.2	79.0	77.6	74.5	..	..	..	..	..
Palm kernel oil										
Indonesia	76	98	119	130	133	173	197	222	246	271
Malaysia	381	429	528	596	553	619	653	684	714	746
Philippines	..	..	..	..	..	..	..	..	..	..
Thailand	5	9	7	6	10	10	11	13	15	16
ASEAN production	462	536	654	732	696	802	861	919	975	1 033
World production	764	831	945	1 051	1 022	..	..	..	..	..
ASEAN percentage of world production	60.5	64.5	69.2	69.7	68.1	..	..	..	..	..
Coconut oil										
Indonesia	557	492	755	782	626	750	800	850	900	950
Malaysia	63	45	51	55	59	36	32	28	24	22
Philippines	1 216	819	1 006	1 610	1 464	1 450	1 525	1 600	1 650	1 700
Thailand	..	..	..	..	..	..	..	..	..	..
ASEAN production	1 836	1 356	1 812	2 447	2 149	2 236	2 357	2 478	2 574	2 672
World production	2 605	2 102	2 638	3 304	2 720	..	..	..	..	..
ASEAN percentage of world production	70.5	64.6	68.7	74.1	79.0	..	..	..	..	..

Sources: Oil World; and PORIM Bulletin (Kuala Lumpur).

a/ Estimate for 1988; projections for 1989-1992.

(b) *Detergent alcohols*

Detergent alcohols based on ethylene oxide are primarily produced in developed countries, although capacity has been building up in Eastern Europe, Western Asia and East Asia. Total manufacturing capacity for these products in the United States amounted to 470,000 tonnes in 1987, with four companies being the main suppliers. Shell Oil overwhelmingly dominates production, with 58 per cent of total capacity. Ethyl has 16 per cent, Procter & Gamble 13 per cent and Vista 8 per cent.

After several years of overcapacity, world-wide changes occurred in the detergent alcohols market in 1988, with shortages arising in the supply of ethylene oxide. Other parts of the chemical sector compete with detergents for use of this product as a raw material. For example, the biggest demand arises from the fibres industry, where ethylene oxide is the starting-point for ethylene glycol, the key intermediate for polyester fibres production. Ethylene glycol is also the basis for automobile antifreeze.

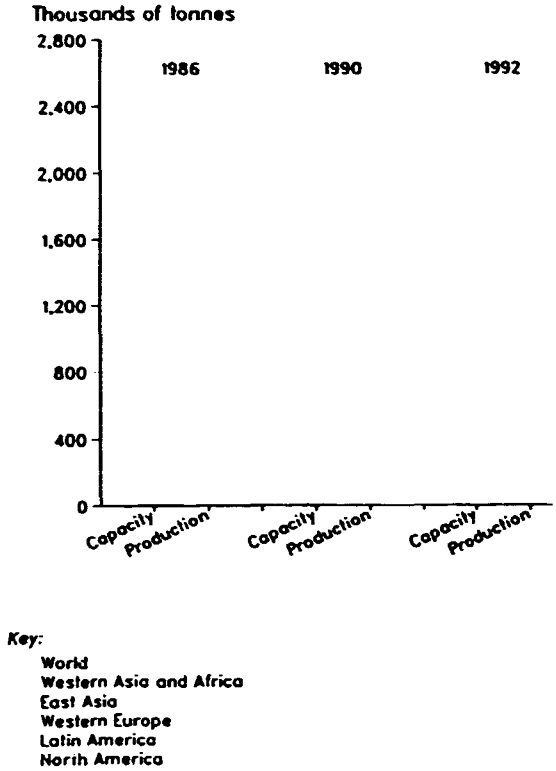
In Western Europe demand for ethylene oxide soared towards the end of 1987. Supply was restricted after a plant owned by British Petroleum Chemicals at Antwerp, Belgium, exploded in July 1987. Another plant, this time owned by BASF, of the Federal Republic of Germany, exploded at Antwerp in March 1989 (ethylene oxide is one of the most volatile chemical molecules). No new ethylene oxide plants were under construction in Europe because the product had generally been losing money during much of the 1980s.

LAB continues to be the main surfactant used in detergents in Japan, the United States and Western Europe. World LAB capacity and production are indicated in figure IV.19. Generally, capacity is higher than production, keeping operating rates low, at 70 to 74 per cent. Many plants are due for start up in East Asia, in particular, and capacity in that region will increase by 60 per cent between 1986 and 1992. Raw material supplies for LAB, which is based on benzene, a by-product of oil refining, are diverse and plentiful, which means shortages in production are less likely to arise. United States LAB capacity is put at around 300,000 tonnes, divided mainly between two companies, Monsanto and Vista. The latter is the largest producer of LAB in the world. Both companies have expanded their plants and the extra capacity is due on stream in 1989, while Monsanto is planning to build a new plant. It is, however, unlikely that any new plants will be built outside the United States.

Capacity utilization in the United States plants has been higher than elsewhere in the world. Over the past five years LAB has showed an annual growth of around 6 per cent, largely because of the trend towards liquid detergents which require higher levels of surfactant. The ban on phosphates also means that more surfactants are needed to achieve the same cleaning power. For the next two to three years, growth is expected to continue at 3 to 4 per cent, which is about twice the rate for surfactants as a whole.

In Europe, demand for LAB has not developed at the same brisk pace and the market is characterized by overcapacity. The increasing use of liquid detergents is expected to inspire growth, but the supply and

Figure IV.19. World linear alkyl benzene capacity and production by region, 1986-1992



Source: Colin A. Houston and Associates

demand situation could remain out of balance. One reason for the problems in Europe is that Eastern Europe and developing countries have traditionally been important export markets for LAB producers in Western Europe. These regions are steadily building up their own capacity, however, and are expected to be almost self-sufficient by the year 2000, when they will be consuming some 800,000 tonnes more than they did in 1986 [145].

(c) *Expansion plans for detergent intermediates*

There are numerous expansion plans for detergent alcohols in developing countries, some more firm than others. Most plans fall in the LAB or oleochemicals category. It is anticipated that the scale of LAB construction in the South will exacerbate the overcapacity situation, despite growing consumption. Nevertheless, it is also said that the future is very bright for LAB producers such as Deten and EMCA in Brazil, Isu in the Republic of Korea and new producers in India.

India has been expanding LAB capacity on the basis of imported technology. Reliance Industries, a major chemical company, inaugurated a 50,000 tonnes LAB plant at Patalganga, near Bombay in 1988. The unit is based on technology supplied by UOP, a subsidiary of Allied Signal of the United States. It is one of three similar units commissioned in India using this technology. Indian Petrochemical Corp. has a 30,000-tonnes-capacity plant at Vadodara, currently being expanded to 43,500 tonnes. Tamilnadu Petroproducts brought a 50,000 tonnes unit on stream at Manali, near Madras and is already taking steps to expand the plant to 75,000 tonnes. The result of these expansions is that India's LAB production balance moved rapidly from deficit to surplus during 1988, when projected demand of 125,000 tonnes was set against supply of over 170,000 tonnes. The situation was made worse by imports early in the year by the Indian State Trading Corp.

Mounting inventories, believed to stand at around 25,000 tonnes at the beginning of the year, prompted companies to ask for Government export support of up to 20 per cent of the selling price. The country's Department of Chemicals and Petrochemicals supported the export efforts, and recommended that help should be given as buyers in the United States, Western Europe and East Asia had expressed interest in purchasing the product. It is important for the three companies mentioned above to establish a position in export markets as India's two main detergent companies, Nirma and Hindustan Lever, which consume over 70 per cent of domestic LAB output, are planning to build their own plants. Smaller Indian buyers include Godrej and Tatas.

In China, a new LAB plant is being built at Fushun, Liaoning Province. A Spanish company is constructing the plant, financed by mixed credits extended by the Government of Spain to help ease China's detergent raw materials shortage. In 1988 all of China's 60 synthetic detergents plants suffered a raw materials problem. It is forecast that to meet demand, three new 50,000-tonnes-per-year LAB plants will be needed in China by the year 2000.

(d) *Expansion plans based on natural resources*

Construction of new facilities based on natural raw materials is increasing rapidly around the world. During 1988, Henkel of the Federal Republic of Germany announced that it was going ahead with three such projects, in Malaysia, China and the United States. The projects are all based on a new process described as a major breakthrough in catalyst and reactor technology, allowing a one-step hydrogenation of triglycerides. In the long term the company expects renewable fats and oils to offer better economics than petrochemical feedstocks for the production of fatty alcohols used in detergents and cosmetics.

Henkel has licensed its technology to Uhde, an engineering group of the Federal Republic of Germany, which is building the plant in China. Henkel will have access to this product. In total, its fatty-alcohols capacity will rise from 180,000 to 250,000 tonnes. In the United States, Sherex, the subsidiary of Schering of the Federal Republic of Germany, plans to spend $50 million on a major expansion of its fatty-alcohols business. At Dublin, Ohio, it will build a new plant with a capacity of up to 60,000 tonnes.

The plant will be based on renewable natural oils and fats such as beef suet, coconut oil and palm oil. Supply of these raw materials is expected to remain adequate, although there is some uncertainty among producers in the North over the continuity of supplies and price stability, given that most output is in the South. There is already talk of custom-designed trees, the result of genetic engineering, growing in the North to produce coconut or palm oil. Coconut oil represents 30 per cent of the raw materials used for oleochemicals production. Already the majority of products from the Philippines is shipped to Japan for further processing. Malaysia, Indonesia and Thailand are all increasing their production of palm oil, while Indonesia and the Philippines are increasing production of coconut oil. Malaysia, on the other hand, is decreasing its production of coconut oil, and Thailand is not a producer.

3. *Supply of other detergent ingredients*

(a) *Phosphate builders*

Phosphate builders are another important component in detergent formulations. These chemicals soften water and prevent the redisposition of dirt during washing. The traditional builder, sodium tripolyphosphate, has come up against environmental opposition and is widely banned, in the United States in particular. Phosphates cause eutrophication (oxygen starvation) of waterways and have been outlawed in nine states and various counties, affecting a third of the United States population. Recently there has been a resurgence of protest activity and a ban is expected in Pennsylvania.

There has been considerable debate in the North over the validity of banning phosphates. Consumers must pay for the shift to other products of equivalent cleaning power. It is estimated that the cost of moving to liquids on these grounds is $40 to $50 million per year for consumers in the United States.

A large part of the market is not subject to bans; for example, dishwasher detergents, which account for 20 per cent of sodium tripolyphosphate use, and the institutional and industrial cleaning market, which accounts for another 15 per cent. Nevertheless, a major producer estimates there will be a steady decline in phosphate demand of around 2 per cent a year. Companies which produce these products are now concentrating on areas of exemption and other applications for phosphates, such as in phosphoric acid for fertilizers.

Other phosphates producers reported continued good business in 1988, partly due to a dramatic decline in imports as the product was diverted to China, and partly through the effects of plant closures in Tennessee and Mexico. Some companies are continuing to develop new products based on phosphates. For example, tetrapotassium pyrophosphate is more soluble in liquids, but also more expensive.

(b) *Citrate builders*

The main alternative builder is sodium citrate. Demand for citrates expanded rapidly, by 14 per cent in 1987, but slowed to from 3 to 5 per cent in 1988. They are primarily used in liquid detergents. Increased demand has caused supply of the source material, citric acid, to increase rapidly. Expansion projects have been initiated in the United States by major producers such as Miles, Pfizer and Cargill. The products are seen as environmentally safe and incorporated in all prime liquid detergents.

(c) *Zeolite builders*

In regions where phosphate builders are banned, zeolites are the next choice for powder detergents. Market demand has grown rapidly, for example, from 35,000 tonnes in 1987 to 90,000 tonnes in early 1989. Despite this, capacity-utilization for zeolite plants in the United States is only 55 to 60 per cent.

Demand in East Asia and Europe, however, has spurred new plant-building. In Europe, two Belgian companies, UCB and Ausidet, joined together in 1988 to make zeolites for use in detergents. The plant, to be sited at Ostend, Belgium, has a capacity of 40,000 tonnes and partly compensates for the closure of phosphate capacity. Demand for zeolites is said to be growing at 20 per cent a year in Western Europe, and these products now account for 50 per cent of the builders market. In Japan, zeolites supply the entire detergent builders market.

(d) *Other builders*

Another product which was considered a potential phosphate replacement is nitrilotriacetic acid. This acts as a much better cleaning agent in cold water than sodium tripolyphosphate. However, it was found that the builder caused metals to dissolve and could possibly cause lead poisoning. It was banned in New York State, and since then has not become popular elsewhere in the United States. It is still used in Canada, however.

Soda ash is also used as a builder, and the detergent industry takes 11 per cent of total output. This was once a cheaply available product, but supply has become tighter and prices have risen. European producers have been accused of operating a cartel and United States producers are lobbying for more access to markets in Europe. A major new project to produce natural soda ash is under way in Botswana. Some companies are carrying out development on the use of soda ash builders.

(e) *Additives*

The market for detergent additives is forecast to rise rapidly in the coming years as environmental concerns and increasing demands for sophisticated cleaning products spur the use of bleaches and enzymes to lift stains.

Peroxygen bleaching agents are experiencing a rapid growth in detergent applications, especially in the United States. In Europe, where washing temperatures are higher, bleaches have been included in detergents for many years. Now, in the United States, a special perborate bleach is combined with an activator to allow it to act at cooler temperatures, without affecting the colour of garments. The basis for the bleaching agents in liquid and powder detergents is hydrogen peroxide, which is favoured as environmentally safer than chlorine. Increased demand for its use in household detergents, as well as in other industries such as pulp and paper, has spurred the construction of many new plants around the world.

Use of per-salts, derived from hydrogen peroxide, is expected to continue to such an extent that they will be considered a necessary ingredient for all detergents. The development of suitable activators will spur their use. A pioneering new detergent product on the United States market has been introduced by Procter & Gamble. The chemical activator used in that product is sodium nonanoyloxybenzene sulphonate. Another chemical more popular in Europe is tetraacetylethylenediamine, developed by Unilever and produced by Warwick International. Hoechst and Henkel, which between them control 80 per cent of Europe's activator market. Another activator, nonylamidosuccinic acid, which may be a replacement for tetraacetylethylenediamine, is under development by Hoechst.

(f) *Enzymes*

Another means of lifting stains from garments at lower temperatures is the addition of enzymes. A genetic engineering company in Denmark, Novo Industri, won approval in 1988 to manufacture its fat-splitting detergent enzyme, Lipolase, in Denmark. Previously, it was only manufactured in Hokkaido, Japan. The company is the first to produce genetically engineered enzymes for the detergent industry.

About 70 to 80 per cent of detergents in Europe contain enzymes, compared with about 40 to 50 per cent in the United States. The European enzyme market is worth about $200 million, compared with from $60 million to $70 million in the United States.

Other estimates put the market value lower, but there is little doubt it is growing rapidly. Other companies active in enzyme production are confined to the North and include Gist Brocades of the Netherlands and Miles Laboratories of the United States. These products are at the very sophisticated end of the detergents industry, and barriers to entry become very high in this research-intensive sector, suggesting that technology transfer to the South will be slow in occurring. Even if developing countries are less strict in holding back construction of plants involving genetic engineering techniques, it is unlikely that companies would be sufficiently interested in investing in a location where highly skilled manpower resources were scarce. Exceptions include countries such as Saudi Arabia, which has spent heavily on nurturing a highly skilled medical establishment.

4. *Costs of production*

For many detergent products, shortages of raw materials and increasing costs of production characterized the business in 1988. Ethylene, the raw material for the detergent alcohols made from ethylene oxide, almost doubled in price from the beginning of 1987 to the end of 1988 in the North. Since the market is global, the same kind of price increases apply also to the South, except where Governments set local prices.

During 1988, the price of ethylene oxide rose by some 40 per cent (to approximately 1,600 deutsche mark per tonne in April) and the price of detergent alcohols based on these feedstocks increased. The situation represented a major change for companies, as traditionally the price of these detergent raw materials has been very low. Many companies in the North tend to be backward-integrated through several products in the detergents intermediates chain. Those which are not—notably the small independent ethoxylates producers—suffered sharp rises in costs. Generally, they switched to using linear alkyl sulphonate in their detergent formulations. This is a fairly major step, however.

The increased demand for linear alkyl sulphonate has put some pressure on benzene raw material, and in early 1989 there were some signs of price increases in the United States. As mentioned above, however, the South is in danger of moving into overcapacity, which will hold prices down. This is already happening in India.

The increase in synthetic detergent alcohol costs has encouraged the shift to naturally derived alcohols. During the late 1970s and mid-1980s, coconut oil prices were generally well above those for ethylene. But a steep fall in 1985/86 brought the cost of coconut oil below that of ethylene, and during 1987 and 1988 it has been seen as a viable alternative.

In Malaysia, crude palm oil could be produced for $160 per tonne in 1988. The selling price fluctuates with the price of competing oils such as tallow and soyabean oil. In 1985, palm oil was selling for $1,200 per tonne. In early 1989 it was around $440 per tonne, compared with ethylene at $700 per tonne.

5. *Environmental issues*

Issues about biodegradability of detergents have become important world-wide, although it is not clear to what extent such concerns are given priority in the South. One school of thought suggests that pollution concerns are much less in many developing countries than in the North. On the other hand, the rising standards of living that are making soaps and detergents less of a luxury item and more a necessity in the South should also promote pollution concerns.

There has been a resurgence of interest in the North concerning the phosphate content of detergents and the effect of waste water in lakes and rivers. Phosphates cause oxygen starvation of waterways by allowing the build-up of abnormally high algae levels. In Western Europe, where phosphate concentrations in detergents has traditionally varied considerably from country to country, greater uniformity is emerging as more and more Governments pass legislation on the issue.

In Switzerland, phosphates in detergents are banned completely, while in Italy the level has been reduced to a maximum one per cent since the beginning of 1989. In the Federal Republic of Germany, following legislative steps, only one third of heavy-duty powder detergents contain phosphates, while in the Netherlands voluntary efforts have increased the share of non-phosphate powders to one third.

By the beginning of 1989, France, Spain and the United Kingdom had not yet introduced any legislation on phosphates. As pressure has been mounting in France and in the United Kingdom, one supermarket chain voluntarily introduced its own brand of phosphate-free detergent. In the United Kingdom, the Soap and Detergent Industry Association has claimed that phosphate eutrophication is not a problem in most parts of the country because of its short and fast-flowing rivers. If there is a problem, the association claims, the solution should be similar to that adopted by Sweden, which is to install facilities at sewage works to strip out the phosphates before water is discharged. The association claims that only 30 per cent of phosphates in water come from detergents.

In the United States the so-called Chesapeake Bay Agreement is seeking a 40 per cent reduction in nitrates and phosphates entering the polluted Bay, on the north-east coast, by the year 2000. The states of Virginia and Maryland banned phosphates in detergents as part of the agreement, signed in 1987, and there were strong calls in 1989 for Pennsylvania to do the same. It was argued, however, that a ban on phosphate detergents by the state would only reduce phosphates entering the bay by 5 per cent.

In the past, it was believed that linear alkyl sulphonate, the major detergent component, was unfriendly to the environment. The soap and detergent industry in the North has gone to great lengths to prove that this is not the case, however. A study released in the United States in 1988 determined that linear alkyl sulphonate was environmentally safe on the following grounds: its rapid and thorough biodegradability; any concentrations found in the environment were lower than toxic levels; it is non-toxic to humans in formulations found in consumer goods; and there is no accumulation in the food chain.

In Europe, a similar study entitled "Review of the environmental safety of linear alkyl sulphonate" was released in August 1988. Commissioned by the European Centre for Studies on Linear Alkylbenzene and Derivatives and the Soap and Detergent Industry Association of the United Kingdom, the report was compiled by Painter and Zabel of the United Kingdom Water Research Centre. It concludes that at the current level of use, linear alkyl sulphonate is unlikely to pose a hazard to the environment.

The annual production of linear alkyl sulphonate in Japan, the United States, and Western Europe is approximately 1.4 million tonnes, according to the study. On the basis of concentrations in sewage and water, the per capita use of linear alkyl sulphonate in Western Europe is approximately 2.5 grammes per day, which is about 35 per cent lower than estimates based on total production data. The difference is partly explained by the loss of linear alkyl sulphonate due to biodegradation in the sewage system. Because linear alkyl sulphonate occurs as a component of waste water, it is generally removed by sewage treatment before water is discharged into the aquatic environment. In some countries, however, waste water is discharged directly without sewage treatment.

Concentrations of linear alkyl sulphonate in raw sewage are generally in the range of from 2 to 5 milligrams per litre, but can exceed 10 milligrams per litre in some countries. The United Kingdom report acknowledges that where untreated effluent is discharged, environmental concentrations could reach levels sufficiently high to cause detrimental environmental effects. In this situation, however, it is noted that linear alkyl sulphonate is degraded faster than other likely chemical components, for example, ammonia, which can be toxic to aquatic life.

In rivers, concentrations of linear alkyl sulphonate are usually less than 0.05 milligrams per litre, although in some countries, levels as high as 1 to 2 milligrams per litre have been reported where untreated waste water is discharged. In the only study of a developing country, quoted in the Painter report, the concentration of linear alkyl sulphonate registered 2.2 milligrams per litre in the Han river at Seoul. Italy registered a concentration of 2 milligrams per litre for polluted sites, but in all other studies quoted levels for polluted sites were below 0.5 milligrams per litre, and for unpolluted sites below 0.05 milligrams per litre.

Appendix

Supplementary statistical data

Table IV.94. Soaps and detergents production and consumption by country, Western Europe

Country	Production			Apparent consumption			Consumption per inhabitant		
	1986 (kilograms)	1987	Percentage change 1986–1987	1986 (kilograms)	1987	Percentage change 1986–1987	1965 (kilograms)	1987	Percentage change 1986–1987
Austria	122 422	127 635	4.26	134 636	133 594	0.,7	18.5	18.4	0.77
Belgium and Luxembourg	340 166	378 288	11.21	295 442	298 613	1.07	28.9	29.2	1.07
Denmark	216 107	209 080	3.25	156 212	162 906	4.29	30.4	31.7	4.28
Finland	68 508	70 904	3.50	68 538	71 372	4.14	13.9	14.4	3.86
France	1 260 395	1 258 778	0.13	1 315 029	1 399 514	5.43	23.6	25.1	5.97
Germany, Federal Republic of	1 690 469	1 730 462	12.37	1 560 086	1 515 802	2.84	25.5	24.7	3.03
Greece	178 210	190 000	6.62	181 130	199 675	10.24	18.2	20.0	10.13
Italy[a]	(1 244 000)	(1 280 300)	2.92	1 244 000	1 280 000	2.92	21.7	22.3	2.70
Ireland	-	-	-	44 683	46 379	3.80	12.7	13.2	3.80
Netherlands	312 700	323 899	3.58	306 647	321 969	6.64	21.0	22.2	5.92
Norway[b]	54 144	55 982	3.40	88 192	87 874	0.36	21.1	20.9	0.85
Portugal	197 164	222 324	12.76	191 990	201 708	5.06	18.7	19.6	4.75
Spain	1 105 477	1 164 983	5.38	1 076 113	1 121 894	4.25	27.6	28.6	3.58
Sweden	145 270	148 445	2.19	196 065	194 041	1.03	23.3	23.1	1.21
Switzerland	150 353	161 343	7.31	152 103	162 873	7.08	23.3	24.8	6.37
United Kingdom	1 577 700	1 577 900	1.26	1 445 600	1 473 400	1.92	25.0	25.4	1.57
Total	8 663 085	8 880 323	2.51	8 456 466	8 676 954	2.61	23.8	24.3	0.03

Source: Association Internationale de la Savonnerie et de la Détergence.

a/ Italy provides figures only for apparent consumption.

b/ Some tonnages are confidential and not included in the total for Norway.

Table IV.95. Soaps and detergents exports and imports by country, Western Europe

Country	Exports			Imports		
	1986 (tonnes)	1987	Percentage change 1986–1987	1986 (tonnes)	1987	Percentage change 1986–1987
Austria	16 093	21 240	31.98	28 307	27 199	3.91
Belgium	159 493	207 490	30.09	114 769	127 815	11.37
Denmark	89 993	86 223	4.19	30 098	40 049	33.06
Finland	13 863	17 475	26.06	13 893	17 943	29.15
France	168 337	153 935	8.56	222 971	294 671	32.16
Germany, Federal Republic of	250 296	360 313	43.96	119 913	145 663	21.47
Spain	50 285	75 863	50.87	20 921	32 774	56.66
Greece	880	2 ?	164.21	3 800	12 000	215.79
Italy	..	..	..	..	..	..
Ireland	..	..	..	44 683	46 379	3.80
Netherlands	58 033	55 710	4.00	51 980	58 810	13.14
Norway	4 702	5 643	20.01	38 750	37 535	3.14
Portugal	7 389	25 870	250.12	2 215	5 254	137.20
Sweden	26 115	36 491	29.73	76 910	82 087	6.73
Switzerland	1 653	2 050	24.02	3 403	3 580	5.20
United Kingdom	149 700	143 500	4.14	17 600	59 000	235.23
Total	996 832	1 194 128	19.79	790 213	990 759	25.38

Source: Association Internationale de la Savonnerie et de la Détergence.

Table IV.96. 1987 index of price evolution of soaps and detergents, Western Europe

Country	Big trademark toilet soaps	Household soaps	Soft soaps	Textile washing products	Dishwashing liquids
Austria	117.5	..	..	114.5	..
Belgium and Luxemburg	147	148	140	139	135
Denmark	158	..	..	276	246
Finland	141	228	183	126	131
France	162.8	177.2	..	159.5	159.5
Germany, Federal Republic of	..	117.3	..	111.9	111.9
Greece	244	212	..	250	260
Italy	188	202	202	202	224
Ireland	135	170	165	155	140
Netherlands	109	1?6	138	120	116
Norway	136	264	148	133	136
Portugal	281	204	682	278	328
Spain	204	250	..	171	190
Sweden[a]	..	..	..	..	..
Switzerland	130	121	97	97	102
United Kingdom	125	166	..	138	119

Source: Association Internationale de la Savonnerie et de la Détergence.
a/ General figure for Sweden: 153.

G. Man-made fibres (ISIC 351)

Non-cellulosic staple and tow
Cellulosic staple and tow
Non-cellulosic continuous fibres
Cellulosic continuous filaments
Fibres intermediates

1. *Outline of the industry*

(a) *Current situation*

The year 1988 proved to be a landmark for the man-made fibres industry in two respects. For the first time, synthetic and cellulosic fibres, which together form the grouping man-made fibres, comprised more than half the world's output of all fibres. The main competing product is cotton and, to a much lesser extent, wool.

The second feature was that more than half the synthetic fibres produced during 1988 originated outside the traditional industrialized regions of North America, Western Europe and Japan. Figure IV.20 shows that other regions supplied 51 per cent of total synthetic fibres. The South and centrally planned economies have, since 1987, supplied more than half the world's output of man-made fibres, and in 1988 their share of this grouping was 52 per cent (figure IV.21).*

The man-made fibres industry has been in far better shape in the second part of the 1980s than during the 1970s and the early part of the decade, thanks to major restructuring efforts by producers in developed countries. Business is still fragile, however, especially in comparison with many other branches of the chemical industry. Prices for fibres intermediates have risen faster than for the fibres themselves, and in some cases shortages of raw materials have restrained production. Some of the largest fibres-producing countries are, today, located in East Asia, notably Taiwan Province and the Republic of Korea. But these economies still rely on imported intermediates for their fibres industry, and frequently dominate world imports in certain raw materials such as acrylonitrile, caprolactam, terephthalic acid and ethylene glycol.

(b) *Definitions*

Man-made fibres are either synthetic fibres (chemical polymers synthesized from hydrocarbons) or cellulosic fibres, made from natural sources, primarily a substance called dissolving wood pulp. A third category is mineral fibres, made, for example, from glass, but these do not generally fall into the textile category and are excluded from statistics.

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*.

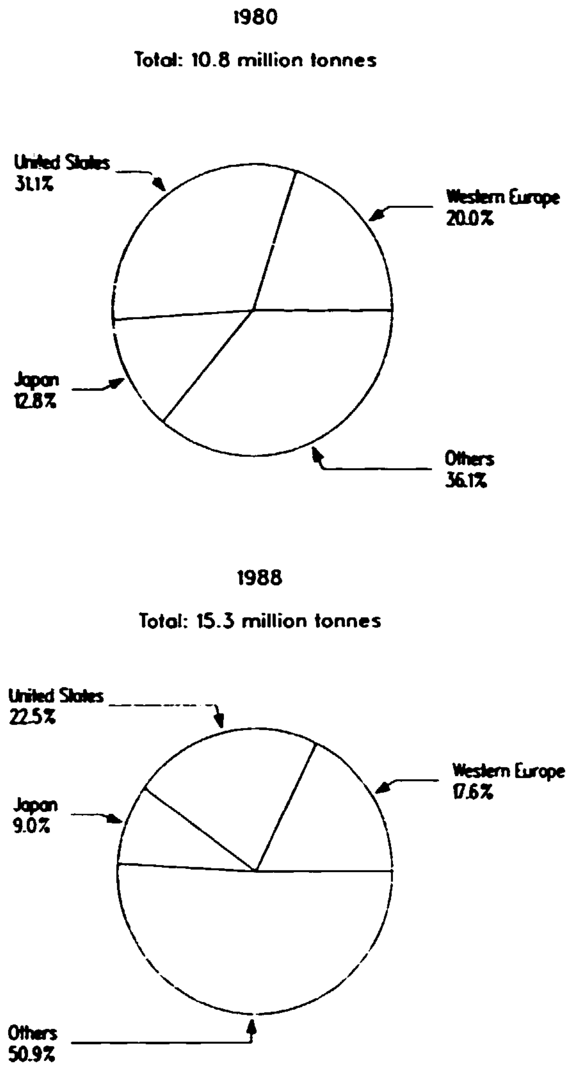
(c) *History*

The man-made fibres industry emerged in 1905 after Courtaulds of the United Kingdom started producing viscose rayon in a plant at Coventry. This is said to have

*As reported by the Akzo corporation in a document entitled "Man-made fibres in 1988".

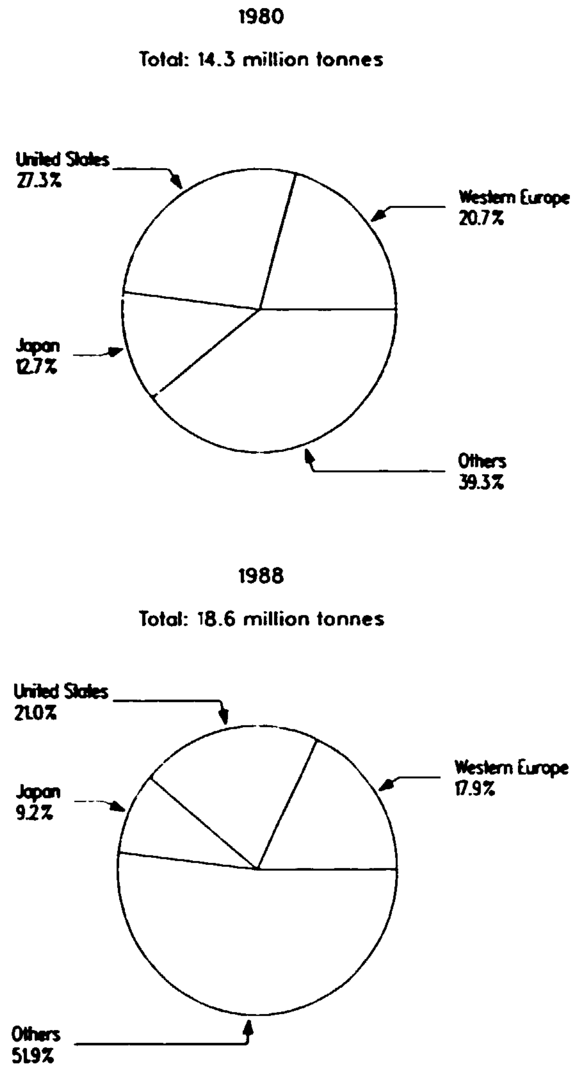
*The subject is discussed in the *Man-made fibre and textile directory*, Hoechst Celanese.

Figure IV.20. World production of synthetic fibres by region, 1980 and 1988



Source: Akzo.

Figure IV.21. World production of man-made fibres by region, 1980 and 1988.



Source: Akzo.

been the first commercially successful production unit, although in the Federal Republic of Germany, Hoechst had established a rayon plant at Bobingen in 1899.

Production of synthetic fibres did not begin until 1938. The polyamide, nylon 66 (polyhexamethylenediamine adipamide) was first produced by Du Pont in the United States. The following year IG Farbenindustrie produced a second nylon, called nylon 6 (polycaprolactam). The outbreak of war led to the separate development of these two materials.

Polyester, today the most common synthetic fibre, was first produced in 1953 by ICI in the United Kingdom and Du Pont in the United States. It is produced by reacting ethylene glycol and terephthalic acid or its derivatives. Acrylic fibre was introduced in 1948 by Bayer in the Federal Republic of Germany and by Du Pont in the United States. The product is at least 85 per cent acrylonitrile by weight.

Table IV.97 shows the rapid build-up of synthetic fibres production (consumption figures are not readily available but are taken within the industry as broadly similar to production as stock movements are not significant). Production grew by 1,008 per cent during the period 1950-1988. Growth from 1950 to 1970 was 399 per cent, but during the next decade this slowed to 70 per cent and during the 1980s growth has been 30 per cent. One significant factor was the 1973 oil price rise which increased raw material costs, allowing natural fibres to become more competitive.

These two periods, pre- and post-oil shock, can be considered as separate stages of development for the fibres industry of the North. The first is characterized by uninterrupted growth and good profits with producers benefiting from economies of scale and little competition. The second period saw competition from the South, increased oil-related costs and severe overcapacity. The third stage, in which the industry is now, is

Table IV.97. World man-made fibres production, 1930-1988
(Thousands of tonnes)

Year	Cellulosics			Synthetics			Total man-made fibres
	Filament yarn	Staple fibre	Total	Filament yarn	Staple fibre	Total	
1930	205	3	208	-	-	-	208
1935	425	65	409	-	-	-	490
1940	542	585	1 127	1	4	5	1 132
1945	401	200	601	14	3	17	618
1950	872	739	1 611	54	16	70	1 681
1955	1 043	1 252	2 295	184	82	266	2 561
1960	1 131	1 533	2 664	417	286	703	3 367
1961	1 135	1 612	2 747	497	333	830	3 577
1962	1 202	1 729	2 931	638	441	1 079	4 010
1963	1 231	1 901	3 132	779	554	1 333	4 465
1964	1 328	2 051	3 379	977	711	1 688	5 067
1965	1 372	2 074	3 446	1 124	916	2 040	5 486
1966	1 378	2 083	3 461	1 300	1 133	2 433	5 894
1967	1 349	2 089	3 438	1 461	1 353	2 814	6 252
1968	1 419	2 239	3 658	1 847	1 802	3 649	7 307
1969	1 421	2 267	3 688	2 147	2 140	4 287	7 975
1970	1 391	2 194	3 585	2 398	2 411	4 809	8 394
1971	1 398	2 219	3 617	2 881	2 827	5 708	9 325
1972	1 377	2 393	3 770	3 235	3 276	6 511	10 281
1973	1 370	2 496	3 866	3 868	3 862	7 730	11 596
1974	1 302	2 443	3 745	3 826	3 754	7 580	11 325
1975	1 148	2 068	3 216	3 790	3 671	7 461	10 677
1976	1 151	2 289	3 440	4 165	4 555	8 720	12 160
1977	1 157	2 388	3 545	4 381	4 923	9 304	12 849
1978	1 148	2 447	3 595	4 699	5 516	10 215	13 810
1979	1 165	2 520	3 667	5 013	5 855	10 868	14 535
1980	1 130	2 392	3 522	4 854	5 925	10 779	14 301
1981	1 053	2 411	3 464	4 986	6 181	11 167	14 631
1982	967	2 227	3 194	4 512	5 791	10 403	13 597
1983	983	2 327	3 310	5 065	6 475	11 540	14 850
1984	959	2 428	3 387	5 444	6 950	12 394	15 781
1985	933	2 301	3 234	5 825	7 268	13 093	16 327
1986	934	2 289	3 223	6 047	7 724	13 771	16 994
1987	917	2 357	3 274	6 447	8 237	14 684	17 958
1988	944	2 398	3 342	6 827	8 468	15 295	18 637

Source: Akzo.

one of slight recovery and specialization of production.

In the South, production of man-made fibres grew strongly throughout the 1970s and 1980s, almost doubling in the boom years between 1970 and 1975 and displaying strong growth again in the mid-1980s. From 1983 to 1987, production growth rates averaged between 7 and 12 per cent. There was a small decline in output from 1981 to 1982, probably attributable to the general recession in that period, which saw a decline in production in all areas.

(d) *Consumption trends*

Per capita consumption of man-made fibres continues to grow and, as might be expected, is much higher in the North, where two thirds of fibres consumed are synthetic. In the South, natural fibres still predominate. Continued population growth and penetration of synthetics in the South imply much scope for further expansion of man-made fibres production.

Total consumption of fibres is projected to reach 44.1 million tonnes by 1995, rising to 49.7 million tonnes by 2000. Of this, synthetic fibres demand is projected to reach 20.5 million tonnes by 1995 [142]. The two main determinants, population changes and growth in world income have suggested an income elasticity of demand of about 0.6 for fibre consumption per head. There is also a clear relationship between the level of economic development and per capita fibre consumption. In 1985, per capita synthetic fibres consumption was 6.7 kilograms in developed countries compared with 0.9 kilograms in developing countries, the latter ranging from 0.2 kilograms per person in India to 1.3 kilograms per person in South-East Asia and 1.8 kilograms in Latin America. Overall, fibre demand is expected to grow at 1 to 2 per cent a year in the North, and 3 to 4 per cent in the South.

A notable feature in the development of fibres consumption is the increasing importance of synthetics over cellulosics, production of which has fallen. The trend towards synthetics has continued despite the increase in raw material prices caused by the 1973 oil price shock. Another trend has favoured the production of staple fibre in preference to filament, especially in the 1970s.

Nearly all growth in fibre consumption since 1973 has been due to the increase in staple fibres, either cotton or wool or synthetic staple, which more closely approximates man-made fibres. Synthetics have won greater popularity than cellulosics because they allow a more sophisticated mix of properties than can be achieved with wood-based cellulosics.

In some regions, notably the centrally planned economies, cellulosics are still important. However, a decline in popularity has caused technological development to fall behind. One company in a developed market economy that is still pursuing development in cellulosics is Courtaulds of the United Kingdom. This firm has a new type of fibre which, it claims, overcomes some of the disadvantages of standard cellulosics and other firms are developing similar products.

(e) *Fibre production in 1988: trends and underlying causes*

Production of man-made fibres in 1988 rose by 4 per cent to 18.6 million tonnes, a record level for the sixth year running. Total output in developed market economies rose only slightly, by 2 per cent in Western Europe to 3.3 million tonnes and by 1 per cent in the United States (table IV.98). Meanwhile, output in Japan was stagnant, although synthetics increased slightly, by 1 per cent (table IV.99). Synthetics growth in Europe was only 1 per cent, and in the United States 2 per cent.

Continuing the established trend, output growth was much stronger in the South and other regions, up

Table IV.98. Geographical breakdown of world production of man-made fibres, 1970-1988 (Thousands of tonnes)

Year	Western Europe	United States	Japan	Other regions	World total
1970	2 634	2 260	1 511	1 989	8 394
1975	2 622	2 983	1 435	3 637	10 677
1980	2 967	3 898	1 811	5 625	14 301
1981	3 115	3 909	1 779	5 828	14 631
1982	2 901	3 167	1 735	5 794	13 597
1983	3 058	3 654	1 765	6 373	14 850
1984	3 219	3 571	1 810	7 181	15 781
1985	3 294	3 524	1 812	7 697	16 327
1986	3 236	3 639	1 739	8 380	16 994
1987	3 276	3 861	1 707	9 114	17 958
1988	3 332	3 918	1 712	9 675	18 637
Percentage change 1987-1987:	+ 2	+ 1	+ 0	+ 6	+4

Source: Akzo.

Table IV.99. Geographical breakdown of world production of synthetics, 1970-1988 (Thousands of tonnes)

Year	Western Europe	United States	Japan	Other regions	World total
1970	1 503	1 553	1 019	734	4 809
1975	1 855	2 513	1 044	2 049	7 461
1980	2 160	3 348	1 378	3 893	10 779
1981	2 160	3 348	1 378	3 893	11 167
1982	2 189	2 713	1 320	4 181	10 403
1983	2 360	3 181	1 340	4 659	11 540
1984	2 521	3 135	1 391	5 347	12 394
1985	2 661	3 094	1 424	5 914	13 093
1986	2 638	3 181	1 382	6 570	13 771
1987	2 671	3 383	1 367	7 263	14 684
1988	2 696	3 435	1 379	7 785	15 295
Percentage change 1987-1988:	+ 1	+ 2	+ 1	+ 7	+4

Source: Akzo.

by 6 per cent for man-made fibres and by 7 per cent for synthetics. However, the increase in production volume was more moderate than in previous years.

Rather than indicating a slow-down in consumption, the trend in the South could be partly due to shortages of raw materials. Among developing countries, growth was again concentrated in South-East Asia and China. In those regions shortages of polyester feedstock led to the under-utilization of spinning capacity. In a separate trend, however, export growth of textiles and clothing slowed.

In the United States, domestic demand for man-made fibres was unchanged from the previous year. However, the processing volume of the textile industry indicated a declining trend. Exports were up and production capacity utilization was comparatively high.

Japan had to cope with strong competition from its South-East Asian neighbours. This was intensified by exchange rate changes. Increased consumption caused textile and clothing imports to increase, while man-made fibre and textile exports fell.

In Western Europe total production of the textile industry was below the previous year's level. However, final consumption of textiles and clothing continued to increase although at a slower rate than in 1987. In line with an established trend, the increased consumption served primarily to raise imports, although the deterioration in the balance of trade for textiles was much less pronounced than in previous years. Production volume of the automotive industry, another customer, reached record levels, while demand for high performance passenger car tyres could barely be met. The overall result was slightly higher sales by the European man-made fibres industry, with above-average growth in industrial fibres, although textile fibres were weaker.

Reports from the Italian Fibres Manufacturers Association, Assofibre, say that Italian synthetics demand fell by 20 per cent in 1988. The trend is attributed to changes in fashion and consumer taste and the strength of imports, particularly clothing. One of the main producers, Snia, suffered from a fall in demand for acrylic fibres in China. The company usually enjoys large overseas sales but is currently laying off workers on a temporary basis at its Porto Marghera plant in northern Italy. During 1988, after agreement with the workers' union, some 7,200 jobs were scheduled to be lost from a total work-force of 17,200. Government-subsidized lay-offs were to account for a further 2,000. The scheme is aimed at reducing climbing labour costs which were expected to reach 25 per cent in 1988 against an industry average of from 20 to 22 per cent. Fibres demand was expected to decline further in the first few months of 1989. As a result, the two main companies, Enimont and Snia, were expected to link in a deal to cut overcapacity.

In the United Kingdom, total production of fibres fell by 2 per cent in the first half of 1988, mainly because of a reduction in synthetic staple production. Cellulosics output continued to increase and total filament yarn production was up. Demand in the United Kingdom fell by 8 per cent but exports more than made up for this, accounting for 50 per cent of total deliveries.

(f) *Production pattern in 1988 by fibre type*

Contrary to previous years, production of synthetic filament showed a higher growth rate than staple. Synthetic filament output reached 6.8 million tonnes, up by 6 per cent, while production of synthetic staple fibres reached 8.4 million tonnes, up by 3 per cent (table IV.100). The production ratio shifted one point

Table IV.100. World production of man-made fibres
(Thousands of tonnes)

Year	Cellulosics: Filament yarn	Cellulosics: Staple fibre	Synthetics: Filament yarn	Synthetics: Staple fibre	Total man-made fibres
1970	1 391	2 194	2 398	2 411	8 394
1975	1 148	2 068	3 790	3 671	10 677
1980	1 130	2 392	4 854	5 925	14 301
1981	1 053	2 411	4 986	6 181	14 631
1982	967	2 227	4 612	5 791	13 597
1983	983	2 327	5 065	6 475	14 850
1984	959	2 428	5 444	6 950	15 781
1985	933	2 301	5 824	7 268	16 237
1986	934	2 289	6 047	7 724	16 994
1987	917	2 357	6 447	8 237	17 958
1988 a/	944	2 398	6 827	8 468	18 637
Percentage change: 1987-1988	+ 3	+ 2	+ 6	+ 3	+ 4

Source: Akzo.
a/ 1988 figures are provisional.

Table IV.101. Shares in world production of synthetic fibres, 1970-1988
(Percentage)

Fibre type	1970	1975	1980	1985	1987	1988
Filament	50	51	45	44	44	45
Staple	50	49	55	56	56	55

Source: Akzo.

in favour of filament, to 45/55 for filament/staple (table IV.101).

Again in 1988, synthetic fibres showed a stronger growth than cellulosics, rising by 4 per cent against growth for cellulosics of 2 per cent. The production ratio for the two classes of fibre was maintained at 82/18 in favour of synthetics (table IV.102). For cellulosics, Western Europe showed the largest increase in output, up by 5 per cent. Demand for both filament and staple fibre in the region seems to have benefited from trends in fashion and was so high that it could not be fully met.

Previous trends in the production structure according to fibre type also continued. The share of polyester and others increased at the expense of polyamide and acrylics (table IV.103). In 1988, polyester accounted for 53 per cent of total output, polyamide 24 per cent, acrylic 17 per cent and others, such as polypropylene, PVC and elastane, 6 per cent.

Polyamide. The production of polyamide, at 3.7 million tonnes (table IV.104 and figure IV.22), was 2 per cent higher than in the previous year. Polyamide filament rose by 3 per cent, while staple production actually fell slightly, by 1 per cent. This was mainly attributable to a fall of 5 per cent in the United States, the largest single manufacturer, with some 60 per cent of world output. For polyamide in total, the United States accounts for 33 per cent of world production.

Polyester. Despite some slow-down in the growth of polyester compared with previous years, this fibre recorded an increase in output of 7 per cent, which was above the average for total man-made fibres production. Output grew in all regions but was most marked outside the group of developed market economies, further emphasizing the growing shift towards production of this fibre in the South. In Western Europe, output of polyester grew by 4 per cent, which was a marked improvement on the previous year when a fall of 2 per cent was recorded. In the United States output grew by 3 per cent and in Japan by 2 per cent. World-wide, the production of filament, which grew at 9 per cent, rose more sharply than that of staple, which grew 5 per cent. Polyester is the fibre favoured by developing countries, and some 61 per cent of total output is now in regions outside Western Europe, the United States or Japan.

Acrylic. For the first time since 1982 world production of acrylics fell. A significant factor was the 7 per cent decrease in output in Western Europe caused by weak demand in the weft knitting branch. Acrylic is often regarded as a Western European fibre linked to the strong knitwear industry but current fashion trends favour polyester and cotton rather than acrylic knitwear. The European industry has been hit by reduced demand from China for acrylic fibres. Not only did China curb its purchasing during 1988, but exports from the United States, helped by a weaker dollar, took a greater share of the Chinese market, and Japan, suffering itself from reduced acrylics demand, fought harder for exports. Demand problems have affected the Italian acrylics industry, causing labour lay-offs, while in the Federal Republic of

Table IV.102. World production of man-made fibres, 1970-1988

Type	1970		1975		1980		1985		1987		1988	
	Thousands of tonnes	Percentage	Thousands of tonnes	Percentage	Thousands of tonnes	Percentage	Thousands of tonnes	Percentage	Thousands of tonnes	Percentage	Thousands of tonnes	Percentage
Cellulosic fibres	3 585	43	3 216	30	3 522	25	3 234	23	3 274	18	3 342	18
Synthetic fibres	4 809	57	7 461	70	10 [illegible]	75	13 093	80	14 684	82	15 295	82
Total man-made fibres	8 394	100	10 677	100	14 301	100	16 327	100	17 958	100	18 637	100

Source: Akzo.

Table IV.103. World production of synthetic fibres, 1970–1988
(Percentage)

Fibre type	1970	1975	1980	1985	1987	1988
Polyamide	40	33	30	26	25	24
Polyester	34	45	47	50	52	53
Acrylics	21	19	19	18	17	17
Other synthetic fibres a/	5	3	4	6	6	6
Total	100	100	100	100	100	100

Source: Akzo.
a/ For example, polypropylene, polyvinyl chloride and elastane.

Table IV.104. Geographical breakdown of synthetic fibres production, 1970–1988
(Percentage)

Item	Production					
	1970	1975	1980	1985	1987	1988
Polyamide						
Western Europe	32	24	20	19	17	18
United States	32	34	33	31	34	33
Japan	16	11	10	9	7	7
Others	20	31	37	41	42	42
World a/	1 895	2 512	3 185	3 421	3 641	3 704
Polyester						
Western Europe	28	19	14	13	11	11
United States	40	41	36	23	21	20
Japan	19	13	12	10	8	8
Others	13	27	38	54	60	61
World a/	1 635	3 359	5 085	6 560	7 613	8 122
Acrylics						
Western Europe	40	38	34	35	32	30
United States	22	17	17	12	11	11
Japan	26	17	17	16	16	16
Others	12	28	32	37	41	43
World a/	1 006	1 385	2 060	2 389	2 535	2 514

Source: Akzo.
a/ Thousands of tonnes.

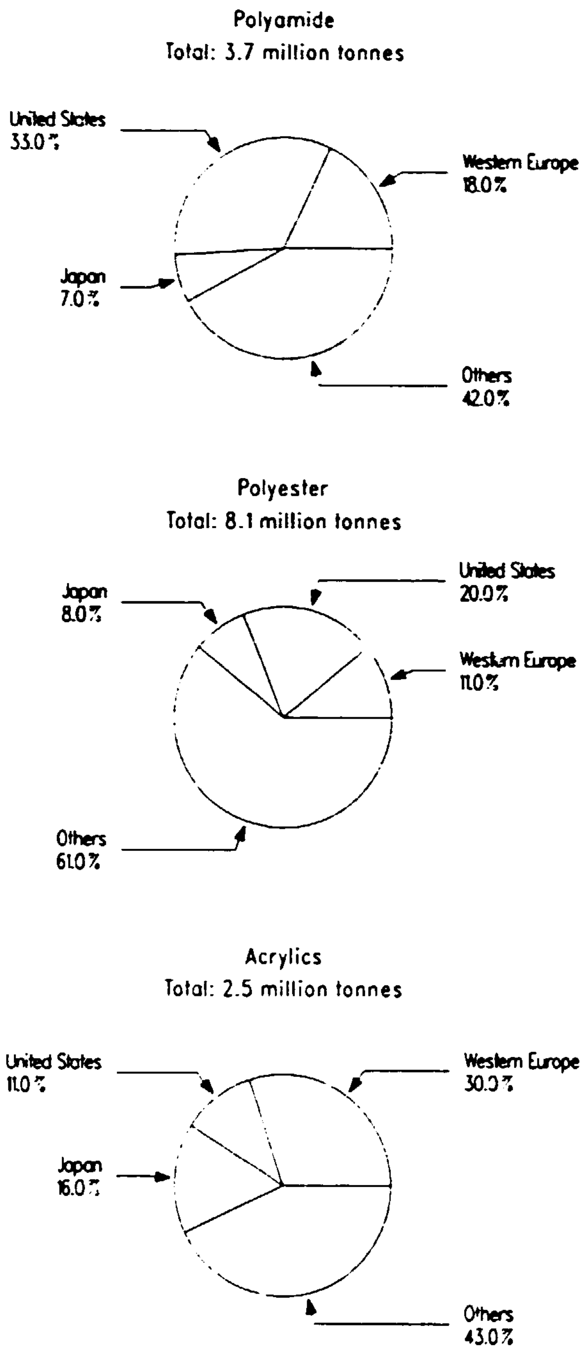
Germany, poor returns from this fibre have been reflected in the lower profits of the Bayer AG fibres branch.

Overcapacity in acrylics remains a problem in all developed regions, with the surplus in Europe put at between 80,000 and 120,000 tonnes per year in early 1989. This was due to be cut by some 35,000 tonnes, however, with the closure of two subsidized plants in Greece and Ireland. United Kingdom consultants, Tecnon, believe the European acrylic fibres business in 1988 reached the bottom of its business cycle. Although fashion still favours polyester, the price-competitive position over acrylonitrile is being eroded owing to the rising cost of certain polyester feedstocks.

(g) *Geographical spread of production*

On a country-by-country basis, the United States is easily the single biggest producer of synthetic fibres. Figures in tables IV.105 and IV.106 differ slightly from the ones already given as they are from a different source and they present a lower output figure for the United States. The ranking of producers is clear between the top two, but is close just below that, with Taiwan Province slightly overtaking Japan and the Republic of Korea sitting just above China and the USSR. These six countries and areas dominate production of synthetic fibres, although the Federal Republic of Germany and Italy figure significantly,

Figure IV.22. Breakdown of synthetic fibres production by region, 1988



Source: Akzo

with 5 per cent and 4 per cent respectively, while Mexico has held its position of around 2.5 per cent. The only other Latin American country to figure in the list is Brazil, which is a relatively large producer, standing 12th in the world with a capacity of 248,000 tonnes.

It is interesting to note, from table IV.105, how the capacity build-ups in certain countries will change the ranking slightly among the top producers. Notably, China will overtake the Republic of Korea and move into fourth position, after capacity increases amounting to 18 per cent have been implemented. India, which is scheduled to increase its capacity by a huge 52 per cent between 1987 and 1990, will become the ninth largest producer of synthetic fibres. Indonesia is another country that will boost output significantly—by 27 per cent, making it the 11th largest producer. Other countries making notable capacity additions in synthetic fibres include Pakistan, which will raise output by 45 per cent, Egypt, with a 54 per cent increase in capacity to 110,600 tonnes, and Thailand, with an 18.5 per cent boost in capacity to 179,200 tonnes. Taiwan Province will consolidate its position as the world's number-two producer with a 24 per cent capacity increase by 1990, adding 360,000 tonnes.

The gradual erosion of the share of production held by the North can be seen in table IV.105. By 1990, the South (excluding centrally planned economies) should be producing 32.4 per cent of world synthetic fibres, gained at the expense of the North, the share of which will have declined to 48.6 per cent. Asia (excluding Japan) will provide 32 per cent of world synthetics output.

(h) *Trade patterns*

Comprehensive trade figures were only available for Western Europe, where statistics are collected by the International Rayon and Synthetic Fibres Committee and frequently used to justify applications for import duties on countries considered to be dumping their products.

Table IV.106, giving leading exporters to Europe, shows how inter-European trade is of primary significance, but for synthetic filament fibres, Taiwan Province, Mexico, Turkey and the Republic of Korea are all significant exporters. For staple fibre, Taiwan Province is the sixth largest exporter to Western Europe, and Turkey, Yugoslavia, Mexico and Japan all sold quantities in excess of 20,000 tonnes in 1987. Because Western Europe was slower than the United States and Japan to balance its supply and demand situation for synthetic fibres it has suffered more from imports. But the region has not been slow in using protective trade weapons such as anti-dumping duties to guard against what it sees as unfair product flows. In 1988 heavy duties were placed on cheap imports of polyester from Mexico, Republic of Korea, Romania, Taiwan Province, Turkey, Yugoslavia and certain United States trading houses.

Exports from the region have remained steady. Imports were high in the first six months of 1987 but fell appreciably in the second half, probably as a result of polyester duties applied at mid-year. It was alleged that imports of polyester staple from the countries cited rose from 34,800 tonnes in 1984 to 71,200 tonnes in 1987, increasing their market share in Europe from 9.6 per cent to almost 18 per cent. Imports of polyester filament textured yarn also rose from 1,300 tonnes in 1984 to 24,000 tonnes in 1987. This increased the market share of importers from 1.6 per cent to 13.4 per cent over the period. The duties payable range up to 43 per cent. It was expected that imported tonnages of polyester would rapidly decline in Europe. Some sources were expected to dry up altogether; notably, Mexico, Romania and Yugoslavia, where the duties had their severest impact. The effect

Table IV.105. World's top 20 producers of synthetic fibres

Country, area or region	Production 1988 (thousands of tonnes)	Production 1986 (thousands of tonnes)	Production 1980 (thousands of tonnes)	Percentage change 1980-1987	Percentage change 1986-1987	Percentage world share 1987	Output 1990 (thousands of tonnes)	Percentage world share 1990
1. United States	3 094	2 919	3 242	-4.5	6	22.4	3 530	19.5
2. Taiwan Province	1 391	1 232	558	149	13	10.1	1 891	10.5
3. Japan	1 341	1 355	1 357	-1.2	-1	9.7	1 771	9.8
4. Republic of Korea	964	862	536	80.8	12.5	7	1 097	6
5. China	910	801	248	267	13.6	6.6	1 257	6.9
6. USSR	836	576	550	52	45	6	992	5.5
7. Federal Republic of Germany	764	742	720	6.1	2.9	5.5	851	4.7
8. Italy	564	572	355	58.4	-1.4	4	619	3.4
9. Mexico	376	296	239	40.6	13.4	2.4	494	2.7
10. Spain	263	271	202	30.2	-2.9	1.9	347	1.9
11. Turkey	260	229	98	16.5	13.5	1.8	366	2
12. Brazil	248	240	231	7.4	3.5	1.8	312	1.7
13. India	231	223	71	255	3.4	1.7	607	3.4
14. United Kingdom	203	208	288	-29.5	-2.5	1.5	266	1.5
15. Romania	201	200	136	47.8	0.75	1.5	247	1.4
16. Indonesia	172	163	95	81	5.6	1.2	377	2
17. German Democratic Republic	161	159	139	15.8	1.1	1.2	212	1.2
18. France	159	167	192	-17	-4.9	1.15	219	1.2
19. Poland	115	148	163	-7.4	2.2	1	192	1
20. Czechoslovakia	132	129	76	73.7	2.6	0.95	182	1
North America	3 224	3 058.4	3 364	-4.2	5.4	23	3 727.3	20.6
Western Europe	2 578	2 553.6	2 164	19.1	0.9	18.7	3 153.2	7.5
South America	783.1	725.1	613	27.7	7.9	5.7	1 124.5	6.2
Asia a/	4 351.8	4 055.3	2 808	54.9	7.3	31.6	6 149.6	34
Eastern Europe and the USSR	1 696.4	1 592.4	1 202	41.1	6.5	12.3	2 230.7	12.3
Total North a/	7 247.7	004.4	6 951	4.2	3.5	52.6	8 792	48.7
Total South a/	3 909.1	3 529.7	2 131	83.2	10.6	28.3	5 771.1	31.9
Total	13 758.7	12 994.2	10 466	31.3	5.9	100	18 050.8	100

Source: Textile Organon, June 1988; and Chemiefasern - Textilindustrie, Man-made Fibre Yearbook 1988 (Frankfurt am Main, 1988).

a/ Excluding centrally planned economies.

Table IV.106. Leading exporters to Europe of synthetic fibres, 1987
(Millions of tonnes)

Filament yarn: Rank	Country or area	Tonnage	Staple Yarn: Rank	Country or area	Tonnage
1.	Germany, Fed. Rep. of	213 552	1.	Germany, Fed. Rep. of	240 717
2.	Italy	95 013	2.	Italy	144 161
3.	Netherlands	64 119	3.	Ireland	59 958
4.	Switzerland	60 926	4.	France	41 907
5.	United Kingdom	53 870	5.	United Kingdom	40 598
6.	United States	40 278	6.	Taiwan Province	39 848
7.	Belgium	38 319	7.	Turkey	35 143
8.	France	37 989	8.	Netherlands	31 572
9.	Taiwan Province	37 398	9.	Switzerland	30 594
10.	Mexico	20 409	10.	Yugoslavia	23 863
11.	Ireland	16 920	11.	Mexico	22 604
12.	Canada	14 697	12.	Japan	21 147
13.	Turkey	14 547	12.	United States	20 797
14.	Denmark	10 368	14.	Spain	20 572
15.	Republic of Korea	10 351	15.	Denmark	20 428
16.	Spain	8 928	16.	Austria	20 158
17.	Japan	8 405	17.	Belgium	18 764
18.	Czechoslovakia	5 649	18.	Romania	14 703
19.	Israel	5 327	19.	Canada	13 734
20.	Yugoslavia	4 617	20.	Republic of Korea	10 988

Source: Textile Organon; and Chemiefasern - Textilindustrie.

on prices was not expected to filter through until the fourth quarter. In another defensive attempt, at the beginning of 1988 the European Commission reopened an anti-dumping enquiry into imports of certain acrylic fibres from Mexico. This followed an earlier case when duties were imposed against importers in Israel, Mexico, Romania and Turkey. Imports from Mexico continued to rise, however, from 721 tonnes in 1985 to 15,400 tonnes in 1988. Prices of the Mexican material undercut EEC producers by from 13 to 25 per cent. The International Rayon and Synthetic Fibres Committee also claimed that some exporters had continued with sales, despite promises to stop. Original price undertakings had also been undermined by the fall in value of the dollar.

In February 1989, the EEC Commission initiated the first-ever fibres anti-subsidy proceedings by bringing charges against Turkish exporters of polyester fibres and yarns. It was claimed that costs of building new plants had been subsidized by up to 50 per cent, and that subsidies had lowered the cost of Turkish polyester fibres in Europe by from 31 to 51 per cent. Polyester filament that should have sold for 7 deutsche mark per kilogram without subsidies was being sold at 4.50 deutsche mark per kilogram and yarn which should have sold for 4 deutsche mark per kilogram was going for 2.80 deutsche mark per kilogram. Between 1984 and 1987, when European consumption of yarns increased by 9 per cent, imports from Turkey rose by 5,500 per cent to over 13,000 tonnes. Polyester fibres consumption in Europe rose by 14 per cent in the same period, but Turkish exports rose by 38 per cent to over 17,000 tonnes. In the same period Turkish exporters increased their share of European fibres sales by 840 per cent [143].

2. *Fibres capacity*

(a) *Structural overcapacity*

Over-enthusiastic building of fibres plants in the North and a surge in capacity in the South combined to form a structural overcapacity in synthetic fibres in the 1970s. By the mid-1970s it was estimated that a drop in demand combined with capacity build-up had led to 3.6 million tonnes of excess capacity, amounting to 26 per cent of the world total. Rationalization steps were taken combining government and private sector action (see example following of Europe's "crisis cartel") and by 1980 the situation was largely under control. However recession led to further problems and by 1985 surplus capacity again stood at 3.6 million tonnes world-wide, or 19 per cent of total capacity.

Western Europe suffered particularly badly and during 1974-1983 capacity utilisation rates for all synthetic fibres averaged 70 per cent against minimum levels for profitable operation of 80-85 per cent. The consequence was substantial financial losses. In 1977, the major producer, Enka (now Akzo Fibres), estimated losses of 16-47 per cent on selling prices for the three main fibres. For the period 1974-1979, losses for the Western European fibres industry amounted to an estimated $4.5 billion [142].

The Western European industry continued to bring on new capacity in the face of recession and global shifts in production. From 1973 until 1978, in fact, synthetic fibre capacity increased by a third. Growing imports of finished textile products aggravated the situation and a lower dollar intensified competition from the United States. In 1980, cheap imports of fibres from the United States were said to be undercutting local prices by from 20 to 30 per cent.

(b) *Restructuring steps taken by developed countries*

Steps taken to restructure the European synthetic fibres industry to deal with the above problems provide an interesting example of an industry's response to overcapacity. In the United States, market mechanisms, sparked by increasing competition from East Asia and Mexico, plus the general decline in consumption growth, had encouraged the closure within two years of more than 200,000 tonnes of capacity. This represented some 23 per cent of total United States synthetic fibres capacity. In Japan, overcapacities in certain fibres were corrected within 18 months, with some help and encouragement from MITI.

In Europe, social and political attitudes in the form of government protection for national industries and employment were blamed for persistent overcapacity. A so-called "crisis cartel" was formed to tackle the problems of the fibres industry. Eventually a plan for producers to co-operate in capacity reductions was approved by the competition department of the EEC. This later came to represent a model agreement, but was never repeated elsewhere in the chemical industry, despite similar problems. Initially, it was agreed that a general capacity reduction of 15 per cent would be undertaken. United States subsidiaries operating in Europe were not prepared to join because of the antitrust implications of the cartel under United States law. However, many undertook voluntary capacity cuts. The first Davignon agreement, named after the competition commissioner at the time, ran from 1978 until 1982.

A second agreement ran from 1982 to 1985. This allowed for cuts in capacity of a further 500,000 tonnes (table IV.107) representing 18 per cent of capacity, and encouraged companies to concentrate on their areas of specialization, dropping some product types altogether. Some countries saw drastic reductions in their capacities. The United Kingdom lost 51 per cent of total synthetics capacity, amounting to 316,000 tonnes between 1977 and 1986. The Federal Republic of Germany lost 269,000 tonnes, or 26 per cent of capacity. Italy, on the other hand, lost only 11 per cent or 66,000 tonnes, and Spain actually increased capacity by 48 per cent over the period. So far as employment was concerned, the United Kingdom suffered most, with some 76 per cent of workers losing their jobs in the synthetic fibres industry between 1975 and 1985. The cost structure of selected synthetic fibres in the region after implementation of the agreement is reflected in table IV.108.

(c) *Capacity utilization and productivity*

Figure IV.23 and table IV.109 show how world capacity utilization in fibres has picked up since 1983. Average world-wide operating rates from 1983 to 1987 range from 80 to 86 per cent, with performances

Table IV.107. Capacity reductions by Western European fibre producers, 1982-1985

Fibre	Capacity 1982 (Thousands of tonnes)	Capacity 1985 (Thousands of tonnes)	Change 1982-1985 (percentage)
Polyamide filament	393	316	-19.6
Carpet	225	171	-24.0
Staple	201	168	-16.4
Polyester filament	428	337	-21.3
Staple	581	510	-1[illegible].2
Acrylic staple	1 052	858	-18.4
Total	2 880	2 380	-18.1

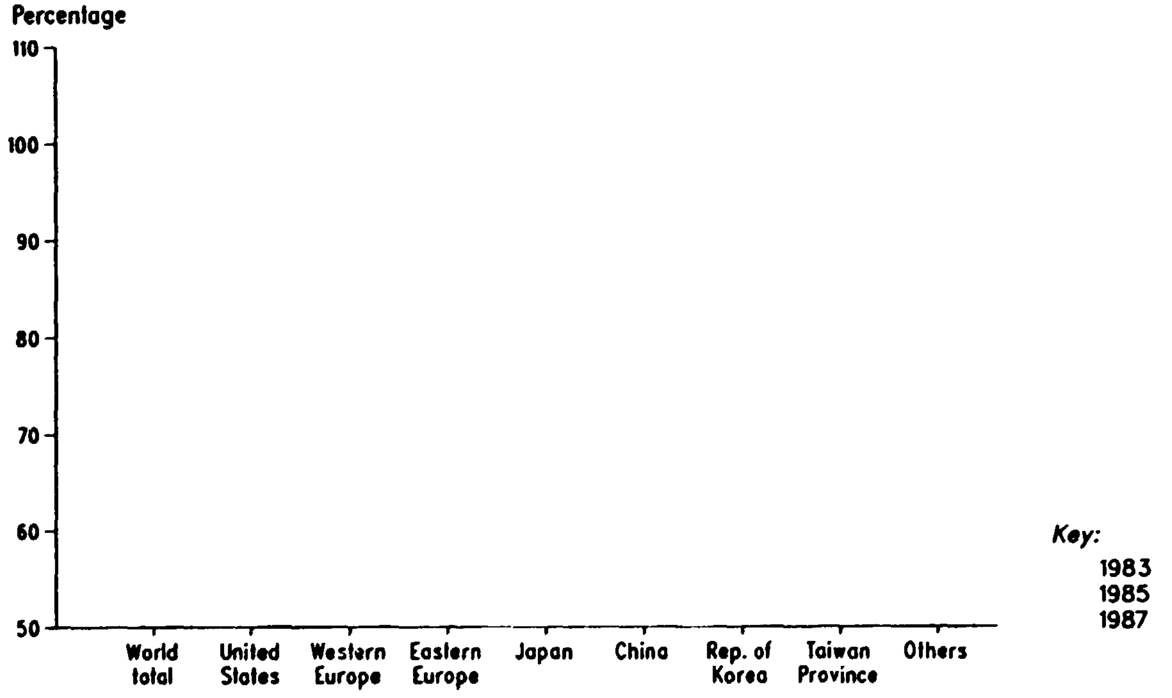
Source: International Rayon and Synthetic Fibres Committee.

generally slightly better than this in the United States but at the lower end of the range in Europe. Capacity utilization in Japan has fluctuated widely, declining from 92.7 per cent in 1984 to 76 per cent in 1987. In the Republic of Korea and Taiwan Province, capacity utilization has not fallen below 90 per cent in the five years shown, but has risen in some years well above 100 per cent.

A consequence of the restructuring has been a remarkable improvement in productivity by the major Western Europe producers, with the United Kingdom seeing an increase in the period just mentioned of 146 per cent. Output levels of 38 tonnes per employee in 1985 made the United Kingdom one of the most efficient producer among Western European countries, although still behind the United States at 62 tonnes.

Compututions for 1987, however, show Italy overtaking the United Kingdom with productivity of 44 tonnes per worker (table IV.110). Far ahead, however, are Taiwan Province, with 79 tonnes produced per worker, and the United States. In the Republic of Korea, productivity in synthetic fibres is not as high as might be expected, showing just 42 tonnes per worker.

Figure IV.23. Man-made fibre capacity-utilization by region or country, 1983, 1985 and 1987.



Source Textile Organon

Table IV.108. Cost structure of selected synthetic fibres, Western Europe, 1986
(Percentage)

Item	Synthetic fibres	
	Acrylic	Polyester
Purchased materials	56.8	47.0
Research and development costs	1.0	1.0
Production and distribution	29.2	33.5
Marketing costs	2.5	1.5
Depreciation	4.5	8.0
Operating profit margin	6.0	9.0
Total	100.0	100.0

Source: Economist Intelligence Unit.

Table IV.109. World-wide man-made fibre production and capacity utilization, 1983-1987

Country, area or region	1983	1984	1985	1986	1987
A. Production					
World total					
Pounds (millions)	30 876	32 746	34 012	34 906	36 578
Share (percentage)	100	100	100	100	100
Capacity utilization	80.4	83.9	82.9	82.7	85.4
United States					
Pounds (millions)	7 273	7 103	6 872	7 054	7 427
Share (percentage)	23	22	20	20	20
Capacity utilization	82.0	80.1	79.0	85.9	88.6
Western Europe					
Pounds (millions)	6 454	6 733	6 903	6 780	6 819
Share (percentage)	21	20	20	19	19
Capacity utilization	78.9	84.5	85.2	82.7	82.2
Eastern Europe					
Pounds (millions)	5 253	5 500	5 669	5 788	6 017
Share (percentage)	17	17	17	17	16
Capacity utilization	81.8	82.3	79.4	78.5	80.3
Japan					
Pounds (millions)	3 761	3 851	3 948	3 694	3 618
Share (percentage)	12	12	12	11	10
Capacity utilization	83.7	92.7	75.9	77.3	76.1
China					
Pounds (millions)	1 129	1 571	2 011	2 185	2 469
Share (percentage)	4	5	6	6	7
Capacity utilization	62.4	71.8	87.0	94.9	85.0
Republic of Korea					
Pounds (millions)	1 492	1 674	1 820	1 931	2 168
Share (percentage)	5	5	5	6	6
Capacity utilization	90.4	97.6	102.6	94.9	90.4
Taiwan Province					
Pounds (millions)	1 851	2 204	2 525	2 981	3 331
Share (percentage)	6	7	7	8	9
Capacity utilization	91.1	97.9	96.3	113.7	90.8
Rest of the world					
Pounds (millions)	3 653	4 110	4 264	4 493	4 729
Share (percentage)	12	12	13	13	13
Capacity utilization	71.9	78.9	73.0	68.0	66.8

Table IV.109 (continued)

Country, area or region	1983	1984	1985	1986	1987
		B. Capacity[a]			
World Total					
Pounds (millions)	38 414	39 017	41 017	42 187	42 812
Share (percentage)	100	100	100	100	100
United States					
Pounds (millions)	8 770	8 857	8 636	8 163	8 205
Share (percentage)	23	23	21	19	19
Western Europe					
Pounds (millions)	8 173	7 964	8 102	8 116	8 189
Share (percentage)	21	20	20	19	19
Eastern Europe					
Pounds (millions)	6 420	6 681	7 132	7 147	7 365
Share (percentage)	17	17	18	17	17
Japan					
Pounds (millions)	4 494	4 156	4 607	4 776	4 778
Share (percentage)	12	11	11	11	11
China					
Pounds (millions)	1 797	2 189	2 310	2 302	2 474
Share (percentage)	5	6	6	6	6
Republic of Korea					
Pounds (millions)	1 651	1 715	1 773	1 981	2 034
Share (percentage)	4	4	4	5	5
Taiwan Province					
Pounds (millions)	2 031	2 250	2 622	3 380	3 177
Share (percentage)	5	6	6	8	8
Others					
Pounds (millions)	5 078	5 205	5 835	6 322	6 590
Share (percentage)	13	13	14	15	15

Source: "Worldwide fibre production and producing capacity survey", Textile Organon, July 1988, and December 1988.
Note: 1 pound = 0.454 kilograms.
a/ - Capacity as of November of each year for the United States and as of March each year for the other countries, areas, and regions.

Table IV.110. Employment and productivity in the man-made fibres industry, 1975-1987[a]

Country, area or country grouping	1975	1980	1986	1987	Percentage change 1975-1987	Productivity per worker (tonnes)
Belgium and Luxembourg	14 845	9 710	8 170	8 280	-44	26
France	20 450	10 920	6 070	5 610	-72	35
Germany, Federal Republic of	43 100	30 300	26 200	26 100	-39	37
India	..	48 410[b]	54 480	..		18
Italy	41 800	29 115	16 440	15 450	-63	44
Japan	91 345	53 104	45 235	41 570	-55	41
Republic of Korea	17 839	19 885	21 055	23 335	30	42
Spain	..	10 640	8 550	8 395	21[c]	36
Taiwan Province	15 256	17 500	16 945	..	11[d]	79
United Kingdom	36 976	17 616	8 530	8 450	-77	38
United States	98 200	81 003	57 280	..	42[d]	62

Sources: International Rayon and Synthetic Fibres Committee; and Economist Intelligence Unit.
a/ Including administrative and technical staff.
b/ 1981 figure.
c/ Percentage change since 1980.
d/ Percentage change 1975-1986.

3. *Man-made fibre industry in selected developing countries and areas*

(a) *China*

The demands of the Chinese textile industry has placed an increasing burden on synthetic fibres production. Textiles consumption per capita increased sharply from 2.5 kilograms in 1975 to 4.6 kilograms in 1986, but is still well below the world average of 6.6 kilograms. To achieve the latter figure China would need an increase of 2 million tonnes of textile products, supported by increases in natural and, to a greater extent, man-made fibres*.

The share of man-made fibres in textile fibres is on the increase, amounting to 9 per cent in 1975 and 24.7 per cent in 1986. It is estimated that by 1990 it will exceed 30 per cent, and that it will reach 40 per cent by the year 2000. The industry is relatively young, stemming from the construction of the first man-made fibre plant in 1957. In 1977 a large polyester fibre plant was built in Shanghai using Japanese technology, and synthetics output accelerated. By 1986, output exceeded 1 million tonnes, with capacity at the end of that year standing at 1.29 million tonnes and a workforce of 240,000. Polyester was by far the dominant fibre, accounting for 57 per cent of total output, followed by viscose, with 18 per cent.

Between 1985 and 1987, China's output of man-made fibres registered a 38.4 per cent increase, and since production first began, the industry has shown an average annual growth rate of more than 20 per cent. The seventh five-year plan (1986-1990), however, calls for a slow-down in annual growth rates to around 9 per cent. Planned output of man-made fibres is 1.45 million tonnes by 1990, which will make China the world's fourth largest producer. During the period 1990-2000, production capacity will continue to grow at a rate of around 7 per cent. Overall, the industry has the advantage that most of its capacity is modern.

China considers that its resources in the chemical industry should allow it to achieve 80 per cent self-sufficiency in raw materials for fibres. The mix of products is to be adjusted to increase the share of acrylics from 7 per cent to approximately 15 per cent. In addition, under the seventh plan quality is to be upgraded as individual enterprises have quality targets to fulfil which are comparable with international standards.

A major target under the seventh plan is to expand new fibre products, including the development of speciality fibres, such as high shrinkage, modified, high-strength, textured yarns. By 1990, the share of these fibres in the total output should have risen from 6 per cent to over 10 per cent. Other targets call for an increase in the share of man-made fibres used in industrial products and home fashions; development of new fibres which are not produced in China, such as polyelasthane and modacrylics; research and development work on high-performance fibres, such as super-high tenacity fibres, high-modulus fibres, conducting fibres, high-temperature-resistant fibres and radiation-resistant fibres. All these provide new materials for modern industries such as the space, electronics and modern chemical engineering industries. New applications will also be promoted.

(b) *Republic of Korea*

In the Republic of Korea synthetic fibres production is dominated by large capital-intensive companies such as Tong Yang Nylon, Hanil Synthetic Fibre (acrylic) and Sun Kyong Fibres (polyester). After accelerating in the 1970s, exports of textiles fell dramatically in the 1980s. This was partly due to the world recession and partly to a tightening of import restrictions on goods of the Republic of Korea. In addition, the industrial competitiveness of the Republic of Korea declined, partly because of rapidly rising wage costs. At $1.77 in early 1987, these compared favourably with Hong Kong and Taiwan Province, but were well in excess of countries such as Turkey ($1.28), Thailand ($0.58) and China ($0.23). On top of this are problems such as labour shortages and currency appreciation. Nevertheless, the Government has been actively promoting the build-up of a synthetic fibres industry.

(c) *Taiwan Province*

In Taiwan Province the synthetic fibres industry achieved a rapid growth between 1976 and 1986, with polyester staple rising 629 per cent during the period and polyester filament achieving growth of 409 per cent. Together the products represent more than three quarters of synthetic fibres output in Taiwan Province. The rapid growth has allowed the area to pass the Republic of Korea as the largest producer in the East Asia and to threaten Japan as the region's largest producer and the world's number two. After having roughly the same synthe[illegible] fibres output in 1982 as the Republic of Korea, Taiwan Province achieved an output in 1986 that was 46 per cent higher than its northern neighbour. Since 1981, feedstock costs in Taiwan Province have been tied to the dollar rather than being kept artificially high, thus benefiting the fibres industry. The demand for synthetic fibres raw materials has risen steadily, and although capacity expansions have been implemented, the area is still heavily dependent on imported materials (table IV.111).

Acrylonitrile capacity grew strongly (119 per cent) over a decade from 57,029 tonnes in 1977 to 125,313 tonnes in 1987. Imports during the same period rose from just five tonnes to 21,174 tonnes in 1986. In 1987, they jumped by 278 per cent to 80,006 tonnes. The area's only production unit, owned by China Petrochemical Development Corporation, has a capacity of 132,000 tonnes and there are no recorded expansion plans. In 1985 and 1986, the unit was running at up to 113 per cent capacity. Unlike the other fibres raw materials, there has always been a small amount of exports of acrylonitrile from Taiwan Province, peaking in 1980 at 26,539 tonnes. These dwindled to just under 3,000 tonnes in 1987.

Pure terephthalic acid production did not begin in Taiwan Province until 1979, when it was 87,580 tonnes. It rose tremendously (470 per cent) to 499,800 tonnes in 1987, representing the largest output of the fibres intermediates. Imports also rose strongly, from

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*See Ji Guobao, "China's man-made fiber industry—trends and outlook", *Chemiefasern-Textilindustrie*.

Table IV.111. Development of supply and demand of fibres raw materials in Taiwan Province
(Tonnes)

Product	Production			Imports			Exports			Consumption a/		
	1977	1980	1987	1977	1980	1987	1977	1980	1987	1977	1980	1987
Caprolactam	16 300	73 327	103 928	71 330	39 919	88 891	-	-	-	87 630	113 246	192 819
Acrylonitrile	57 029	103 970	125 316	5	-	80 006	3 593	26 539	2 944	53 441	77 431	202 378
PTA b/	-	172 745	499 800	158 700	113 434	477 140	-	-	-	158 700	286 179	976 940
Ethylene glycol	42 000	128 680	195 339	51 518	6 111	192 059	-	3 088	487	93 518	131 703	386 911
Total	115 329	478 722	924 383	281 553	159 634	838 096	3 593	11 908	3 431	393 289	608 559	1 759 048

Source: Petrochemical Industry Association of Taiwan, Handbook 1988 (Taipei, 1988).

a/ Production + Imports - Exports.

b/ Pure terephthalic acid.

158,700 tonnes in 1977, when this was the only source of supply, to 477,140 tonnes in 1987. Production capacity for pure terephthalic acid was scheduled to increase significantly in 1989 when China American Petrochemical Company increased its plant capacity from 500,000 tonnes to 750,000 tonnes. Statistics for 1988 were not available, but a new producer, Formosa Chemicals and Fibre Corporation, was scheduled to bring on stream a 200,000 tonne plant. That corporation is a major local producer of nylon and synthetic yarn as well as cellulosic fibres, so the move involves backward integration. Taken together, the two expansions should balance out import requirements. However, further polyester capacity is being installed in no less than five new units (see appendix table IV.116).

Caprolactam production rose from 16,300 tonnes in 1977 to 103,928 tonnes in 1987 (537 per cent). Imports fell steadily from 71,330 tonnes in 1977 to 34,188 tonnes in 1985. They then picked up and reached 88,891 tonnes in 1987, a 45 per cent increase on the previous year. The China Petrochemical Development Corporation was the only producer until 1988, when the Formosa Chemicals and Fibre Corporation was due to start up a 100,000 tonnes plant. This represents a further step in the fibre company's backward integration.

Ethylene glycol production rose by 365 per cent from 42,000 tonnes in 1977 to 195,339 tonnes in 1987. Since 1978, the area has been an importer of ethylene glycol and quantities rose steadily to reach 192,059 tonnes in 1987, a 27 per cent increase on the previous year. Exports exist but are negligible. Oriental Union Chemical Corporation, the main producer with a 150,000 tonne plant, was due to bring on stream a 224,000 tonnes unit in 1988. Another small producer, China Man-made Fiber Corporation, has a small 55,000 tonne plant. Both units will replace imports.

In the past three years operating rates for caprolactam, acrylonitrile and terephthalic acid plants have ranged from 95 to 113 per cent. Only for ethylene glycol, among the fibres intermediates, have they been lower, at 78 to 87 per cent. This is possibly because imported ethylene glycol has been cheaply available, particularly from new plants in Saudi Arabia. The increase in imports recorded would bear this out.

4. *Competitive situation*

(a) *Raw material costs and supply*

An escalation in raw material costs in the past two years has seriously affected synthetic fibres producers world-wide. Acrylonitrile, the raw material for acrylic fibres, rose strongly in price in 1987 and the first half of 1988, although some slackening in demand caused prices to level off in the middle of the year.

World demand for acrylonitrile, put at 3.65 million tonnes in 1988, is expected to grow to 4.1 million tonnes by 1992, according to United Kingdom consultants, Tecnon. There were some shortages in supply during 1987, caused mainly by the lengthy closure of China Petrochemical Development Corporation plant in Taiwan Province after hurricane damage. During 1988 the balance of supply and demand in the United States was fairly tight as a slight downturn in demand from the acrylic fibres market was offset by increased exports to East Asia. The latter region remains a major importer, taking 250,000 tonnes in 1987 and the build-up in acrylic fibres capacity will keep imports high. Plans for new acrylonitrile plants are fairly restricted. In China a small 50,000-tonnes-per-unit plant is being installed, while in the Republic of Korea there are problems over the availability of propylene, the raw material for acrylonitrile. In Taiwan Province, the China Petrochemical Development Corporation has announced a new 100,000-tonnes-per-year project as part of its Kaohsiung petrochemical complex, but this is being held up by environmental objections.

There are three expansions planned for the United States, totalling 230,000 tonnes per year, and a possible new plant in Europe. In Latin America, demand growth will continue as acrylic fibres output increases, notably in Brazil, and there are plans for an acrylonitrile unit there. Eastern European countries currently import acrylic fibres to cover their textile needs. Overall, East Asia will provide the motor behind acrylonitrile demand, which will exceed supply beyond 1992.

Capacity utilization for pure terephthalic acid plants has been high as shortages in the East Asia have sucked in imports. A spate of construction is forecast to take world capacity to 9.06 million tonnes by 1995.

Demand is forecast to reach 8.6 million tonnes, allowing capacity utilization rates to remain high. World ethylene glycol consumption is projected to grow at a 3.8 per cent average until 1995, as sufficient capacity is likely to be in place and operating rates could stay at 78 per cent during the period 1990-1995.

(b) *Industry structure*

The synthetic fibres industry has been dominated by a small number of large firms. Initially the monopoly was sustained through patent protection and later by the large entry barriers resulting from economies of scale in both research and production. The world's top 10 firms controlled approximately 6 million tonnes of synthetic fibre capacity or 40 per cent of the world total in 1986 [143]. Their share has declined since the late 1970s, however, with the development of capacity in the South.

(c) *Major companies in the North and South*

Du Pont of the United States is the largest producer of fibres in the world. It was also the fifth largest chemical company in the world in terms of sales in 1987 ($17.6 billion), and the first in terms of profit ($1.6 billion), a position which it has held since 1980 [144].

The company manufactures polyester, polyamide 66 and acrylic fibres, as well as the high-technology aramid fibres Kevlar and Nomex and the elastane Lycra. Production locations are mainly concentrated in the North. In Western Europe, in particular, fibres form an important part of overall business, accounting for roughly 30 per cent of turnover in 1986. About a quarter of those sales were in the Federal Republic of Germany. In the South the company's ownership is limited to Argentina, where it holds 82 per cent in Ducilo. In Brazil it owns 100 per cent of Du Pont do Brasil, and in Mexico it has 40 per cent of Nylon de Mexico.

Du Pont is particularly strong in the polyamide carpet fibre branch, making both staple and bulk continuous filament for the carpet industry. Significant developments include the introduction of products with hollow fibres, which refract light and hide soil, and those with stain-resistant and anti-static properties. Its polyester products are used in cotton and wool non-wovens, fillings and carpets. The company stopped making acrylic fibres in Europe when it closed its plant in Northern Ireland in 1980, after accumulating losses of $70 million from the operation since it started in 1968. Developments in the Du Pont fibres business today focus on speciality fibres such as its Kevlar high-strength aramid fibre, which is used in the defence and aerospace industries. A lengthy patents lawsuit with Akzo of the Netherlands has hampered international marketing of this product, but settlement was finally reached in 1988 and sales should now move ahead.

Another major producer, Hoechst of the Federal Republic of Germany, acquired Celanese of the United States in 1987, significantly boosting its worldwide fibres activities. Its potential production monopoly in the United States was such that the Federal Trade Commission obliged the company to sell off some of its polyester fibres businesses in order to win approval for the acquisition.

In 1987 Hoechst was the world's third largest chemical company, with sales of $23.5 billion. Fibres sales are very important, forming the third largest turnover group for the company and representing 10 per cent of total sales. Hoechst is a major producer of polyester. Its interests in the South include 100-per-cent-owned polyester producer, Hoechst do Brasil, and 40-per-cent-owned Celanese Mexicana.

Hoechst has a comprehensive product range, selling most of its polyesters output to the textile industry, but holding a strong presence in the industrial sector. For example, it is Western Europe's leading supplier of branded polyester fibre for carpet tufting and makes not only standard polyester staple fibres but also polybutyleneterephthalate, which dyes readily and has good recovery properties, making it suitable for carpet use. In the polyester filament yarn textile branch, Hoechst introduced a new fabric called Trevira Finesse, which has breathing and waterproof properties suitable for swimwear. Other products are made from acrylic and viscose and sophisticated blends of these and other polymers with polyesters.

In addition to producing fibres, plus the required intermediates, dyestuffs and other products for the business, Hoechst is active in building and licensing synthetic fibres plants through its engineering arm, Uhde GmbH.

Table IV.112 shows the 12 largest Western European man-made fibre companies in 1987. About half the 82 companies listed in Europe that year were owned or partly owned by the top 10 [145]. None of the companies have enjoyed good profits in recent years, and all have generally felt the effect of higher raw material costs. Snia Fibre, the Italian fibres company, reported a drop in profits of 13 per cent in 1988 to $20 million, and although the Netherlands firm Akzo more than doubled profits from 1987, it described 1988 levels as poor. In the United Kingdom, Courtaulds profits fell in the first half of 1988, and for ICI, fibres was one of the least profitable activities. The last point

Table IV.112. The 12 largest West European man-made fibre producers
(Thousands of tonnes per year)

Company	Total capacity a/
Akzo/Enka	390
Courtaulds	360
Rhône Poulenc	290
ICI	270
Hoechst	270
Montefibre	245
Enichem Fibre	200
Snia Fibre	185
Bayer	165
Lenzing	140
Du Pont	120
Säteri	70
Total	2 705

Source: [145].
a/ Including associates.

is also true of the three chemical companies of the Federal Republic of Germany, Hoechst, Bayer and BASF, despite the highly integrated nature of their fibres businesses.

In the South, leading fibres firms are concentrated in Asia and all nine listed in table IV.113 are from either Taiwan Province, the Republic of Korea or India.

(d) *Foreign ownership and remote sourcing of componenis*

As may be seen from table IV.114, the transnational corporations firms all 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, often of the Federal Republic of Germany, dominate fibres technology supply. A significant trend among the European companies has been the acquisition of firms in the United States, such as the Hoechst take-over of Celanese and the purchase by BASF of American Enka. Japanese companies are expected to move more and more into Europe, and 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. This may be part of another trend towards greater integration of fibres and textile activities.

Table IV.113. Leading fibres companies in the South, 1988

Company	Country	Sales (10^3 dollars)	Profit/ loss	Assets
Formosa Chemicals and Fibre	Taiwan Province	553	86.2	688
Tongyan Nylon	Republic of Korea	514	14.3	811
Hanil Synthetic Fibre	Republic of Korea	497	14.7	600
JK Synthetics	India	366	(1.9)	
Givalior Layer Silk	India	362	-	189
Chil Synthetic Textiles	Republic of Korea	305	4.9	268
Hvalon-Teijran	Taiwan Province	282	16.8	409
Svnkyong Fibres	Republic of Korea	221	6.8	241
Century Enka	India	184	-	94

Source: South, August 1988.

Table IV.114. World man-made fibre ownership affiliations and percentage of capital ownership in developing countries[a/]

Transnational corporation	Home country	Developing country/area	Affiliate (percentage share)
Akzo N.V.	Netherlands	Brazil	Companhia Bahiana de Fibras (45)
			Polyenka (51)
		Colombia	Enka de Colombia (48)
		Ecuador	Enkador (48)
		India	Century Enka (39)
		Mexico	Fibras Quimicas (40)
Asahi Chemical Industry Co. Ltd.	Japan	India	Baroda Rayon Corp. (1)
		Indonesia	P.T. Indonesia Asahi Chemical (51)
		Republic of Korea	Tong Yang Polyester (50)
Bayer A.G.	Germany, Federal Republic of	Iran	Sherkat Sahami Aliaf (50)
		Peru	Bayer Industrial S.A. (60)
Celanese	United States	Brazil	Celanese do Brasil (100)
			Celanese do Brasil Nordeste (100)
		Mexico	Celanese Mexicana (40)
E.I. Du Pont de Nemours & Company	United States	Argentina	Ducilo (82)
		Brazil	Du Pont do Brasil (100)
		Mexico	Nylon de Mexico (40)

Transnational corporation	Home country	Developing country/area	Affiliate (percentage share)
Hoechst A.G.	Germany, Federal Republic of	Brazil	Cia. Brasileira de Sintéticos (100)
ICI Limited	United Kingdom	India	Chemicals & Fibres of India Limited (55)
		Pakistan	ICI Pakistan Manufacturers (70)
Kuraray Company Limited	Japan	Indonesia	Kuma Fiber (40)
Mitsubishi Rayon	Japan	Taiwan Province	Tong Hwa (19)
Rhône-Poulenc S.A.	France	Argentina	Rhodia Argentina Qûimica e Têxteis (100)
		Brazil	Rhodia S.A. (100)
			Rhodia Nordeste (99)
Teijin Limited	Japan	Indonesia	P.T. Tifico (65.8)
		Republic of Korea	Sunkyung Fibres (5.5)
		Thailand	Teijin Polyester (45)
Toray Industries	Japan	Indonesia	P.T. Indonesia Toray Synthetics
		Republic of Korea	Cheil Synthetic Textiles (22.8)
		Malaysia	Kolon Industries (19.3)
			Penfibre SDN. Berhad (100)
		Philippines	Philippine Polyamide (16.5)
		Thailand	Toray Nylon Thai (30)

Source: Textile Organon, vol. 57, No. 6 (June 1987).
Note: The percentage owned by the named transnational corporation is given in parentheses.
a/ Licensing and royalty agreements are not included; nor are textile involvements outside man-made fibres.

5. *Technology trends*

The main thrust of development is towards high-technology fibres for applications in the automobile, aerospace, defence and other industries. Forecasts say that by 1993 the European industry will be paying $2.8 billion for high-technology fibres from fibre optic cabling to composite materials used in jet fighters. In apparel, companies are trying to produce new fibres for specific applications, for example sportswear, which has been an industry of rapidly expanding potential. The variety of products has probably increased most rapidly in the carpet branch, and many companies have a very young range of brands. In the North, in particular, companies are concentrating their efforts on broadening market size by introducing new products and devoting increased spending to marketing and advertising.

6. *Short- and medium-term outlook*

Fibres demand is expected to remain strong in 1989 and 1990. However, the expected capacity build-up of 4.3 million tonnes, or 31 per cent of 1987 capacity, by 1990 looks dangerously like overbuilding yet again, and could lead to approximately 2 million tonnes, or 11 per cent, of surplus capacity. In the short term there are signs that the cost pressures on fibres raw materials are easing, and that fibres producers, particularly in East Asia, will benefit from the added supply of intermediates in the next few years. A key factor will be the influence of oil prices on raw material costs.

Hoechst says that in the first quarter of 1989 sales in the group's man-made fibres division were up by 20 per cent. However, it cannot be assumed that this is a world-wide trend, as much of the increase may be due to the exclusion of cheap polyester imports under the 1988 anti-dumping measures. The group has outlined plans to make further investments in South-East Asia, hoping to expand sales revenue from the region to between 10 and 15 per cent, compared with between 3 and 4 per cent in 1988. Such moves will be an ongoing feature of the synthetic fibres industry, with the transnational corporations hoping to participate more and more in the areas of largest growth potential, namely the South and centrally planned economies, while concentrating on product specialization in the markets of the North.

Appendix

Supplementary statistical data

Table IV.115. New man-made fibre plants, 1988

Region, country or area and company	Fibre (polymer)	Staple or Filament	Capacity (thousands of tonnes)	Engineering company	Status
<u>North</u>					
Austria					
Glanzstoff Austria GmbH	Viscose	Glauber's salt	26 400	Ebner	1 vacuum-crystalization plant: engineering, delivery, installation and start-up
Lenzing AG	Viscose	Spin bath finish	100 000	Ebner	1 evaporation plant: engineering, delivery, and installation start-up
Belgium					
Concordia	PA6	F	500	Val Lesina-Cora AG	Engineering
Germany, Federal Republic of					
BASF AG	PA6	H-4-S Pilot	-	Ems-Inventa	Engineering
Du Pont	PA6.6				Engineering
Greece					
E.T.M.A. SA	Polyamide 6.6	F, POY	1 000	Didier Engineering	Under construction
Italy					
EniChem Fibre SpA	PA6	Extraction plus drying or extraction plus post-condensation	6 600 4 000	Ems-Inventa	Engineering
EniChem Fibre SpA	PES	St	9 000	Zimmer AG	Under construction
EniChem Fibre SpA	PAC	St	5 000	EniChem Fibre	Under construction
Netherlands					
DSM	PA6	Technical yarn	..	Fischer	Engineering
Spain					
La Seda de Barcelona	PES	Polymer St.	40 000	Zimmer AG	Under construction
Turkey					
Dusa	Polyamide 6.6	Tyre cord	18 600	Chemtex	Engineering
Filament A.A.	Polyester	F,POY	1 800	Zimmer AG	Engineering
United Kingdom					
Kodak Ltd. Workington	PES	Polymer	52 500	Zimmer AG	Under construction
United States					
Carolina Eastman	Polyester	Polymer	105 000	Zimmer AG	Under construction
General Electric	Polyester	Polymer	35 000	Zimmer AG	Engineering (extension)
Tennessee Eastman	Polyester	Polymer	..	Zimmer AG	Delivery
Guilford Mills, Gainesville	PES/PA6 Cora AG	Filament Engineering	1 500	Val Lesina-	
<u>South</u>					
Argentina					
Petroquimica General Mosconi	PET chips Krupp Koppers	17 000 (Fischer process)	..	Ems-Inventa	Under construction
Chile					
Quimica Industrial	PES	St	7 000	Chemtex	Under construction

Region, country or area and company	Fibre (polymer)	S[illegible]r F[illegible]	Capacity (thousands of tonnes)	Engineering company	Status
China					
CNTIC	PAC	St	30 000	Chemtex	Engineering
	PAC	St	45 000	Chemtex	Engineering
	PAC	St	50 000	Chemtex	Start-up
Sinopec	PES	Polymer, F	5u 000	Chemtex	Under construction
CNTIC, Chongquing					
Hubei Hua Feng Import Corp., Yichang	PES	POY	2 600	Didier Engineering	Under construction
Shenzhen	PES	F, FDY	1 080	Didier Engineerirg	Engineering
Changsha Nylon Factory	PA6	Chips, F	3 300 2 000	Ems-Inventa	Under construction
Hai Xin Spinning and Weaving	PA6	POY	2 300	Ems-Inventa	Engineering
Shanghai Chemical	PA6.6	Industrial yarn	1 700	Fischer	Under construction
Wuxi No.2 Synthetic Fibre Factory	PES	Industrial yarn	2 000	Fischer	Engineering
Research Institute Shanghai	PES/PA6	Bicomponent	..	Fischer	Under construction
Shunde Nylon Plant	PA6	Polymer	6 600	Fischer	Engineering
Shunde Nylon Plant	PA6	FDY	6 600	Fischer	Engineering
Wangqing	PES	Industrial yarn	1 500	Fisher	Engineering
Sinopec	PES	Post-conden-sation	6 660	Fischer	Engineering
Jinzhou Synthetic FI.PL.	PA6	Polymer,HSO FOY	3 500	Lurgi	Under construction
Liaoyang, Petro-chemical Fibre Company	PP/PE	Master batch	1 000	Uhde	Under construction
Anhui Vinylon Chaohu	PES	F	1 000	Val Lesina-Cora AG	Engineering
Fujian Chemical Fibre, Yongan	PES	F	1 000	Val Lesina-Cora AG	Engineering
YiZheng Joint	PES	Polymer	533 000	Zimmer AG	Part 1 in operation, part 2 under construction
Hainan Development and Construction Corporation	PES	F,POY	4 000	Zimmer AG	Start-up
Shantou Polyester Cnips Plant	PES	Polymer	8 000	Zimmer AG	Engineering
Mudanjiang Textile	PA6	Polymer and tyre cord	4 900	Zimmer AG	Engineering
Shaanxi State Cotton Mill	PA6	Polymer and tyre cord	4 400	Zimmer AG	Engineering
Colombia					
Lafayette, Bogota	PES/PA6	F	1 250	Val Lesina-Cora AG	Engineering
India					
IEL	PES	St	20 000	Chemtex	Under construction
DCL Polyester Limited	PES	F, Poly-condensation	21 000 19 500	Ems-Inventa	Engineering (Fisher process)
Gujarat Nylons Limited	PA6	Polymer,HSO, POY	8 000	Lurgi	Engineering
Petrofils Co-operative Limited	PA6	Polymer,POY, FOY	12 000	Lurgi	Engineering
Shree Synthetics Limited	PES	POY	6 600	Lurgi	Under construction
ICI Pakistan	PES	Polymer, St	Extension approx. 7000 tonnes per year	Simon-Carves	Engineering
Punjab Polyfibres	PES	Polymer, St.	25 000	Zimmer AG	Under construction
Swadeshi Polytex	PES	Polymer, St	28 000	Zimmer AG	
Nirlon Synthetics Limited	PA6	Polymer and tyre cord	10 500	Zimmer AG	Under construction

Table IV.115. (continued)

Region, country or area and company	Fibre (polymer)	Staple or Filament	Capacity (thousands of tonnes)	Engineering company	Status
Indonesia					
P.T. Pan Asia Synthetic Abadi	PES	F,POY	15 200	Ems-Inventa	Engineering
P.T. Yasinta	PES	F,POY	17 500	Zimmer AG	Under construction
South Pacific Viscose (SPV)	VI	Glauber's salt	33 600	Ebner	1 vacuum-crystalization plant: engineering, delivery, installation and start-up
Kenya					
Sunflag	PES	F, POY	2 500	Didier Engineering	Ordered
Nigeria					
Integrated Fibres Ltd.	PES	POY	2 000	Lurgi	Under construction
Tolaram	PES	poy	8 000	Lurgi	Under construction
Spintex Mills, Lagos	PES/PA6	F	2 500	Val Lesina-Cora AG	Engineering
Pakistan					
Gatron Industries	PES	Polymer	11 000	Zimmer AG	Under construction
S.G. Rayon	PES	F, POY	1 700	Didier	Engineering
Rupali Polyester Limited	PES		13 000	Toray	Engineering
Republic of Korea					
Kolon Industries Incorporated	PA6	Polymer	17 500	Zimmer AG	Under construction
Tong Yang Nylon	PA6	Polymer	23 000	Zimmer AG	Under construction
Tong Yang Nylon	PA6.6	Polymerization	2 000	Fischer	extension, engineering
Tong Kook	PES	Polymer, F	24 500	Cehmtex	Engineering
Taiwan Province					
Tainan Spinning Company	PES	Polymer,F POY	52 000	Zimmer AG	Under construction
Shinkong Synthetic Fibre	PES	Polymer	42 000	Zimmer AG	Under construction
	PES	Polymer	105 000	Zimmer AG	Engineering
Lutravil Far East Company Limited	PET	Spun-bonded	..	Fischer	Engineering
Far Eastern Textiles Limited	PES	Polymer	60 000	Lurgi	Under construction
Thailand					
Toray Nylon	PES	POY	..	Toray	Engineering
Venezuela					
Sudamtex	PET	Polymer	10 000	Fischer	Extension
Eastern Europe and USSR					
Bulgaria					
PAC			14 000	Snia BPD	Under construction
Czechoslovakia					
Technopol AG	PA6	F, POY	560	Zimmer AG	Engineering
German Democratic Republic					
Schwarza, Rudolstadt	VI	St	13 200	Chemtex	Under construction
Hungary					
Chemokomplex	PAC		20 000	Simon-Carves	Engineering
Slovchemia/Magyar	VI		10 000		proposed
Poland					
Tomaszow	VI		15 000		Modernization

Region, country or area and company	Fibre (polymer)	Staple or Filament	Capacity (thousands of tonnes)	Engineering company	Status
Union of Soviet Socialist Republics					
Uvat	PA6.6		7 000	Salzgitter	Engineering
Blagoveschensk	PES	St	50 000	Chemtex/KSL	Engineering
Mogilev	PES	F	24 650	Uhde	Start-up
TMI	PP	Spun-bonded	20 000	Chemtex/KSL	Engineering
TMI-Kursk	PES	St	50 000	Chemtex/KSL	Engineering
Kiev	PA6		8 000	Snia BPD	Engineering
Yugoslavia					
Progres	PA6	Polymer	7 000	Zimmer AG	Engineering

Source: Chemiefasern - Textilindustrie, Man-made Fibre Yearbook 1988 (Frankfurt am Main); and European Chemical News, International project review, March 1989.

Note: F = Filament; FDY, FOY = fully oriented yarns; HSO = High speedy only; PA = Polyamide, PAC = Polyacryl; PES, PET = Polyester; POY = preprinted yarns; St = staple; VI = Viscose.

H. Agrochemicals (ISIC 351216)*

Insecticides
Fungicides
Herbicides
Disinfectants
Growth regulators

1. Outline of the industry

Agrochemicals are artificial substances added to crops to promote growth by interfering with external influences harmful to the plant. They do not include fertilizers. They normally work by destroying, or rendering ineffective, organisms such as insects, weeds and disease-causing fungi that can disrupt plant development. Another branch of agrochemicals is concerned with plant-growth regulators, which aid specific growth aspects which a farmer wishes to encourage—for instance, the promotion of branching in fruit trees. Total world agrochemicals sales are about $20 billion a year and should grow at some 3 per cent a year in the 1990s, according to analysts' estimates, with particular expansion in developing countries where use of agrochemicals at present is relatively small. Use of agrochemicals (also called pesticides or crop-protection compounds) is intrinsically connected to the world agricultural industry and also to other aspects of farming supply businesses such as seeds provision, a branch worth about $13 billion a year in retail sales.

Agrochemicals supply is dominated by the world's big chemicals companies such as Bayer of the Federal Republic of Germany, Ciba-Geigy of Switzerland, Du Pont of the United States and the United Kingdom's ICI. The 14 biggest companies in agrochemicals account for about 75 per cent of world sales, according to estimates (see table IV.116).

*UNIDO acknowledges the contribution of Peter Marsh, *Financial Times*. This article also draws on "Global pesticide industry" (UNIDO.PPD.98).

Table IV.116. Leading agrochemical companies, 1987

Company	Country	Estimated sales in 1987 (billions of dollars)
Bayer	Germany, Federal Republic of	2.0
Ciba-Geigy	Switzerland	2.0
ICI	United Kingdom	1.6
Rhône-Poulenc	France	1.6
Du Pont	United States	1.2
Monsanto	United States	1.2
Shell	United Kingdom/Netherlands	1.0
BASF	Germany, Federal Republic of	1.0
Hoechst	Germany, Federal Republic of	1.0
Dow Chemical	United States	0.8
Schering	Germany, Federal Republic of	0.8
Sandoz	Switzerland	0.6
American Cyanamid	United States	0.6

Source: County NatWest WoodMac.

New scientific ideas, in particular biotechnology or the artificial manipulation of genetic fragments in plants by novel techniques, are becoming increasingly important in the agrochemicals industry. By these means, the biological growth mechanisms of plants can be altered to make them resistant to insect or fungal attack, thus reducing the need for orthodox agrochemicals or making it possible to apply these materials in smaller quantities. Another idea is to "programme" plants by altering their genetic make-up to make them resistant to attack by certain kinds of weed-killers which are normally non-selective. That could have the effect of letting farmers spray on greater quantities of specific weed-killers confident that these would destroy only weeds and would not affect the crops which had been genetically protected. The use of new ideas in genetic engineering to aid agrochemicals application is linked to seeds supply because seeds containing altered genetic material would need to be provided to work with specific kinds of agrochemicals. In some cases, specific kinds of seeds would develop in a set way (for instance, to produce plants resistant to attack by certain insects) without the need for conventional agrochemicals. That explains why many of the top agrochemicals companies have been diversifying into the seeds business in recent years.

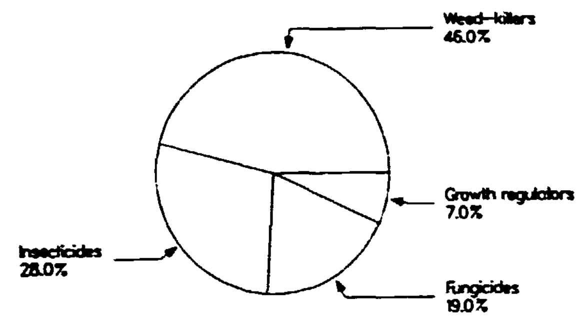
Use of agrochemicals has in the past few years often been linked to environmental problems. Many agrochemicals are highly poisonous either to people or wildlife if ingested in large quantities. Manufacturing and storing the compounds can thus sometimes be dangerous. Over-application of the materials can also lead to problems if the substances leach into water supplies, possibly after running off from fields. There can also be dangers of pesticide residues contained on the leaves or stalks of crops and fruit and which then enter the human food supply. These are problems which the agrochemicals industry will certainly need to address in the coming decade.

The Food and Agricultural Organization of the United Nations, in co-operation with member countries and other international organizations, has drawn up guidelines on the harmonization of pesticide registration requirements and control procedures. More recently an international code of conduct on the distribution and use of pesticides has been put forward in order to assist developing countries in the formulation of their own national regulatory standards [146].

Figure IV.24. The agrochemical market in 1988

1988

Total: $ 20 billion

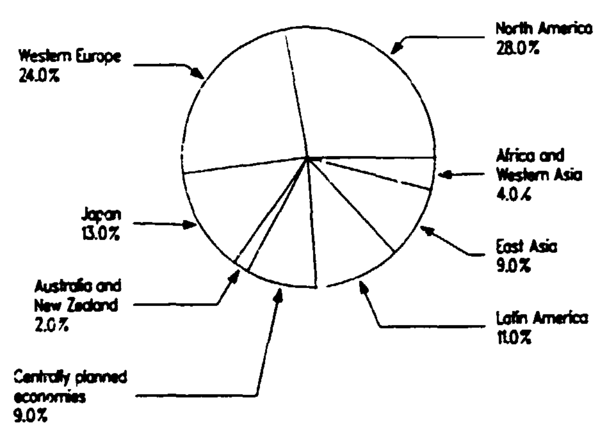


Source: Ciba-Geigy.

Figure IV.25. World production and sales of agrochemicals by region, 1988

1988

Total: $ 20 billion



Source: Shell.

2. *The agrochemicals market*

Agrochemicals can be split into four basic types: weed-killers (also called herbicides); insecticides; fungicides; and plant-growth regulators. Of the $20 billion 1988 world market in agrochemicals, the split between the different types is shown in figure IV.24.

The industrialized countries of Western Europe, North America and Japan consume some two thirds of the world's agrochemical production and sales. The breakdown of sales by geographical area is shown in figure IV.25. National breakdowns are difficult to come by. Figures from Shell, however, are available to show the distribution of agrochemical sales in Western Europe. Out of a total market of $5.6 billion in 1988, the estimated percentage shares of particular countries are as follows: France, 29 per cent; Italy and the Federal Republic of Germany, 14 per cent each; United Kingdom, 12 per cent; Belgium and Netherlands, Spain and Scandinavia, 7 per cent each; Greece and Turkey, 3 per cent each; and others, 4 per cent.

Different regions show different characteristics in terms of their consumption of specific types of agrochemicals. Hence the non-industrialized countries, which include many tropical or semi-tropical areas where insect pests are rampant, are high users of insecticides. The highly developed agricultural industry in North America is, on the other hand, a big user of weed-killers as part of its efforts to remove any possible implements to high crop yields. Western

Europe, meanwhile, is the biggest single user of fungicide used to check crop disease, probably due to the relatively high rainfall in this part of the world which is often associated with plant disease. Consumption of agrochemicals by region is described in figure IV.26.

3. *Leading agrochemical companies*

The biggest companies in the agrochemicals business are listed in table IV.116 Other significant companies in the business include Unilever (United Kingdom/ Netherlands), Eli Lilly, Rohm and Haas, FMC (United States) and Kumiai (Japan). In April 1989, Dow Chemical and Eli Lilly combined their agricultural chemicals businesses to form a new company called Dow Elanco. This will be the world's fifth largest agrochemicals company, with annual sales of $1.5 billion.

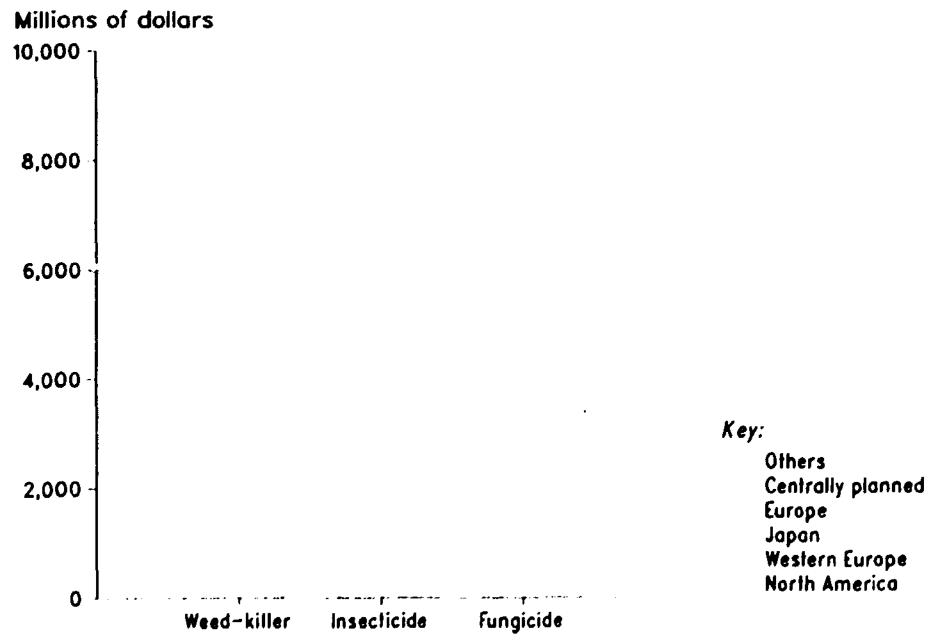
The leading agrochemicals companies are all from the North and long established. Their common characteristics include a world-wide marketing network and extensive experience in research and development. They are engaged in both the active ingredient and formulation sectors of the business and sell each other's products in countries where market size does not justify establishing a dedicated organization. One exception is Kumiai Chemical, which was 18th on the list in 1986. This company was set up in 1949 and has become the leading agrochemical supplier in Japan. Kumiai is a more than 90 per cent domestic market-oriented company which works in close collaboration with local agricultural co-operatives. Research and development programmes and inward licensing are other key elements of success in Kumiai's industrial strategy.

State authorities control the manufacture and trade of pesticides in China and the USSR. State-owned enterprises enjoy a large degree of freedom both in production and in sales of pesticides in Hungary. Research projects by enterprises in Hungary are mainly targeted towards the manufacture of patent-expired active ingredients and generic pesticide preparations. The pesticide formulation branch is particularly strong in the Republic of Korea because only technically graded agrochemicals are allowed to be imported.

Different companies in the North have different strengths in the various areas of crop protection. Thus, in weed-killers, Ciba-Geigy is thought to be the biggest company with an estimated 13 per cent of the world market. Monsanto is next with about 9 per cent, followed by Bayer and BASF, both with about 7 per cent. In insecticides, Bayer is the biggest company with some 14 per cent of the market. Rhône-Poulenc is next with 10 per cent. FMC and Hoechst have about 5 per cent each. In fungicides, Bayer has 18 per cent of the world total, Ciba-Geigy 14 per cent, Rhône-Poulenc 10 per cent, Du Pont 8 per cent and BASF and Sandoz about 5 per cent each.

Table IV.117 gives a breakdown of the biggest selling agrochemical products world-wide. It can be seen from this that Ciba-Geigy, the biggest weed-killer company, has two highly important products in this field, Dual and atrazine; Bayer, the biggest insecticide company, has one big selling product in this area—methyl parathion—and is also strongly represented in table IV.117. Many of the products on the list are off patent (patents normally last from 17 to 20 years from

Figure IV.26. Consumption of agrochemicals by region, 1988



Source Ciba Geigy

Table IV.117. World's top 15 agrochemical products, 1987

Generic name	Product Name(s)	Launch date	Chemical class	Product type	Company(ies)	1987 sales estimate (millions of dollars)
Atrazine	Atrazine	1957	Triazine	Herbicide	Ciba-Geigy etc.	640
Glyphosate	Roundup	1972	Organophosphorus	Herbicide	Monsanto	620
Methyl parathion	Methyl parathion	1947	Organophosphorus	Insecticide	Bayer etc.	480
Paraquat	Gramoxone	1962	Bipyridyl	Herbicide	ICI etc.	440
Trifluralin	Treflan	1964	Toluidine	Herbicide	Eli Lilly etc.	320
Alachlor	Lasso	1966	Amide	Herbicide	Monsanto	270
Chlorpyrifos	Dursban/Lorsban	1965	Organophosphorus	Insecticide	Dow	240
Benomyl	Benlate	1967	Benzinaldazole	Fungicide	Du Pont	280
Metribuzin	Sencor/Lexone	1971	Triazine	Herbicide	Bayer/Du Pont	215
Metolachlor	Dual	1974	Amide	Herbicide	Ciba-Geigy	210
2,4-D	2,4-D	1942	Hormone	Herbicide	Vertac etc.	210
Deltamethrin	Decis	1977	Pyrethroid	Insecticide	Roussel Uclaf	210
Fenvalerate	Sumicidin/Pydrin/ Belmark	1976	Pyrethroid	Insecticide	Sumitomo/Du Pont/ Shell	210
Methabenzthiazuron	Tribunil	1968	Urea	Herbicide	Bayer	200

Source: County NatWest WoodMac.

the date of invention) and can thus be sold in their generic rather than branded version by companies which copy the chemical formulae from the inventors of the materials.

4. *Links with the agriculture industry*

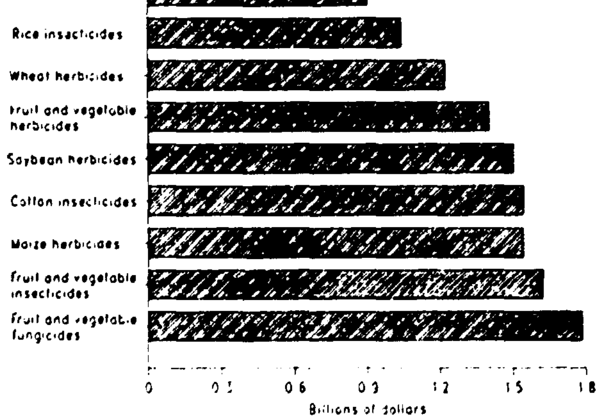
In terms of market value, the 14 biggest agrochemical branches shown in figure IV.27 account for roughly three quarters of the total market. As figure IV.27 indicates, most agrochemicals are aimed at the 10 or so major crops in the world, including maize, wheat, rice, cotton, soybean, sugarbeet, vines, general fruit and vegetables. Some of the principal types of agrochemicals used in these specific market areas are discussed in section 6.

Crop structure is another major determinant of the demand for major pesticide groups. Tables IV.118 and IV.119 show this relationship. Data on some of the main crop types for which agrochemicals are applicable are given in figure IV.28, which shows that wide discrepancies exist in the use of agrochemicals between different countries, with developed countries generally being far greater users of the materials than developing countries. Thus, for maize the United States is responsible for about a fifth of the world's planted area, but more than a half of herbicide use. Europe (which in this figure includes the USSR) accounts for 12 per cent of planted area and 22 per cent of herbicide consumption. In the case of cotton, the United States has 12 per cent of the area and 16 per cent of insecticide use and 30 per cent of herbicide use. Looking at rice, Japan has only about 1 per cent of planted area, but accounts for more than a half of total world use of herbicides and fungicides and nearly a half of the world use of insecticides.

Greater application of agrochemicals is partly responsible for crop yields in many developed countries being better than those elsewhere. It is not, of course, the only reason—others being better use of agricultural machinery, more suitable climate, etc. However, it seems self-evident that greater use of agrochemicals in many developing countries could have a big effect in increasing their agriculture yields. This is one reason why many agrochemical suppliers are attempting to step up their efforts in those countries. They see the possibility of a much larger market for their goods in developing countries than has been the case in the past.

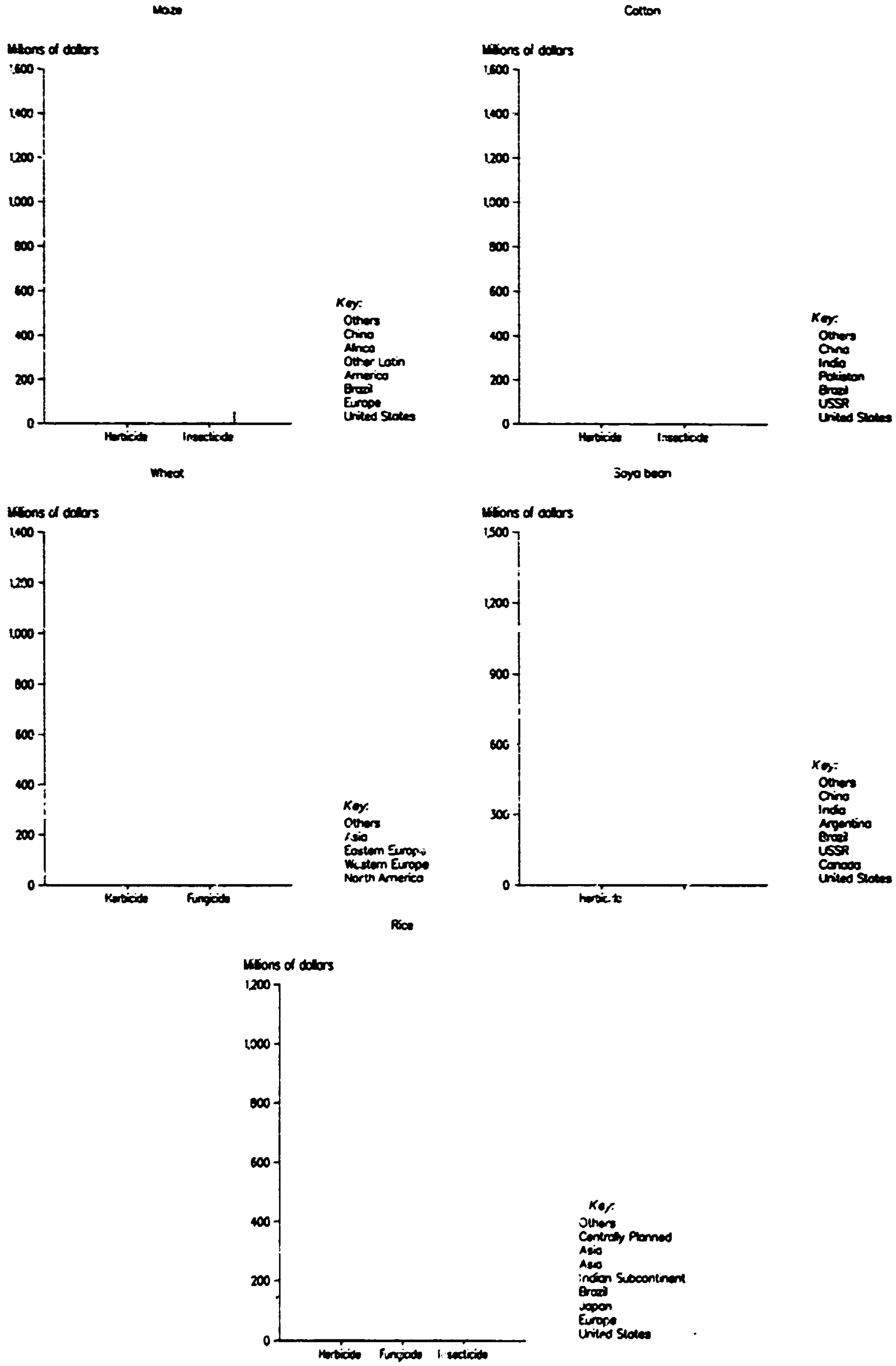
The reasons why agrochemical consumption in developing countries has to date been much less than in others include: lack of awareness of chemicals in developing countries; less intensively farmed agriculture systems in which the use of agrochemicals does

Figure IV.27. The 14 largest agrochemical branches, 1987



Source: County NatWest WoodMac

Figure IV.28. Consumption of agrochemicals by type and region, 1987



Source: County NatWest WoodMac

Table IV.118. Pesticide use in 1986 for different crops

Crops	Herbicides Percentage	Insecticides Percentage	Fungicides Percentage	Total pesticides Millions of dollars	Total pesticides Percentage
Fruits and vegetables	16.3	26.6	43.4	4 805	25.6
Rice	10.5	17.0	15.6	2 585	13.8
Maize	18.0	8.0	1.3	2 090	11.1
Cotton	4.7	25.2	1.7	2 010	10.7
Wheat	14.2	2.3	13.4	1 910	10.1
Soybean	17.4	2.9	2.0	1 755	9.3
Sugarbeet	5.7	3.0	1.5	735	3.9
Others	13.3	14.8	21.1	2 910	15.5
Total	100.0	100.0	100.0	18 800	100.0

Source: [146], p.9.

Table IV.119. Grain crop losses in 1986 (Percentage)

Crop	Total losses	Cause of loss: Weeds	Disease	Insects
Wheat	24	10	9	5
Rice	48	11	9	28
Barley	21	9	8	4
Oats	27	10	10	7
Millet	37	18	10	9
Rye	20	15	3	2

Source: [146], p.9.

not appear so appropriate; relative lack of availability of many agrochemicals owing to the absence of local manufacture and small marketing and sales efforts by agrochemicals producers and suppliers; and lack of training of farmers and agriculture workers.

Use of agrochemicals among farmers in developed countries is by no means uniform. Much will depend on how keen a farmer is to maximize yields by organizing his work around the requirement to arrange for specific spraying at set times before, during and after the growing season for particular crops. The amount of mechanization on the farm will also affect the degree to which a farmer uses agrochemicals. Applications of these materials is intrinsically linked to equipment including mixing facilities, spraying systems and tractors. If a farmer is to make fullest use of agrochemicals, he will need to invest in such equipment at fairly high levels. He will also need it in good condition. Acting against the general swing towards rising agrochemical use, there has been a trend in some developed countries in recent years to stress the possibly unpleasant environmental effects of agrochemicals. This has led with little doubt to a reduction in the use of the materials by many farmers on the grounds that they want to minimize the risk of their action causing environmental problems. Some farmers have gone to the length of not using agrochemicals at all—this is part of the so-called organic farming movement in which farmers sell their products with a "pesticide-free" label which they hope will appeal to certain sections of consumers.

Use of the materials for particular crop types will also depend to a large degree on the potency of specific agrochemical classes when used with certain plants. Another factor is selectivity—the extent to which a weed-killer, insecticide or fungicide will home in on a specific agent which has a negative effect on a particular plant. Selectivity is all-important in the case of weed-killers. A large number of these chemicals kill all plants with which they come into contact. Hence they are of no use in spraying on to fields after germination has started and plants are sprouting or producing leaves. Weed-killers of this type can be applied only prior to the growing season. Other types of weed-killers differentiate between plant types—attacking only specific weeds and leaving alone crops such as maize or wheat which the farmer is trying to produce, and can thus be applied all through the growing season. Application of insecticides and fungicides is often effective only when made at specific times of the year; for example, when certain pests are at the larva stage or before a particular disease has had time to have a large effect on plant growth. A farmer has to be aware of these times and to organize spraying accordingly. This presses home the idea that a high level of knowledge about the interaction between chemicals and plant growth should be backed up by the necessary training.

UNIDO has developed a model for pesticides use which could have particular application in forecasting the demand of developing countries.

Table IV.120 summarizes the assumptions made in the model concerning the application of pesticides in the treatment of different types of crops and fruits under various climatic conditions.

Decimal fractions in table IV.120 represent the percentage of the agricultural area where crops and fruits are treated with pesticides. The intensity category of agricultural production is determined at the country level according to the number of tractors, the area of planted and irrigated land and fertilizer use in tonnes of nitrogen, phosphorus and potassium per hectare of cultivated land.

Table IV.120. Annual average frequency of treatments of agricultural products with pesticides

Climatic zone	Pesticide group	Intensive FC	Intensive CC	Intensive FR	Intensive GR	Semi-intensive FC	Semi-intensive CC	Semi-intensive FR	Semi-intensive GR	Extensive FC	Extensive CC	Extensive FR	Extensive GR
Cold oceanic	F	0.2	1.0	4.0	6.0	0.1	0.5	3.0	4.0				
	H	0.9	0.8	-	-	1.0	0.6	-	-				
	I	0.3	2.0	4.0	6.0	0.1	2.0	3.0	4.0				
Moderate continental	F	0.3	2.0	6.0	8.0	0.2	1.0	4.0	6.0	-	0.5	0.5	0.5
	H	1.1	0.8	0.3	0.3	1.0	0.6	0.2	0.2	0.1	-	-	-
	I	0.5	3.0	6.0	8.0	0.3	3.0	4.0	6.0	-	3.0	2.0	2.0
Subtropical	F	0.5	4.0	9.0	11.0	0.3	3.0	7.0	10.0	0.1	2.0	2.0	2.0
	H	0.8	0.5	0.3	0.3	0.5	0.5	0.2	0.2	0.1	0.1	-	-
	I	0.6	3.0	9.1	10.0	0.4	3.0	5.0	7.0	0.5	3.0	3.0	3.0
Tropical dry	F					0.1	0.5	0.5	1.0	-	0.3	0.2	1.0
	H					0.1	0.1	-	-	-	0.1	-	-
	I					0.2	1.0	2.0	2.0	0.1	1.0	1.0	1.0
Tropical rainy	F					0.3	2.0	4.0	3.0	-	1.0	1.0	2.0
	H					0.1	0.1	-	-	-	0.1	-	-
	I					0.5	4.0	4.0	4.0	0.3	2.0	3.0	3.0

Source: [146], p. 5.
Note: F: fungicides; H: herbicides; I: insecticides.
FC: field crops; CC: cash crops; FR: fruits; GR: grapes.

Another determinant of pesticide finished product demand is the average quantity applied to a unit area of agricultural land (table IV.121).

From the above assumptions demand for the three major groups of pesticides can be estimated using an econometric model for a given country, classified according to climatic zones and degree of agricultural development. Using a total of 119 countries, certain estimates and regional multipliers, varying from 1.1 in North America to 1 in Northern Europe, 2 in Southern Europe, through 0.7 in Tropical Africa and 0.6 in South-East Asia, yielded the results presented in table IV.122.

As can be seen, the results in table IV.122 compare well with the figures for actual consumption of pesticides. The model is thus considered good enough to be used to estimate current or future consumption.

Taking a closer look at conditions in the producer market, in 1987, 219 pesticide chemicals were produced in 291 plants in the United States. Eight companies (12 per cent of all companies) owned 150 plants (52 per cent of all plants). Six of the eight companies produced pesticides in all four categories. Most of the other 61 companies produced only one product, characteristic of the companies that were already well-established in the chemical industry when they began producing pesticides.

Table IV.121. Annual average dose of major pesticide groups (Kilograms per hectare)

Pesticide group	Quantity
Fungicides	6
Herbicides	8
Insecticides	4

Source: [146] p. 5.

The comparison of industry and product data in table IV.123 shows that only a small value of pesticides is manufactured outside the sector classified as pesticide industry. Pesticide production registered a constant dollar growth of about 2 per cent between 1972 and 1985. The value of production per worker (total employment) was $358,194 in 1987. The compound annual percentage changes were generally lower for the period from 1980 to 1985 than for the period from 1972 to 1985. This indicates that the pesticide industry has reached maturity in the United States.

5. *World trade in pesticides*

World trade in pesticide finished products was analyzed in a UNIDO study [147] which concluded that the salient feature is the dominance of developed countries which have the comparative advantage of being able to handle information effectively. Developed countries accounted for over 96 per cent of exports and 61 per cent of imports. Developing countries accounted for only 3 per cent of exports, but 22 per cent of imports.

In developing countries imports exceed exports by as much as 10 to one, and the largest part of the exports are intraregional (see table IV.124). While the Latin American region (mainly Argentina, Brazil and Mexico) has traditionally been the leading exporter among developing regions, exports from Asia (particularly from China, Hong Kong, Malaysia and Republic of Korea) have grown more rapidly than total world exports of pesticides in the last decade. Africa

Table IV.122. Comparison of data and model estimates for pesticide consumption, 1975 and 1980
(Thousands of tonnes of active ingredient)

Region or country grouping	1975 Data	1975 Estimates	1980 Data	1980 Estimates
Developed regions	1 422	1 410	1 612	1 604
North America	497	436	464	509
Northern Europe	237	241	300	287
Southern Europe	124	126	141	143
Eastern Europe	461	507	598	548
Japan	30	31	36	37
Other industrialized countries	74	69	75	79
Developing regions	533	550	621	696
Latin America	150	164	179	199
North Africa	45	42	78	65
Tropical Africa	48	61	44	48
West Asia	48	52	65	66
Middle and South Asia	49	39	53	47
East Asia	15	26	33	29
South East Asia	18	15	15	20
Other Asia	161	150	155	224
Non-reported a/	117	118	135	138
Total	2 073	2 077	2 368	2 439

Source: [146] p. 5.
a/ Inserted to indicate separate model estimates in world total.

Table IV.123. Trends for agricultural chemicals in the United States market, 1984-1987

Item	Unit	1984	1985	1986	1987	Compound annual percentage change 1972-1985	1980-1985
Industry data							
Value of shipments	10^6 dollars	5 695	5 217	5 008	5 158	12.3	4.2
Value of shipments	10^6 1982 dollars	5 923	5 389	4 958	4 776	2.0	2.2
Total employment	Thousands	15.3	15.0	14.8	14.4	1.6	1.6
Production workers	Thousands	9.2	8.9	8.8	8.6	2.1	1.9
Average hourly earnings	Dollars	12.07	12.51	13.01	13.79	9.1	8.6
Product data							
Value of shipments	10^6 dollars	5 613	5 125	5 023	5 023	11.8	1.8
Value of shipments	10^6 1982 dollars	5 906	5 334	4 925	4 784	1.5	0.4
Shipments price index	1982 = 100	95.2	96.3	102.1	101.6	9.4	1.6
Trade data							
Value of imports	10^6 dollars	266	361	373	415	19.8	12.9
Value of exports	10^6 dollars	1 406	1 267	1 328	1 487	14.1	0.7

Source: [146], p.25.

has experienced drought and famine in parts of the continent over a period of time which simultaneously brought a dramatic decline in pesticide trade.

The weighted average tariff on pesticide imports was between nil and 19.4 per cent for all countries studied, with values generally being from one to a few per cent. There is some evidence that, like tariffs, non-tariff barriers tend to increase with the level of product fabrication. Price controls and volume controls cause an unequal treatment of domestic and foreign goods, and demand becomes insensitive to changes in world market prices. Volume control, in the form of

Table IV.124. The 10 largest importers of pesticides among developing countries, 1984 (Millions of dollars)

Country	1984
China	343
Iran (Islamic Republic of)	186
Argentina	82
Egypt	81
Saudi Arabia	61
Sudan	53
Pakistan	51
Colombia	33
Cuba	33
Malaysia	33

Source: UNIDO statistical data base.

licences, quotas and even import prohibition, appears to be the most common non-tariff measure. Technical barriers such as health and safety regulations are considered part of domestic policy in both developed and developing countries. The bulk of pesticides exports from developing countries are directed towards other developing countries. Liberalization in South-South trade may be a viable method for improving export prospects. Trade restrictions introduced by technical barriers will be lessened with increasing industrialization.

On the basis of general experience, export (f.o.b.) prices are usually about 8 per cent lower than the import (c.i.f.) prices. The top 20 exporters in 1984, at global level, are shown in table IV.125, and the 10 largest developing country exporters in table IV.126.

Table IV.125. Top exporters of agrochemicals, 1984 (Millions of dollars)

Country or area	1984
Germany, Federal Republic of	837
United States	708
United Kingdom	562
France	462
Switzerland	385
Belgium	255
Netherlands	231
Japan	216
Italy	132
Hungary	96
USSR	48
Brazil	59
Hong Kong	37
Israel	34
Singapore	34
Guatemala	33
Denmark	33
Colombia	25
China	18
Romania	17

Source: UNIDO data base.

Table IV.126. The 10 largest exporters of pesticides among developing countries and areas, 1984 (Millions of dollars)

Country or area	1984
Brazil	59
Hong Kong	48
Singapore	34
Guatemala	33
Colombia	25
China	18
Costa Rica	11
Republic of Korea	10
Malaysia	9
El Salvador	7

Source: UNIDO data base.

6. *Main agrochemical types*

The previous section gave some data about different types of agrochemicals as regards specific crops. This section provides information about the most important kinds of crop protection compounds in terms of scientific classification. The source for data is County NatWest WoodMac.

(a) *Herbicide market: total value of approximately $9.2 billion in 1988*

Triazines. These are the biggest-selling herbicides, with 1987 sales of $1.58 billion. They are applied to soil and can give selective weed control for a number of crops including maize (the most important crop type for this kind of herbicide) sorghum, sugar-cane and pineapple. Big suppliers include Ciba-Geigy, which makes atrazine, a product launched in 1957. It is well out of patent. Sales of atrazine, made by Ciba-Geigy and by other companies which produce generic copies of the chemical, are estimated to have been $640 million in 1987, making it the world's biggest selling agrochemical.

Ciba-Geigy also makes chemicals related to atrazine which fall into the triazine class including simazine, ametryne and prometryne. Shell, which makes cyanazine, is another leading company. Bayer and Du Pont are also important makers of these chemicals. This type of agrochemical has seen strong growth in the past, but patents on some of the older established triazines have been expiring in recent years, leading to generic copies of the chemicals becoming available at a lower price from companies other than the original developer. Another factor which is expected to reduce sales is heavy competition from rival products. According to County NatWest WoodMac, sales growth rates between 1972 and 1987 were 2.6 per cent a year; sales are expected to decline by 2.7 per cent a year between 1987 and 1990.

Amides. Estimated sales of amides were $1.06 billion in 1987. They are mainly used in maize, soybean and rice and to stop growth of grasses and broad-leaved weeds. The dominant producer is Monsanto. This company in 1966 launched alachlor, which it sells under the Lasso brand name and is the biggest selling amide. Another important amide is Dual (generic name metholachlor) made by Ciba-Geigy. Total alachlor sales are estimated to have been $270 million in 1987, making it the world's sixth biggest-selling crop protection compound. Other suppliers include Bayer, Rohm and Haas, Schering, Rhône-Poulenc and Shell. From 1972 to 1987 it had a growth rate of 6.2 per cent a year, which is expected to decline by 1.3 per cent a year between 1987 and 1990.

Carbamates. Estimated annual sales of carbamates amount to $880 million. It is used for maize, rice, cereals, sugar-cane and sugar-beet. The biggest producer is ICI; others include Schering, BASF, Rhône-Poulenc and several Japanese companies, for example, Kumiai, Nissan, Shionogi. The growth rate between 1972 and 1987 was 3.6 per cent per year and from 1987 to 1990 sales are not expected to change significantly. The main products include Eradicane, Sutan, Ro-Neet, Vernam, Tillam, all sold by ICI. ICI gained these products through its acquisition of Stauffer, a United States company in 1987.

Urea-based herbicides. The market for urea-based herbicides is $770 million a year. Europe and the United States account for virtually all the sales as these chemicals are little used in Japan. Linoron, sold by both Hoechst and Du Pont, is the biggest-selling product, but Ciba-Geigy's product is also important. The chemicals are effective at killing young seedling plants following uptake from the soil as they germinate. From 1972 to 1987 the growth rate was 0.9 per cent a year, and the market is forecast to decline at the rate of 2.4 per cent a year between 1987 and 1990. The biggest urea agrochemical is methabenzthiazuron (brand name Tribunil) sold by Bayer with estimated annual sales in 1987 of $110 million.

Toluidines. Sales of toluidines in 1987 reached $680 million. It is used against weeds attacking soybean, cotton, peanuts and cereals. There are only two major products in this area, Treflan, made by Eli Lilly, and American Cyanamid's Prowl (also marketed as Stomp). Ciba-Geigy and BASF have in the past marketed these kinds of herbicides, but have now ceased to manufacture them. The market grew at 4.1 per cent a year between 1972 and 1987, and is expected to decline at the rate of 3.6 per cent a year between 1987 and 1990. Treflan had sales in 1987 estimated at $320 million, making it the world's fifth biggest selling agrochemical.

Hormone weed-killers. There is a $535 million market for hormone weed-killers, which are widely used in many crop growth areas. The chemicals were invented mainly after the Second World War and are mostly out of patent. The dominant type is 2,4-D. Other kinds are known by their chemical names MCPA and MCPP. Dow Chemical was a major supplier of 2,4,5-T, which has been seriously linked with environmental hazards. The market was stable from 1972 to 1987. Over the next few years a large decline in the market is expected because of competition from other weed-killer types. 2,4-D, market by Vertac and other companies, had sales in 1987 estimated at $210 million, which made it the world's 12th biggest-selling agrochemical.

Diazines. A relatively fast growing class, diazines recorded sales of $525 million in 1987. Sales from 1972 to 1987 grew by 15 per cent a year and are likely to continue growing from 1987 to 1990, but at a lower rate of about 3 per cent a year. There are four major diazine products: methazole (brand name Probe) sold by Sandoz; oxadiazon (Ronstar) sold by Rhône-Poulenc; bentazone (Basagran) sold by BASF; and pyrazolate (Sanbird) sold by Sankyo. It is used to a large degree in rice, cotton, cereals.

Diphenyl ethers. There is a $430 million market for diphenyl ethers. Major products are Blazer sold by BASF, Hoelon (Hoechst) and MO (Mitsui). It is important in the Japanese rice market. Recent weed-killers of this type have included Reflex from ICI, Challenge from Rhône-Poulenc and Cobra from PPG. The market grew at 16 per cent a year between 1972 and 1987 and was forecast to continue to grow from 1987 to 1990 at some 6 per cent a year.

Imidazolinones. Sales of imidazolinones totalled $165 million in 1987. The three main products, all of them developed by American Cyanamid, are imazaquin (Scepter), imazamethabenz (Assert) and imazethapyr (Pursuit). Main outlets are soybeans, wheat and barley. All these products are new to the market; the first, Scepter, was launched only in 1984. They are reckoned to have good growth prospects over the next few years; the estimated sales growth from 1987 to 1990 was expected to be 37 per cent a year. Scepter's sales are thought to be about $150 million a year.

Sulphonyl urea herbicides. Sales of sulphonyl urea herbicides amounted to about $200 million in 1987. The dominant material is chlorsulphuron (Glean), which is made by Du Pont, the discoverer of this class of agrochemicals. Du Pont put Glean on the market in 1982 and has followed this up with a number of other chemicals of the same class; for example, Classic, Canopy, Gemini, Londax, Oust, Express, Harmony, Ally. Sales growth from 1987 to 1990 was expected to be about 22 per cent a year. This product is mainly used on wheat, barley and soybean.

Quaternary ammonium products. The main chemical in this group is paraquat, brand name Gramoxone, sold by ICI. This is a non-selective weed-killer, which kills all plants, but is deactivated by soil and so has no long-lasting effect. Hence crops can be successfully grown after weed removal with the material. Paraquat is the world's fourth biggest-selling agrochemical with sales of $440 million.

Glyphosate-type materials. The main product in this category is Roundup, sold by Monsanto, which is the second biggest selling crop protection compound. Annual sales are about $620 million. Like paraquat it is non-selective. It is also non-residual, and can be used with a variety of crops. A material related to Roundup is gluphosinate (Basta), which Hoechst has started marketing over the past few years.

(b) *Insecticide market: total 1988 sales of $5.8 billion*

Organophosphates. The organophosphates market was worth $2.2 billion in 1987, or about a third of total annual insecticide sales. There are about 80 well-known materials sold as insecticides which belong to this category. There are some doubts about their application due to environmental and handling problems which result from their relatively high toxicity in large doses. They are used with virtually all the main crops. The biggest selling compound is methyl parathion, a chemical first sold in 1947 which is now marketed by a variety of companies, including Bayer. Sales of organophosphates in 1987 estimated at $480 million, giving it the position of the world's third biggest selling agrochemical. Another big selling organophosphate is chloropyrifos (Dursban) sold by Dow Chemical. Leading manufacturers besides Bayer include Sumitomo, ICI, Monsanto and American Cyanamid. Estimated annual sales from 1972 to 1987 increased at approximately 3.3 per cent a year and they were expected to grow at 1.2 per cent a year from 1987 to 1990.

Pyrethroids. Sales of these materials, which are applied to cotton and fruit and vegetables crops in particular, amounted to $1.5 billion in 1987. FMC, Shell, Sumitomo and Roussel Uclaf are among the major manufacturers. These materials are based on natural substances in the form of pyrethrum powder extracted from the heads of certain flowers belonging to the chrysanthemum family. Big-selling compounds of this type are deltamethrin (Decin) sold by Roussel Uclaf and fenvalerate, which is sold under a variety of trade names by Sumitomo, Du Pont and Shell. Other important pyrethroids include Karate from ICI, Rody and sumi-Alpha from Sumitomo, Mavrik from Sandoz, and Baythroid from Bayer. The materials first went on sale in the 1970s and have had good growth rates. Annual growth rates from 1987 to 1990, in terms of sales, are likely to be about 8 per cent, according to estimates.

Carbamates. The market for carbamates in 1987 was $1.3 billion. The main manufacturers include Rhône-Poulenc, FMC, Du Pont, Mitsubishi, Sumitomo, Hokko and Bayer. The biggest selling product is Sevin, orginally sold by Union Carbide. The product became the property of Rhône-Poulenc after the French firm bought the agrochemical interest of Union Carbide in 1987. Sevin was the material made at the Bhopal plant of Union Carbide in India which suffered a catastrophic accident in 1984, killing 2,000 people when a cloud of isocyanate gas used in the production process escaped from pipework. Sales in this branch grew at an average rate of some 3 per cent a year from 1972 to 1987. A growth rate of about 1.4 per cent a year was expected from 1987 to 1990.

Organochlorine compounds. Annual sales of these compounds amount to about $500 million. Very cheap compounds were developed after the Second World War and their use grew strongly in the 1950s. But since then they have been associated with environmental problems due to toxicity. Nowadays little is used in developed countries for this reason. The materials were used especially intensively on cotton and maize. Chemicals include DDT, toxaphene, lindane, aldrin, chlordane and endrin. Shell, Velsicol and Rhône-Poulenc are among the makers. Sales are expected to decline markedly over the next few years.

Avermictin Bla. This compound is a bio-pesticide obtained from streptomyces avermitilis. It has a very high level of insecticidal, acaricidal and nematicidal activity.

(c) *Fungicides: total market value of $3.8 billion in 1988*

Dithiocarbamates. Sales of these commodity chemicals widely used by many manufacturers were around $810 million in 1987. Used against potato blight and other diseases affecting a wide range of fruit and vegetables, the biggest-selling product is Maneb, sold by Du Pont and others, sales of which amounted to some $260 million in 1987, making it the seventh biggest-selling agrochemical. Other important suppliers incude Rhône-Poulenc, Rohm and Haas, Montedison, Bayer, Hoechst and BASF. Sales have been growing slowly in recent years, but, as the market has matured, are expected to decline in the 1990s.

Inorganics. Sales of inorganics, which are especially important for fruit and vines, amounted to some $600 million in 1987. Many of these compounds contain sulphur and copper. Its main producers include Rhône-Poulenc, Sandoz and CP Chemical. The market has been stable or in decline in recent years.

Benzinidazole. The market for benzinidazole, which is used widely in orchards, vineyards and fields containing cereals, sugar-beet and soybeans, amounted to around $550 million in 1987. Benomyl (Benlate) sold by Du Pont is the most important fungicide in terms of sales, with estimated annual sales of some $280 million. Hoechst, BASF and Nippon Soda are also important suppliers. There have been some problems with these chemicals from an environmental point of view. The market grew very fast between 1972 and 1987, at 10.6 per cent a year, and was expected to continue growing, but at slower rate, at some 4.7 per cent a year between 1987 and 1990.

Triazoles. Sales of triazoles, which are used in a variety of crops including cereals, fruits, vegetables and vines, amounted to $385 million in 1987. The main products include Bayleton, Baycor, Baytan, Bayfidan, all sold by Bayer; Sonax and Topas, sold by Ciba-Geigy; and Radar and Impact, sold by ICI. Triazoles launched recently include Punch (Du Pont) and Systhane (Rohm and Haas). Bayer is estimated to account for about two thirds of total sales in this group, according to estimates. These products were developed only in the 1970s, and the sales growth is expected to be good in the 1990s.

Organophosphorus materials. Sales of these materials, used especially on rice, vines, citrus and vegetables, amounted to $270 million in 1987. There are just four big-selling products in this category. They are Kitazin, sold by Kumiai; Curamil, sold by Hoechst; Aliette, sold by Rhône-Poulenc; and Hinosan, sold by Nihon Tokushu Nohyaku Seizo, a Japanese affiliate of Bayer. Sales grew from 1972 to 1987 at about 6 per cent a year, and are expected to continue growing over the next few years.

7. *Research and development*

When agrochemicals first became important after the Second World War relatively little was spent on research and development. The materials were largely simple chemicals produced using uncomplicated manufacturing processes. Today the situation is quite different. The aim increasingly in the agrochemicals business is to find new materials capable of destroying weeds, insects or fungi which will have an effect as good as, or better than, past generations of the materials, but which have lower toxic effects and which can be applied in smaller doses to minimize environmental problems. Another aim is to make the chemicals more selective, so that they have an effect only on specific kinds of weeds or other organisms. In recent years, regulations covering the use of agrochemicals have become far more stringent in many developed countries and also in some developing countries. That has compelled manufacturers to conduct more detailed and lengthy trials to test the suitability of agrochemicals and to ensure that environmental problems are minimized. All these factors push up research and development costs. Nowadays these can easily account for some 10 per cent of turnover of agrochemical companies. The research costs apply not only to the task of finding new products, but also to modifying existing products to make them appropriate for new kinds of applications; for example, for use in different crop types or for fighting new kinds of pests.

The research and development process in many agrochemical companies is extremely laborious. For example, at Bayer, researchers test some 14,000 new compounds each year for efficacy against specific crop types. The work is done either in glasshouses where different strains of crops can be grown for testing with novel chemicals or, for larger scale tests, in fields. The costs of this work, in terms of developing new compounds, can be very high. For instance, it can easily take $60 million and about eight years to develop a new agrochemical from scratch, carry it through the necessary trial procedures intended to demonstrate acceptable lack of toxicity and environmental problems, and then put in on the market at a suitable price for farmers to buy the material in reasonable quantities.

New types of analytical instruments, for example, mass spectrometers or highly powerful microscopes, can be used to spot tiny quantities of material. This can be useful in the development work. In this way, for instance, researchers can detect tiny quantities of agrochemicals which may remain on crops after they are harvested and turned into food, and which may (depending on the specific toxicology characteristics of the chemical) be harmful to health.

Probably about a quarter of the total cash spent on research and development work in agrochemicals is for pure scientific research, the rest being devoted to development trials. In the pure research area, scientists are trying to come up with new basic methods of interfering with plant growth action to optimize yields. It helps here to understand the basics of how most agrochemicals work. Most weed-killers contain chemicals that stop the operation of vital biological fragments such as enzymes that are contained in plant or animal cells. These are needed if specific weeds or other plants are to grow. In this way, for instance, an agrochemical might bind to a particular chemical site on a specific enzyme. The enzyme might be one that is linked with the process in a plant or weed that takes nutrients from the soil and turns these into energy. The action of the chemical would be to block the site, thus preventing the enzyme from connecting up in a chemical reaction to a protein molecule. That would have the effect of stopping the work of the enzyme. As a result, the plant would gain the energy it needs to grow. In this way the development of the plant or weed would be severely slowed down.

The researcher will obviously want to stop the growth of a weed, but would hope that the crop intended to be protected would be allowed to grow unimpaired. The chances are that the chemical the researcher comes up with will have a blocking effect on enzymes involved with the development process of both the weeds and the crops, in which case all would suffer. The trick here is to select, for blocking, an enzyme which is highly important in a weed but (because of the different growth characteristics and metabolic behaviour of different agricultural specimens) is not so important in the crop the researcher wants to grow normally.

For insecticides or fungicides, the strategy is different. The mode of action in this case is connected with the pest or fungus that poses a nuisance to the crop. It could be that the chemical interferes with enzymes or other biochemicals linked to the successful development of those organisms.

The above is a rough explanation of how many of today's agrochemicals work. It does not, however, describe how most of them have been developed. Until almost the mid-1980s there was virtually no possibility of a scientist designing an agrochemical to work in the way described. Most agrochemicals developed in the past few decades have come to light by a hit-and-miss technique. Researchers mainly have stumbled upon these materials using a trial process to screen thousands, if not millions, of known synthetic chemicals or natural substances for activity in inhibiting a known weed, bug or disease. If they find there is significant activity of this sort, they go on to further stages in development procedures, perhaps modifying the chemical in some way to make it more efficient or reduce any toxic side-effects. Only after the substance has been shown to work do the scientists come up with theories—involving mechanisms such an enzyme action—explaining how it works.

In recent years the nature of the research process has changed. Rather than looking for new chemicals in this random manner, scientists are more concerned with designing compounds to do a specific job. This is summed up under the general title of the customized product approach. Similar trends are also evident in drugs industry research. Scientists have been helped in this general trend by biotechnology, which in recent years has become a powerful tool in agrochemical (as well as pharmaceutical) research and development. Biotechnology is the umbrella term for a wide range

Table IV.127. Pesticide research and development expenditure by major companies, 1986

Company	Agrochemical sales (millions of dollars)	Agrochemicals research and development (millions of dollars)	Research and development (percentage of own sales)
Bayer	2 380	195	11.5
Ciba-Geigy	1 780	148	11.3
Rhône-Poulenc	1 105	86	10.2
Monsanto	1 067	94	9.2
ICI	1 040	86	10.5
Shell	1 005	76	11.9
BASF	925	84	11.2
Hoechst	890	98	14.2
Du Pont	780	84	12.7
Dow	770	68	10.0
Schering	640	62	15.9
Am. Cyanamid	458	45	10.8
Sandoz	422	40	15.1
Stauffer	405	40	10.8
Eli Lilly	389	45	12.7
Kumiai	350	22	8.8
Rohm & Haas	347	34	11.0
FMC	340	48	16.0
Union Carbide	300	32	12.8
Sankyo	290	16	13.4

Source: Wood-Mackenzie & Co. Ltd., Agrochemical Service.

of scientific techniques, mostly invented during the past 10 years, for understanding the nature of, and manipulating, gene fragments in plant or animal cells. Using biotechnology methods, a researcher can thus pinpoint aspects of the genetic make-up of the materials in plant cells that control the growth of plants. He can then design a chemical that will interfere with this activity in a set way—such as by blocking sites on enzymes in the fashion described above. In a similar way, parts of the proteins and other biological fragments which control the increase of pests that a researcher wants to destroy can be interfered with to stop biological growth and reduce hazards to crops that the pest might eat or otherwise damage. Scientific tools important for this purpose include computerized modelling equipment, which help researchers to design novel compounds that can be tailored to attack specific parts of the biological fragments. Table IV.127 indicates how research and development expenditure is allocated by different companies.

8. *Biochemical crop control methods*

Linked with the world of agrochemicals in recent years have been a variety of methods designed to interfere with plant development using biology-based techniques. Some of these ideas stem from the work in biotechnology referred to above. At the root of these ideas are efforts to influence the growth of plants (or to stop the activities of insects and fungi that would have a negative effect on this) by changing the genetic characteristics of plant or animal cells. In this way, for instance, the genetic characteristics of tomato plants could be altered to make them grow more quickly to produce fast ripening fruit. Another example could be to make the plant secrete a specific substance that is toxic to an insect that normally causes the growth of plants to be stunted. Many of the top agrochemical companies are investigating the possibilities of these biochemical crop control methods. In future these might be used either independently or with conventional agrochemicals as part of the drive to improve crop yields.

The interest in this area is intrinsically linked to developments in the seeds industry. Until recently seeds production was a fragmented, low-technology area dominated by companies which had grown out of the conventional agrochemical supply industries. The value of traded seeds production is much higher, because much use of seeds, especially in developing countries, comes from farmers producing seeds for their own consumption on their own farms.

The notion coming from biochemistry and genetic engineering that seeds can be programmed to grow in set ways has, however, led to many changes in the seeds industry. The idea now is for seeds companies to come up with products that are highly tailored packages of genetic material with specific characteristics and which as a result lead to plants with uniform aspects to their development. As a result of these theories, many of the big agrochemicals companies have moved into seeds production in recent years, either through buying existing smaller companies or through internal research and development. Companies which have moved in this direction include ICI, Rhône-Poulenc, Monsanto and Sandoz. Established seeds companies, including two United States companies—Pioneer and Dekalb (which is owned by the pharmaceutical company Pfizer)—have also been investing in biology-based techniques to improve their seeds packages. Smaller companies set up in recent years which could come up with new biology-based methods of plant control include Mycogen, Calgene, Agracetus and Crop Genetics, all of the United States, and United Kingdom companies such as the Agricultural Genetics Company. The trend is also being investigated by big food companies such as WR Grace, Kellogg, Nestlé and Campbell Soup, all of which are looking at biological control techniques as possible ways of developing uniform crops that could be more useful for processing into food.

There is much excitement in the agrochemicals business about the long-term implications of these developments. However, it seems likely that few of the techniques will become widely applied before the next century. This is partly because of the in-built resistance in the agriculture community to new ideas and partly because of the long development times required for many of the new techniques. Many in the agrochemicals industry also point out that it would be impossible from a practical point of view to transfer to plants all the genes that would be required to make them grow in an optimal way. In those circumstances, it will be a very long time indeed, if at all, before the need for agrochemicals is affected by the new ideas.

Many biological control techniques appear to offer the chance of being more environmentally friendly than conventional methods of crop control using agrochemicals. They are more tied in many cases to the use of naturally occurring biological materials which could have a less disruptive effect on the environment. There is a possible disadvantage as well, however. The use of some biological control methods involves the release into fields of some new genetically engineered proteins and other organisms. These could, in theory at least, also interfere with other forms of life—for example mankind or animals—by settling in human or animal cells. For this reason, rigorous safety rules, during the development stage of biological crop control methods, will need to be applied.

In practice, biological crop control methods can be split into the following areas:

Chemical shielding. This applies to methods to make crops resistant to destruction from specific weed-killers. Several herbicides, including Roundup and paraquat, are non-selective. In other words, they kill all plant life, not just the weeds that the farmer wants to destroy, but any crops present on the field. That means a farmer has to be careful about when he applies such materials. They obviously cannot be used when his crops have started to grow, as it leads to inflexibility in application. The idea of chemical shielding is to build into the genetic structure of plants a gene that is resistant to the action of a specific weed-killer. This would operate by, for instance, adding a particular fragment that blocks the action of a part of the chemical chain in the weed-killer which has the effect of stopping crop growth. If this were done, a farmer would be able to spray on the herbicide, confident that only weeds would be killed, leaving the growth of crops protected genetically in this way. Companies doing research into chemical shielding include Monsanto, American Cyanamid, Rhône-Poulenc and Du Pont. The approach is closely allied to seed production because the agrochemical supplier would work closely with a seed developer to ensure that plant seeds of the appropriate type contain the right kind of genetic protection. They would then be used with the specific agrochemical to which they were resistant.

Genetic uniformity. A variation on the above idea is to introduce protection to certain species of a crop. The idea of this would be to ensure that only specific strains of certain plants survived an application of a herbicide, which would kill all the strains a farmer did not want along with any weeds. This would have the effect of ensuring a crop with a uniform genetic make-up, which would be important in food processing and industrial applications. Bayer, of the Federal Republic of Germany, has been doing research along these lines. It wants to ensure that, with oil seed rape, only specific grades of the plant develop. This is important from the point of view of the oil extracted from the crop. Different genetic species produce slightly different oils which may not be suitable for the application the developer of the crop has in mind—for example for use in fragrances, food processing and industrial chemicals. Scientists at Bayer think they may be able to make strains of rape seed that are resistant to Sencor, one of Bayer's big selling herbicides. Spraying this chemical on a field would thus kill all plant life, except for these grades.

Tailored plants. The idea here is to insert genes into a seed that will make a plant grow in a specific way. ICI has had some success in reprogramming tomato plants to produce fruit with ripening characteristics that facilitate canning. For example, they may ripen earlier than normal grades of plant—or produce a fruit that is less squashy than conventional tomatoes. Similar ideas are applicable to many other kinds of fruit and vegetable that have to enter the food-processing chain after harvest.

In-built insect resistance. Attack by insects or fungi is normally combated by spraying agrochemicals. Often the threat to the plant is not so much the insect itself, unless it actually eats up the plant in a significant way, but viruses that it carries. Calgene, a United States company, is one of several biotechnology businesses looking at the possibility of introducing into plants like cotton segments of biological material that make them resistant to attack by insects such as the boll-worm. A variation on this is to introduce a gene that will confer protection against particular viruses that an insect may carry. That is similar in principle to vaccinating people against viral diseases like measles. There is some interest in this approach in protecting plants against diseases such as sugar beet yellow.

Novel modes of attack. This involves engineering through biological processes novel types of chemicals to have the same effect as conventional agrochemicals but which use a different approach. The new approach may well be particularly effective. It also attempts to address the problem that many types of existing insecticide and fungicide are not working as well as in the past due to insects or fungi building up resistance to them—in the same way that viruses build up immunity to vaccines. ICI is among several companies interested in using fermentation processes to turn out novel protein-based mixtures of chemicals for such applications. Mycogen, a United States biotechnology company, is working on a new crop control spray comprising a protein that kills caterpillars. The protein is wrapped inside tiny cells made of natural polymers and having very fine dimensions. The material poisons the caterpillars as they break through the cell walls. Mycogen hopes the product will be on the market in the next few years.

Hijacking bugs. This involves harnessing naturally occurring bacteria and other organisms to fight insect attack. Such organisms exist in profusion in nature. The question is how many plant species survive attack of this kind using purely their own resources. The idea is to use these organisms to target specific species. Several companies are working on the idea of injecting into naturally occurring bacteria a gene from another bacterium called *Bacillus thuringienis*. This bacterium exists naturally. It makes a toxin to kill corn borers, insects that damage maize growth. Similar ideas could be used to combat other types of insects which interfere with the growth of other crops.

Worm application. Agricultural Genetics Company, a small United Kingdom company in which Ciba-Geigy has a stake, is working on insect control strategies involving the use of tiny worms called nematodes. These exist naturally and prey on specific kinds of insects for food. The plan is to breed large numbers of these minute organisms in a selective way and then introduce them to fields to target pests which a farmer wants to destroy.

9. *Manufacturing capacity of developing countries*

Developing countries can be classified according to the stage of development of their pesticide industry (see table IV.128).

(a) *Countries without manufacturing facilities*

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

Table IV.128. Classification of countries according to their pesticide manufacture possibilities

Countries without manufacturing facilities	Countries with formulation plants	Countries or areas with pesticide chemical production
Angola	Bangladesh	Algeria
Benin	Bolivia	Argentina
Botswana	Burundi	Brazil
Central Africa	Cameroon	China
Cyprus	Chile	Hong Kong
Equatorial Guirea	Cameroon	India
Gabon	Chile	Indonesia
Gambia	Colombia	Mexico
Guinea	Costa Rica	Republic of Korea
Guyana	Côte d'Ivoire	Thailand
Honduras	Cuba	Turkey
Kampuchea	Dominican Republic	
Lebanon	Ecuador	
Malawi	Ethiopia	
Mauritania	Egypt	
Mongolia	Ghana	
Mongolia	Guatemala	
Mozambique	Iran (Islamic Republic of)	
Namibia	Iraq	
Niger	Jamaica	
Senegal	Jordan	
Somalia	Kenya	
Togo	Libyan Arab Jamahiriya	
Uganda	Madagascar	
Uruguay	Malaysia	
United Arab Emirates	Morocco	
	Myanmar, Union of	
Western Sahara	Nigeria	
Yemen Arab Republic	Pakistan	
Zambia	Sri Lanka	
Zimbabwe	Syrian Arab Republic	
	Tunisia	
	Tanzania, United Republic of	
	Viet Nam	
	Zaire	

Source: [146].

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 an 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 belonging to this group indicates 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. 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 world-wide marketing.

(e) *Countries with capabilities for world-wide 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.

10. The future

Agrochemicals companies generally are fairly optimistic about the 1990s, which they reckon should see growth restored to an industry that was somewhat stagnant in the mid-1980s. That would mean total sales of agrochemicals rising by several per cent a year on the current total revenues of some $20 billion annually. Newer, more environment-friendly crop protection compounds, aided by the slow introduction of the novel biological crop control methods, should give a boost to the industry. Much, however, depends on the state of farming generally around the world. In Western Europe and the United States, agriculture has been in difficulties for much of the 1980s because of over-production and problems involving government payment methods for crops. The problems were made worse by the 1988 drought in the United States. There should be significant growth in developing countries, particularly China, India and other Asian countries. Elsewhere, Eastern Europe and countries in South America like Argentina and Brazil are expected to become more self-sufficient in food production, and hence their use of agrochemicals would increase.

I. Plastics industry (ISIC 3513)

Polyethylene, polypropylene, polystyrene, polyvinyl chloride

Basic monomer raw materials: ethylene, propylene, styrene, vinyl chloride and advanced plastics materials

1. Current situation

(a) *World consumption in 1988*

In 1987 and 1988 consumption and production of major bulk thermoplastics soared, showing double-digit growth rates that have not been easy to explain in an industry generally considered to have matured. It seems that basic plastics used in household and industrial goods have a greater substitution potential than previously recognized and consumption reacts very strongly to an economic upturn. Generally, 1988 was characterized by supply shortages world-wide for the second year running. In response to this situation, and thanks to the increasing profits accruing from plastics production, many companies in the North and South are investing in new capacity which will be on stream in the early 1990s. But the boom cycle is considered to have peaked and by then demand growth, it is anticipated, will have slowed. Thus, the plastics industry may again be characterized by overcapacity and poor profitability, as in the early 1980s.

The plastics industry continued to expand in 1988 at rates far ahead of general economic growth. Consumption of the five major commodity plastics materials (low density polyethylene, including linear polyethylene; high density polyethylene; polypropylene; polystyrene; and polyvinyl chloride) exceeded forecasts in both North and South. As is frequently the case, comprehensive statistics are only available for the North. For the South, occasional country-by-country production and consumption figures can be found. In all cases the consumption of plastics is increasing rapidly, spurred by the rapid industrialization of many developing countries, and the role played by the various plastics materials in construction and packaging and other aspects of everyday life. Production is also displaying an increasing shift towards the South, as many countries build plastics units as part of an integrated chemical industry. Sometimes such projects are based on the supplies of hydrocarbon raw materials, as in North Africa and Western Asia, Eastern Europe, Indonesia, Venezuela, and other oil- or gas-rich areas. In some cases, projects are mainly inspired by an urge to industrialize, for example, in the cases of Brazil, the Republic of Korea and Taiwan Province. In rapidly developing East Asia a longer term problem may be a shortage of naphtha, the oil-derived raw material on which plastics are ultimately based.

(b) *Consumption figures for the North in 1988*

For the fourth consecutive year, consumption of commodity resins and engineering plastics saw considerable gains in Western Europe, averaging 9 per cent for the five high-volume resins named above. In Japan, consumption increases averaged 8 per cent for the same five plastics. In the United States, as expected, consumption growth slowed, registering a 4 per cent growth over the previous year, which had seen an exceptionally high increase of 9 per cent. Within this scenario, there was a slightly different emphasis according to product and region (figure IV.29).

In Western Europe, for which only consumption figures were available at the time of writing, the highest growth occurred in polypropylene (12.9 per cent). This product has typically enjoyed the greatest expansion, being the newest polymer and thus still penetrating new markets, although in 1987, somewhat surprisingly, high-density polyethylene was at the top of the growth league. During 1988 the latter polymer registered a growth of 10.6 per cent. Polystyrene showed unusually high consumption growth of 7.7 per cent, mainly due to a rise in packaging film and sheet. The group of low-density polyethylenes showed a moderate growth of 4.1 per cent. This was entirely due to the expansion of markets for the relatively young linear low-density film grades. Consumption of non-linear polyethylene was virtually stagnant. Despite environmental pressure over links between cancer and food contact with polyvinyl chloride, this plastic saw a healthy growth of 6.6 per cent over 1987.

In Japan, in total contrast to Europe, low-density polyethylene was the star performer among the commodity plastics, showing a production growth rate of more than 14 per cent. The increase was due to a marked rise in demand for plastic film, and an almost doubling of exports. Polypropylene saw growth in production of 9.6 per cent, polystyrene 8.5 per cent, polyvinyl chloride 5.9 per cent and high-density polyethylene 6.35 per cent.

In the United States, total resin sales at just over 4 per cent were only slightly above growth in gross national product. Rather than indicating a downturn in plastics consumption, however, it seems that consumption was restrained by capacity limitations. Actual demand in the United States was slightly higher, rising by 5.3 per cent. Low-density polyethylene sales rose by 2.6 per cent, polyvinyl chloride by 2.9 per cent, high-density polyethylene by 1.1 per cent, polypropylene by 8.7 per cent and polystyrene by 5.6 per cent [148].

(c) *Factors accounting for the higher consumption*

There have been many attempts to explain the high plastics consumption figures of recent years. The spending boom in developed countries on products such as television sets and audio equipment has increased demand for component casing as well as packaging materials. Such demand is unlikely to be sustained and represents a form of stock-building. Increased use of plastics in the automotive industry, construction, food and drink packaging, the agricultural sector, sewage pipes and infrastructure development are all sources of increased consumption. Frequently plastics are replacing traditional materials such as glass or steel, where their lighter weight allows for energy-saving. The reduction in cost of basic plastics after the drop in oil prices since 1982 has spurred substitution. Often plastics substitute other members of the basic polymers group.

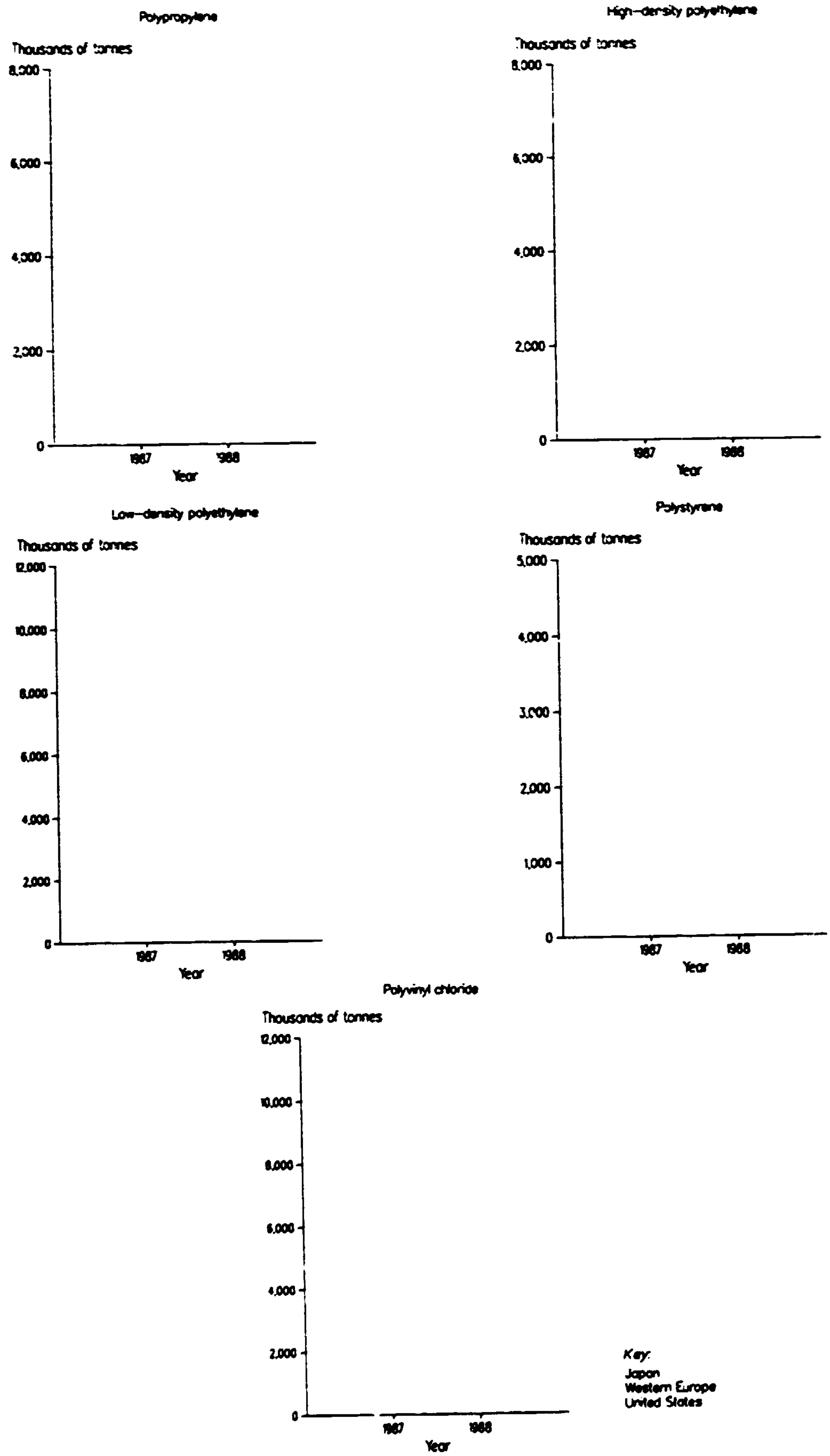
Generally growth is measured in terms of penetration into new applications, or substitution, plus the growth of applications into which the product has already penetrated. The latter is usually measured by an index of industrial production. Because plastics growth has outperformed expectations from these two indicators for two years at least, chemical economists have revised their views on certain aspects of demand growth. Many say the substitution factor is greater than first thought. Generally stock-building is dismissed as a cause of inflated demand, as stocks of polymer have not been evident on the warehouse floor during the period of shortages. Shell Chemical Company, however, has introduced a theory of inventory-building along the polymer stock chain to explain why demand expectations in developed countries based on traditional indicators have been thwarted. In the case of low-density polyethylene, for example, this would include product at the converter, packaging film at the converter, film at the manufacturer, goods wrapped in film at the manufacturer, goods in shipment and those at the retailer or wholesaler plus the polymer used in wrapping those goods etc. Shell says history shows the cumulative stock effect can be as much as plus or minus 10 per cent. Industry can be in stock growth for a number of years as it appears to be at present, and it is difficult to predict when destocking will commence. Thus use of apparent prevailing demand indicators to project future demand can be dangerous, the company warns. The projected decline of plastics demand in Western Europe is illustrated in figure IV.30.

(d) *Demand in terms of end use*

In terms of individual products, in Western Europe approximately 80 per cent of the 7 million tonnes of low-density polyethylene sold is used in film applications. Demand for stretch wrap was particularly high, rising 10 per cent, while other food applications also increased. In contrast there was no growth in pallet shrink wrap or use in sacks and heavy duty bags. The past five or six years have seen considerable investment in packaging applications for polyethylene; for example, aseptic packaging for food protection. Demand for high-density polyethylene reached 2.55 million tonnes. Some 70 per cent goes into consumer packaging and the other 30 per cent into industrial packaging [149].

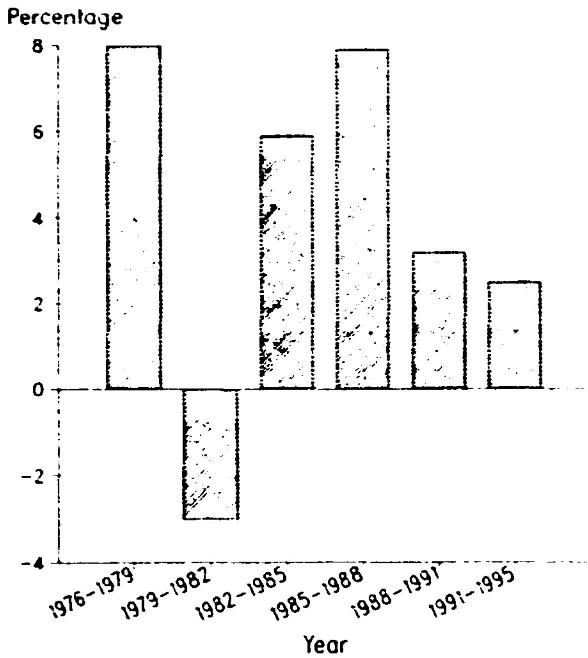
Polypropylene consumption reached nearly 3 million tonnes in Western Europe. Packaging is consuming more and more product, but so is the textile industry, where polypropylene use in carpets saw considerable growth at the expense of nylon. Moulding applications also grew last year, and high growth was recorded in

Figure IV.29. Plastics sales in 1988



Source: Modern Plastics International

Figure IV.30. West European plastics demand evolution, 1976-1995



Sources Chem Systems International, and Enimont

the automotive market, with new developments introduced, for example, by Fiat.

The market for polyvinyl chloride reached 4.9 million tonnes in Western Europe. Building and construction accounts for around half of polyvinyl chloride usage, with window frames and pipes being a particular market. Special injection moulding compounds such as those used in television and computer housings showed increased sales, as did the packaging market. In fact, around 20 per cent of polyvinyl chloride usage was in bottles and rigid film or sheet for food packaging, despite the worries over migration of carcinogenic plasticizers from polyvinyl chloride into foodstuffs.

Polystyrene saw the highest growth rates in Western Europe since the 1970s, with consumption reaching 1.62 million tonnes. There was strong demand for packaging from the audio and video sector of the consumer durables markets, and there was some replacement of the more expensive acrylonitrile benzene styrene polymer resin in certain applications such as data processing and telephone equipment and other appliances. Competition with polypropylene in packaging applications was reduced. Meanwhile, in the United States in particular, the market for oriented polystyrene sheet grew rapidly. This light, tough, clear material is a replacement for polyvinyl chloride in some cases.

Comprehensive figures are not available for the markets of the South but as a general indicator, total demand for major plastics in Taiwan Province grew by 14.3 per cent in 1987, following 28.5 per cent growth in 1986. Total demand was 1.92 million tonnes. Annual growth of demand in the Republic of Korea from 1987 to 1997 is projected to be 7.3 per cent per year for low-density and linear low-density polyethylene, 8.6 per cent for high-density polyethylene, 5.8 per cent for polypropylene, 8.2 per cent for polyvinyl chloride and 7.9 per cent for polystyrene and acrylonitrile benzene styrene. East Asian markets in general showed strong expansion during 1988, although towards the end of the year spot supplies of plastics moved into surplus, mainly as a result of reduced purchasing by China. In South America, overall demand growth rates were from 7 to 10 per cent. A slight fall in demand on domestic markets was compensated for by booming export demand.

(e) *Trade in bulk plastics*

The pattern of trade is shifting significantly in favour of the South and centrally planned economies. Expressed in terms of ethylene equivalent, Western Europe's share in world net chemical trade has been declining sharply since 1986, as has that of Japan. North Africa and Western Asia has become a large net exporter, while the import requirement of the East Asian and Latin America is on a downward track. By 1995, Western Europe's substantial trade surplus in ethylene-derived plastics (700,000 tonnes) will have declined to a deficit of 100,000 tonnes.

Although comprehensive world trade statistics are not available for 1988, a review of trends in the United States, plus selected reports for other areas, are presented below.

United States trade in plastics improved further in 1988 according to the United States Department of Commerce. The surplus of exports over imports rose by 41 per cent from 1986 to 1988 to an estimated $2.7 million. Exports in 1988 increased by 3 per cent following a gain of 32 per cent in 1987. The largest markets were Canada, representing 14 per cent of the total, Mexico, 8 per cent and Japan, 7 per cent. Imports rose an estimated 8 per cent in 1988, compared with a gain of 14 per cent in 1987. The leading suppliers were Canada, with 27 per cent of imports, and Japan, with 21 per cent.

Another region of plastics trade which always attracts international attention is that between the Arab Gulf countries and the rest of the world, particularly Western Europe. As detailed in *Global Report 1988/89* ([2], p. 204), trade in plastics between the member countries of the Gulf Co-operation Council (GCC) and the EEC has become a political issue. A large new basic petrochemicals industry has emerged in the North Africa and Western Asia region, notably in Saudi Arabia, accounting for some 5 per cent of world capacity Among some of the main export-oriented products are basic plastics, sold primarily to relatively nearby markets in Europe. A duty is charged on the imports once a small duty-free quota allowed under the Generalized System of Preferences is exceeded. The Gulf Co-operation Council is negotiating a bilateral preferential trade deal to allow duty-free access for a wide range of goods between the EEC and the Gulf states, petrochemicals being the main focus of the deal from the Arab side. Even though plastics were in short supply world-wide in 1987 and 1988, the European plastics industry opposed moves by the EEC to allow duty-free access, mainly because it is anticipated there will be a slackening in market demand in 1989 and beyond, making imports into Europe once more unwelcome.

In November 1988, the EEC took steps to limit and eventually terminate duty-free import quotas for polyethylene from Saudi Arabia under the Generalized System of Preferences. Polyethylene exports from GCC countries to the EEC in 1987 represented just 3 per cent of the EEC total capacity of 7.2 million tonnes, but most of the sales were of linear low-density polyethylene, and those exports represented 22 per cent of the (still quite small) EEC capacity. However, EEC capacity is set to rise sharply, from 600,000 tonnes in 1987 to 1.6 million tonnes by 1992, reducing the share taken by imports.

According to the consultant Chem Systems International, there will be a significant shift in regional trade in polyethylene in the 10 years from 1985 to 1995. The picture in 1985 for the three types of high-density, low density and linear low-density polyethylene was one of large exports of low-density and high-density polyethylene from the United States and Western Europe, each region exporting around 400,000 tonnes of the former, and from 200,000 to 400,000 tonnes of the latter. Both regions imported linear low-density polyethylene, while North Africa and Western Asia was a growing exporter of all types. The rest of Asia represented a large importer, taking 800,000 tonnes of low-density polyethylene, 380,000 tonnes of high-density polyethylene and 180,000 tonnes of linear low-density polyethylene.

By 1995, exports from the United States and Western Europe (see above) will have fallen considerably, at the expense of growing exports from North Africa and Western Asia and reduced imports by the rest of Asia. Under a high oil price scenario, polyethylene exports from the United States and Western Europe, based on expensive oil products, will shrink even more, and products based on cheap gas in North Africa and Western Asia and East Asia will be even more competitive.

The United States is generally still holding up as an exporter of all product types, although imports were up dramatically for high-density polyethylene (60 per cent), polystyrene (28.6 per cent) and polyvinyl chloride (247.1 per cent). Polypropylene imports fell by 36 per cent, probably as a result of plant start-ups in the United States. In Western Europe exports declined for all plastics in the face of shortages at home, and imports only rose for high-density polyethylene and polypropylene. In Japan, polypropylene exports were up noticeably, but for polyvinyl chloride and high-density polyethylene, both exports and imports declined. Low-density polyethylene exports were up 7 per cent.

2. *Manufacturing capacity*

(a) *Capacity additions in developed and developing countries*

As already mentioned, shortages in plastics supply has prompted a new wave of investment plans throughout the world. The pace of investment in developed countries is slower than in the South, but there are plans by major companies for new plastics plants in the United States and Western Europe, and a phenomenon known as "capacity creep" is extending the production limits of many existing plants. In Japan, developments mainly centre on restarting idle capacities moth-balled under the severe capacity cut-backs of the mid-1980s.

Generally, it may be considered in retrospect that capacity cuts were over-zealous for all products, and had the market demand of 1987 and 1988 been properly anticipated, they would have been less severe. Although shortages persist for the time being, many doubt whether the markets will be sufficiently large in the 1990s to absorb the extra output from all new plants under construction or proposed. Some of the older plants in the North do need replacing and this will involve some restructuring in the early 1990s when oversupply begins to become apparent.

According to projections by Morgan Stanley, between 1988 and 1992 Europe's capacity for polyethylene will increase by 18 per cent, for polypropylene by 40 per cent, for polystyrene by 8 per cent and for polyvinyl chloride by 6 per cent. In the United States, capacity increases during the same period will be 27 per cent for polyethylene, 51 per cent for polypropylene, 16 per cent for polystyrene and 15 per cent for polyvinyl chloride (see table IV.129).

New producers in North Africa and Western Asia, East Asia, Latin America, Eastern Europe and the USSR, Tropical Africa and other regions will increase their capacities by the following amounts: polyethylene, 69 per cent; polypropylene, 246 per cent; polystyrene, 365 per cent; and polyvinyl chloride, 118 per cent.

As a result, between 1988 and 1992, world capacity for polyethylene could increase by 24 per cent to 36 million tonnes, polypropylene by 59 per cent to 16 million tonnes, polystyrene by 17 per cent to 10.3 million tonnes and polyvinyl chloride by 16 per cent to 21.5 million tonnes. Demand will not be able to keep pace with such increases, and from a position of full capacity utilization, operating rates will fall back.

Table IV.129. United States plastics capacity additions, 1988-1992
(Thousands of tonnes)

Product	1988	1989	1990	1991	1992	Total
Polyethylene	640	710	941	199	..	2490
Polypropylene	492	501	118	181	68	1360
Polystyrene	254	181	54	..	..	489
Polyvinyl chloride	204	177	426	..	..	807

Source: Chemical Matters, November 1988.

(b) *Global capacity utilization*

Capacity utilization at plastics plants was even higher in 1988 than in 1987, averaging around 91 per cent for the five bulk thermoplastics and running at around 89 per cent for polyethylene, 83 per cent for polystyrene, 93 per cent for polyvinyl chloride and 102 per cent for polypropylene. But as stated already, increases in consumption are not expected to keep up with capacity expansions. Thus it is anticipated that by 1992 capacity utilization of plastics units will have dropped to 85 per cent for polyethylene and polypropylene, 82 per cent for polystyrene and 88 per cent for polyvinyl chloride. New plants in the South might generally be expected to operate at higher rates than those in the North, thanks to greater availability of on-site polymer raw materials derived from natural gas. Those developing countries and areas without indigenous hydrocarbon raw material supplies (notably, the Republic of Korea and Taiwan Province) could be at a disadvantage, however, as the raw material naphtha becomes scarce. Taking polyethylene as one example, capacity is expected to be persistently above consumption up to and beyond the year 2000 (see figure IV.31).

3. *Restructuring and redeployment*

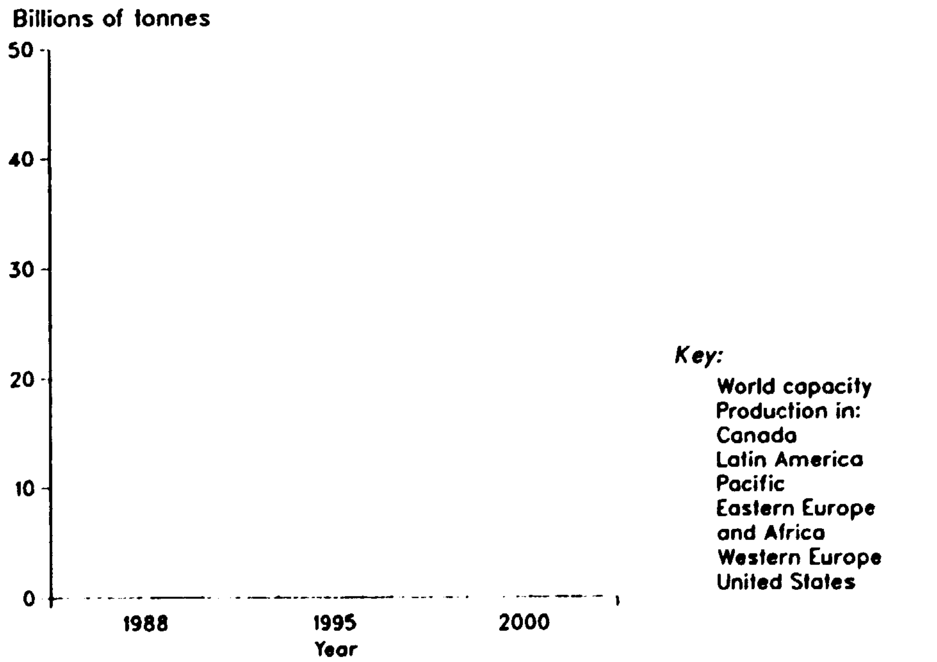
(a) *Structure of production costs*

By far the largest element in the cost of production is the monomer raw material price. During 1987 and 1988 this has been high, as strong demand drove up price levels for ethylene, propylene, styrene (made from ethylene and benzene) and vinyl chloride monomer, the basic raw materials for polyethylene, polypropylene, polystyrene and polyvinyl chloride. The high monomer price prevailed despite the relatively low price of oil, and the profit margins on the monomers were high, frequently higher than on the plastic resins they were used to produce. For the latter, however, soaring world demand inspired price increases in 1988 of some 20 per cent above the already high levels of 1987. Utilities, other cash costs and general overheads for plastics plants are a low proportion of the total production costs, the units being generally capital-intensive rather than labour-intensive. Depreciation and financing costs can run at about twice the raw material costs for a brand-new unit, and these can be a major consideration for companies just starting up plants in developing countries.

The economics of running a plastics plant can be crucially dependent on an integrated monomer raw material position. In 1987 and 1988, for example, styrene prices were so high that only polystyrene producers with a captive styrene supply were in a position to make profits. Depending on a company's individual accounting practice, profits will accrue to a plastics unit or monomer unit according to the internal transfer price involved in the shift from one production unit to another.

To take one example in the South, a deficit of ethylene and propylene monomers for plastics production has created problems for companies in the Republic of Korea as import prices are well ahead of domestic levels, putting non-integrated companies at a disadvantage. For example, in October 1988 the domestic price for ethylene was $443 per tonne compared with a cost of $850 per tonne for imported material. The domestic price of polyethylene at the

Figure IV.31. World polyethylene capacity and production by region, 1988-2000



Source: European Chemical News

time was $980 per tonne, making it difficult to operate using imported feedstock.

Broadly speaking, it can be said that many plastics producers in the South have a cost advantage thanks to indigenous supplies of oil or natural gas. But high depreciation and financing costs offset this in the short term, as many plants in the North are fully depreciated.

Utilities costs can be a significant enough factor to influence site selection. For example, Electricité de France, with a surplus of nuclear-generated power to sell, has induced Shell and Exxon to locate a planned new polyethylene unit in France by offering a tailor-made electricity package.

(b) *Company profitability of plastics production*

That plastics production was extremely profitable in 1987 and 1988 is evident in the results reported by companies in both North and South. The Saudi Basic Industries Corporation (SABIC) quadrupled profits in 1987 to 1 billion Saudi Arabian riyals ($266.6 million), and sales revenues doubled to 8 billion Saudi Arabian riyals. Among the most successful of the company's products is polyethylene, which saw a 50 per cent increase in price in the second half of 1987. In 1986, in contrast, prices were at rock bottom, and the company was being forced to sell at cash cost despite huge overheads on its brand new plants. Table IV.130 provides data on the leading plastics companies in the South.

In the North, the top 10 chemical companies in 1987 were all, apart from one, heavily dependent on good returns from their plastics business. All had record results. British Petroleum Chemicals, one of the world's leading producers of polyethylene, increased profits by 126.4 per cent in 1988. Return on capital was 31 per cent in comparison with 5 per cent in 1984. In the case of ICI, another United Kingdom company which has been trying to move away from cyclical products such as plastics towards drugs and agrochemicals, plastics and petrochemicals in 1988 contributed 27 per cent of overall profits and a 30 per cent profit increase over the previous year.

(c) *Role of Governments in industrial development*

In both North and South there has been a tendency for Governments to reduce their holdings in the plastics industry, although new plant construction in developing countries is generally under overall government control even if wide private sector participation is invited. Argentina's so far unsuccessful efforts to divest government holdings in the chemical industry has been mentioned above, as has Colombia's general tendency to leave plastics industry development to the private sector. In many South-East Asian countries the policy is for Governments to control upstream or basic petrochemicals production, allowing private and foreign firms to participate in downstream plastics plants. Incentives such as tax holidays or cheap utilities are still frequently offered to attract foreign investment.

4. *Plastics industry by region*

(a) *Latin America*

Among the Latin American countries, Brazil and Venezuela have been most active in building up plastics production capacity, although many plans are being laid in Argentina without much real development. The region is still a net importer of plastics and petrochemicals, but huge investment projects under way could make it an overall exporter by the

Table IV.130. Leading plastics companies in the South, 1988
(Millions of dollars)

Company	Country or area	Sales[a/]	Profit	Net assets
Yukong	Republic of Korea	2 851	66.3	1 286
Sabic	Saudi Arabia	2 122	266.6	6 292
Nan Ya Plastics Corporation	Taiwan Province	1 045	58.9	862
Lucky	Republic of Korea	839	32	820
Copene	Brazil	800	160	1 000
Formos Plastics Corp.	Taiwan Province	700	55.9	649
Indian Petro-chemicals Corp.	India	493	42	..
Copesul	Brazil	569	65	397
Petroquimica Uniao	Brazil	421	100	415
Korea Plastics	Republic of Korea	232	6.6	182
Pequiven	Venezuela	216	75.7	565
Polioefinas	Brazil	262	62	107
Vulcan	Brazil	177	9.9	45

Sources: South, August 1988; European Chemical News, 16 January 1989; Chemical Week, various issues; and Chemical Matters, 22 December 1988.
a/ Including all products.

mid-1990s, particularly for products such as polypropylene, for which active construction is in progress.

Bolivia, in another co-operation deal with a neighbouring country, has signed a natural gas supply contract with Brazil. The deal also covers the purchase of half the annual production of a new 100,000-tonnes-per-year low-density polyethylene plant. The purchase of urea fertilizer is also included, as well as 500 megawatts of electricity generated from natural gas. It is of enormous significance to Bolivia, which until now has depended on sales of gas to Argentina, valued at $250 million per year, for half the total earnings of the State natural gas concern. That contract is running out, and the new deal with Brazil allows Bolivia to sell more lucrative downstream products from its gas. The result is that the Bolivians will have to start installing petrochemical facilities, as well as a new pipeline and electric power plant, representing the transition of an economy based on tin exports to one based on natural gas and its products.

Overall, the Latin American Petrochemical Association is advocating regional integration and co-operation as the way forward for industries in the different countries. So far little progress has been made in this direction, despite various bilateral protocols signed between countries. Further integration or a Latin America common market would end predatory competition, and the duplication of plants, thus saving hard currency.

The rush to invest in some countries, notably Brazil, has sparked warnings that investment projects should not be based on 1988 high prices. A fall of from 20 to 30 per cent in petrochemical prices has been forecast, and consultants have recommended that Latin American producers seek to develop markets within the region and in East Asia rather than relying on exports to the United States. Brazil already represents half of Latin America's $15 billion turnover in petrochemicals. Growth in sales is expected to continue at 5 per cent a year until 1990, and then rise to between 7 and 8 per cent after new plants are commissioned, increasing supply. Supply is set to increase in Brazil alone by from 35 to 40 per cent in 1992.

Of Brazilian petrochemicals exports, finished plastics goods make up a tiny fraction, the main exports being plastics resins for further processing abroad. Increased processing within Brazil would add value to exports. For example, in 1988, plastics resins sold abroad were achieving average prices of $1,200 per tonne, while processed plastics products were fetching $2,630 per tonne. Plastics expansion plans in Latin America are summarized in table IV.131.

Brazil is already a net exporter of certain plastics, but a huge $6.3 billion investment programme to 1995 will remove import requirements and give the country a permanent export presence. The enormous oil industry development plan in Brazil has meant that subsidiary companies of the State oil monopoly, Petrobras, have been called on to provide profits for upstream developments. Fortunately, the high prices for petrochemicals and plastics in the past two years have allowed the petrochemicals arm, Petroquisa, to contribute good profits. Petroquisa is a holding company and some of its subsidiaries are earmarked for privatization. Already, at Brazil's largest petrochemical complex in the north-east of the country, 51 per cent of the Copene ethylene cracker has passed into private hands and similar plans were in hand for the country's oldest cracker, at the petrochemical complex in São Paulo. This is owned by Petroquimica Uniao, which may also build a proposed new petrochemical complex in Rio de Janeiro. Privatization is important to this company if it wants to enter into joint ventures with foreign partners to build plastics and other plants associated with the new complex.

By the end of 1988 the question of funding for this new $2 billion complex was still in question. Although the Brazilian petrochemical industry has been making good profits from sales of products abroad, the recession at home has made domestic market profitability poor. Brazilian firms are currently exporting from 40 to 50 per cent of output compared with 20 per cent in the past, with sales helped by shortages in the United States and Europe. Export earnings from the chemical industry overall exceeded $1 billion in 1988, compared with $690 million for all of 1987. A low-density polyethylene producer, Poliolefinas, has already earmarked 90,000 tonnes for export in 1989, and is forecasting record profits. However, for another State-owned producer, Copene, exports fell in 1988, although profits rose to $160 million on sales of $800 million, a 10 per cent rise over 1988. The company produces ethylene, which is then sold to plastics producers. Despite the profits, it claims its prices need to double to catch up with production costs, and that during 1988 Brazilian ethylene prices were roughly half those in Europe and the United States.

The Government of Brazil has not yet decided whether further petrochemical development will be given priority funding. In an otherwise flat period, this industry, together with pulp and paper, has received more investment than any other. Brazil already produces 53 per cent more ethylene than the next Latin American producer, Mexico, and under the National Petrochemical Plan currently being implemented, output will double from the existing 1.4 million tonnes by 1995. If it is built, the new complex must be in Rio de Janeiro, because development in polluted São Paulo has been restricted by law since 1982.

Another project which has been given approval but which may never go ahead, is a polyvinyl chloride unit in the northern State of Alagoas. The project, to produce 150,000 tonnes per year of polyvinyl chloride, is scheduled for start-up in 1992. A new plant to make 120,000 tonnes per year of polyvinyl chloride was started up at this site in 1988. The new project is proposed by Brasivil, which would turn the company into one of the world's leading exporters of polyvinyl chloride. However, the country already produces some 670,000 tonnes per year of polyvinyl chloride against local consumption of only 430,000 tonnes. Even if consumption grows at 10 per cent a year, it will only reach 630,000 tonnes per year by 1992. If all planned expansion goes ahead, Brazil will have a surplus of almost 400,000 tonnes per year looking for space in the international polyvinyl chloride market.

As an alternative to continued construction, one development route pursues by the Government of Brazil is the consolidation of different companies into bigger and more powerful entities. For example, three

Table IV.131. Plastics expansion in Latin America, 1989-1992

Country and location	Product	Capacity (thousands of tonnes)	On-stream date
Argentina			
Ensenada	Polypropylene	130	1990
Bahia Blanca	Polyvinyl chloride		
Neuquen	Polypropylene	100	
	Linear low-density Polyethylene	150	
Santa Fe	Polyvinyl chloride	50	
Mendoza	Polypropylene	60	
Rosario	Polystyrene	30	
Bolivia	Polyethylene	100	
Brazil			
Rio de Janeiro	Polypropylene	100	
	Polyethylene	200	
	Polystyrene	50	
	Polyvinyl chloride	180	
Camacari, Bohia	Polyethylene	260	
	Polyvinyl chloride	180	
Alagoas	Polyvinyl chloride	150	
Triunfo	Polyvinyl chloride	180	
	Polypropylene	160	
	Low-density polyethylene	70	
	Polystyrene	65	
Colombia			
Cartagena	Linear low-density Polyethylene	60	
	Polypropylene	60	
Mexico			
Lazaro Cardenas	Linear low-density Polyethylene	120	
Morelos	High-density polyethylene	120	
	High-density polyethylene	130	
	Polypropylene	100	
	Low-density polyethylene	80	
Peru	Polystyrene	15	1989
Venezuela			
José	Polypropylene	70	1992
El Tablazo	Polyvinyl chloride	80	1991
	Polyethylene	150	1991
	Polypropylene	70	1991

Sources: Chemical Week, 6 November 1988; European Chemical News, various issues; and Chemical Matters, various issues.

producers of polypropylene were merged in 1988, including a subsidiary of Royal Dutch Shell, into a megaproducer which will also build a new plant. Other efforts are under way to carve a niche in world markets, and a Brazilian consortium, involving co-operation with Japan's Mitsubishi Kasei, recently bid unsuccessfully for a petrochemicals and plastics complex in Portugal. A Brazilian polyvinyl chloride joint venture is proposed in the United States.

In Argentina, the petrochemicals and plastics industry is among the best performers in a struggling economy. Approvals have been given for new plants and expansions worth $2 billion. At present, plastics production in Argentina is being hampered by a deficit in ethylene and propylene raw materials, but plans for a new ethylene cracker at Bahia Blanca will end this, although somewhat belatedly.

In early 1988 the Government cut import duties on a range of petrochemical raw materials from some 53 per cent to a maximum 20 per cent in an attempt to open up the petrochemicals industry to overseas competition. The move also helps ease local feedstock shortages, about which many companies have complained loudly. However, threats by the Government in early 1989 to abolish its subsidies on local petrochemical raw materials has thrown a shadow over further investment plans. Under the current system, raw materials are sold at prices some 20 per cent lower than prevailing international levels, and the Government compensates sellers—generally refineries—at a cost of some $110 million per year. There has been pressure to divert this money to health and education.

Petrochemicals account for . 5 per cent of industrial GDP in Argentina, but this will increase after new investments have been made. The industry employs 16,000 people and accounts for 10 per cent of Latin American production. It runs a balance-of-trade surplus of around $200 million. The total value of exports—mainly plastics—was expected to reach between $500 million and $550 million in 1988. As in the rest of Latin America, the industry is characterized by high capacity utilization, declining operating costs, strong demand and good profit margins. It is said that structural change is taking place in Argentina's petrochemical industry, moving away from a protectionist, domestic market-oriented approach to a more export-oriented strategy. Moves to privatize several companies have, however, been slow and bogged down in political opposition. One of the most attractive prospective privatizations is of Polisur, which produces polyethylene and is pursuing a successful export strategy in East Asia and other markets.

A significant decision taken in late 1988 awarded a contract for a huge gas separation plant in inland Neuquen State to a consortium led by Dow Chemical of the United States and a local group, Perez Companc. The Italian group, Eni, spent a long time trying to win this contract. The selection of Dow Chemical will lead to the development of new polyethylene plants at the site, while Italy's Himont is hoping to develop polypropylene there. Overall, the site will become Argentina's third petrochemical complex and the second involving plastics, with downstream investments worth $800 million. There is talk of a fourth in the west of the country, with products to be exported through Chile's Pacific Ocean port of Valparaiso. Distance from world markets is a disadvantage to Argentine producers, but the local supply of cheap gas more than offsets this. The country's first polypropylene plant was started up at the end of 1988, and a Shell subsidiary is planning another unit in co-operation with a local company, Ipako. The key to the project will be propylene supplies from Shell's oil refinery in Argentina. The inland polypropylene unit, planned by Himont for Neuquen Province, would be based on propylene derived from gas, a process that is only economical in areas with very cheap gas.

Chile has no plastics production and relies on Brazil for 30 per cent of its polypropylene supply. It has, however, two huge natural-gas-based petrochemical projects in Tierra del Fuego, one producing methanol and the other proposing to produce ammonia and urea fertilizers. Products from these plants will be used to pay for Brazilian polymer supplies.

In Colombia, the wide-ranging $2 billion petrochemical investment programme is much more under the control of the private sector than in other Latin American countries. Major foreign companies, such as Hoechst, Dow Chemical and BASF, will participate in plastics and other projects valued at some $2 billion over the next four years. The willingness of foreign firms to participate in building petrochemical plants in Colombia is unexpected in view of the serious rebel problem in oilfield areas. The country's main oil pipeline was dynamited by guerrillas 51 times in 1988, but the threat to industrial developments around Cartagena is not seen as serious. However, political pressure has prevented the construction of polypropylene plants by the State-owned companies Ecopetrol and Colpropilena. The Government of Colombia prefers to channel oil revenues into social programmes and further oil exploration. Leaving plastics production to the private sector may prove to be a prudent policy in a few years time when profits from plastics plants inevitably dwindle as supply increases.

In two other Latin American countries, Bolivia and Chile, petrochemicals and plastics production is less developed, but where projects are in hand, a good deal of co-operation with neighbouring countries is involved.

In Venezuela, petrochemicals have overtaken refining as the second most important investment sector for the State monopoly, Petroleos de Venezuela, with only oil production taking a larger share of investment. Officially, spending is expected to reach $4.5 billion by 1994, but could actually be $6 billion. However, the country's expansion plan is behind schedule because of slowness in decision-taking within the State petrochemicals company, Pequiven. In some cases, expansion in plastics and petrochemicals is spurred by considerations other than market outlets for those products. For example, the major expansion in aluminium production has increased the requirement for imported caustic soda used in the production process. The cost of this petrochemical has escalated to about $600 per tonne from some $60 per tonne a few years ago. Plans have been made for the domestic production of 220,000 tonnes to meet import requirements, and a new plant, due to start in 1994/95, will be built in Anzoategui in Eastern Venezuela at a cost of $300 million. To help offset the cost, Pequiven is studying an ethylene dichloride and vinyl chloride monomer plant to be based on chlorine by-product. This could lead to investment in polyvinyl chloride. The latter projects provide part of the justification for Venezuala's second ethylene cracker at José, in the East.

Mexico was set to take an important step in eliminating its $400 million deficit in petrochemicals trade with the start-up in early 1989 of the major new Morelos complex in the state of Veracruz. A second stage is due to start up in 1990. The complex includes a new ethylene cracker to provide feedstock for a high density polyethylene plant and others. A further study is under way for linear low-density polyethylene, not currently made in Mexico, but with high market growth potential.

The lowering of world oil prices has spurred the Mexican Government to increase the production of petrochemicals and other manufactured goods to help the economy. Financing difficulties have caused long delays with projects, although petrochemical allocations have not been cut too much since it is difficult to stop and start large engineering projects. The Government's aim is for the country to become a major exporter of petrochemicals based on its oil supplies. To encourage this the production monopoly held by State-owned Pemex was eased in 1986, allowing private sector development at a time when the Government company was in financial difficulty.

(b) *North Africa and Western Asia*

In North Africa and Western Asia, a new wave of petrochemical expansion started to emerge in 1988, inspired by the high prices and good profits gained from investments made so far. In Saudi Arabia, a further round of expansion to the huge petrochemical industry built between 1975 and 1985 will be less costly because the infrastructure is now in place. Markets have been developed and large amounts of raw material are available. It is interesting to note that Saudi Arabia is now planning to use its refined oil products for petrochemicals production instead of the supplies of gas which were harnessed for the first round of development. Around $1 billion has been earmarked to more than double petrochemical capacity at Yanbu on the Red Sea coast. The focal point will be a new cracker based on liquid naphtha feedstock rather than gas. This will allow production of 200,000 tonnes per year of propylene as well as 500,000 tonnes per year of ethylene. From these materials, polyethylene and polypropylene can be produced, and proposals for new units are under study. Overall, SABIC intends to double its total production (including chemicals, fertilizers and steel) to 20 million tonnes within the next five years.

Most of the projects in Saudi Arabia have been built with North American, Western European or Japanese partners in order to gain access to technology and marketing expertise. The case of polyvinyl chloride production, however, provides an example of South-South co-operation. The only polyvinyl chloride producer in Saudi Arabia is National Plastics Co., a joint venture between SABIC and Lucky Goldstar of the Republic of Korea. A study is under way to increase capacity by 100,000 tonnes per year to 300,000 tonnes per year. Furthermore, a major venture is said to have been undertaken between SABIC and Indian partners. The Government of India spends $285 million a year on plastics imports.

Elsewhere in North Africa and Western Asia plastics expansion plans started to take shape in 1988 under the influence of booming markets and high profits. In certain cases, government-owned companies are unhappy that decisions to build new plants were not taken soon enough to allow the products to be available for sale at high 1988 prices. As it is, by the time new plants are studied and built, market prices will probably have slipped. The prevailing wisdom in the Arab Gulf countries is that the most sensible option in developing local resources is to add value from downstream development instead of selling oil and gas in the open market. Some countries regret not pursuing this path earlier, and there have even been attempts to blame foreign advisers who, several years ago, succeeded in convincing certain Arab countries not to embark on petrochemical projects. In 1982, for example, when companies were losing money on plastics and other petrochemicals, Kuwait Petroleum Industries Corporation shelved plans for a $1.3 billion complex at Shuaiba and closed an aging complex the company had acquired at Rotterdam. Both investments would have proved invaluable in the period of plastics shortages since 1987 [150].

Gulf advisers, notably the Gulf Organization for Industrial Consulting, are now urging swift development in the region as a whole to accelerate production of petrochemicals. It suggests adding 2 million tonnes of petrochemicals in the next three to four years and a further 1.85 million to 1.99 million tonnes by the end of the 1990s.

In addition to the above-mentioned plans in Saudi Arabia, Bahrain is likely to press ahead with construction of a polypropylene facility, and Kuwait has reactivated a polypropylene plant. Abu Dhabi may move into the polyethylene business, while Qatar has overcome earlier problems with gas supplies to its polyethylene plants and may build more plants based on new gas supplies from the the North Field, the world's largest gas field (see table IV.132).

Other countries in North Africa and Western Asia, notably Egypt, Islamic Republic of Iran, Iraq, Libyan Arab Jamahiriya and Turkey have been building up plastics production capacity.

(c) *East Asia*

In East Asia, the Republic of Korea and Taiwan Province have taken over from Japan as the engines of production growth for plastics and petrochemicals. Japan is still a major exporter to all economies in the region, but the Republic of Korea is trying to move away from this close relationship by establishing stronger links with the EEC and the United States. After serious rationalization of plastics capacity under the supervision of MITI, Japan's law on temporary measures restricting expansions was lifted in 1988. The result was a flood of plans by producers to restart moth-balled plants or expand existing facilities. Some 230,000 tonnes of polyethylene capacity was restarted in 1988, and more expansions were planned for 1989. Around 70,000 tonnes of propylene capacity was restarted in 1988, and proposals for a further 300,000 tonnes have already been put before MITI to be started by 1990.

In the Republic of Korea, the petrochemicals industry has since 1970 been dominated by three companies, Yukong of Sunkyong, Honam Ethylene Company of Daelim and the Lucky Goldstar group. Recently, the Samsung group started construction of a major petrochemicals and plastics complex at Sosan. Forecasts of shortages have forced the Government to open up industry and opportunities are seen for companies to supply products listed on the import diversification items list issued in 1988. Pressure from Washington for the Republic of Korea to open up its markets and from local companies wishing to diversify production resulted in the liberalization of the petrochemical industry. However, obtaining licences from the Government is still slow. Until recently, companies tended to stick to a one-product policy, which is not useful in the generally highly-integrated petrochemicals and plastics industry. Past restrictions on production have left the Republic of Korea with severe shortages of ethylene raw material for its plastics industry and the situation will probably worsen (possibly to an ethylene shortage of 400,000 tonnes in 1992). Users such as the automobiles, electronics and computer industries are expanding more rapidly than plastics production [151].

A temporary overcapacity situation was forecast to emerge for high-density polyethylene in the Republic of Korea in 1989, turning the country into a net exporter. But if domestic demand continues to grow at 8 per cent a year, shortages will once again be experienced in 1992.

Table IV.132. Plastics capacity and expansion in Western Asia

Country	Product	Existing capacity in 1988	Planned capacity in the 1990s
Bahrain	Polypropylene	-	100
Kuwait	Polypropylene	-	80
	Low-density polyethylene	-	165
	Polystyrene	-	32
Qatar	Low-density polyethylene	140	-
	Polypropylene	-	150
Saudi Arabia	Polyethylene	900	500
	Polystyrene	100	-
	Polyvinyl chloride	200	100
	Polypropylene	-	350
Iran (Islamic Republic of)	Low-density polyethylene	60	160
	Low-density polyethylene	30	-
	Polyvinyl chloride	60	90
	Polystyrene	-	120
	Polypropylene	-	100
Total	Polyethylene	1 120	825
	Polyvinyl chloride	260	190
	Polystyrene	100	152
	Polypropylene	-	630

Sources: Chemical Matters, 3 March 1989; and European Chemical News, various issues.

Overall, the Republic of Korea's petrochemical industry has made rapid strides in its short 15-year history. Two complexes at Ulsan and Yeochon have a combined capacity of 0.5 million tonnes and include 50 downstream units. The start-up of the second complex unfortunately coincided with the second oil shock and a major downturn in the petrochemical industry. However, by 1984, recovery was well underway and the Government approved expansions by Yukong and Daelim (Honam Ethylene), due for completion in 1989, as well as the construction of a new cracker by Lucky Petrochemical, due for completion in 1991.

The start-up in 1988 of a 77,000-tonnes-per-year polypropylene plant at Yochon City added further strain to the country's olefin deficit. The shortfall in propylene monomer (raw material for polypropylene) was expected to reach 350,000 tonnes by the end of 1988. The world's largest polypropylene unit (200,000 tonnes) is due to start up at Ulsan in 1990, further hightening the strain. In the face of capacity shortages, investment announcements have been numerous in the Republic of Korea, and expansion plans amount to 850,000 tonnes for polyethylene and over 1 million tonnes for polypropylene. It has been forecast that the plastics industry of the Republic of Korea will not mature until the end of the century, by which time it will be a net exporter and able to exploit the nearby markets of China and the Democratic People's Republic of Korea.

During 1988, the Government of Thailand approved a master plan for the country's second petrochemical complex involving an investment cost of $1.25 billion by the government-owned National Petrochemical Corporation. It is to be built at Mab Ta Pud alongside the first complex. Private sector companies will invest in plants to produce polyethylene, polyvinyl chloride, polypropylene and polystyrene. Technology supplied by BASF of the Federal Republic of Germany has been chosen for the new polypropylene plant, due for completion in 1990. As demand for plastic is expected to be insufficient in Thailand to absorb the output from this and another private sector project under construction at Mab Ta Pud, the country will become an exporter. A Belgian firm, Solvay, is involved in plans for a large new polyvinyl chloride project due on stream in 1992, when more ethylene supplies become available.

In Taiwan Province, monomer feedstock shortages restricted plastics production. In 1988 the ethylene market in Taiwan Province was technically balanced, but a shortage of 150,000 tonnes was expected in 1989 as new plastics units started up. Imports of ethylene were due to begin in early 1989 after the start up of an import terminal by China General Plastic Corp. at Kaohsiung. Two projects to build ethylene crackers to provide feedstock for plastics production are being held up because of environmental objections. The units, for the State-owned China Petroleum Corp. and the private Formosa Plastics Corp. are not expected on stream before the end of 1991, by which time import requirements will exceed 300,000 tonnes. Formosa Plastics has been threatening to make its investment in the United States if environmental objections persist. In all, six new ethylene crackers are either planned or under construction in Taiwan province.

Because of the nature of the country's export industries, demand for plastics is booming. In 1987, polyvinyl chloride represented 44 per cent of total demand, at 850,435 tonnes. Production was 773,114 tonnes. In order to keep up with local demand, imports rose 167 per cent to just over 84,000 tonnes, while exports fell 69 per cent to 6,843 tonnes. Some 19 per cent of demand is represented by polystyrene and acrylonitrile benzene styrene at 378,971 tonnes. Production of acrylonitrile benzene styrene rose 37 per cent to 207,686 tonnes, while imports rose 30 per cent to 30,075 tonnes, and exports rose 47 per cent to 87,393 tonnes. Low-density polyethylene accounted for 13 per cent of demand at 254,353 tonnes. Production was down 4 per cent to 200,146 tonnes, and exports fell 16 per cent to 22,071 tonnes. Imports rose 4 per cent to 76,459 tonnes. Some 11.9 per cent of demand was accounted for by polypropylene, at 229,782 tonnes. Production was down 1 per cent at 211,383 tonnes, while imports were up 63 per cent to 6,843 tonnes and exports were down 98 per cent to 436 tonnes. High-density polyethylene accounted for 11 per cent of demand at 210,791 tonnes. Production was down 8 per cent to 174,589 tonnes and imports rose 204 per cent to 43,598 tonnes, to help make up the deficit. Exports fell 75 per cent to 7,339 tonnes.

In Malaysia, foreign companies are hoping to take advantage of offshore gas supplies and participate in the development of the country's fledgling petrochemicals and plastics industry. Proposals are being studied for a $1 billion complex on the east coast, involving the production of ethylene and polyethylene. Companies interested in participating include British Petroleum Chemicals of the United Kingdom, Dow Chemical of the United States, CTC Corp. of Taiwan Province and China's Petrochemical Corp. (Sinopec). A new polystyrene plant is to be built in the southern State of Johore through a joint venture between Japanese firms Idemitsu and Sumitomo and Malaysian interests.

In Indonesia, studies are progressing concerning massive petrochemicals and plastics development. Royal Dutch Shell has been requested by the Indonesian Government to undertake a study for an integrated olefins complex which would provide feedstock for several private sector plastics projects already under way. A Japanese and Indonesian venture is already building a complex at Merak, West Java, to produce 70,000 tonnes per year of polyvinyl chloride. A second project will produce polypropylene and polyethylene, with Shell and British Petroleum hoping to provide technology for the two plants.

In Singapore, Shell succeeded in acquiring the government share in the Pulau Ayer Merbau petrochemical complex in 1988. After years of losses, the cracker and downstream plastics operations have been making profits and expansions are planned.

In the Philippines two petrochemical firms from Taiwan Province are investing in a new complex to produce polyethylene and polypropylene.

Still a major importer of plastics, China is gradually starting up new units commissioned in the mid-1980s. For example, in 1988 it brought on-stream the country's first linear low-density polyethylene plant, located at Daquing. This 60,000-tonnes-per-year plant will partly replace imports, but total polyethylene imports are around 500,000 tonnes. New ethylene capacity of over 1 million tonnes was started up in China in 1987 and 1988, but the country still remains a major importer of the product. In the first six months of 1988, China's chemical output rose by 12 per cent, according to the country's chemical industry ministry. Product shortages, however, have caused price rises. High-density polyethylene, for example, rose from 8,800 yuan renminbi to 9,200 yuan renminbi per tonne, and linear low-density polyethylene from 8,700 yuan renminbi to 9,000 yuan renminbi per tonne. Restrictions on foreign exchange in late 1988 caused imports of plastics into China to slow down. This had a major effect on international markets, and prices of plastics on the spot market in Western Europe, a major exporter, began to fall.

Overall, major expansion plans in the plastics industry are aimed at making up for critical shortages of wood and timber needed in China's industrial modernization drive. In 1988, the country was producing 1.3 million tonnes of raw and semi-finished plastics, but still needed to import over 1 million tonnes per year. Expansion plans are designed to increase plastics materials production to 4 million tonnes by 1990. To meet this target, advanced technology worth $800 million is being imported from North America, Western Europe and Japan. China's steel industry is facing energy, transport and financing problems, and its production of 80 million tonnes falls behind the demand of 95 million tonnes. Polyvinyl chloride is thus expected to take a larger role in providing piping for irrigation. For water and sewage, 80,000 kilometres of pipes are scheduled to be installed by the year 2000, and if only half are made of plastics, 300,000 tonnes will be required.

The packaging industry, which currently uses 5 million cubic metres of wood per year, forecasts that some 1.5 million tonnes of plastic packaging material will be needed by the end of the century. Due to environmental and conservation pressures, China has decided to cut 9 million cubic metres less timber during its current seventh five-year plan.

In India, plastics buyers were calling for more relaxed import duties in 1988, after an official delegation succeeded in locating only 315,000 tonnes of plastics available for import in the next two years. Heavy import duties cause Indian buying to be sporadic, which discourages international suppliers. The Government of India has acknowledged the problem and agreed in principle to a revision of the tariff system to allow a floating duty to adjust to the rise and fall of international prices. Production plans for plastics are pressing ahead. For example, Reliance Petrochemicals is planning a huge complex at Hazira in Gujarat State, on the basis of local gas supplies.

A private company in Pakistan is proposing to build the country's first polypropylene facility at the new port of Qasim on the Arabian Sea. The country's National Development Finance Corporation is proposing to obtain funding from the World Bank for a study. The cost is likely to be in the region of $40 million for a 40,000 tonnes plant. Pakistan currently imports around 40,000 tonnes per year of polypropylene at a cost of $2,300 per tonne, including import duties. Construction of a larger plant would allow exports, but there are some worries about the supply of propylene feedstock. A polyethylene plant is also under study for the country.

(d) *Eastern Europe and the USSR*

Countries in Eastern Europe and the USSR are heavily involved in petrochemical and plastics expansion plans (see table IV.133). The Soviet Union in

Table IV.133. Plastics expansion in Eastern Europe and the USSR

Country and location	Product	Capacity (millions of tonnes)
Bulgaria		
Devnia	Polyvinyl chloride	140 000
Burgas	Linear low-density polyethylene	50 000
Czechoslovakia		
Kralupy	Polystyrene	60 500
Bratislavia	Linear low-density polyethylene	12 000
Hungary		
Budapest	Polystyrene	65 000
Leninvaros	Polypropylene	60 000
Leninvaros	Low-density polyethylene	60 000
Poland		
Plock	Polypropylene	10 000
USSR		
Blogoveschensk	Polypropylene	20 000
Buddyennovsk	Polypropylene	100 000
	High-density polyethylene	100 000
Nizhnevartovsk	Polypropylene	150 000
	Polyethylene	500 000
Kazan	High-density polyethylene	200 000
Sakhalin Island	Polypropylene	50 000
	Low-density polyethylene	200 000
Tenghiz	Polypropylene	400 000
	Polyethylene	600 000
Tobolsk	Polypropylene	350 000
Novyi Urengoi	High-density polyethylene	600 000
Surgut	Polyethylene	230 000
	Polystyrene	300 000
Total	Polyethylene	2 552 000
	Polystyrene	125 800
	Polypropylene	1 140 000
	Polyvinyl chloride	140 000

Sources: Chemical Week, 6 November 1988, European Chemical News, various issues; and Chemical Matters, various issues.

particular has numerous major projects under way. The Tenghiz polymer project, to be associated with the Tenghiz oil and gas deposits near the Caspian Sea, one of the world's largest oilfields, calls for production of 600,000 tonnes of polyethylene and 400,000 tonnes of polypropylene among other products. A consortium including partners from developed market economies has been set up to develop the project.

Two other consortia led by United States firms have also been established for massive petrochemical developments in Siberia. A project near Tomsk will produce 200,000 tonnes of polyethylene, 100,000 tonnes of polystyrene and 30,000 tonnes of other plastics. In total, billions of roubles have been earmarked for five massive oil- and gas-based chemical complexes in Western Siberia. The projects at Surgut and Tobolsk are the most advanced and between them will produce 230,000 tonnes of polyethylene, 300,000 tonnes of polyestyrene and 350,000 tonnes of polypropylene. From 80 to 90 per cent of the output of these plants will be exported to pay for the investment cost, although by the mid-1990s exports will decline a little. Half of the output from the massive Tenghiz polymer project will be exported. Taken together, the proposed Soviet exports cover the entire import requirement of Western Europe.

5. *Technological developments*

(a) *Process refinements*

Technological developments in the bulk plastics industry focus on improving properties through the better and more efficient incorporation of additives and lower-cost operations through energy- and polymer-saving improvements. No major technological breakthrough has emerged in bulk plastics since the development of the low-pressure polyethylene process to produce linear low-density polyethylene in the 1970s. Among the most interesting developments, however, have been in the polypropylene field. This is the newest of the bulk polymers, and still shows the best growth prospects. Himont of the United States has refined its Spheripol process to allow the mixing-in of additives at the polymer production stage, instead of later at the converter. The company claims that new process polypropylene grades are one reason for the extraordinary growth in polymer consumption. The changes focus on modifications to catalysts and new polymerization processes, and often involve significant increases in productivity. For example, one gram of conventional catalyst on average yields about 1 kilogram of polymer, while one gram of super-high-activity catalyst yields 20 kilograms or more. It is estimated that by 1991 two thirds of all polypropylene production plants will be operating with new reactor processes and new-breed catalysts.

Generally, technology refinements occur mainly in the North. Countries in the South which have acquired technology from the chemical companies or engineering firms of the North have often ensured that the licensing agreement includes access to future refinements of the process. New producers are thus unlikely to fall behind in process technology, and often have better plants than their competitors in the North because of their younger age profile.

(b) *Plastics recycling*

Growing concern about the environment has encouraged the plastics industry to pay greater attention to the possibility of recycling material instead of dumping waste in the ground—frequently the most popular method of disposal. Community collection programmes and private recycling companies are becoming more common. According to the Franklin Institute, although plastics constitute 7 per cent of the solid waste stream, they have only a 1 per cent recovery rate compared with 21 per cent for paper and 29 per cent for aluminium. Rigid plastics containers have been the main type of recycled plastic, mainly polyethylene-terephthalate soft drink bottles or high-density-polyethylene containers. In the United States, many chemical companies have active recycling programmes, and several associations now exist to plan new methods of collecting and sorting waste.

Demand for degradable plastics is expected to grow rapidly, and it has been projected that in the United States, the country most advanced in environmental legislation, nearly 15 per cent of consumer plastic wastes will be degradable by 1992, compared with 1 per cent in 1957. In the United States, nearly 300 separate proposals for state and federal legislation aimed at plastics disposal were pending in early 1989.

(c) *Other environmental issues*

Environmental concern in the plastics industry tends to focus on the recycling problem, food contact, notably in the case of polyvinyl chloride, and conditions of production at the plant. A ban on all uses of polyvinyl chloride is being discussed in Denmark, and this could have major repercussions throughout the EEC if, after 1992, harmonization of environmental legislation takes all standards up to the highest level. Bans on the use of plastics in packaging have been discussed in other Western European countries. A study by a market research organization in the Federal Republic of Germany on the consequences of a total packaging ban in the country indicated that total packaging weight would rise by 304 per cent, loose waste volume by 156 per cent, compacted waste volume by 113 per cent, energy consumption by 101 per cent and costs by 112 per cent. In the Federal Republic of Germany, plastics represent 14 per cent of the weight and 27 per cent of the total value of packaging. Replacement would result in 54 per cent higher paper and cardboard consumption, 21 per cent higher glass consumption and 53 per cent higher metal consumption.

To illustrate the size of the waste problem, the municipal solid waste stream in the EEC amounts to 100 million tonnes per year. Plastics represent 7 per cent of the waste. Separation of plastics from the waste stream has generally proved uneconomical and incineration is seen as the most realistic method of disposal. Incinerator emission control is one of the main issues in Europe regarding plastics and the environment.

In the South, growing awareness of the harmful nature of chemical production to the environment has led to local protests. Notably, production at one of the 10 petrochemical complexes in Taiwan Province was brought to a halt in 1988 after pollution of a local fish farm occurred.

6. *Outlook for the plastics industry*

As stated at the beginning of this section, there is some concern that the recent buoyant plastics markets will suffer a downturn in line with world economic activity in late 1989. By April 1989 there were already clear signs of price slippage for the major bulk plastics and indications that stocks were building up. In the longer term there is real concern that overcapacity will return to the plastics industry in the early 1990s as a result of the intense construction and planning activity from 1987 to 1989. Tables IV.129 and IV.134 reflect the construction plans world-wide in the plastics industry. An awakening realization that too many units are planned may lead to the abandonment of some of them, particularly polypropylene plants. For example, in Latin America 10 new polypropylene units are scheduled to come on-stream by 1992, but there are serious doubts whether there will be sufficient propylene feedstock supplies. On the more optimistic side, new applications—for example, polypropylene car bumpers—are opening up markets continually.

Table IV.134. World polypropylene capacities, 1986 and 1990
(Thousands of tonnes)

Region, country or area and firm	1986	1990[a/]
Western Europe		
Alcudia	78	180
Amoco	160	180
Appryl	160	250
BASF (Germany, Federal Republic of)	134	180
BASF (Spain)	..	28
Danubia	140	200
DSM	125	125
EPSI	50	50
Himont	515	495
Hoechst (Germany, Federal Republic of)	205	255
Hoechst (France)	80	120
Hüls	110	120
ICI (United Kingdom)	210	300
ICI (Netherlands)	100	150
Montefina	240	250
Neste	..	370
Norpolefin	75	120
Shell (United Kingdom)	115	130

Region, country or area and firm	1986	1990a/
Shell (France)	120	130
Shell (Netherlands)	75	135
Shell (Germany, Federal Republic of)	..	90
Solvay	135	155
Statoil	..	75
Total	2 900	4 200
United States		
Amoco	450	450
Cosden (Fina)	225	380
Eastman	65	165
El Paso	159	305
Exxon	300	440
Himont	635	815
Norchem	113	113
Phillips	145	200
Shell	365	365
Soltex	140	140
Other	..	50
United States Steel	235	280
Total	2 800	3 700
Japan		
Asahi	12	52
Chisso	160	250
Idemitsu	80	120
Mitsubishi Chemical	35	95
Mitsubishi PC	220	270
Mitsui Toatsu	155	155
Mitsui PC	120	140
Nippon Sekiyo	28	80
Showa Denko	92	92
Sumitomo	145	145
Tokuyama Soda	100	100
Tonen	76	100
UBE Kosan	105	105
Total	1 300	1 800
Other		
Formosa Plastics	85	160
Himont (Canada)	83	115
HMC (Thailand)	..	75
Hoechst (Australia)	28	28
Honam PC	90	170
Honam Oil	..	77
ICI (Australia)	60	60
IPC (India)	30	120
Israel	..	60
Korea PC	115	210
Nigeria	..	32
Petkim (Turkey)	50	60
Petroquim (Argentina)	..	30
Petroquimica Colombiana	..	120
PIC (Kuwait)	..	60
Polibrasil	96	96
Polipropileno	65	65
PPN	75	150
PRC	170	425
Propylven (Venezuela)	..	40
Safripol	25	40
Shell (Australia)	76	90
Shell (Canada)	115	130
Taiwan PP	110	180
TPC (Singapore)	122	144
Total	1 400	2 700
Eastern Europe and the USSR	750	880

Source: World Petrochemical Analysis, March 1988.
a/ Announced.

and it has been claimed that world demand is growing at 300,000 tonnes per year. Furthermore, technology developments are making older plants obsolete and thus likely candidates for closure.

For the other relatively new polymer, linear low-density polyethylene, global capacity is still well short of demand forecasts, and it is said that to meet projected 1995 demand of between 7 million and 7.6 million tonnes, around 3 million tonnes of new capacity is required. At least that quantity is under construction in the South and the centrally planned economies, not considering the various new projects proposed for Western Europe and the United States.

It is now generally accepted that bulk plastics production is shifting more and more to the South, with the long-established companies of the North concentrating their efforts on product niches and sophisticated marketing techniques. With relatively small R + D budgets, it will be some years before the new producers of the South can catch up, although there are isolated examples of more sophisticated plastics production moving to the South. They will benefit, however, from their increasing ability to meet home demand and their export potential based on a feedstock cost edge. Profits will continue to be good, but they are unlikely ever to regain the unusual levels of 1988.

J. Iron and Steel (ISIC 371)

New technologies may hold key to the success of steelmaking in developing countries*

1. An overview

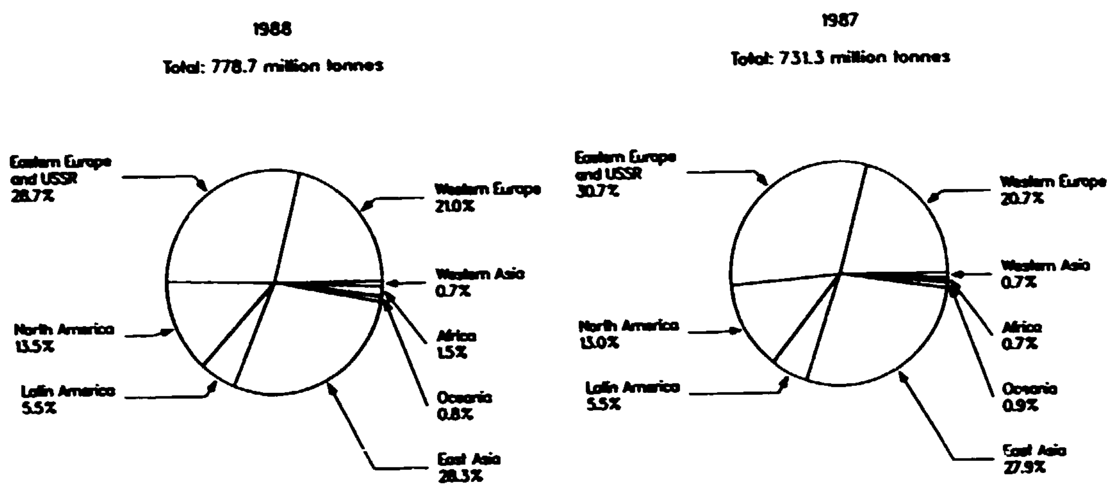
In 1988 output reached a record figure for the world iron and steel industry. A total of 780 million tonnes of crude steel was produced, 6 per cent above the figure for the previous year (see table IV.135 and figure IV.32). The growth is attributed to demand from the automotive and construction industries. Developed countries experienced a growth of 8.8 per cent to 487.6 million tonnes, with the United States showing a 11.4 per cent increase to 90.1 million tonnes. The EEC output, at 137.5 million tonnes, was 8.6 per cent above that of the previous year, and the other major contributor to the industry—Japan—produced 105.7 million tonnes, 7.3 per cent above the 1987 result.

Growth elsewhere was less spectacular. Eastern Europe and the USSR increased production to an estimated 226.6 million tonnes, representing an increase of only 0.8 per cent, while China and other Asian centrally planned economies produced 65.8 million tonnes, 4.8 per cent higher than the estimated figure for 1987. So far as individual countries are concerned, the USSR was by far the leading producer in 1988, followed by Japan, the United States, China and the Federal Republic of Germany (table IV.135).

According to OECD data, growth in those countries was almost 9 per cent overall, and consumption in the OECD area was given as 11 per cent higher

*This article is based on the contribution of Brian Cooper, Editor of *Steel Times International*

Figure IV.32. World production of crude steel by region, 1987 and 1988.



Source: United Nations Economic Commission for Europe

Table IV.135. Output of major steel-producing countries, 1987 and 1988

Country or area	1987 Rank	1987 Tonnage (millions)	1988 Rank	1988 Tonnage (millions)	Percentage change 1987-1988
USSR	1	161.9	1	163.0	0.7
Japan	2	98.5	2	105.7	7.3
United States	3	80.9	3	90.1	11.4
China	4	56.0	4	59.2	5.7
Germany, Federal Republic of	5	36.2	5	41.0	13.3
Brazil	7	22.2	6	24.6	10.8
Italy	6	22.8	7	23.7	3.9
Republic of Korea	11	16.8	8	19.1	13.7
France	8	17.7	8	19.1	7.9
United Kingdom	9	17.1	10	19.0	11.1
Poland	9	17.1	11	16.7	-2.3
Czechoslovakia	12	15.4	12	15.3	-0.6
Canada	14	14.7	13	15.2	3.4
Romania	13	15.0	14	14.5	3.3
India	15	13.1	15	14.3	9.2
Spain	16	11.7	16	11.8	-0.9
Belgium	17	9.8	17	11.2	14.3
South Africa	18	8.9	18	8.7	-2.2
Taiwan Province	24	5.9	19	8.5	44.1
German Democratic Republic	19	8.2	20	8.1	-1.2
Turkey	21	7.0	20	8.1	15.7
Mexico	20	7.6	22	7.8	2.6
Democratic People's Republic of Korea	22	6.7	23	6.8	1.5
Australia	23	6.1	24	6.4	4.9
Netherlands	25	5.1	25	5.5	7.8
Sweden	26	4.6	26	4.8	4.3
Austria	28	4.3	27	4.6	7.0
Yugoslavia	27	4.4	28	4.5	2.3
Luxembourg	32	3.3	29	3.7	12.1
Venezuela	29	3.7	29	3.7	..
Argentina	30	3.6	31	3.6	..
Hungary	30	3.6	31	3.6	-..
Finland	34	2.7	33	2.8	3.7
Bulgaria	33	3.0	34	2.5	-16.7
Egypt	36	1.7	35	2.0	17.6
Indonesia	35	2.1	36	1.9	-9.5
Other countries		16.2		17.6	8.6
Total world		735.9		780.0	6.0

Source: International Iron and Steel Institute, World Steel in Figures (Brussels, 1989).
Note: This table lists all countries producing more than 2 million tonnes of crude steel in either year shown.

than in 1987 (see table IV.136), reaching its highest level since 1979. Data on world apparent steel consumption are given in table IV.137.

In the United States, where the steel making industry is entirely privately run, many companies were able to post profits for the first time in a decade. In Australia, where the steel industry is dominated by Broken Hill Property, also a private company, profits were once again posted after a massive rationalization programme. In most other countries there is a degree of government involvement in the steelmaking industry, notably in Europe, Latin America and, above all, the centrally planned economies. In Japan the "big five" steelmaking companies have become increasingly diversified and rely less on steel for their overall performance. However, rationalization plans by those companies in the steel industry have been slowed as demand was sustained throughout the year and satisfactory figures were recorded generally. In Europe, the EEC "crisis" regime was phased out completely, leaving EEC steel makers exposed to the realities of the free market. This turned out to be less terrible than expected, since the market conditions were in fact better suited to a system of no quotas on production levels and enabled steelmakers to increase capacity utilization and make money on volume.

The other major regions with developed market economies involved in steelmaking are Latin America and South-East Asia. Latin America recorded a 7 per cent growth in crude steel output, thus completing six years of uninterrupted growth at a cumulative annual rate of 5 per cent, and passing from 27 million tonnes in 1980 to 42.8 million tonnes in 1988. Despite this, the commercial side of Latin American steelmaking remains decidedly unsatisfactory, with low internal prices, insufficient profitability, high indebtedness and interest rates, scarce credit, and (claim the Latin Americans) protectionist policies being pursued by developed countries against imports.

The growth countries and areas of South-East Asia, the Republic of Korea and Taiwan Province, have enjoyed government support in the setting-up of their steelmaking industries, but have recently made the major companies Pohang (Republic of Korea) and China Steel (Taiwan Province) more self-supporting by partially privatizing them. Other South-East Asian countries do not have major iron and steel industries, although Malaysia does produce steel from domestically produced direct reduced iron.

The timing of the buoyant market in Europe was fortunate for the British Steel Corporation, which was privatized at the end of 1988 after having announced record profits. Other European steelmakers are also being removed from government control now that EEC rules allow little scope for being shielded from the market-place with subsidies. Relief is probably felt on both sides—by steelmakers since they can now develop their companies along strictly commercial lines without regard to politics, and by Governments since they will no longer have to pour money into the industry when times once again become hard, as is generally expected. Even if the current market persists for some time, it is clear that steel will not continue its current growth rate.

(a) *The problem of output measurement*

Traditionally steel production has been measured in terms of crude steel; that is, liquid steel which is poured from the furnace or converter plant. This was the way in which individual plants measured production, and the figures obtained were added up to give a country's output. It has become increasingly recognized that this method is unsatisfactory and does not give a

Table IV.136. OECD crude steel production and consumption, 1987 and 1988

Country, region or economic grouping	Crude steel production: 1987 (10^6 tonnes)	Estimated percentage change 1987-1988	Expected percentage change 1988-1989	Apparent steel consumption: 1987 ingot equivalent	Estimated percentage change 1987-1988	Expected percentage change 1988-1989
EEC	125.98	9	-2	117.95	9	-2
Other Western Europe	24.69	7	-6	26.32	6	-
Austria	4.30	5	1	2.55	9	0
Switzerland	0.87	11	-	2.71	1.3	-
Finland	2.67	4	2	2.17	8	3
Norway	0.84	5	-20	1.36	- 5	-5
Sweden	4.60	4	-2	4.08	8	-1
Turkey	7.04	-	-	8.85	-	-
Yugoslavia	4.37	2	-	4.60	-	-
United States	80.88	14	-6	111.52	8	-6
Canada	14.74	0	2	14.64	7	-6
Japan	98.51	7.3	-	88.27	15.8	-3.5
Australia	6.06	-5.7	10.8	6.02	5.4	-
New Zealand	0.41	46	-	0.92	-24	-
OECD Total	351.27	8.7	-	365.64	11	-3.5

Source: Organisation for Economic Co-operation and Development, press release A(89)4 (Paris, 1989).

Table IV.137. Apparent steel consumption, 1982 to 1988
(Millions of tonnes of crude steel equivalent)

Country, region or economic grouping	1982	1983	1984	1985	1986	1987	1988
Japan	70.0	66.3	73.9	74.0	71.0	76.7	86.6
EEC	101.7	99.4	102.7	101.7	103.6	104.1	120.9
Other Western Europe	20.8	21.0	22.5	22.6	23.2	24.2	24.3
United States	92.1	96.0	114.6	109.3	99.0	105.8	112.3
Canada	10.2	11.1	13.3	13.4	12.5	13.7	15.4
South Africa	5.8	5.3	5.7	5.0	5.1	5.2	5.7
Oceania	6.5	5.8	6.8	6.7	6.7	6.5	6.7
Total	307.1	304.9	339.2	332.6	321.1	336.3	371.9
Latin America	30.8	22.3	26.8	27.3	29.6	31.4	30.5
Africa except South Africa	12.2	10.9	11.0	12.8	10.2	12.0	11.2
Western Asia	19.1	20.7	19.0	18.9	10.1	9.0	9.6
Asia except Japan, China, and Democratic People's Republic of Korea	43.7	43.6	44.2	47.2	50.5	58.8	63.6
Total	105.8	97.5	101.0	168.2	100.4	111.2	114.9
Total developed market economies	412.9	402.4	440.2	438.8	421.5	447.5	486.8
USSR and Eastern Europe	205.5	211.8	213.6	212.3	217.1	218.5	218.0
China and Democratic people's Republic of Korea	47.2	58.2	66.8	77.5	80.3	78.1	78.8
Total centrally planned economies	252.7	270.0	280.4	289.4	297.4	296.6	296.8
Total world	665.6	672.4	720.6	728.6	718.9	744.1	783.6
Unallocated	-20.0	-8.6	-9.9	-9.6	-5.6	-8.0	-5.2
World crude steel production	645.6	663.8	710.5	719.0	713.3	736.4	778.4

Source: International Iron and Steel Institute, World Steel in Figures (Brussels, 1989).

true picture of steel production. The nature of steel production is such that crude tonnage cannot accurately reflect the success of the product in the market-place. As explained below in the section on technical developments, there are two main reasons why this is so. Liquid steel is not an end-product, but only an interim state. In recent years it has been found that continuous casting is a considerably more efficient way to convert liquid steel into semi-finished steel in the form of slabs, blooms and billets. The introduction of this technology has been estimated to increase yield figures by up to 25 per cent, thus considerably reducing the amount of liquid steel needed to make the same tonnage of semi-finished steel. The second main reason for the statistical inaccuracy is that steel has been developed as a product into a more competitive, higher strength, better-performing material. To build the same structure or component using steel now takes less of the material in weight terms, although the value of the steel may, and probably will, be higher.

In order to overcome this problem, which creates the impression that steel is a dying industry, the International Iron and Steel Institute has developed a method of recording output of finished steel. Although the method may appear simple and straightforward, it is far from that, since finished products from a steel mill differ considerably from one another and are very difficult to compare. The Institute has 44 member countries from which it now obtains revised statistics, but it is virtually impossible to obtain parallel figures from non-member countries, in particular those with centrally planned economies. Nevertheless, the overall message is that crude steel figures reflect too pessimistic a picture of steel output, and that the liquid steel growth reported in the 1988 figures from nearly all countries demonstrate that steel is not an outdated material produced by a smokestack industry, but that it is a competitive, modern, developing material that has a real future in a wide range of industries. These include, notably: the automotive industry, where the threat from aluminium and plastics has been long recognized and confronted; the construction industry, where steel has been making major inroads into a market previously dominated by reinforced concrete; and general engineering, where the properties of steel have long been recognized and never replaced.

(b) *Nature of the industry*

The steelmaking industry is considered to involve the actual melting of steel. Some statistics include rerolling or processing within their definition of steelmaking, but strictly speaking they should be excluded. Countries may be involved in the steel industry, but they do not make steel. They add value to steel which has been purchased from an outside source.

It is important to understand that steel is in itself a raw material for other industries, and thereby differs from many other industrial branches. Its consumers are invariably industrial concerns themselves. Individuals do not buy steel as a product, but only things made from steel. So what does the steel industry produce?

It is generally recognized that the steel industry begins with iron making and ends with the delivery of long products or flat products to the consumer industry. Long products are sections, bars, rod and rail. Flat products are sheet in the form of strip and plates. Makers of flat products have been increasingly involved with transforming their plain strip into coated strip of one kind or another as a result of market demand. This can be either metallic or organically coated, the former being galvanized or tin-plated, and the latter painted or plastic-coated. Much of the investment made by established steelmakers in recent years has been in strip coating lines to match the demand of the automotive industry for rust-resistant steel for bodyshells and structural components.

The interesting development in steelmaking has been the way in which the different product lines have directed steel production technology into two very different channels. While they inevitably overlap, the two main systems have distinct regional characteristics which are described below.

(c) *Process routes*

Integrated plants. To produce flat steel the integrated process route is used exclusively. This involves coke and iron ore as the basic raw materials, and the coke itself must be produced from metallurgical coal. Integrated plants are highly capital intensive and only viable today if built on coastal sites with deep water ports and with annual capacities of 2 million tonnes or more.

Many of the countries with long-established steelmaking plants no longer have domestic supplies of raw materials, which must therefore be imported. The major sources for iron ore today are Australia, Brazil, United States and USSR, although the latter two play only a small part in the world iron ore trade. India has extensive reserves, but not of high enough quality to meet the exacting standards of many integrated plants in developed market economies. Sweden has a well-established ore-mining industry, and while it is a player on the international scene, it concentrates on specialized qualities for the European market. Coal is also an internationally traded commodity, with Australia again being a major supplier. Metallurgical coal is transformed into coke in coke ovens which may or may not be attached to the ironworks, and is then charged with iron ore and limestone in the blast furnace which produces liquid iron, referred to as hot metal. After desulphurization and dephosphorization, the hot metal is charged into a basic oxygen converter where it is blown with oxygen to remove carbon and produce liquid steel. A typical batch size at this stage amounts to about 300 tonnes. In most modern steel plants the liquid steel is treated at a secondary steelmaking station where it is degassed, refined, stirred and adjusted for temperature prior to casting by means of continuous casters. At this point the steel first takes its shape and is cast into slabs (for rolling into flat products such as wide strip), blooms (for rolling into rails or heavy sections) or billets (for rolling into rods, bars and light sections). An integrated plant may have all of these facilities, but it is becoming increasingly uncommon for it to have only a bloom and billet casting plant. This is because of competition from the second main steelmaking process route, known generally as the mini-mill.

Mini-mills. A mini-mill produces bloom and billet through a very different primary stage. It uses scrap as its main raw material, and melts it in an electric arc furnace, refines it in a secondary steelmaking plant where appropriate, and casts again through continuous casters. They are far less capital-intensive than integrated plants, and the capacity of a single mini-mill plant would typically be up to 1 million tonnes per year. Mini-mills started to compete in the lower end of the market, producing reinforcing bar for concrete where quality requirements were low and scrap was an adequate raw material, and an area in which they continue to concentrate very successfully. So successful have they been that the integrated plants have been largely squeezed out of this market sector. They have been built at relatively low capital cost in regions of good scrap availability and have served a localized market. Integrated plants have found these conditions hard to match, and have in many cases been forced to abandon the rebar market. In the United States, mini-mills have made the most significant impact, but in Europe they have also had considerable influence.

It is interesting to note that in those countries where the mini-mill might have been expected to make a real contribution to national infrastructure, that is, where there has been a rapid expansion in building and low capital availability, as in developing countries, it has been unable to capitalize on its advantages. This is because those countries had neither a ready supply of scrap steel nor a dependable electricity network--both essential for the successful mini-mill. There are certain anomalies, however, as illustrated by the example of India, where the state-owned integrated plants have been losing money for years. They have been using out-of-date plant, resulting in low productivity and poor quality. There has been a demand for rebar and light sections from the building industry, and it might be expected that the mini-mill formula could have filled a need. Mini-mills were built in many locations, but they competed for the limited scrap supply and the power grid was insufficiently reliable to provide the electricity to drive the furnaces. The scrap problem was then met by a new development called direct-reduced iron. This is a solid charge material suitable for arc furnaces and produced from lower-grade iron ores and coals (or natural gas). Since India has large reserves of both low-grade ore and coal, the conditions would seem right for the production of direct-reduced iron as the feedstock for the arc furnaces.

In general, the establishment of direct reduction plants (notably the pilot and demonstration plant for the production of sponge iron, established with UNDP and UNIDO co-operation, and other plants which followed) could be considered a step in the right direction, using low- or non-coking coals. In some other countries direct-reduced iron has also been successfully exploited. In Venezuela, the huge natural gas fields are being exploited to reduce iron ore into direct-reduced pellets for export, and in South Africa coal-based direct-reduction technology has been refined to the point where it is operating successfully. A very specialized production technique in New Zealand has also proved to be technically feasible, although commercial problems have plagued the new plant of New Zealand Steel. In Europe and the United States, direct-reduced iron is not produced, nor is it used in any quantities, since scrap is readily available at competitive prices. It is interesting to speculate how long this will remain the case, since the choice of raw materials for use in mini-mills is largely an economic matter.

However, direct-reduced iron does have a quality advantage over scrap, and there is currently a trend, especially in developed countries, for mini-mills to move up-market in their product range, and to do so they rely on a better quality of feedstock material. This can either be more highly segregated scrap, at an increased cost, or direct-reduced iron. One mini-mill in the United States is being watched very closely. It will be the world's first mini-mill to make flat products, previously the sole domain of the integrated producers. This plant will be melting scrap in addition to direct-reduced iron imported from Venezuela.

The electric arc furnace method is used to produce not only basic steel grades, but also many special engineering and tool steel grades, as well as stainless steels. The reason for this is that batch sizes tend to be smaller, and the mini-mill concept is able to provide a more flexible service. In the case of special grades, scrap selection becomes even more important, and secondary steelmaking, sometimes referred to as ladle metallurgy, is a vital and integral part of the process. Some very specialized remelting techniques are also used to produce high-quality, high-alloyed ingots and billets for special forging applications. This market could not be more different from the rebar market, and yet it is frequently included in steel output statistics.

In addition to the above-mentioned methods, there are many hybrid operations which involve mixtures of technology either to suit local conditions or as a result of historical development. These occur particularly in developing countries, although in the South the very latest dedicated, integrated and mini-mill plants frequently exist, using state-of-the-art technology supplied by traditional steel producers such as those of the Federal Republic of Germany, Japan, United Kingdom or United States. Open-hearth furnaces are scarce among developed market economies, but in Eastern Europe and the USSR they still provide up to half of total production.

2. *Trade and technology*

Tables IV.138 and 139 show how Japan led in world steel exports in 1987 and China and the United States led in imports. Intra-EEC trade is high, according to table IV.140, which also shows the high exports from Japan to China, the Republic of Korea and other Asian countries. North America is a large recipient of exports from the EEC and Japan. OECD trade data are given in table IV.141.

The decade of hard times which the steel industry has recently pulled through provided a stimulus to research and development work on new, energy-saving, environmentally acceptable technologies. The result has been a cleaner and more dynamic, market-led steel industry.

(a) *Process control*

The introduction of reliable automated process control equipment has had an enormous impact on all steps of the steelmaking process from blast furnace operation right through to rolling mills. Without modern process control equipment other advances would have been impossible. For the integrated plant, in particular, the concept of "hot charging" has become commonplace in the past five years. The technique seems obvious. It is a method of maintaining the heat in the cast slab, bloom or billet, in order to reduce the energy input at the reheating furnace prior to hot rolling. At the same time, it decreases the amount of energy consumption and work in progress, speeds production and reduces capital plant requirements. The disadvantage is that it is difficult to use since it allows for no error in scheduling and is very demanding in terms of machine reliability. In theory there is no allowance for buffer stocking, although in practice there is always a degree of buffering and an element of reheating. Hot charging itself has degrees of refinement depending on the actual operation, and the ultimate variation involves hot direct charging with no cooling down or reheating allowed at all. This would not be possible without complex central control on all items of equipment throughout the steel plant. The newest integrated plant in the world at Kwangyang in the Republic of Korea has been designed for hot direct charging of slabs into the rolling mill. Older plants often have difficulty with the plant layout, necessitating the transport of hot slabs over some distance without significant loss of temperature. Nippon Steel in Japan and others have made great advances with this method.

(b) *Direct linking*

Hot charging is just one form of direct linking. The concept can also be applied to other stages in the steelmaking process, which has always been regarded

Table IV.138. Major exporters and importers of steel, 1987

Rank	Country	Total exports (millions of tonnes)	Rank	Country or area	Total imports (millions of tonnes)
1	Japan	25.2	1	United States	18.7
2	Germany, Federal Republic of	18.9	2	China	14.5
3	Belgium and Luxembourg	12.4	3	Germany, Federal Republic of	12.5
4	France	11.0	4	USSR	10.8
5	USSR	9.2	5	France	8.5
6	Italy	7.2	6	Italy	7.8
7	Brazil	6.5	7	German Democratic Republic	5.5
8	United Kingdom	6.5	8	Japan	5.0
9	Republic of Korea	6.1	9	United Kingdom	4.4
10	Netherlands	5.2	10	Netherlands	3.8
11	German Democratic Republic	4.8	11	Belgium and Luxembourg	3.8
12	Spain	4.8	12	Taiwan Province	3.5
13	Canada	4.2	13	Republic of Korea	3.5
14	Czechoslovakia	4.1	14	Turkey	3.5
15	Romania	3.1	15	Canada	2.8
16	Austria	3.1	16	Hong Kong	2.6
17	Sweden	2.9	17	Spain	2.4
18	Turkey	2.8	18	Thailand	2.2
19	South Africa	2.6	19	Switzerland	2.2
20	Poland	2.3	20	India	2.0

Source: International Iron and Steel Institute, World Steel in Figures (Brussels, 1989).

Table IV.139. Major net exporters and importers of steel, 1987

Rank	Country	Total net exports[a/] (millions of tonnes)	Rank	Country or area	Total net imports[b/] (millions of tonnes)
1	Japan	20.2	1	United States	17.6
2	Belgium and Luxembourg	8.6	2	China	14.4
3	Germany, Federal Republic of	6.3	3	Taiwan Province	2.4
4	Brazil	6.0	4	Thailand	2.1
5	Czechoslovakia	3.5	5	India	1.9
6	Republic of Korea	2.6	6	Hong Kong	1.8
7	France	2.6	7	Nigeria	1.7
8	South Africa	2.5	8	USSR	1.5
9	Spain	2.3	9	Switzerland	1.3
10	Romania	2.3	10	Saudi Arabia	1.3
11	United Kingdom	2.1	11	Algeria	1.3
12	Austria	1.9	12	Malaysia	1.2
13	Canada	1.4	13	Singapore	1.2
14	Netherlands	1.4	14	Philippines	1.1
15	Poland	1.1	15	Greece	0.9

Source: International Iron and Steel Institute, World Steel in Figures (Brussels, 1989).
a/ Exports minus imports.
b/ Imports minus exports.

as a batch process. Today continuous casting is universally applied, and hot linking has joined the caster to the hot mill in a continuous link. Upstream the steelmaking process remains a batch process in the basic oxygen furnace converter, and looks to remains so for the foreseeable future. However, basic oxygen furnace plants often operate two out of three vessels at a time (with one down for maintenance), and can therefore effectively supply a continuous batch flow of steel to the casters. Downstream, however, real progress is being made in the cold mill. Linking of the stages of pickling, cold rolling, anealing, temper rolling and even strip processing such as slitting and shearing is now practised in some European mills. This avoids intermediate decoiling and coiling, saves time and energy and is able to produce a more

Table IV.140. World steel trade by area, 1987
(Millions of product tonnes)

Importing country, region or economic grouping	Exporting country, region or economic grouping: EEC	Other Western Europe	North America	Latin America	Africa	Western Asia	Japan	Other Asia	Oceania	Eastern Europe and USSR	Total imports
EEC	36.5	5.3	0.2	0.9	0.3	-	0.3	0.3	-	3.6	47.4
Other Western Europe	6.9	1.8	-	0.7	0.5	-	0.2	-	0.1	2.2	12.4
North America	6.9	1.3	4.0	2.6	-	-	4.4	1.8	0.2	0.3	21.5
Latin America	1.8	0.1	0.4	0.8	0.1	-	0.8	-	-	1.0	5.0
Africa	2.7	0.3	0.1	0.2	1.4	-	0.5	-	-	0.6	5.8
Western Asia	1.3	0.8	-	0.3	0.1	0.6	0.9	0.9	0.1	1.5	6.5
Japan	0.1	0.3	-	0.9	0.1	-	-	3.0	0.1	0.5	5.0
Other Asia	3.4	0.9	0.5	2.4	0.4	-	9.4	1.2	0.4	2.1	20.7
Oceania	0.1	-	-	0.2	-	-	0.8	0.1	0.2	-	1.4
China and Democratic People's Republic of Korea	1.4	1.0	-	1.2	0.1	-	5.9	2.2	0.3	3.0	15.1
Eastern Europe and USSR	6.5	1.8	-	-	0.1	-	2.0	-	-	11.0	21.4
Total exports	67.6	13.6	5.2	10.2	3.1	0.6	25.2	9.5	1.4	25.8	162.2

Source: International Iron and Steel Institute.

Table IV.141. OECD steel imports and exports, 1987 and 1988

Country, region or economic grouping	Imports of steel mill products: 1987 (10^6 tonnes)	Estimated percentage change 1987–1988	Estimated percentage change 1988–1989	Exports of steel mill products: 1987 ingot equivalent	Estimated percentage change 1987–1988	Estimated percentage change 1988–1989
EEC	10.56	1	-	30.57	-1	-
Other Western Europe	12.21	8	-	13.61	10	-
Austria	1.16	11	-	3.06	4	-
Switzerland	2.16	5	-	0.86	30	-
Finland	0.81	7	1	1.53	7	1
Norway	1.10	-5	5	0.76	5	-5
Sweden	1.94	7	-4	2.86	6	-7
Turkey	3.46	-	-	2.81	-	-
Yugoslavia	1.58	-	-	1.73	-	-
United States	18.10	8	-7	1.04	65	-25
Canada	2.74	17.5	-25	3.79	-10	4
Japan	4.97	50	-	25.12	-6.9	-
Australia	0.91	44.7	-	1.32	-29.2	-4.9
New Zealand	0.53	-25	-	0.14	130	-
OECD Total	50.02	11.5	-	75.59	-1	-

Source: Organisation for Economic Co-operation and Development, Press release A(89)4 (Paris 1989).

consistent, and therefore more quality-controlled, product. The dream of a fully continuous integrated plant may be some years away yet, but the advances of recent years using modern process control equipment lead some to suspect that it is possible to achieve an automated plant in which the total time to produce strip steel from iron ore is reduced from two or three weeks to just a few hours.

(c) *Moving away from coal*

The coke ovens are essential for running a blast furnace, but they are peripheral in that they only make the fuel to drive the blast furnace and to reduce the ore. They are expensive, have limited lives and need careful designing to avoid environmental problems. They also need expensive metallurgical coal to convert to coke. Ironmakers have met this problem in the following three ways:

(a) By developing techniques to extend coke oven life using hot refractory repair methods, thereby reducing the need for new capital investment;

(b) By developing methods of reducing the demand for coke in the blast furnace, using granulated or pulverized coal injected through the blast furnace tuyeres;

(c) By working on new smelting reduction techniques which use cheaper quality coals and ores to produce hot metal.

The first two methods have become common practice in ironworks and steelworks in Japan and other developed market economics, and most of the major companies have been involved to some extent in the third method. To date prototype and pilot plants abound, but only in South Africa has smelting reduction been tried on a commercial scale. Early problems with the plant are now being overcome, and the next year or two will probably bring an increase in the use of these processes on a small commercial scale. This could be of vital interest to developing countries where coal and ore qualities are inadequate to meet the needs of the traditional blast furnace. Capital costs are lower, there is no demand for reliable electricity supply, and product quality should be good. For developed countries, where output is high, these smelting reduction technologies are unlikely to meet the huge capacities of blast furnace production, but if they can be scaled up in time to meet the next round of major investment in coke oven facilities, then they will have a promising future. Steelmakers in developed countries certainly hope so.

The technique of coal injection is now being widely used, and replacement ratios of up to 120 kilograms per tonne of hot metal have been achieved. The coal is used as a fuel and reducing agent, but has none of the structural properties of the coke in a blast furnace stack, which allows a permeable burden to be maintained. Interestingly, the technique has been developed separately in China, where it is probably more widely used than elsewhere, but other developed countries are catching up and reaping significant benefits.

(d) *New steelmaking technologies*

Pulverized coal also finds increasing application at the steelmaking stage, in converter vessels, electric arc furnaces and in recently developed specialized technologies. It is an energy source used to increase the scrap melting potential of converters (which are limited to around 25 per cent scrap under normal conditions), and to reduce electrical energy and electrode consumption in arc furnaces. The applications have made technologists realize the possibilities of hybrid systems which rely neither on electricity nor on a hot metal supply, and merely inject oxygen, coal and perhaps other hydrocarbon fuels in order to provide decarburization and melting energy in one move. In addition, one such system incorporates scrap preheating to further reduce total energy consumption Once again these steelmaking technologies are of great interest for developing countries which have the required raw materials, since they are flexible in their melting programmes.

The electric arc furnace itself has been the subject of much research and is now a highly tuned primary melting vessel with productivity figures which would have been unheard of just a decade ago. Interesting ideas for direct current furnaces and plasma furnaces have recently emerged, and these may find success in particular applications. Continuous steelmaking through an electric arc furnace is now in commercial use in the United States, with scrap preheating as an integral part.

(e) *Thin slab and strip casting*

The impact made by mini-mills on the integrated plants has been described in connection with the market for long products. Very recent developments now extend the possibilities for mini-mills to encroach further on the integrated industry and to produce flat rolled products. This development is known as thin slab or strip casting and is a technology whereby the casters make a product which is far nearer to the finished required shape than the traditional casters. Thin slab down to 25 millimetres and strip down to 3 millimetres is now being cast directly, and the rolling mill requirements have been accordingly reduced. For metallurgical reasons, some ro'ling is necessary in order fully to exploit the properties of the materials, but the traditional and expensive hot mill will no longer be necessary. The massive capital cost involved in building a hot strip mill will be removed and the mini-mills will break into the market for flats. They will still have to address the raw material (scrap) quality problem already discussed, but with careful scrap selection and judicious use of direct-reduced iron this can be overcome. Initially, mini-mills producing flats will not encroach on the high-quality end of the market. Integrated plants will also be able to benefit from strip casting technology if speeds can be made sufficiently high. It has taken many years for the conventional continuous casters to reach their current stage of sophistication, speed and quality production. It is difficult to forecast when, if ever, strip or thin-slab casting would take over completely.

(f) *Environmental control*

Environmental control is playing an increasingly important role in both developed countries and NICs. Steelmaking has an image of being a dirty industry, but that is now a thing of the past. New steelworks more closely resemble chemical production plants than their predecessors. Up to 20 per cent of total expenditure on a greenfield steelworks is made on environmental control equipment. In many cases there is an energy payback as well, since recovered dusts can be recycled and recovered off-gases are now being used as valuable fuel instead of being flared off as before. In existing plants the problem is more complex since environmental control is viewed as a non-productive expense, but in developed countries in particular the legislative requirements are such that a steelmaker can be forced out of business if he does not conform to pollution control regulations. Developing countries often have less strict requirements.

3. *Future trends*

This review should serve to illustrate that statistics alone cannot explain what is happening in the steel industry world-wide. The diversity of technologies and the fact that steel is only a raw material for another manufacturer adds considerable complications to the interpretation of statistics. Although 1988 was a good year world-wide for steel, it was probably not the beginning of a strong upward trend. Capacity utilization was high following a decade of rationalization and diversification for some of the larger companies. The achievements of the Republic of Korea stand out from the rest, but are seen as part of a burgeoning local economy. China continues to show strong growth, with no let-up in sight, but consumption per capita is still a fraction of that experienced in developed countries. Latin America will remain debt-ridden and a victim of current high interest rates, but steel consumption will probably grow none the less. 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 Europe breaks down boundaries and further increases competition. In the meantime, the need for modernization in Eastern Europe and the USSR seems to be greater than ever before.

K. Footwear (ISIC 342)

Developing countries are a step ahead in shoe production. Which ones will sustain the momentum?*

1. *Production, consumption and trade*

Simplified shoemaking 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 1987 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 25 per cent of world shoemaking and developing countries 75 per cent (see figure IV.33). By 1987, the shares had changed to 18 per cent and 82 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 50 per cent, while Eastern Europe and the USSR, Western Europe and North America have seen their combined share reduced from 47 per cent to 36 per cent.

The major changes over the period have been for four countries or areas to register substantial increases in shoemaking. Brazil, China, Taiwan Province and the Republic of Korea have all registered increases of over 200 million pairs, while Italy, Portugal, Thailand and Yugoslavia have all experienced increases of over 50 million pairs each. At the other end of the scale, the United States has seen its shoemaking decrease by over 200 million pairs, and France, Federal Republic of Germany and United Kingdom have also registered significant decreases. Table IV.142 shows China as the leading producer in 1987, with 1.9 billion pairs, followed by the USSR with 1.05 billion pairs. Table IV.142 also shows clearly the dominance of Asia in world shoe production, with nearly half of total output.

Table IV.142. Leading footwear producers, 1987
(Millions of pairs)

Country, region or economic grouping	Output
China	1 903
USSR	1 052
Taiwan Province	803
Brazil	592
Republic of Korea	534
Italy	456
Japan	409
India	390
United States	291
Mexico	243
Spain	190
France	183
Poland	163
Turkey	158
Thailand	147
United Kingdom	125
Yugoslavia	122
Romania	121
Pakistan	120
Czechoslovakia	119
Hong Kong	101
Indonesia	92
German Democratic Republic	88
Portugal	80
Germany, Federal Republic of	79
EEC	1 169
Western Europe (non-EEC)	1 214
Eastern Europe and USSR	1 756
North and Central America	629
South America	846
Asia	4 922
Total world footwear output	10 536

Source: Footwear Technology Centre, *World Footwear Markets 1989*.

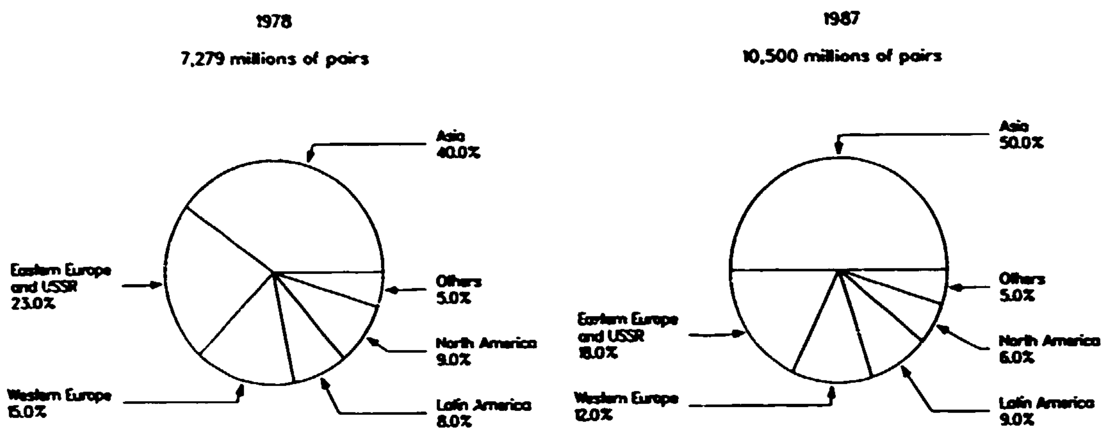
So far as consumption of shoes is concerned, Asia and the Middle East are in the lead (table IV.143), although in terms of pairs per head, European countries dominate (table IV.144).

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, Thailand, and even Indonesia, as manufacturing gravitates to lower labour cost producers. India should figure within this scenario, but has yet to exploit its undoubted potential.

Taiwan Province is moving into leather footwear to increase unit prices, both as a hedge against pairage quotas but also because of its higher manufacturing

*This article is based on the contribution of Iain Howie, International Editor of *World Footwear*.

Figure IV.33. World production of footwear by region, 1978 and 1987



Source: Footwear Technology Centre, *World Footwear Markets 1989*

Table IV.143. Consumption of shoes by region, 1987

Region or economic grouping	Millions of pairs
EEC	1 426
Non-EEC Western Europe	1 581
Eastern Europe and USSR	1 733
North and Central America	1 777
South America	704
Asia and the Middle East	3 560

Source: Footwear Technology Centre, World Footwear Markets 1989.

Table IV.144. Per capita consumption of shoes, 1987

Country, area or economic grouping	Pairs per head
Switzerland	6.4
France	6.0
United States	5.6
German Democratic Republic	5.4
Germany, Federal Republic of	5.2
United Kingdom	5.0
USSR	4.2

Source: Footwear Technology Centre, World Footwear Markets 1989.

costs. The area is also keeping an interest in lower-priced products not only within its own industry, but also through developing offshore manufacturing in China, Indonesia or Thailand.

The year 1987 will probably be remembered most of all for the continued rise of China as a major exporter drawing in European and North American know-how as well as East Asian companies from Taiwan Province, Japan, Hong Kong and the Republic of Korea to help in shoemaking, particularly in sports styles. During 1987, Taiwan Province continued to be the world's largest footwear exporter in volume terms (table IV.145), followed by the Republic of Korea, Italy and Hong Kong. As indicated in a separate section on Taiwan Province, production may have peaked and exports started to weaken in 1988. Other significant factors in the year were the continuing depression in the Italian footwear industry, largely fostered by the weak United States dollar, the continued lack of protection for North American producers and the rise of Thailand as an alternative source of low cost footwear. That low-labour-cost producers such as Greece and Turkey have not exploited their proximity to the European market more effectively is surprising. Leading importers (table IV.146) are headed by the United States, which suffers internally from fierce overseas competition.

Table IV.145. Leading footwear exporters, 1987

Country, region or country grouping	Millions of pairs
Taiwan Province	744
Republic of Korea	418
Italy	384
Hong Kong	332
EEC	701
Non-EEC Western Europe	733
Eastern Europe and USSR	181
North and Central America	26
South America	157
Asia and the Middle East	1 844

Source: Footwear Technology Centre, World Footwear Markets 1989.

Table IV.146. Leading footwear importers, 1987

Country, region or economic grouping	Millions of pairs
United States	938
Hong Kong	273
Germany, Federal Republic of	304
France	206
United Kingdom	178
Japan	136
USSR	135
EEC	958
Non-EEC Western Europe	1 100
Eastern Europe and USSR	158
North and Central America	1 174
South America	15
Asia and the Middle East	482

Source: Footwear Technology Centre, World Footwear Markets 1989.

(a) *Exchange rates*

The effect of fluctuating exchange rates during the past few years has had a profound influence on the sourcing of footwear. It is, perhaps, the unpredictability of these changes that has been particularly disturbing. Countries and areas that have been linked to the US dollar, such as Taiwan Province, were able to take advantage of their favourable position with the United States relative to countries such as Italy and Spain. The cost of Italian shoes in the United States has increased considerably, and Italian losses in recent years can be mainly attributed to their downturn in the United States market. At the same time, they were able to retain their position with their leading EEC customer—the Federal Republic of Germany—because they did not have a problem of an unfavourable movement in exchange rates.

Some would argue that over a period, rates will move both ways and bring advantages and disadvantages. However, the Italian industry seems convinced that it has now lost the lower price market in the United States forever as a result of currency fluctuations and will, in future, have to concentrate on higher-quality footwear where cost is not such a determining factor. Therefore, a more lasting effect at least in this particular market sector may well be possible.

Even Taiwan Province and the Republic of Korea have experienced problems with the movement of the Taiwanese dollar and the won against the United States dollar. Such volatility in currency movements makes it difficult to plan ahead for both buyers and sellers, especially when so many other factors are involved.

(b) *Free trade and protectionism*

The decline in the footwear industries of developed countries was almost universal in 1987, with European countries particularly badly hit. France and Italy filed claims for restricting imports from the East Asian volume producers, and their lead could well be followed by a blanket coverage for the EEC in general.

The United States' footwear industry has long been accustomed to fighting a (generally) losing battle with the President of the United States for protection of the industry. Before leaving office in early 1989, the former President once again used his veto to block moves for protection of the United States footwear and clothing industries. It is doubtful whether the new President will radically change things.

Two interesting developments in the area of free trade are the proposed free trade agreements between Canada and the United States and the EEC single market scheduled for 1992. Only four sizeable markets (over 100 million pairs) may be said to be relatively open—United States, United Kingdom, Federal Republic of Germany and France. USSR imports are essentially only from other CMEA countries and Japan's only from neighbouring East Asian countries.

2. *Labour costs*

The advantage achieved through lower labour costs is a determining factor in sourcing of footwear. A product such as sports footwear, involving approximately 75 operations in manufacturing, will inevitably move to countries with lower cost structures. It is becoming ever more difficult to make these products (other than very high performance products) in Europe, the USSR and other countries. Sports companies, such as Nike and Reebok, either produce virtually everything in East Asia, or like Adidas, Puma and Simod, are increasingly moving in that direction, although Simod perhaps relies more on Eastern Europe and the USSR and other countries.

However, as economies become more industrialized their wage levels increase. Taiwan Province and the Republic of Korea are now looking to produce higher-quality goods, as they can no longer compete with the wage levels in China, Indonesia and Thailand. This is rather disturbing, as it is reported that from at least 10 to 15 per cent of the work-force in the Republic of Korea is aged 16 or under. Brazil, traditionally thought of as a fairly low-cost producer, is also looking at lower-cost countries. For instance, Vulcabras, a leading shoe producer, has entered a joint venture agreement in China.

The effect of labour costs can be seen by the requirement for manufacturers to complement their domestic production of higher-quality goods by establishing production units in nearby countries with lower costs (if available). These are needed to produce the lower quality volume output or to carry out stitching and cutting operations. In this way, the Federal Republic of Germany makes use of Portugal, as France makes use of North Africa, the United States of Puerto Rico, while Hong Kong, Japan, Republic of Korea and Taiwan Province are now using China, Thailand and Indonesia.

3. *The use of technology*

Developed countries are continually looking for solutions to combat the seemingly endless flood of imports from lower-labour-cost countries. These solutions include, at various times, forms of protection, improved marketing, emphasis on special footwear or high quality footwear, superior design or craftmanship and the use of advanced forms of technology. Apart from the last consideration there have been problems with the other solutions. Protection is not an option if Governments are committed to free trade. Aggressive marketing has tended to be carried out by companies using low-cost sourcing; for instance, sports footwear companies such as Reebok and Hi-Tech, and distributors such as Wortman International. Special or high-quality footwear does indeed fit in with the concept of what high-labour-cost countries should produce, but is, by its very nature, a restrictive market.

Superior design nowadays can be at the end of a terminal or telefax, and the craftmanship gap may be narrowing. This is because skilled workers in developed countries are retiring and not being replaced, while the level of skill, even if relatively low in countries such as China and Thailand, has improved in the Republic of Korea and Taiwan Province with the co-operation of companies from developed market economies.

The use of modern technology, on the other hand, is said to benefit developed countries almost exclusively, because there is less need for developing countries to reduce their labour resources. The question is rather one of the extent to which the use of technology makes developed market economies more competitive. Does it bridge the price gap to such an extent that buyers will switch sources? On a purely price comparison, it is doubtful whether the price difference between the very low-cost producers and those of the United States or the Federal Republic of Germany, for example, can be totally bridged, even with the help of the most advanced technologies. Price alone will therefore not be sufficient to stimulate the use of advanced technology. Other factors must come into play, such as the ability to deliver first orders and repeats before the competition from overseas. Techniques such as "just-in-time" production methods are designed to do this, in addition to providing other advantages such as better quality control, reduced rejects, lower stocks and reduced space requirements. Indeed, higher quality production is a major ingredient in the success of developed countries. They should be able to ensure that the use of technology is instrumental in giving them an edge in quality, greater accuracy, reduced complaints and a shorter time for replacements.

The use of the Japanese inspired "just-in-time" or "quick response" techniques in shoemaking has been more widespread in English-speaking countries such as Australia, the United Kingdom and the United States than elsewhere. Although there is a good deal of interest in the technique in Europe, it has evoked little enthusiasm. The average Italian or Spanish company could claim that it is already flexible and able to produce quickly. The technique is not applicable for all types of footwear, and some factories run it for some lines only.

Automatic stitchers and other computer-controlled machines have certainly come into prominence in shoemaking in the 1980s but do not have the potential to revolutionize factories to the extent that CAD/CAM and computer integrated manufacturing do. CAD systems are available in two- and three-dimensional versions, although the use of the design facility on these systems has not been taken as far as it could be. Although the return on investments may be difficult to quantify, there are advantages in speeding up the pattern grading and cutting process while reducing or eliminating the cost of press knives and sample production. Over 200 systems have already been sold, mainly in the United States and Europe, with France and Italy having the largest number of systems. Even so, Italy has less than 20 systems for an industry consisting of 9,000 firms. However, there are only about 160 firms with over 100 employees, hence the potential is more limited than it would at first appear to be. France is in many respects a country that is willing to make use of new techniques and new technology. It has about 15 systems for an industry of 370 firms, of which approximately 90 have more than 100 employees.

CAD/CAM use should expand further into medium-sized firms, and larger companies, most of which now have CAD systems, can be expected to upgrade into three-dimensional or newer system versions. The really interesting development will no doubt be computer-integrated manufacturing, in which computer-generated data from the design stage can be directly input to the production process to provide full control over the machines and operations involved in each stage of production. The average footwear manufacturer in developed countries has a work-force of from 100 to 200 employees. It can be expected that this figure will drop to 50 or even less by the end of the century—probably even before. This is likely to be caused by a combination of further automation and a sub-contracting of operations, such as stitching or cutting, to external specialists.

As a first step towards computer-integrated manufacturing, the links between CAD systems and shoe machines are being investigated so that agreed standards will facilitate interchangeability. The United Kingdom-based Footwear Technology Centre is playing a major role in this. It is necessary for such initiatives to receive support and agreement if the industry is to progress to the more automated factories of the future and to avoid the problems of divergent standards which other industries have had to face.

Communications, by bringing together the various countries of the world, represent an important facet of technology. It is increasingly seen that distance need not be a barrier. This has implications for the supply of footwear. Companies which work on an international basis, such as Adidas, Bata and Reebok, can more easily communicate between their various plants and designs can be speedily transmitted. There is little evidence to suggest that improved forms of communication have a direct effect on determining the location of footwear manufacturing, but they are likely to reinforce trends already in evidence.

4. *Likely future trends*

The industry will be watching with interest the development of existing trends and the likely emergence of others in the next few years. Some of the more interesting questions are as follows:

(a) Will China continue to be receptive to outside influences, particularly after the recent turmoil? Will the tendency of Taiwan Province and other East Asian giants to source offshore continue? If so, will Taiwan Province become a quality footwear manufacturer leaving China and Thailand to sub-contract lower priced footwear?

(b) Can Italy regain its predominant position, or has it lost the lower-price markets for ever? How will the 1992 EEC unification affect trade within and outside the EEC? Will trade agreements—bilateral or otherwise, as between Canada and the United States or between the EEC countries—affect the general level of trade with excluded parties? Will resources such as just-in-time techniques help to stem the flow of imports? Can automation in shoemaking be a realistic goal and will it help to save the footwear industry in developed countries?

The two issues that will be important in the next few years will be whether the Republic of Korea and Taiwan Province are able to produce their own brands of quality leather footwear, and whether the transfer of orders to China, Indonesia and Thailand to reduce costs and avoid tariff and other barriers in developed market economies will be feasible. At present there are mixed thoughts as to whether the country and the area in question have the attitude to quality, productivity, deliveries and management that will be necessary on a long-term basis. The long-term involvement of the Republic of Korea and Taiwan Province in offshore locations is likely to depend on whether it is possible to foster the growth of such an attitude.

For developed countries, only by cultivating an improved image and a market recognition of value added, and by meeting requirements at the right time, in the right size, colour and fit, and at the expected price, can they save what is left of their footwear industries. They will also need to look at low-cost areas to supplement their high quality products. For example, an area such as the Caribbean Free Trade Zone offers exemptions from taxes and duties for long periods or in perpetuity, and often makes available rented factory shells in addition to low labour costs. In that Zone, a country like the Dominican Republic might well be of special interest to countries such as the United States or those wishing to export to the United States.

5. *Recent developments in selected major producing countries and areas*

(a) *Brazil*

Brazil produces approximately 550 million pairs of shoes a year, which makes it the fourth largest producer in the world. It exports 135 million pairs, most of them to the United States. Leather footwear is a major component, and only Italy has a more impressive export record. About 110 million pairs go to the United States, but proposed United States sanctions against Brazilian goods are causing the Brazilians to investigate other outlets, principally in Europe.

Brazilian exports have been hindered by the Cruzado Plan, which consisted of a series of measures designed to reduce inflation. In 1987 devaluation in relation to the United States dollar was helpful to exporters, but manufacturers have been under pressure to retain their own costs to remain competitive. The lifting of the price freeze saw price escalation on the domestic market and dampened home sales of footwear, causing a degree of retrenchment in the industry. Raw material and component costs also rose sharply.

However, provided that the Brazilians can resolve their trade dispute with the United States and control their own economy, the prospects for Brazilian footwear manufacturers as producers of medium-quality leather footwear should continue to be good in North America and elsewhere.

(b) *China*

While Taiwan Province has established itself as the leading shoe exporter, China may claim to have made the greatest progress as a shoemaking country in the past decade. It has attracted great interest both from overseas suppliers anxious to secure ever cheaper sources of supply and also from suppliers of machinery, materials, components and technology who see market opportunities in an expanding industry.

With the greater openness of the Chinese market in the 1980s, contact with developed market economies has stimulated both investment and production in shoemaking, although there is a danger of expecting too much progress too soon. It will take considerable time for the country to modernize its shoemaking. However, joint venture involvement with firms of Taiwan Province and Hong Kong entrepreneurs provides a basis for the industrialization of Chinese shoemaking while meeting quality requirements and delivery dates whatever the style of footwear.

(c) *Federal Republic of Germany*

The Federal Republic of Germany is a major footwear consumer and a market that demands high quality and good service, second only to the United States as an importer. The domestic manufacturing industry has been unable to compete with imports and now produces less than 100 million pairs within the country. Shoe manufacturers of the Federal Republic of Germany have long made use of lower wage countries, both through setting up their own factories or through joint ventures. Austria, for example, has for several years been a second home for footwear producers of the Federal Republic of Germany. Adidas has factories there and Gabor has a larger plant in Austria than in its home country. More recently, Portugal has gained in popularity as a manufacturing country, with about 12 companies of the Federal Republic of Germany operating there.

The year 1987 was not a good one for the shoe industry of the Federal Republic of Germany, with a 9 per cent decrease in output to 79 million pairs and imports up by 14 per cent to 273 million pairs. Exports, however, increased by 7 per cent to 36 million pairs.

(d) *France*

France suffered markedly in 1987, with production down by 13 million pairs to 182 million, exports down by 3 million pairs to 55 million and imports up by 32 million pairs, making it the third largest footwear importer in the world (excluding Hong Kong, which is, essentially, a re-exporter). Imports into France were particularly strong from China, Republic of Korea and Taiwan Province at the lower price levels, and from Italy for the higher-quality market.

The strength of the French shoe manufacturing industry is in their quality brands such as Cardin, Lacoste, Jourdan and Kelian, although those companies have also felt the impact of a changing market. France, however, is vigorously pursuing the modernization of their manufacturing plant, particularly through automation and the introduction of CAD/CAM systems.

(e) *Italy*

Although Italy is still the most influential footwear industry in the world through its leading role in fashion, its innovative shoemaking machinery and comprehensive components and accessories industries, it has been beset by major problems during the past three years. These have arisen through a downturn in overseas markets, particularly in the United States and the United Kingdom, coupled with an import surge which now claims some 40 per cent of the market. Imports, particularly from the East Asia, have reached 85 million pairs.

The problems for Italy in the United States may be attributed to exchange rates, in particular an initial unfavourable trend which made it extremely difficult for Italy to compete at the lower end of the market. Rises in Italian inflation and wage rates have not helped. It is reported that about 300 firms closed in 1987, mainly small concerns but including De Rocco, the second largest producer. Exports fell by 7 per cent in 1987 to 380 million pairs, although the major market, the Federal Republic of Germany, remained stable.

(f) *Mexico*

There are three major shoe production areas in Mexico, Leon being the largest, followed by Guadalajara and Mexico City. Since the recent lifting of import restrictions, Mexico has been under pressure from imports. But the pressure is turning out to have a positive effect on Mexican footwear manufacturers.

As they saw their domestic market threatened, they have made serious moves to become competitive internationally. Definite inroads have been made in two directions. First, they became aware that they had to know and respond to fashion trends. Secondly, they became more quality-conscious. To help with fashion information, a National Fashion Committee has been established to supply up-to-date information to shoe manufacturers. They hold conferences twice a year to highlight trends.

Mexico claims to have over 4,500 footwear manufacturers, broken down as follows: 2,200 factories with less than 100 workers; 1,800 factories with between 100 and 300 workers; and 600 factories with over 300 workers. Some 500,000 workers are involved in the footwear, tanning and supply industries, of which 230,000 are in shoe factories. This number, however, does not include people who take uppers home, stitch them and return them to the factory the next morning for completion. This is common practice in many shoe factories in Mexico.

Mexico produced about 245 million pairs of shoes in 1988, including nearly 86 million pairs of men's, 84 million pairs of women's and 66 million pairs of children's. About nine million pairs of shoes are referred to as unisex.

Exports from Mexico have been increasing steadily, and in 1988 were said to be about 34.5 million pairs. Of that total, only 2.6 million pairs were leather, 30 million were rubber and canvas and 1.7 million were plastic. These were shipped to Canada, Federal Republic of Germany, France, Italy, Sweden, Switzerland, and United States. Mexico has an advantage in the North and South American markets because of proximity and wage rates which are lower than many in the East Asia, especially Hong Kong, Taiwan Province and the Republic of Korea.

(g) *Republic of Korea*

Like Taiwan Province, the Republic of Korea has for many years been a volume producer for developed market economies. It has been especially prominent in the export of sports footwear, usually as the producer for a prominent name. That situation is now changing. The Republic of Korea is beginning to realize that it can produce quality products in its own right and with its own brand names. The catalyst for change was, perhaps, the political unrest of 1987 which had the effect of increasing, albeit slowly, the rights of workers and also loosening the foreign buyers' control of costs and deliveries. The won-dollar relationship moved unfavourably, workers wages rose by 29 per cent, raw material costs increased and moves were made in countries such as France, Italy and the United Kingdom to limit footwear imports from the Republic of Korea.

The overall effect was to make the Republic of Korea look at lower-cost opportunities for shoe manufacture and to consider making their own brands of sports footwear. As a result, companies have begun joint ventures in China, Indonesia and Thailand. For example, Tongyang has a venture with Waxon of Indonesia to produce leather shoes; Taehwa and HS Corporation are establishing plants in Indonesia and Thailand; and Sunkyong has a venture with Salim to establish a production facility at Cibinang near Jakarta.

Own brands which have been established by firms in the Republic of Korea include Pro-Specs by Kujke, Arrow by Sunkyong and Le Caf by Hwa Soung Corporation which formerly produced for Adidas.

Recent strikes and cost increases are reported to have led to the closure of over 50 companies, but the industry is still substantial, with some 220 firms employing at least 150,000 people producing 530 million pairs annually. The Government has recently announced that it is providing 3.5 billion won to establish a footwear institute at Pusan.

(h) *Spain*

Spain, like Italy, has experienced hard times in recent years, being hampered by an unfavourable exchange rate compared with other competitors. Unlike Italy, Spain was able to stabilize its exports at 102 million pairs in 1987, although imports have increased from 8 million to 20 million. Current problems affecting the Spanish economy include high inflation and wage increases, as well as an over-dependence on the United States market and a somewhat lack-lustre image for quality and marketing.

(i) *Taiwan Province*

Following significant growth during the past decade, Taiwan Province has become the world's largest footwear exporter in volume terms at over 740 million pairs annually. However, peak production has perhaps been reached as the area starts meeting the type of problems experienced by the more mature shoemaking countries. A 6 per cent decrease in exports in 1987 was followed in the first half of 1988 by further falls in exports to countries such as the United States, France and the United Kingdom. This has been caused by an appreciation of the Taiwanese dollar, rising wage costs, skills shortages and a degree of labour unrest.

The response of Taiwan Province has been to upgrade its production and to look to offshore production for lower-cost lines. Various estimates have been made of the involvement of Taiwan Province in East Asian countries, with reports that some 30 companies from the area have signed joint venture and similar agreements for footwear production in China. This number is expected to rise to around 100 by 1990, and similar numbers are quoted for Thailand and Indonesia.

The advantages of this type of arrangement are that it allows Taiwan Province to remain competitive while making a profit from sub-contracted work as well as circumventing restrictions on the import of footwear from the area into countries such as France, Italy and the United States. There is, however, a limitation on how many Taiwan Province firms can afford to pursue this route to survival, and sedition laws still, in theory, restrict direct dealing with China.

One of the Taiwan Province companies successfully making use of the lower costs and abundant workforce offshore is Sherwood, an Adidas licensee which has invested over 1 million in a company near Bangkok, Thailand. The company, Oriental Sports, produces sports footwear.

The short-term prospects of the Taiwan Province shoemaking industry are sombre. At the time of writing, some 400 firms were reported to be on short time, with a more uncertain future than for many years past. However, this has not prevented the industry from looking into the advantages to be gained from using CAD systems in shoemaking and from a lowering of the duty on imported leather (some 90 per cent of its leather supplies are imported).

(j) *United Kingdom*

The United Kingdom is one of the four major importers of footwear in the world. Its relatively open policy of trading and centralized retail sector have made it highly accessible to would-be exporters. This has not helped the domestic manufacturing industry, especially as United Kingdom producers have traditionally not been major exporters. Helped by favourable exchange rates and lower inflation in recent years, there has been a steady increase in exports, but at around 20 million pairs annually this compares unfavourably with the import level, which reached 178 million pairs in 1987. Production in 1987 was 125 million pairs, which is somewhat down on the peak level of 200 million pairs reached in the 1960s, but shows a degree of stability through the mid-1980s. Some sectors, such as women's medium-priced footwear, have found greater difficulty than others in maintaining their share of the market.

Quality men's shoes, for example, continued to enjoy success at home and abroad. However, an extra 23 million pairs of footwear were imported, entirely due to an upsurge in imports from East Asia, which accounted for 50 per cent of the total.

The United Kingdom footwear industry is in a state of flux, with major footwear production capacity being sold off by retailers. For example, both the British Shoe Corporation and the Ward White Group have sold their factories. The Burlington group has taken over the British Shoe Corporation factories, while a management buy-out at Ward White has formed the Shoe Group.

The latest statistics point to further rationalization within the British footwear manufacturing industry and a continuing upsurge in shoe imports from East Asia.

(k) *United States*

The United States footwear market is the most important in the world by virtue of its sheer size and sophisticated requirements. The domestic shoemaking industry has had major problems in competing with imports from all sources, with the production of non-rubber footwear falling in 1987 to 222 million pairs, a loss of almost 20 million pairs. It should be realized however, that a substantial proportion of this output is made "offshore", particularly in Puerto Rico, which enjoys lower wage costs and duty-free access to the United States.

Imports actually fell by 3 million in 1987 to 938 million pairs, mainly as a result of losses by Italy and Spain although imports from East Asia continued unabated from Taiwan Province, 434 million pairs; from the Republic of Korea, 192 million pairs; from China, 48 million pairs; and from Hong Kong, 29 million pairs. This pressure from imports threatens to further decimate the United States shoemaking industry, and there have been moves over an extended period of time to convince the Administration that limitations should be placed on the volume of imports.

There is no doubt that since the ending of the "orderly marketing agreements" with East Asian countries there has been a tremendous upsurge in imports. However, United States manufacturers have also had some success. Timberland and other companies such as Sebago, Allen Edmonds, United States Shoe and Dexter have enjoyed success in creating and promoting an image of the United States way of life which has translated into shoe sales in overseas markets, including Italy.

L. Newsprint and printing and writing papers (ISIC 34119 and 341122)

Developing countries are forging ahead towards greater self-sufficiency*

1. *Current situation for world paper and board business*

In this section the current state of world-wide markets for newsprint and for printing and writing paper is surveyed and a summary of the outlook for the future presented. It will focus on the markets in Asia, Africa and Latin America, the prospects for growth of production in these regions and how they are affected by the main paper-making nations in North America and Western Europe.

A review of the world's output of paper and board is necessary to put these particular markets in their context. It is almost certain now that 1988 was the sixth record year in a row for the world's production of paper and board, according to *Pulp and Paper International*. This is the longest record run in the past 20 years. The same is true for pulp production.

The current estimate is that 226 million tonnes of paper and board were produced world-wide in 1988, a rise of 5 per cent from 1987. The forecasts for the current year show that yet another record could be set in 1989, when, for the first time, production will exceed 230 million tonnes of paper and paperboard (table IV.147).

With these basic output figures, it is not surprising that many of the other related indicators are following a similar record-breaking path. Apparent consumption has led output up the same six-year sequence; industry operating rates remain high; cross-border trade continues to rise; the big bulk products such as newsprint, market pulp and kraft liner board have been doing well.

Generally, booming business has meant good profits. An index of sales and profits of the top 100 pulp- and paper-producing companies in the world shows record levels for both consolidated sales and net earnings in 1987. Perhaps a new high point was reached in the 1988 financial year. The increased profitability is a key driving force for both new capital investment in production equipment and in the growth of acquisitions and mergers. At least 19 million tonnes per year of new paper and board capacity have a good chance of coming on stream during the period from 1989 to 1992. This 19 million-tonne-per-year projected addition of new capacity is 55 per cent higher that the one recorded by Capinvest in early 1988, when the survey covered the years from 1988 to 1991.

The region showing strongest real growth in both consumption and production is Asia. Its share of total world production has been rising steadily, from 20 per cent in 1983 to a possible 24 per cent in 1989. At the moment its output is led by Japan, China, Republic of Korea and Taiwan Province. One forecast is that Asia will be using 76 million tonnes of paper by 2001, more than will be consumed in Western Europe.

Japan makes half of this continent's total output and its consumption and output continues to rise. Adding China, the Republic of Korea and Taiwan Province, these four make close to 90 per cent of the total and the output of each of the four has been growing fast. Others which show signs for strong growth in the near future are Indonesia and Thailand. And in Australasia, both Australia and New Zealand are set for further expansion of production.

2. *The newsprint market*

The tightness of the world's newsprint market during the past two years was illustrated by Abitibi-Price in a recent report*. While newsprint production world-wide rose by 3.7 per cent in 1987 to 30.3 million tonnes, capacity only grew by 1.3 per cent to 32.7 million tonnes (table IV.148). The average mill operating rate of 93 per cent was almost certainly the highest it has ever been. The unused 7 per cent is considered to be more apparent than real, such that the demand/capacity ratio in 1987 was close to the operational limit, a situation which continued through most of 1988.

The capacity side is now one major factor which is beginning to upset the balance. A recent forecast is for

*UNIDO acknowledges the contribution of Peter Sutton, Editor of *Pulp and Paper International*.

*Presented at the Fourth Publication Papers Conference of *Pulp and Paper International*, London, November 1988.

Table IV.147. World paper and board production, 1988 and 1989

Region	1988 (thousands of tonnes)	Percentage change 1987-1988	1989a/ (thousands of tonnes)	Percentage change 1988-1989
North America	86 409	3.4	88 300	2.2
Western Europe	57 377	6.8	58 690	2.3
Asia and Australasiab/	51 683	9.0	55 135	6.7
Eastern Europeb/	17 873	2.1	18 750	4.9
Latin Americab/	10 457	-0.6	10 755	2.8
Africa	2 422	0.8	2 606	7.3
World total	226 221	4.9	234 230	3.5

Source: Pulp and Paper International.
a/ Forecast.
b/ Estimated.

Table IV.148. World newsprint production, 1987 and 1988

Region	1987 (thousands of tonnes)	Percentage change 1986-1987	1988[a] (thousands of tonnes)	Percentage change 1987-1988
North America	14 972	4.0	15 407	2.9
Western Europe	7 263	4.7	7 552	4.0
Asia and Australasia	4 677	2.4	5 255	12.3
Eastern Europe	2 027	3.4	2 036	0.4
Latin America	989	-0.9	1 050	6.2
Africa	356	-6.3	400	12.3
World total	30 284	3.7	31 700	4.7

Source: Pulp and Paper International, International Fact & Price Book.
a/ Estimated.

world newsprint production capacity to rise by 18 per cent world-wide, reaching 38.5 million tonnes per year by 1992. The world's consumption of newsprint is forecast to rise to 34.7 million tonnes a year by 1992, up 14 per cent from 1987. It is foreseen that demand from Japan and other Asian countries will increase more rapidly than that of North America and Europe.

(a) *Europe*

From mid-1988 to mid-1990, about 1.5 million tonnes of new annual capacity will be coming on stream in Europe, nearly half of it in the EEC. This resurgence of the EEC as a newsprint producer is because many of the owners of this new capacity want to use waste paper in the future to make newsprint, so it is a good idea to be close to a major input source. It is also because of the relative cost and availability of energy in the future in Europe, and proximity to the major buyers of newsprint. These reasons have been given by some Nordic suppliers who are investing in new newsprint machines in the EEC.

Newsprint apparent consumption in 1988 in Western Europe was just over seven million tonnes, about 5 per cent up from 1987. Looking back, Western Europe's consumption averaged 3 per cent annually from 1981 to 1987 (thus including the bad years of 1981 and 1982), reaching 6.7 million tonnes in 1987. Europe's share of the world's consumption has remained the same over this period at 22 per cent, second only to North America's massive 45 per cent share. The good balance between supply and demand in 1987 and 1988 did not lead to any significant rise in prices—clearly, newsprint did not become scarce for any lengthy period in Europe.

Europe's share of the world's newsprint capacity may rise from 24 per cent in 1987 to 25 per cent in 1992, or 9.6 million tonnes of the total of 38.5 million tonnes. By contrast, Europe's share of world newsprint consumption is forecast to be around 7.3 million tonnes in 1992, about 4 per cent more than it was in 1988. So European demand for newsprint seems likely to carry on rising, but not at the same strong rate of recent years. This is assuming there is no serious decline in economic performance. This future imbalance of consumption and capacity also means European mills may well be looking for markets further afield.

The net short-term result may be a European market where price increases are difficult to push through, price discounts rise, and some down time by newsprint producers may be necessary. But owing to fair demand, the trough in what should be a typical newsprint cycle may not be as deep as some past ones.

(b) *North America*

The short-term outlook for the world's biggest newsprint producing region is not good. North America is about to be immersed in its own surge of new capacity, starting around the middle of 1989. Add to this the depressing figures for United States newsprint consumption and the result could well be that United States producers will want to ship even more tonnage to Europe and the Pacific rim.

Twelve, possibly 13, new newsprint machines will start up in North America by the end of 1991, bringing between 2.2 and 2.4 million tonnes of new capacity each year. Probably five of these will start before the end of 1989, gradually adding about one million tonnes to a total annual United States capacity of 15.7 million tonnes.

The anticipated arrival of this new tonnage is already affecting prices, pushing back a first-quarter price rise attempt and increasing discounts from list prices. The consumption figures also do not help price rises. Having grown at a fairly steady pace in the past few years, United States newsprint consumption started to turn down early in the second quarter of 1988, so that the total for the year was 12.3 million tonnes, just 0.1 per cent higher than the 1987 figure, according to the Canadian Pulp and Paper Association. The forecasts for United States newsprint consumption in 1989 cluster around 2 per cent growth or less.

One result will be more newsprint tonnage looking for overseas markets. With the advantage of a dollar that has considerably weakened on most foreign exchanges, the United States mills are aggressive, with exports rising by 34 per cent to 381,000 tonnes, while imports dropped about 20 per cent to 280,000 tonnes.

The price difference between Europe and the United States makes Europe attractive. In the middle of the first quarter of 1989, for example, the difference between the selling price on the United States West Coast and the price in the Federal Republic of

Germany was over $100 per tonne, though the recent strengthening of the dollar will have cut back this difference. It is also likely that with both Europeans and United States producers seeking sales to keep mills running, prices in the Pacific rim markets are set to decline further.

One effect of these developments in the world's major markets will be the arrival of more newsprint tonnage in the other regions of the world. The long-held view that Asia, and sometimes Africa and South America, are used as sites for selling cheaply unwanted tonnage from Europe and America during time of oversupply may be about to surface again. The availability of good-quality but inexpensive paper will inevitably be imported by countries where new newsprint production is starting up or planned.

3. *The market for printing and writing papers*

Many branches—perhaps even all—of the printing and writing papers business have been enjoying strong demand in the world's major markets: Europe, North America and Japan. Similar to newsprint, certain branches may be heading towards oversupply. Unless demand carries on at its strong pace, this new production capacity could hurt some markets—such as the coated printing paper businesses in Europe and the United States—from a supplier's point of view.

The follow-up effect may be increased availability of printing and writing papers from Europe and the United States in Asia, Africa and the Middle East (table IV.149). In addition, some Asian countries and areas, notably the Republic of Korea and Taiwan Province, are expanding output in this branch rapidly, while Japan remains a dominant supplier.

The term "printing and writing papers" is all-encompassing. It is slowly falling into disuse due to better definition of grades and collection of key figures. The branch includes: coated and uncoated wood-containing (or mechanical) paper, used mainly for printing, such as super calendered paper and lightweight coated paper; coated and uncoated wood-free papers, uses of which stretch from the growing use of coated wood-free printing papers, through to the booming business p[illegible] market, covering copy paper, computer print-out [illegible]r and new laser-printer papers. Many of these are sold in sheets rather than reels.

(a) *Europe*

Europe has the best and probably the most sophisticated market for printing and writing papers. Most of the suppliers of printing papers to Europe's printers have been enjoying a strong growth in demand over the past two years (see table IV.150). But there are signs now that a less satisfactory market may develop by the latter half of 1989 because the growth in demand seems set to carry on at close to the levels of 1988, which will be a problem for some grades of paper, supply of which may expand at a faster pace.

In the magazine paper branch, the size of the rise in demand and its persistence has soaked up new production capacity in Europe. The threat of overcapacity which loomed in 1986, particularly in the coated wood-containing papers branch, disappeared. This is because of advertisers' continuing preference for printed media, and equally important, their desire for higher-quality print, meaning more demand for coated papers. The lightweight coated wood-containing grades and coated wood-free papers have been the main beneficiaries.

One result of the good times is new capital investment and once again the threat of overcapacity looms. It is possible that this time oversupply will affect the market, hitting prices—or at least price rises—and requiring some down time at paper mills. Indeed, there are reports that these events started to happen by the second quarter of 1989. More export business outside Europe is one answer.

Coated wood-free printing grades have benefited from the desire for more high-quality promotional literature and colour advertising. Growth of consumption of coated wood-frees in Western Europe has averaged 8.4 per cent annually from 1980 to 1987, outpacing even the 6 per cent per year growth of coated wood-containing grades, such as lightweight coated. Apparent consumption of coated wood-free in 1987 in Western Europe was 2.8 million tonnes, and in

Table IV.149. World production of printing and writing papers, 1987 and 1988

Region	1987 (thousands of tonnes)	Percentage change 1986-1987	1988 a/ (thousands of tonnes)	Percentage change 1987-1988
North America	21 253	6.5	22 784	7.2
Western Europe	18 902	7.3	21 071	11.5
Asia/Australasia b/	10 386	6.4	12 252	18.0
Eastern Europe	2 785	-3.4	2 843	2.1
Latin America	2 440	-2.4	2 545	4.3
Africa	520	4.6	546	5.0
World total	56 286	6.0	62 041	10.2

Source: Pulp and Paper International.
a/ Estimates for 1988 of some countries in Eastern Europe, Asia and Australasia, Latin America and Africa.
b/ Increase is also partly due to reclassification of Japan's grades of printing and writing papers.

Table IV.150. Western Europe: main output of printing and writing papers, 1988

Region	Uncoated mechanical (10^3 tonnes)	Percentage change 1987-1988	Uncoated wood-free (10^3 tonnes)	Percentage change 1987-1988	All coated (10^3 tonnes)	Percentage change 1987-1988
EEC[a]	2 107	8.0	4 842	5.6	6 035	7.8
Scandinavian countries	2 658	7.7	1 703	11.5	2 104	28.3
Others	380	45.0	441	-0.2	701	15.3
Total	5 145	9.9	6 986	6.5	8 840	12.7

Source: Pulp and Paper International.
a/ Excluding Greece.

1988 it was probably above 3 million for the first time. Growth from 1983 to 1987 alone was about 9 per cent per year, totalling 1.3 million tonnes.

There is unlikely to be any shortage of supply. Indeed if demand slackens, a period of oversupply may quickly arise. Several new capital investments have been announced to increase production. One estimate puts the growth in production capacity at nearly 6 per cent per year over the next four years, thus adding 1.2 million tonnes. Exports outside Europe will need to be maintained or increased in the next few years. This will not be easy, as plans for new capacity in the main target markets, North America and the Pacific rim countries, are already under way.

(b) *Lightweight coated paper markets*

Like the coated wood-free sector, increases in print advertising expenditure, in specialist magazines, in direct mail and in promotional publications designed to project a quality image, are all pushing up demand for coated wood-containing grades, particularly lightweight coated paper (usually considered to be below 72 grams per square metre). The rate of growth and its persistence caught some paper market analysts by surprise (table IV.151). As yet there are no strong reasons why this growth in demand should slow down in the short term.

Another important factor pushing the rise in print advertising is the improvement in printing costs and quality. The big Swedish newsprint producer SCA has decided to enter the lightweight coated market. One of the reasons the company has given for doing so is that it sees a definite boost to paper consumption and enhanced competitiveness of print against other advertising media as a result of these improvements.

Table IV.151. Lightweight coated printing paper: growth rates of end-uses in Europe and North America, 1987
(Percentage)

Item	Europe	North America
Magazines	50	56
Catalogues	24	24
Direct mail	22	18
Others	4	2

Source: Edward Walker Associates.

Preliminary estimates are that consumption of lightweight coated and other coated magazine papers in the EEC increased to about 2,677,000 tonnes in 1988, up 11.8 per cent from 1987. In contrast, an estimate based on real prices for lightweight coated paper shows they only increased by about 5 per cent during the year in major European markets.

There has not been any major shortage of lightweight paper in the past few years. Thus even in this good demand period there has not been a serious supply shortage, though delivery times have been occasionally stretched. This is one reason why prices and price rises have not been as solid as many suppliers hoped. It also bodes ill for any decline in demand in the near future, particularly because most of Europe's planned new capacity to make magazine printing papers is for lightweight coated grades. As usual, it is not so much the increase in capacity as the concentration of it within a short time span. From mid-1988 to mid-1990 about 1 million tonnes per year of new lightweight coated output will be starting up in Europe. But it is also worth noting that there is a gap of at least one year, 1991, when no major new additions of capacity have been announced to start up—so far. This would be a good time for the market to digest the addition of capacity in 1989-1990.

Overall, growth in demand looks set to continue, but it may not maintain its present level. The first reports of production down time and price depression in Europe have started to appear. One safety valve is the export market outside Europe. Exports to North America continue to grow, despite the dollar's fall in value compared to most European currencies. Some suppliers also see Latin American and Pacific rim countries as potentially big buyers of lightweight coated paper. For example, SCA considers that even if the United States paper industry supplies part of the anticipated expansion of lightweight coated paper consumption in the United States, there will be quite substantial possibilities in other markets for European lightweight coated paper.

Traditionally the second major type of wood-containing quality printing paper, super calendered papers are usually highly-filled papers for rotogravure and offset printing. Lightweight coated paper is also super calendered, but its coating is the key to success these days. Lightweight coated possesses higher smoothness, gloss and brightness, which makes this grade the choice for high-quality publications. Partly as a result of this trend, several recent forecasts expect the growth rate of consumption of uncoated wood-containing printing papers in general, and super calendered paper in particular, to be the slowest of the printing papers in Europe. There are few plans coming up to expand super calendered paper production capacity in Europe—in contrast to the main plans for new lightweight coated and coated wood-free paper machines. A few super calendered paper-makers are also known to be considering the addition of some capacity for surface treatment and even a complete new coating line.

It is estimated that super calendered paper consumption in the EEC was 1.67 million tonnes in 1988, just 0.2 per cent up from 1987, though this hides considerable variation across Europe, such as significant increases in consumption in France and the United Kingdom. However, demand in the biggest market, the Federal Republic of Germany, for super calendered rotogravure fell in 1988 by about 7 per cent.

There are other factors which may make the future more uncertain. One is the rise of new domestic production capacity in the big North American market, which may limit future growth of European imports. In common with other European printing papers, super calendered imports to the United States doubled in 1984 to about 440,000 tonnes. They fell back somewhat in the next two years, but reached the same level again in 1987 and probably more in 1988. In contrast, domestic production has increased from 335,000 tonnes in 1982 to 715,000 tonnes in 1987, which was in itself a 30 per cent rise from 1986. United States consumption totalled 1.16 million tonnes in 1988, up 22 per cent from 1986. Europeans cannot rely on the United States market to take on any oversupply which may arise in Europe.

The arrival of new types of printing paper could also affect future demand for super calendered paper—and lightweight coated paper as well. These new grades as yet have only a small market share, but there is an increasing variety of them. The most common type aims at fitting itself in between lightweight coated and super calendered, mostly in the heat-set offset branch, both in terms of quality and price. A generic name for it has yet to be established. Machine-finished coated, machine-finished pigmented, surface-pigmented, slightly-coated and surface-treated paper are among the names being used, and they are not entirely interchangeable.

The new grades are the first results of two trends, one technical and one market. The technical trend is to carry out more finishing of the paper on the paper machine itself, rather than off it. Most of the big lightweight coated producers in Europe, for example, have coating and super calendering lines which are separate from the paper machine. Now there is a trend toward on-machine coating and calendering for new or rebuilt machines. Carrying out these processes while making the paper at high speed is not easy.

However, several European companies are producing these grades and others intend to follow, most of them in Finland. This trend is timely for another reason. It appears to be a good way of upgrading aging and narrow newsprint machines which are becoming uncompetitive in the newsprint branch, where wide and fast-printing machines are fashionable. It looks like a good way to make a higher-value paper for an investment cost which compares favourably with a new machine.

This is not just happening in Europe. Some North American firms have added a different type of coater to the one popular in Finland, and are making a surface-pigmented paper, sometimes using starch, on ex-newsprint machines for heat-set offset printing. Meanwhile, several Japanese mills are already using yet another kind of coating unit to make a range of slightly-coated papers using a newsprint machine and are enjoying considerable success.

(c) *Europe's market for writing papers*

Europe's market for writing papers has seen good and growing demand in recent years, particularly in the business papers branch. It has also suffered from occasional oversupply leading to limited periods of down time. The effect of the steep rise in chemical market pulp prices has affected non-integrated paper-makers, many of whom are in this branch. For the uncoated wood-free branch, the prospect as regards new supply is fairly bright and has been helped by the addition of coaters at some key mills, keen to join the fast-growing coated wood-free branch.

Consumption of uncoated wood-frees, which encompass the largest part of the writing paper branch, is expected to exceed five million tonnes for the first time in Europe in 1989. It has been growing at nearly 6 per cent each year on an average since 1982. The biggest single market in 1988 was the United Kingdom (table IV.152).

Table IV.152. Europe: Consumption of uncoated wood-free paper, 1988
(Thousands of tonnes)

Region or country	Total 1988 consumption
United Kingdom	1 006
Germany, Federal Republic of	882
France	855
Spain	403
Total EEC	4 087
Total Western Europe	4 688

Source: Pulp and Paper International.

The demand prospects for some other branches are also good. The growth rate in Western Europe has been 7 per cent annually since 1985, mainly spurred by the increasing installations of office equipment which use paper. A4 photocopying paper is a big branch, but demand for paper for uses such as laser printers is growing much faster. New markets should develop in future when, for example, plain rather than thermal paper is used in the new generation of telefax machines.

Table IV.153. United States markets for printing and writing papers, 1988

Type	Total shipments (thousands of tonnes)	Percentage change 1987-1988
Uncoated wood-containing	1 449	7.6
All coated paper	6 685	7.5
Uncoated wood-free	10 300	3.5
Bleached Bristols	1 035	9.2
Thin paper	208	-8.7
Cotton-fibre paper	148	0.2
Total	19 825	5.2

Source: Pulp and Paper International.

(d) *North American market for printing and writing papers*

By far the world's biggest producer of printing and writing papers, the massive United States market, is largely self-contained, and it seems likely that the influence of United States paper as a competitor in the markets of developing countries is not going to be a major factor in the near future. Any drop in demand due to economic recession may change this, particularly as new capacity is being installed. Thus it is likely that potential United States exporters will have their eyes on European markets. As a generalization, United States paper in this branch is considered to be of a lower standard quality than the European; this is a situation which is starting to be rectified in some respects, partly by bringing in European technology.

As in Europe, printing and writing papers have been a major growth branch for the United States. Output of uncoated wood-containing and coated printing papers has grown particularly strongly in recent years (table IV.153). United States exports of printing and writing papers amount to only about 1 per cent of production, nearly 20 million tonnes per year. Imports are more significant, particularly for printing paper. They are equal to about 14 per cent of domestic production.

4. *Asia and Australasia's markets for newsprint and printing and writing papers*

Output and consumption of newsprint and printing and writing papers are dominated by Japan. But there are several countries where the printing and writing papers branch is developing fast, and a few where newsprint production capacity is also rising.

(a) *Newsprint paper markets*

Looking at the newsprint prospects for the 10 key East Asian countries and areas, China, Hong Kong, Indonesia, Japan, Malaysia, Philippines, Singapore, Republic of Korea, Taiwan Province and Thailand, a recent report by Tasman Pulp and Paper forecast that demand will grow by 950,000 tonnes from 1988 to total 5.8 million tonnes annually by 1992. This growth will be 500,000 tonnes in Japan and 450,000 tonnes in the other nine countries and areas, such that Japan's share of total Asian demand will drop slightly from 63 to 61.5 per cent.

Taking into account new capacity, Tasman forecast that production of newsprint will increase by a total of 680,000 tonnes overall from 1988 to 1992, or 17 per cent above 1988, giving a 1992 total of about 4.6 million tonnes. The region's self-sufficiency, including tied imports (that is, those from mills abroad, mostly in North America, which are owned by companies in the region, mainly Japanese) will show an overall increase of 3 per cent (to 86 per cent). By excluding Japan, however, self-sufficiency could rise by 10 per cent (to 67 per cent), according to Tasman.

A major increase in new production capacity is already taking place in Japan (table IV.154), such that there may be the need for some down time to match demand by the early 1990s. The Republic of Korea's demand for newsprint will continue to be among the strongest growers, but planned domestic expansions should be able to meet that demand and even maintain its small export business. However, there have been reports of small amounts of United States newsprint arriving in the Republic of Korea for sale at prices below the domestic product. If this trade develops, it would adversely affect domestic suppliers.

China's demand is forecast to rise about 5 per cent annually from an estimated consumption of 650,000 tonnes in 1988. Tasman considers there will be some small expansions in China and perhaps one foreign joint venture in a newsprint mill by 1991. But there is also the possibility that China will finalize a joint venture greenfield newsprint line in one of the coastal

Table IV.154. Newsprint capacity expansions, 1988-1992

Country	Thousands of tonnes
China	100
Indonesia	65
Japan	460
Malaysia	65
Philippines	35
Republic of Korea	180
Total	950

Source: Tasman Pulp and Paper.

provinces. There are several plans for such a project involving a foreign partner and using some imported waste paper.

Malaysia is also expected to start making some newsprint; there are already several plans under discussion which could start to replace imports, which totalled 123,000 tonnes in 1987. Along with the Republic of Korea, Hong Kong is expected to show strong growth in demand, above the 5.5 per cent per year average for the nine Asian countries and areas (excluding Japan). However, there is little prospect of domestic production. Indonesia has been the most enthusiastic developer of an export business, not just for newsprint but other paper grades as well. It has moved from being a net importer to an exporter of newsprint since it was first produced there in 1985. One more newsprint printing machine is expected to start up there before 1992. The paper industry in the Philippines is showing some signs of recovery. The sale of Picop, the biggest company in the industry, probably to a foreign company, could lead to new capital investment. Newsprint output totalled 101,000 tonnes in 1988, up 22 per cent from 1987. The prospects are that this could rise further. Thailand makes no newsprint today, but there may be some possibility of this changing in the longer term, tied in with the many plans for new eucalyptus plantations, though other grades are more likely to be produced.

It is worth taking extra note of the development of tied as opposed to free imports (in other words, those newsprint shipments from foreign companies which have no connection with the buyer) into the region. It is Tasman's view that import growth will be totally taken up by the rise in tied imports, such that free imports remain static. In 1992, it is forecast that Japan's imports will total 490,000 tonnes, of which about 85 per cent will be tied tonnage. For the others, total imports could be 850,000 tonnes, of which about 100,000 would be tied. Setting the balance between tied imports and domestic production will be a more important element for Japanese companies in the future. The trend in currency values is unlikely to favour increased exports of newsprint from Japan. But the tied tonnage may be directed to other markets as the business climate varies.

Outside the region, India is also expanding its newsprint production fairly rapidly, and the further development of bagasse-based paper should help push output above the total of 280,000 tonnes in 1987. There is a forecast that its newsprint production could be nearly 1 million tonnes per year by the mid-1990s, but this currently looks optimistic.

New Zealand's newsprint output totalled 295,000 tonnes in 1988, up 27 per cent from 1987, when production was disrupted by an earthquake affecting the Kaweru mill. Further rebuilding at this mill should result in an additional 45,000 tonnes per year of newsprint from mid-1991. The longer-term prospects for increased output look good, partly due to the effect of the sale by the Government of its forestry assets to private companies.

A recent estimate for Australia put newsprint consumption at 690,000 tonnes from mid-1988 to mid-1989, a rise of 4 per cent from the previous 12-month period. Newsprint consumption is expected to increase at between 2 and 3 per cent per year in the next few years, but expansion of domestic capacity is likely to replace imports and cover this growth.

In general, the prospects for greater self-sufficiency in newsprint look good in the longer term, but a major inhibiting factor may be increasing production capacity in Europe and North America. Combine this new supply with a decline in demand in home markets and the result could be more foreign high-quality newsprint on sale in Asian markets at lower prices. This would have a consequent effect on new capacity projects in the region.

(b) *Markets for printing and writing papers*

Several Asian countries already have well-developed printing and writing papers branches, often based almost entirely on wood-free papers (table IV.155). It is also a branch in which there will be much new capital investment.

Table IV.155. Asia/Australasia: output of printing and writing papers by key countries and areas, 1988

Country or area	1988 total output (thousands of tonnes)	Percentage change 1987/1988
Japan	7 627	16.5
China[a/]	2 500	5.0
India[a/]	950	5.5
Republic of Korea	893	20.5
Australia[a/]	267	0.5
Taiwan Province	458	7.0
Malaysia[a/]	110	11.1
Philippines	54	-11.5
New Zealand	48	9.1

Source: Pulp and Paper International.
a/ Estimated.

Along with packaging paper and board, the printing and writing papers branch in the region is generally bigger and stronger than domestic newsprint production, though in many cases mills rely on imported fibre. The outlook is for further new capacity and higher quality with more coated grades. Compared to domestic output, imports and exports are a small part of the total business, though in the case of the Republic of Korea and Taiwan Province this is slowly changing. The gradual relaxation of import controls and tariffs is likely to attract more competitive imports, while producers in these countries and areas are also looking abroad for more business.

The Republic of Korea is the prime example of an established printing and writing papers branch. It is largely based on wood-free grades; there is a small output of mechanical paper—often imported chemi-thermomechanical pulp is the only wood-containing ingredient. Domestic demand is strong, partly as a result of relaxed controls of the press and increased pagination, and partly because of an increasingly affluent middle class. Planned production capacity expansions could well lead to oversupply and thus the final demise of some of the small to mid-sized paper-makers. If all current plans for new capacity went ahead (which is unlikely), the Republic of Korea's output of wood-frees, about 700,000 tonnes per year, could almost double by the early 1990s. The output of coated grades is likely to increase more rapidly than uncoated. This is a large and established market, so it currently seems unlikely that, despite falling duties, imports could compete in a major way in the Republic of Korea's market for printing and writing papers. It is more likely that the Republic of Korea will try to build on the export trade of recent years, most of which is within the region of the Pacific rim, notably China, Hong Kong and Singapore.

Japan, China, India and Taiwan Province are the other key producers (table IV.156). As with newsprint, those with the greatest potential to expand are Thailand and Indonesia. Japan's massive printing and writing papers business is largely self-contained (total traded tonnes—imports and exports—to total output is just 7.4 per cent), though imports increased sharply in 1988, up to 299,000 tonnes compared to 8,000 in 1987, a level at which they had stuck since 1984. By contrast, exports fell by 10 per cent, but stayed within the range of from 250,000 to 300,000 tonnes, as they have since 1982.

China's aim is to be making more than 20 million tonnes per year of paper and board by the year 2000. Hence the current phase of investment plans, mostly in modernization of existing paper lines rather than new greenfield mills. The three key branches targeted for expansion are paperboard, newsprint and printing papers, particularly coated grades. A central problem for China and most other producers in Asia is finding sufficient fibre of acceptable quality at economic costs.

Certainly the scale of planned investments in new uncoated wood-free paper capacity around the Pacific rim show that demand for quality chemical pulp and chemi-thermomechanical pulp is set to increase. The lack of substantial domestic fibre resources in most countries throughout this region means a greater dependence on pulp from much further afield. Indonesia is one of the few exceptions since it has extensive forests, but accessibility, distance from the market and quality limit their potential.

In the longer term, however, the price of imported pulp is driving several of the producers in the region to plan reafforestation projects, notably in China and Thailand, or to search for pulp-mills abroad in which to invest—mainly in North America, as some Japanese and Republic of Korea paper producers have done. It is also clear that the level of investment and interest within the region is also increasing, as exemplified by the interest shown by Taiwan Province companies in Indonesian and Thai paper-mills.

This part of Asia is growing rapidly in terms of both paper consumption and paper output. The demand for newsprint and printing and writing papers is set to rise with increasing affluence, and the region's paper-makers are gearing themselves up to meet that demand. While they may fend off paper suppliers from outside the region, their dependence on pulp from outside will only be reduced when they have rebuilt sustainable forest resources or made better use of their non-wood fibre supply.

Table IV.156. Pacific rim: wood-free paper capacity increases, October 1988-1991
(Thousands of tonnes)

Country or area and company	Capacity increase	Country or area and company	Capacity increase
Japan		Republic of Korea	
Hokuetsu	100	Hankuk	100
Jujo	92	Shinmoorim	66
Ohtaka Shijyo	50	Ssangyong	100
Kishu	57	Namhan	100
Toyo	130	Hankuk	100
Daishowa[a/]	372	Hongwon	66
Sanyo Kokusaku	120	Heesung	100
Kanzaki	50	Chonju	140
Total	971	Shinho	66
		Total	838
Taiwan Province		Indonesia	
Cheng Loong	100	Indah Kiat	50
Yuen Foong Yu	20	Indah Kiat	7
Yuen Foong Yu	100	Total	57
TPPC	20		
Union Paper	20		
SK Corporation	10		
Total	270		
Overall total			2 136

Source: Roger Wright, data presented at the Sixth Market Pulp Symposium of *Pulp and Paper International*, May 1989.
a/ Several projects.

5. *Latin America's markets for newsprint and printing and writing papers*

With an output of about 1 million tonnes per year of newsprint and 2.5 million tonnes per year of printing and writing papers, Central and South America is edging toward self-sufficiency, at least among the leading producers. There are several projects which will add to the continent's capacity in these branches in the short term. However, the real development of its paper-making potential lies much further ahead and will follow the massive increase in pulp production which is now beginning. Brazil, by far the dominant producer, Mexico, the second biggest paper-maker but the top newsprint producer, and Chile, now starting to use its big forest resources, are the three which are leading the way (table IV.157 and IV.158).

The dependence on imported newsprint remains strong (table IV.157). Canada ships far more than any other supplier. Canadian newsprint shipments to Latin America have stayed around 400,000 tonnes per year in the 1980s, reaching a high of 600,000 tonnes in 1981 and a low of 300,000 in 1986. Well behind come shipments from Finland and the United States, each around 40,000 tonnes per year in recent years. There is also little trade within the continent. The natural aim of maximizing the value of the wood resources means chemical pulp production is favoured over mechanical and in some ways this works against increasing output of newsprint. But there are two major projects ahead which will not only increase output but probably export trade as well.

The Pisa project in Brazil will be bringing about 240,000 tonnes per year of new newsprint capacity on to the market by the mid-1990s. Further in the future, Venezuela's first big newsprint-mill has got as far as a letter of intent between the two big foreign producers, Abitibi-Price and Bowater, and the Government and national newspaper publishers. When completed, it will bring 200,000 tonnes per year of newsprint capacity, which could totally replace Venezuela's current imports of the grade. Meanwhile, in Chile, another foreign owner, Fletcher Challenge, is rebuilding

Table IV.157. Newsprint: output and trade of key Latin American countries, 1988

Country	Output (thousands of tonnes)	Percentage change 1987-1988	Imports (thousands of tonnes)	Percentage change 1987-1988	Exports (thousands of tonnes)	Percentage change 1987-1988
Argentina	228	0.9	29	-49.1	25	398.0
Brazil	247	6.5	111	-39.7	10	-33.3
Chile	184	2.8	..	..	..	..
Colombia	0	0	75	-15.1	0	0
Guatemala	1	0	4	6.1	0	0
Mexico	361	2.9	3[illegible]	157.1	37	-58.0
Peru	0	0	85	-2.3	0	0
Venezuela	0	0	181	27.5	0	..
Total a/	1 050	6.2	..	..	..	..

Source: Pulp and Paper International.
a/ Including estimates made for the rest of Central and South America.

Table IV.158. Printing and writing papers: output and trade of key Latin American countries, 1988

Country	Output (thousands of tonnes)	Percentage change 1987-1988	Imports (thousands of tonnes)	Percentage change 1987-1988	Exports (thousands) of tonnes)	Percentage change 1987/1988
Argentina	187	3.2	29	30.3	34	200.0
Brazil	1 324	1.1	53	-7.0	437	40.1
Colombia	120	5.7	6	-25.6	7	-14.1
Chile	66	3.1	-	-	-	-
Guatemala	24	18.0	4	14.3	3	50.0
Mexico	466	-0.4	14	75.0	79	64.6
Peru	77	37.5	-	-	-	-
Venezuela	138	17.0	7	133.3	1	-
Total a/	2 545	0.2	-	-	-	-

Source: Pulp and Paper International.
a/ Including estimates made for the rest of Central and South America.

pulp-making capacity at its Bio-bio mill, adding a top-wire and new press section, thus probably raising capacity by about 20,000 tonnes per year. The mill is also adding a new mechanical pulping line, part of which will be chemi-thermomechanical pulp. Others in Mexico and Argentina are also adding such pulp capacity as the popularity of the grade catches on in those countries as elsewhere (table IV.159).

Partly because of a ready supply of chemical pulp, domestic production of printing and writing papers is more than twice that of newsprint. Among the top eight producers, Brazil's growing exports of printing and writing papers, nearing 500,000 tonnes in 1988, means that total output more than covers apparent consumption of 1.92 million tonnes. These exports reach beyond South America and, until disrupted by a recent trade ban, the United States was becoming an increasingly important market.

Already about 950,000 tonnes per year of new capacity of printing and writing papers are likely to come on stream in the early 1990s. Most of this will be wood-free and based on eucalyptus. The increasing interest by major foreign companies in the acquisition of South American forest products companies is a further sign of expansion to come. Difficulty in getting sufficient capital to develop production has been a limiting factor for some local companies. But it is further in the future that the significant development of paper-making capacity will occur. Announced over the past two years, there are now many plans to increase planted forest area and to increase pulp capacity (table IV.160). Most of these plans are in Brazil and Chile. Some will not be completed, but a sufficient number of projects are likely to succeed, bringing, initially, new export sales of pulp. But in the longer term, there is the certainty that at least part of the massive pulp-making capacity will be integrated with paper machines, an opportunity to add value which will not be missed.

6. *Africa's newsprint and printing and writing papers markets*

There is one age-old difficulty in discussing these markets in Africa, namely that of finding recent reliable figures for paper output and trade. There is now a second new problem. By far the biggest producer on the continent, South Africa stopped releasing any such figures in 1987. Its paper industry is also in such a different stage of development that it can be taken separately from the rest of Africa. Therefore, from the little information available, it may be roughly estimated that the continent, excluding South Africa, possibly made about 50,000 tonnes of newsprint and 200,000 tonnes of printing and writing papers in 1987. There is no reason for that figure to have increased significantly in 1988.

Of imports, the major newsprint suppliers—the Scandinavian countries and North America—supplied about 100,000 tonnes to Africa (excluding South Africa) in 1987, most of it going to Egypt, followed by Nigeria. This was a little below the average annual newsprint exports of those suppliers to Africa in the 1980s, which was 132,000 tonnes, but it does not look like import replacement is the reason. Egypt and Nigeria have been among the biggest buyers throughout this period.

Table IV.159. Known projects for new capacity in the newsprint and printing and writing papers branch in Latin America[a/]

Country and company	Main grade	New tonnage (thousands of tonnes per year)	Possible start-up year
Brazil			
Champion	Printing and writing papers	120	1992
Impacel		130	1991
Pisa	Newsprint	240	1992
Papel Simao	Wood-free printing and writing papers	115	1989
Papel Simao	Printing and writing papers	170	1992
Ripasa	Printing and writing papers	180	1991
Votorantin Grup	Wood-free printing and writing papers	80	1990
Chile			
Tasman, Bio-bio	Newsprint	20	1989
Colombia			
Cartón de Colombia	Newsprint	100	..
Mexico			
Celulose de Chihuahua	Printing and writing papers	80	1990
Venezuela			
Abitibi-Price/Bowater	Newsprint	200	1994
Manpa	Printing and writing papers	65	1990

Source: Pulp and Paper International.

a/ These include definite expansions plus projects which are likely but not certain to proceed.

Table IV.160. Likely projects for market pulp-making in Latin America

Company	Output in 1988	New capacity	Start-up year	Comments
	(thousands of tonnes per year)			
Argentina				
Alto Parana	220	30	1989	Removing bottleneck
Puerto Piray	..	210	1992	Under construction
Massuh, Con-Bath	..	100	1992	
Total a/	220	340	1992	
Brazil				
Aracruz	490	520	1991	Under construction
Cenibra	350	350	1991	Under construction
Riocell	220	300	1992	Boiler purchased
Champion	280	20	1990	Removing bottleneck
Champion/Mato Grasso	..	200	1993	Planned
Simao	200	170	1992	Planned
Suzano	330	70	1989	Removing bottleneck
Jari	..	40	1991	Planned
Bahia Sul	..	420	1992	Under construction
Copener	..	340	1993	Planned
Celmasul	..	340	1994	Planned
Celpag	..	176	1991	Under construction
Celuba	66	24	1990	Switch to eucalyptus
Chile				
CMPC, Simpson paper	..	315	1990	Under construction
Arauco, Arauco mill	155	30	1988	Completed
Arauco	..	350	1992	Planned and approved
Arauco, Constitucion	225	39	1988	Completed
Scott, Shell	133	133	1992	Planned and approved
Total a/	380	867	1992	
TOTAL	2 256	4 207	1993	

Source: Pulp and Paper International.
a/ Estimated.

About 1.2 million tonnes of paper and board were imported by African countries in 1987. From the few real figures available, it looks as if on average about one half of this amount would be newsprint and printing and writing papers, about 600,000 tonnes. As there are only a few tonnes of exports by African paper-makers (again, excluding South Africa), most of these 600,000 tonnes would have come into the continent from outside—or from South Africa.

Africa's per capita consumption of all paper and board (this time including South Africa) has remained virtually unchanged since 1970, averaging 5.3 kilograms per year, to 1987, when it was 5.6 kilograms. This is one third that of Asia, one fifth that of Latin America, and one twenty-fifth that of Western Europe.

With such high imports compared to output and such a large untapped potential per capita growth, Africa should, on the basis of these simple figures, be a good place to build a paper-mill. Unfortunately, it often is not, as repeated attempts have shown.

Weak economies, lack of infrastructure, difficulties of importing raw materials and spare parts, the frequent scarcity of a domestic fibre supply, the need for imported management to install and start up the mill and train the personnel, the lack of sufficient funds for such a highly capital intensive industry, all are unfortunately familiar problems. But that said, there are some good producers of printing and writing papers and newsprint and there are several countries which are likely to develop their industries further. Egypt (making about 50,000 tonnes per year of newsprint and printing and writing papers combined), Kenya (about 30,000 tonnes per year), Nigeria (about 30,000 tonnes per year), Morocco (about 25,000 tonnes per year) and Algeria (about 40,000 tonnes per year) all have this potential.

So does Zimbabwe, which provides a good example of a small industry working hard to expand. It operated at full capacity in 1988, making 82,000 tonnes of paper and board, including 15,000 tonnes of newsprint and 5,000 tonnes of printing and writing papers. Imports were kept down to 1,000 tonnes of newsprint and 5,000 tonnes of printing and writing papers, such that demand remains high. The two major companies in the industry moved partly out of State control, edging into the private sector.

Price controls have restricted investment, but it is possible that liberalization of trading policies will occur in 1989. Promising developments include a joint waste-paper collection operation, plans for a national paper-making school and expansion projects which could double the industry's capacity by the mid-1990s, making it capable of meeting domestic demand for the first time in years. Overall, this seems to be an exceptionally good example of a small industry with sensible expansion objectives. Unfortunately, this is the exception rather than the norm in Africa.

M. Brewing Industry (ISIC 3133)

Reaching out to the global markets*

1. *Market conditions*

World beer production rose only slightly in 1987 over the previous year, to 1,044 billion hectolitres from 1,015 billion (see figure IV.34 and table IV.161 in the appendix to this section). This was despite a slight drop in Europe to 432,715 million hectolitres. Production in North and South America rose some 8,000 million hectolitres to 393,772 million hectolitres (despite a slight drop in the United States). The biggest increase was shown by East Asia, where beer production rose by approximately 17,000 million hectolitres, most of it (10,000 million hectolitres) in China.

During 1987, the world's top 40 brewers in the developed market economies provided 65 per cent (630.8 million hectolitres) of total world production. The United States remains the single biggest market in the world, accounting for 23 per cent of world beer sales. However, per capita consumption of beer is highest in the Federal Republic of Germany at 145.9 litres in 1986, followed by the German Democratic Republic at 142 litres. Third was Czechoslovakia (134.8 litres), then Denmark (128.8 litres).

One of the most significant trends in recent years is the increasing internationalization of the brewing business. Both Europe and the United States have seen a number of take-overs in key areas by Australian companies. For instance, Elders and Bond Brewing have launched a number of major attacks on the world brewing scene, acquiring Courage Ltd. in the United Kingdom in 1986 and Canada's Carling O'Keefe at the beginning of 1987. Bond Brewing purchased G. Hellman Brewing in Wisconsin, United States, in 1987. The companies are the only two from Australia among the top producers (table IV.162), but both figure amongst the largest seven in the world.

In Europe, following the creation of a joint international marketing company in 1986, Belgium's two largest breweries, Artois NV and Brasserie Piedboef SA, joined forces in the domestic market. The new group, Belbrew, wants to be in a position to develop its market within the new barrier-free European market in 1992, and to expand sales of Stella Artois outside Belgium.

The French market, dominated by Groupe BSN (the biggest brand is Kronenbourg) has seen declining sales in recent years. The company is number eight in the world with a total volume of 19.8 million hectolitres. BSN also produces beer in Belgium, Italy, Spain and a number of African countries. It recently reached an agreement with the Italian brewing company, Peroni, to create a new Italian brewing group that will have an estimated 40 per cent of the 13 million hectolitres domestic market. The biggest competitor in Italy is Birra Dreher SpA (owned by Heineken).

The Federal Republic of Germany is still facing problems since the abolition of the Reinheitsgebot, the beer purity law which allowed only the use of malt, hops, yeast and water in beer, a law which created a multitude of smaller brewing companies in that country. This was challenged in 1982 by the French brewer, Brasseries du Pêcheur, which alleged discrimination by the Federal Republic of Germany against other countries within the EEC. However, the move to harmonization in the EEC compelled the abolition of this law by the European Court of Justice, allowing the importation of competitive products that used other ingredients. Other European brewers see great potential in this market which has been closed for so long, but the biggest problem may be the parochialism of the German drinker. One way to overcome it may be licensing (transporting beer is expensive as it is mostly water) and in 1987, in fact, the small United Kingdom brewer Gibbs Mew became the first United Kingdom company to license a brewery, to the Bavarian brewer Graf Arco, in the Federal Republic of Germany.

In the United Kingdom, as already mentioned, Elders' takeover of Courage in 1986 gave the Australian company a large foothold in the European market, particularly useful now that industries of all kinds are preparing for trade barriers to be dismantled in the EEC single market of 1992. Meanwhile, Australia's Bond Brewing has built up a stake in Allied Lyons, the United Kingdom's biggest brewing company, which brews Castlemaine XXXX under licence. The other major brewers in the United Kingdom are Whitbread, Grand Metropolitan, Bass and Scottish and Newcastle. Bass owns the rights to Carling Black label in the United Kingdom as well as Europe, the Middle East and Hong Kong, and this beer is claimed

*This article is based on the contribution of Hugh Darrington, *Food Manufacture*.

Table IV.162. World's leading brewing companies' sales by volume[a/b/]

Rank	Company	Headquarters country	Volume 1986 (millions of hectolitres)	Volume 1987 (millions of hectolitres)	Percentage change 1986–1987	World share 1986 (percentage)	World share 1987 (percentage)
1	Anheuser Busch Inc.	United States	85.3	90.1	5.6	8.8	9.3
2	Miller Brewing Co (Phillip Morris)	United States	46.5	47.2	1.5	4.8	4.9
3	Heineken NV	Netherlands	42.1	43.0	2.1	4.4	4.4
4	Kirin Brewery Co. Ltd.	Japan	29.6	30.4	2.7	3.1	3.1
5	Bond Corp.[c/]	Australia	31.0	29.9	-3.5	3.2	3.1
	Total top five		234.5	240.6	2.6	24.3	24.8

Rank	Company	Headquarters country	Volume 1986 (millions of hectolitres)	Volume 1987 (millions of hectolitres)	Percentage change 1986-1987	World share 1986 (percentage)	World share 1987 (percentage)
6	The Stroh Brewery Co.	United States	27.2	25.8	-5.1	2.8	2.7
7	Elders Brewing Group	Australia	20.0	21.0	5.0	2.1	2.2
8	Groupe BSN	France	18.5	19.8	7.0	1.9	2.0
9	Adolph Coors Co.	United States	18.5	19.2	3.8	1.9	2.0
10	Companhia Cervejaria Brahma	Brazil	18.0	18.0	-	1.9	1.9
	Total top ten		336.7	344.4	2.3	34.8	35.5
11	Companhia Antartica Paulista	Brazil	16.8	17.0	1.2	1.7	1.8
12	South African Breweries Ltd.	South Africa	14.3	16.5	15.4	1.5	1.7
13	Carlsberg Ltd.	Denmark	15.9	16.3	2.5	1.6	1.7
14	Cerveceria Modelo SA	Mexico	13.8	15.8	14.5	1.4	1.6
15	Fomento Proa	Mexico	15.5	15.7	1.3	1.6	1.6
	Total top fifteen		413.0	425.7	3.1	42.7	43.9
16	San Miguel Corp.	Philippines	10.8	14.0	29.6	1.1	1.4
17	Santo Domingo Group	Spain	13.3	14.0	5.3	1.4	1.4
18	Bass PLC	United Kingdom	13.7	13.8	0.7	1.4	1.4
19	Artois Piedboeuf Interbrew d/	Belgium	13.0	13.0	-	1.3	1.3
20	Guinness PLC	United Kingdom	10.9	11.4	4.6	1.1	1.2
	Total top twenty		474.7	491.9	3.6	49.1	50.8
21	Sapporo Breweries Ltd.	Japan	10.4	11.1	6.7	1.1	1.1
22	Cerveceria Polar SC	Mexico	9.5	10.8	13.7	1.0	1.1
23	Labatt Brewing Co. Ltd.	Canada	9.1	9.3	2.2	0.9	1.0
24	Allied-Lyons PLC	France	9.0	9.0	-	0.9	0.9
25	S&P	United States	10.4	8.8	-15.4	1.1	0.9
	Total top twenty-five		523.1	540.9	3.4	54.1	55.8
26	Whitbread & Co. PLC	United Kingdom	8.0	8.0	-	0.8	0.8
27	Erste Kulmbacher Actienbrauerei AG e/	Germany, Federal Republic of	7.4	8.0	8.1	0.8	0.8
28	Molson Breweries of Canada Ltd	Canada	7.8	7.7	-1.3	0.8	0.8
29	Grand Metropolitan PLC	United Kingdom	7.2	7.5	4.2	0.7	0.8
30	Oetker Group	Germany, Federal Republic of	7.0	6.9	-1.4	0.7	0.7
	Total top thirty		560.5	579.0	3.3	58.0	59.8
31	Asahi Breweries Ltd.	Japan	5.0	6.7	34.0	0.5	0.7
32	Dortmunder Union-Schultheiss Brauerei AG	Germany, Federal Republic of	6.1	6.0	-1.6	0.6	0.6
33	Paulaner-Salvator-Thomasbrau AG	Germany, Federal Republic of	5.8	6.0	3.4	0.6	0.6
34	Oriental Brewery Co. Ltd.	Rep. of Korea	5.0	5.6	12.0	0.5	0.6
35	Grupo Cruzcampo SA	Spain	4.8	5.2	8.3	0.5	0.5
	Total top thirty-five		587.2	608.5	3.6	60.7	62.8
36	Scottish & Newcastle Breweries PLC	United Kingdom	5.0	5.2	4.0	0.5	0.5
37	Suntory Ltd.	Japan	4.5	5.1	13.3	0.5	0.5
38	Grupo Damm SA	Spain	4.3	4.6	7.0	0.4	0.5
39	Holsten-Brauerei AG	Germany, Federal Republic of	3.7	3.7	-	0.4	0.4
40	Brauerei Beck GmbH&Co	Germany, Federal Republic of	3.6	3.7	2.8	0.4	0.4
	Total top forty brewers		608.3	630.8	3.7%	62.9%	65.1%

Source: Impact Databank.

a/ Including agency and license brands.

b/ Total share overstated because some agency and license brands double counted.

c/ 1986 revised to include 1987 acquisition of G. Heileman, Pittsburgh Brewing and C. Schmidt trademarks.

d/ 1986 and 1987 restated to include 1988 merger of Brasseries Artois and Piedboeuf.

e/ 1986 revised to include 1987 acquisition of Henninger, Eichbaum, Moninger and Brauhaus Frankenthal.

to account for 20 per cent of the United Kingdom beer market.

In the United Kingdom interest is currently focused on the tied house which is being investigated by the Monopolies and Mergers Commission. This probably means that future growth on the retail side will be in free houses.

2. *Top brands*

Looking down the list of top beer brands, Budweiser (brewed by Anheuser Busch), is by far the world's biggest selling beer, reaching a new sales record of 60 million hectolitres or 6.2 per cent of the total market in 1987 (table IV.163). Budweiser is brewed under licence in seven countries, including the United Kingdom and Japan, as well as being exported to 30 others. Coors is licensed in Canada and Japan.

The second best selling beer in global terms was Japan's Kirin beer, reaching 25 million hectolitres. Kirin achieved this level despite the fact that all its major domestic competitors recorded faster growth in 1987. Most of the growth in the Japanese market is due to the rise in popularity of dry beer, introduced by Asahi brewing. This company came back to life after a bad slump in sales, with its Super Dry brands. At the same time Asahi started to produce Coors beer, franchised to it by the giant United States company, Adolph Coors Co., and another competitor, Suntory, began producing Carlsberg, licensed by United Breweries of Denmark. With its home market becoming increasingly fragmented, Kirin is looking for acquisitions or licensing agreements overseas, particularly in East Asia.

Next in the league table is another United States product, Miller Lite (Miller Brewing), at 23 million hectolitres. This is the world's biggest-selling light beer, although it has been facing a rising flood of "me too" products. It is exported to Japan, the Philippines and the Republic of Korea and licensed in Canada and the United Kingdom. A European beer, Heineken, is next in the world beer league, at 15.6 million hectolitres. This company is known for having aimed its products at a larger number of small markets, and has interests in breweries in a vast range of countries, including Africa, Canada, the Caribbean, Greece, Ireland, Italy, South America and Spain. In 1987 a new Amstel lager brewery was inaugurated by Heineken in Burundi (40 per cent owned by the Burundi state).

It is also worth mentioning Guinness in the global context. Although number 20 in the league table (with 7.2 million hectolitres), it is a very interesting product in that in a field dominated by lagers and light beers, it continues to record rising sales. Guinness is a traditional Irish black stout, and over half of its sales are produced in breweries in Ireland and the

Table IV.163. World's top beer brands, 1986 and 1987

Rank	Brand	Company	Country	Volume 1986 (10^9 hectolitres)	Volume 1987 (10^9 hectolitres)	Percentage change	World share 1986 (percentage)	World share 1987 (percentage)
1	Budweiser	Anheuser-Busch	United States	58.2	60.0	3.1	6.0	6.2
2	Kirin Beer	Kirin Brewery	Japan	25.0	25.0	-	2.6	2.6
3	Miller Lite	Miller Brewing (Phillip Morris)	United States	22.9	23.0	0.4	2.4	2.4
4	Heineken	Heineken NV	Netherlands	15.8	15.6	-1.3	1.6	1.6
5	Antartica	Companhia Antartica Paulista	Brazil	12.6	13.0	3.2	1.3	1.3
	Total top five			134.5	136.6	1.6	13.9	14.1
6	Brahma Chopp	Companhia Cervejaria Brahma	Brazil	12.3	12.5	1.6	1.3	1.3
7	Miller High Life	Miller Brewing (Phillip Morris)	United States	13.0	11.6	-10.8	1.3	1.2
8	Polar	Cerveceria Polar CA	Mexico	9.5	10.8	13.7	1.0	1.1
9	Coors Light	Adolph Coors	United States	8.7	9.8	12.6	0.9	1.0
10	Castle Lager	South African Breweries	South Africa	8.8	9.5	8.0	0.9	1.0
	Total top ten			186.8	190.8	2.1	19.3	19.7
11	Busch	Anheuser-Busch	United States	8.3	9.4	13.3	0.9	1.0
12	Bud Light	Anheuser-Busch	United States	7.7	9.4	22.1	0.8	1.0
13	Corona	Cerveceria Modelo SA	Mexico	7.9	9.4	19.0	0.8	1.0
14	Coors	Adoph Coors	United States	9.7	9.3	-4.1	1.0	1.0
15	Sapporo Draft	Sapporo Breweries	Japan	8.4	9.1	8.3	0.9	0.9
	Total top fifteen			228.8	237.4	3.8	23.7	24.5
16	San Miguel Pale Pilsen	San Miguel	Philippines	6.8	9.0	32.4	0.7	0.9
17	Old Milwaukee	Stroh Brewery	United States	8.8	8.7	-1.1	0.9	0.9
18	Carlsberg	Carlsberg	Denmark	7.8	8.0	2.6	0.8	0.8
19	Aguila	Santo Domingo Group	Spain	7.0	8.0	14.3	0.7	0.8
20	Guinness	Guinness PLC	Ireland	6.9	7.2	4.3	0.7	0.7
	Total top twenty			266.1	278.3	4.6	27.5	28.7

Rank	Brand	Company	Country	Volume 1986	Volume 1987	Percentage change	World share 1986	World share 1987
				(10^9 hectolitres)			(percentage)	
21	Kronenbourg	Groupe BSN	France	6.3	6.4	1.6	0.7	0.7
22	Milwaukee's Best	Miller Brewing (Phillip Morris)	United States	5.7	6.3	10.5	0.6	0.7
23	Michelob	Anheuser-Busch	United States	6.3	6.1	-3.2	0.7	0.6
24	Asahi	Asahi Breweries	Japan	4.5	5.7	26.7	0.5	0.6
25	Carling Black Label a/		United Kingdom	5.7	5.5	-3.5	0.6	0.6
	Total top twenty-five			294.6	308.3	4.7	30.5	31.8
26	OB	Oriental Brewery	Republic of Korea	4.9	5.4	10.2	0.5	0.6
27	Carta Blanca	Fomento Proa	Mexico	5.6	5.3	-5.4	0.6	0.5
28	Foster's	Elders Brewing Group	Australia	4.8	5.2	8.3	0.5	0.5
29	Kirin Draft	Kirin Brewery	Japan	4.0	5.0	25.0	0.4	0.5
30	Tuborg	Carlsberg	Denmark	4.9	5.0	2.0	0.5	0.5
	Total top thirty			318.0	334.2	4.8	33.0	34.5
31	Lion Lager	South African Breweries	South Africa	4.5	5.0	11.1	0.5	0.5
32	Suntory	Suntory	Japan	4.6	4.9	6.5	0.5	0.5
33	Schaefer	The Stroh Brewery	United States	5.0	4.8	-4.0	0.5	0.5
34	Amstel	Heineken NV	Netherlands	4.5	4.5	-	0.5	0.5
35	Old Style	Bond Corp.	Australia	4.9	4.5	-8.2	0.5	0.5
	Total top thirty-five			342.3	357.9	4.6	35.4	36.9
36	Kanterbrau	Groupe BSN	France					
37	Stroh's	The Stroh Brewery	United States	4.5	4.3	-4.4	0.5	0.4
38	Superior	Fomento Proa	Mexico	4.3	4.2	-2.3	0.4	0.4
39	Labatt's Blue	Labatt Brewing	Canada	3.9	4.1	5.1	0.4	0.4
40	Pabst Blue Ribbon	S&P	United States	4.7	4.0	-14.9	0.5	0.4
	Total top forty brands			363.9	378.8	4.1	37.6	39.1

Source: Impact Databank.

a/ Carling Black Label trademark owned by Bass in the United Kingdom; by Carling O'Keele (Elders IXL) in Canada and by Bond in the United States.

Table IV.164. World's top beer brands in 1987 - owned versus licensed production and exports

Rank	Brand	Production: Total	Production: Owned	Production: Volume exported	Production: Licensed	Percentage: Owned	Percentage: Share exported	Percentage: Licensed
		(millions of hectolitres)						
1	Budweiser	60.0	58.8	0.4	0.8	98.0	0.7	1.3
2	Kirin Beer	25.0	24.9	0.1	a/	99.6	0.4	a/
3	Miller Lite	23.0	22.5	0.1	0.4	97.8	0.4	1.7
4	Heineken	15.6	7.5	5.1	3.0	48.1	32.7	19.2
5	Antartica	13.0	13.0	-	-	100.0	-	-
6	Brahma Chopp	12.5	12.5	a/	-	100.0	a/	-
7	Miller High Life	11.6	10.8	0.1	0.7	93.1	0.9	6.0
8	Polar	10.8	10.8	a/	- 100.0	a/	-	
9	Coors Light	9.8	9.3	-	0.5	94.9	-	5.1
10	Castle Lager	9.5	9.3	a/	0.2	97.9	a/	2.1
11	Busch	9.4	9.4	a/	-	100.0	a/	-
12	Bud Light	9.4	9.4	a/	-	100.0	a/	-
13	Corona	9.4	7.4	2.0	-	78.7	21.3	-
14	Coors	9.3	9.0	-	0.3	96.8	-	3.2
15	Sapporo Draft	9.1	9.0	0.1	-	98.9	1.1	-
16	San Miguel Pale Pilsen	9.0	9.0	a/	-	100.0	a/	-
17	Old Milwaukee	8.7	8.6	0.1	-	98.9	1.1	-
18	Carlsberg	8.0	5.8	1.0	1.2	72.5	12.5	15.0
19	Aguila	8.0	8.0	-	-	100.0	-	-

Table IV.164. (continued)

Rank Brand	Production				Percentage		
	Total	Owned	Volume exported	Licensed	Owned	Share exported	Licensed
	(millions of hectolitres)						
20 Guinness	7.2	5.2	0.6	1.4	72.2	8.3	19.4
21 Kronenbourg	6.4	5.5	0.5	0.4	85.9	7.8	6.3
22 Milwaukee's Best	6.3	6.3	a/	-	100.0	a/	-
23 Michelob	6.1	6.1	a/	a/	100.0	a/	a/
24 Asahi	5.7	5.7	a/	- 100.0	a/	-	
25 Carling Black Label	5.5	5.1	a/	0.4	92.7	a/	7.3
26 OB	5.4	5.4	a/	- 100.0	a/	-	
27 Carta Blanca	5.3	5.2	0.1	-	98.1	1.9	-
28 Foster's	5.2	3.7	0.5	1.0	70.0	10.0	20.0
29 Kirin Draft	5.0	5.0	a/	-	100.0	a/	-
30 Tuborg	5.0	2.4	0.6	2.0	48.0	12.0	40.0
31 Lion Lager	5.0	4.9	a/	0.1	98.0	a/	2.0
32 Suntory	4.9	4.9	a/	-	100.0	a/	-
33 Schaefer	4.8	3.9	0.9	-	81.3	18.8	-
34 Amstel	4.5	3.7	0.4	0.4	82.2	8.9	8.9
35 Old Style	4.5	4.5	-	-	100.0	-	-
36 Kanterbrau	4.3	4.3	a/	-	100.0	a/	-
37 Stroh's	4.3	4.2	0.1	-	97.7	2.3	-
38 Superior	4.2	4.2	a/	-	100.0	a/	-
39 Labatt's Blue	4.1	3.7	0.4	a/	90.2	9.8	a/
40 Pabst Blue Ribbon	4.0	4.0	a/	- 100.0	a/	-	
Total Top 40 brands	378.8	352.9	13.1	12.8	93.0	3.5	3.4

Source: Impact Databank.
Note: Data include foreign subsidiary sales in which brewer has a controlling interest minus exports.
a/ Less than 50,000 hectolitres or 0.05 per cent.

United Kingdom. Like Heineken, it is established in a larger number of scattered markets, including Cameroon, Liberia, Malaysia and the Seychelles.

Table IV.164 indicates the varying degrees to which beer brands are licensed. For example, the Dutch beer, Heineken, is heavily licensed, as is Guinness, Foster's, Tuborg and Carlsberg.

As Impact International points out, while developed market economies are dominated by the United States market, there are a number of other breweries producing enormous quantities. Brazilian companies such as Brahma and Antartica produced 18 and 17 million hectolitres respectively in 1987, with Brahma's top brand Brahma Chopp coming number six in the world league with 12.5 million hectolitres, and Antartica brand number five with 13 million hectolitres.

South African Breweries (SAB) sold 16.5 million hectolitres in 1987, with its leading brand Castle Lager number 10 in the world. San Miguel in the Philippines sold 14 million hectolitres, 9 million of which was the San Miguel Pale Pilsen brand.

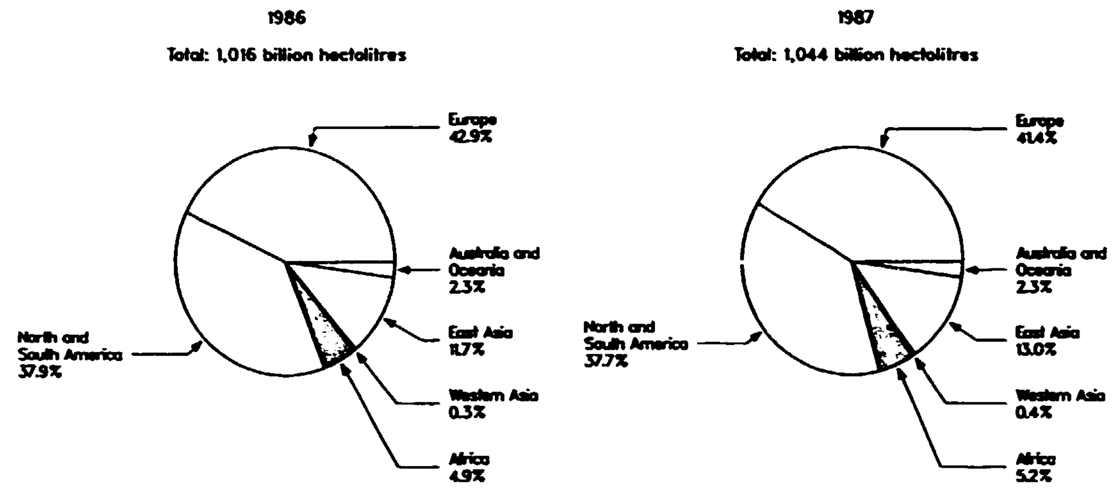
The Carlsberg Brewery of Hong Kong and Danebrew Consult completed a six-year project in 1987 for the modernization of the Cantonese brewery at Guangzhou, China.

Although there has been a constant shift between brands over the past few years, it would seem that the total market has reached its volume limits for the foreseeable future, which means that the frenetic activity between companies to gain a larger slice of it will continue. New products or improved margin are one way out. The United States seems to be the role model for the rest of the world, with companies everywhere emulating United States marketing strategies and products.

In 1987, the world's top 20 breweries accounted for more than 50 per cent of the total beer market. This dominance is expected to increase.

Brewing Industry Statistics

Figure IV.34. World beer production by region, 1987 and 1988



Source: Joh Barth (international hops merchants).

Table IV.161. World beer production, 1986 and 1987
(Millions of hectolitres)

Country or area	1986	1987
A. Europe		
Germany, Federal Republic of	94 100	92 744
United Kingdom	59 166	59 887
USSR	55 000	50 000
German Democratic Republic	24 300	25 000
Spain	24 126	25 000
Czechoslovakia	22 783	22 228
France	20 655	19 894
Netherlands	17 988	17 547
Belgium	14 500	13 990
Yugoslavia	10 500	11 790
Poland	11 380	11 644
Italy	11 082	11 122
Romania a/	11 000	10 000
Hungary	9 222	9 600
Austria	8 948	8 932
Denmark	6 200	8 200
Bulgaria	6 000	7 000
Ireland	5 456	5 369
Portugal	3 945	4 977
Switzerland	4 112	4 115
Sweden	4 100	4 [illegible]10
Finland	3 285	3 423
Greece	3 150	3 200
Norway	2 135	2 167
Luxembourg	732	662
Malta	135	164
Albania a/	100	100
Iceland	38	40
Total	434 138	432 805

Country or area	1986	1987
B. North and South America		
United States	230 545	229 297
Brazil	43 760	47 500
Mexico	29 287	31 537
Canada	22 815	22 114
Colombia	16 600	17 600
Venezuela	11 200	12 100
Peru	6 800	7 500
Argentina	5 900	5 800
Cuba a/	2 930	3 600
Chile	2 200	2 546
Ecuador	2 385	2 000
Panama	880	1 360
Paraguay	900	1 200
Bolivia	800	1 180
Dominican Republic	1 200	972
Guatemala	710	970
Costa Rica	800	800
Jamaica	650	800
El Salvador	650	670
Honduras	540	601
Uruguay	750	600
Trinidad and Tobago	350	470
Puerto Rico	300	376
Nicaragua	550	350
Guyana	100	150
Netherlands Antilles	132	150
Suriname	112	123
Barbados	80	90
Martinique	65	65
Saint Lucia	60	57

Table IV.161. (continued)

Country or area	1986	1987
Haiti	25	47
Guadaloupe	30	32
Saint Kitts and Nevis	25	27
Belize	25	25
Grenada	25	26
Bahamas	-	21
Saint Vincent and the Grenadines	13	17
Total	384 194	393 773
C. Africa		
South Africa	14 500	18 000
Nigeria	6 840	7 000
Cameroon	5 400	5 500
Zaire[a]	4 205	4 310
Kenya	3 200	3 500
Côte d'Ivoire	320	1 350
Zimbabwe	1 050	1 300
Gabon	880	1 000
Ethiopia	842	964
Burundi	884	931
Congo[a]	850	850
Zambia	800	800
Algeria[a]	600	750
Rwanda	641	642
United Republic of Tanzania	850	588
Angola[a]	530	550
Ghana	650	526
Burkina Faso[a]	500	500
Morocco	400	500
Togo	400	452
Namibia	350	411
Egypt[a]	472	400
Central African Republic	306	294
Mauritius	200	257
Tunisia	325	256
Botswana	134	248
Madagascar	260	240
Benin	274	219
Swaziland	171	216
Mozambique	229	213
Lesotho	200	205
Malawi	160	160
Senegal	160	153
Liberia	110	138
Uganda[a]	55	135
Reunion	100	117
Chad	115	103
Niger[a]	90	100
Mali[a]	80	80
Democratic Yemen	85	53
Seychelles	42	49
Sierra Leone	36	47
Guinea Bissau	20	19
Gambia	12	17
Total	49 388	54 143
D. Western Asia		
Turkey	2 000	2 500
Iraq	517	500
Israel	412	420
Cyprus	260	270
Lebanon	130	130
Syrian Arab Republic[a]	90	90
Jordan	34	35
Total	3 443	3 945
E. East Asia		
Japan	49 980	53 500
China	40 000	50 000
Philippines	8 300	10 200
Republic of Korea	8 066	8 800
Taiwan Province	3 537	3 864
Viet Nam[a]	2 000	2 000
India	1 800	2 000
Hong Kong	1 250	1 360
Democratic People's Republic of Korea[a]	1 000	1 000
Thailand	800	960
Indonesia	718	843
Malaysia	650	507
Singapore	391	385
Iran (Islamic Republic of)[b]	100	100
Mongolia[a]	100	100
Sri Lanka	72	75
Nepal	45	45
Myanmar, Union of[a]	50	40
Lao People's Democratic Republic[a]	10	10
Pakistan	10	10
Bangladesh[a]	5	5
Democratic Kampuchea[a]	5	6
Total	118 889	135 810
F. Australia and Oceania		
Australia	18 170	18 765
New Zealand	3 924	4 087
New Guinea	494	520
Fiji[a]	165	170
Tahiti	118	120
New Caledonia	55	63
Samoa	50	54
Total	22 976	23 779
World total	1 015 917	1 044 163

Source: Joh Barth (International hops merchants).

a/ Estimated.

b/ Non-alcoholic.

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319|320

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Statistical Annex

World Industry Development Indicators

Technical notes

1. Sources for the following country tables are:

(a) the UNIDO 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 (1988-1989) 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 for temporary overvaluation of the national currency (Argentina, Chile, Dominican Republic, El Salvador, Guatemala, Nicaragua, Paraguay, Sierra Leone, Trinidad and Tobago, Uganda, Uruguay.

The correction was done by adapting exchange rates to the reported inflation rates.

Exchange rates for Hungary and Poland are average market (principal) rates as reported by *International Financial Statistics*.

3. Figures followed by "/c" are in 1980 constant prices.

4. For the centrally planned economies UNSO provides an estimate of GDP based on country reports of NMP. NMP figures are no longer reported. MVA is estimated from industrial activities by applying a reduction factor derived from industrial statistics.

5. There are two parts to the annex. The first part consists of full page reports on 100 countries for which more complete data is available. This is a subset of the sample of 129 countries used to derive the sectoral forecasts of manufacturing value added for 28 industrial branches. Each of these pages contains a diagram of industrial structural change, graphs of GDP and MVA growth rates, described in items 6 and 7 below, and tabular data as described in items 8 to 13 below.

The second part of the annex consists of short tables for each of the remaining countries.

6. The diagram of industrial structural change is based on the value added in 1980 constant prices. For each branch an index number for the periods 1980, 1985 and 1990 is calculated from the base year 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, Main Aggregates* (OECD, Department of Economics and Statistics);

(e) *World Outlook* and *Quarterly Economic Review* (The Economist Intelligence Unit);

(f) *World Bank Atlas;*

(g) *Centrally Planned Economies, Economic Overview* (The Conference Board, Inc.);

(h) *Economic Forecast* (North Holland);

(i) Abecor European Bank Service;

or else estimated on the basis of statistical analysis and other *ad hoc* information, including various periodicals and newpapers.

Forecast growth rates for 1989 and 1990 for each country were projected using

(a) the long-term trend in GDP;

(b) the cyclical deviations from that trend; and

(c) when it proved significant, GDP in another country or a group of other countries.

Growth rates of aggregate MVA were forecast on the basis of regression techniques relating MVA and GDP. Five different types of regressions are tested for this purpose. The relationship producing the best ex-post forecasting figures was finally selected.

Estimates of sectoral MVA for 1987 to 1990 for each country were based on regression equations which contain GDP, aggregate MVA, lagged own-sector MVA and production indices as independent variables.

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 1988 to 1990 were projected only for a sample of 129 countries. Again various national sources and UNIDO estimates were used to improve the coverage of the 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; 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: *(a)* 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; *(b)* 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 items "profitability" and "productivity" are averages across all branches, except that only those branches were included for which all the required data (gross output, value added, wages and salaries, and employment) were available.

11. For the calculation 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 the shares of all branches are equal, the degree of specialization equals 0. If only one branch exists, the value is 100.

Summary of indicators

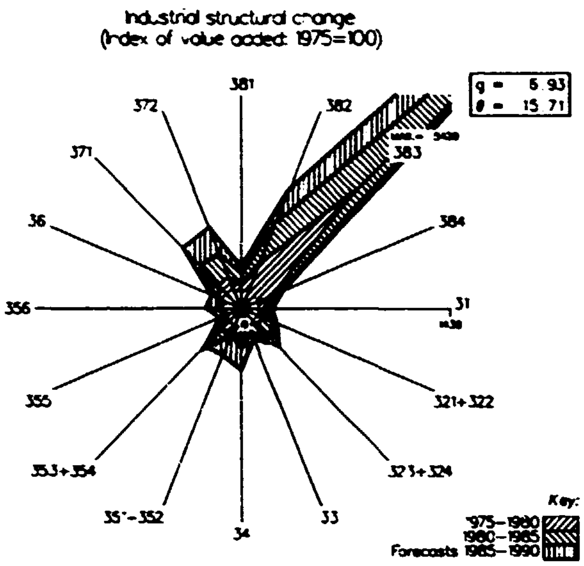
/na	value originating from national accounts statistics
/c	in 1980 constant prices
/e	estimated by UNIDO/PPD/IPP/GLO
/f	forecast by UNIDO/PPD/IPP/GLO
. . .	no value available
—	value is less than half a unit
n.a.	not available

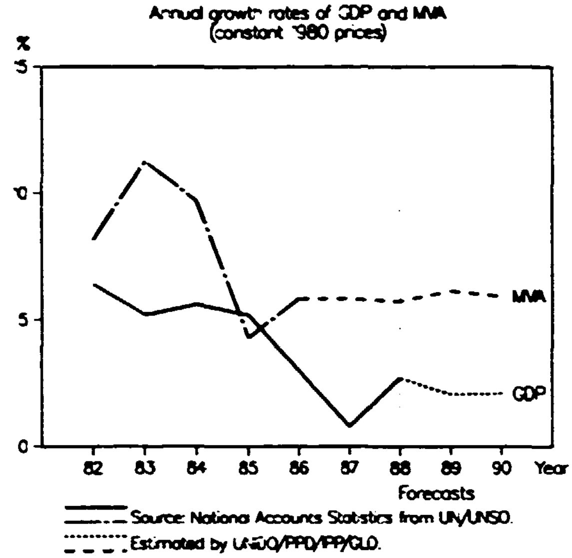
Regional classification of countries and territories:

Country or territory	UNITAD region		Page
AFGHANISTAN	Indian Subcontinent	(IN)	A-109
ALBANIA	Centrally planned Europe incl. USSR	(EE)	A-109
ALGERIA	North Africa and Western Asia	(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-109
BANGLADESH	Indian Subcontinent	(IN)	A- 13
BARBADOS	Latin America and the Caribbean	(LA)	A-109
BELGIUM	Western Europe (Industrialized)	(WE)	A- 14
BELIZE	Latin America and the Caribbean	(LA)	A-109
BENIN	Tropical Africa (Sub-Sahara)	(TA)	A-109
BERMUDA	North America	(NA)	A-110
BHUTAN	Indian Subcontinent	(IN)	A-110
BOLIVIA	Latin America	(LA)	A- 15
BOTSWANA	Tropical Africa (Sub-Sahara)	(TA)	A-110
BRAZIL	Latin America	(LA)	A- 16
BRUNEI DARUSSALAM	Asia East and South-East, Oceania	(AS)	A-110
BULGARIA	Centrally planned Europe incl. USSR	(EE)	A- 17
BURKINA FASO	Tropical Africa (Sub-Sahara)	(TA)	A- 18
BURUNDI	Tropical Africa (Sub-Sahara)	(TA)	A- 19
CAMEROON	Tropical Africa (Sub-Sahara)	(TA)	A- 20
CANADA	North America	(NA)	A- 21
CAPE VERDE	Tropical Africa (Sub-Sahara)	(TA)	A-110
CENTRAL AFRICAN REPUBLIC	Tropical Africa (Sub-Sahara)	(TA)	A- 22
CHAD	Tropical Africa (Sub-Sahara)	(TA)	A-110
CHILE	Latin America	(LA)	A- 23
CHINA	Centrally planned Asia	(OA)	A-111
COLOMBIA	Latin America	(LA)	A- 24
COMOROS	Tropical Africa (Sub-Sahara)	(TA)	A-111
CONGO	Tropical Africa (Sub-Sahara)	(TA)	A- 25
COSTA RICA	Latin America	(LA)	A- 26
COTE D'IVOIRE	Tropical Africa (Sub-Sahara)	(TA)	A- 27
CUBA	Latin America	(LA)	A- 28
CYPRUS	North Africa and Western Asia	(WA)	A- 29
CZECHOSLOVAKIA	Centrally planned Europe incl. USSR	(EE)	A- 30
DENMARK	Western Europe (Industrialized)	(WE)	A- 31
DJIBOUTI	Tropical Africa (Sub-Sahara)	(TA)	A-111
DOMINICAN REPUBLIC	Latin America	(LA)	A- 32
ECUADOR	Latin America	(LA)	A- 33
EGYPT	North Africa and Western Asia	(AN)	A- 34
EL SALVADOR	Latin America	(LA)	A- 35
EQUATORIAL GUINEA	Tropical Africa (Sub-Sahara)	(TA)	A-111
ETHIOPIA	Tropical Africa (Sub-Sahara)	(TA)	A- 36
FIJI	South-East Asia	(AS)	A- 37
FINLAND	Western Europe (Industrialized)	(WE)	A- 38
FRANCE	Western Europe (Industrialized)	(WE)	A- 39
FRENCH GUIANA	Latin America and the Caribbean	(LA)	A-111
FRENCH POLYNESIA	Asia East and South-East, Oceania	(AS)	A-111
GABON	Tropical Africa (Sub-Sahara)	(TA)	A- 40
GAMBIA	Tropical Africa (Sub-Sahara)	(TA)	A-112
GERMAN DEMOCRATIC REPUBLIC	Centrally planned Europe incl. USSR	(EE)	A- 41
GERMANY, FEDERAL REPUBLIC OF	Western Europe (Industrialized)	(WE)	A- 42
GHANA	Tropical Africa (Sub-Sahara)	(TA)	A- 43
GREECE	Western Europe (South)	(WE)	A- 44
GUADELOUPE	Latin America and the Caribbean	(LA)	A-112
GUATEMALA	Latin America	(LA)	A- 45
GUINEA	Tropical Africa (Sub-Sahara)	(TA)	A-112
GUINEA-BISSAU	Tropical Africa (Sub-Sahara)	(TA)	A-112
GUYANA	Latin America and the Caribbean	(LA)	A-112
HAITI	Latin America and the Caribbean	(LA)	A-112
HONDURAS	Latin America	(LA)	A- 46
HONG KONG	South-East Asia	(AS)	A- 47
HUNGARY	Centrally planned Europe incl. USSR	(EE)	A- 48
ICELAND	Western Europe (Industrialized)	(WE)	A- 49
INDIA	Indian Subcontinent	(IN)	A- 50
INDONESIA	South-East Asia	(AS)	A- 51
IRAN (ISLAMIC REPUBLIC OF)	North Africa and Western Asia	(WA)	A- 52
IRAQ	North Africa and Western Asia	(WA)	A- 53
IRELAND	Western Europe (Industrialized)	(WE)	A- 54
ISRAEL	Western Europe (South)	(WE)	A- 55
ITALY	Western Europe (Industrialized)	(WE)	A- 56
JAMAICA	Latin America	(LA)	A- 57
JAPAN	Japan	(JP)	A- 58

Country or territory	UNITAD region		Page
JORDAN	North Africa and Western Asia	(WA)	A- 59
KENYA	Tropical Africa (Sub-Sahara)	(TA)	A- 60
KOREA, DEMOCRATIC PEOPLE'S REP	Centrally planned Asia	(OA)	A-113
KOREA, REPUBLIC OF	South-East Asia	(AS)	A- 61
KUWAIT	North Africa and Western Asia	(WA)	A- 62
LAO PEOPLE'S DEMOCRATIC REPUBL	Centrally planned Asia	(OA)	A-113
LESOTHO	Tropical Africa (Sub-Sahara)	(TA)	A-113
LIBERIA	Tropical Africa (Sub-Sahara)	(TA)	A-113
LIBYAN ARAB JAMAHIRIYA	North Africa and Western Asia	(AN)	A- 63
LUXEMBOURG	Western Europe (Industrialized)	(WE)	A- 64
MADAGASCAR	Tropical Africa (Sub-Sahara)	(TA)	A- 65
MALAWI	Tropical Africa (Sub-Sahara)	(TA)	A- 66
MALAYSIA	South-East Asia	(AS)	A- 67
MALI	Tropical Africa (Sub-Sahara)	(TA)	A-113
MALTA	Western Europe (South)	(WE)	A- 68
MARTINIQUE	Latin America and the Caribbean	(LA)	A-113
MAURITANIA	Tropical Africa (Sub-Sahara)	(TA)	A-114
MAURITIUS	Tropical Africa (Sub-Sahara)	(TA)	A- 69
MEXICO	Latin America	(LA)	A- 70
MONGOLIA	Centrally planned Asia	(OA)	A-114
MONTSERRAT	Latin America and the Caribbean	(LA)	A-114
MOROCCO	North Africa and Western Asia	(AN)	A- 71
MOZAMBIQUE	Tropical Africa (Sub-Sahara)	(TA)	A-114
MYANMAR, UNION OF	Indian Subcontinent	(IN)	A-114
NAMIBIA	Tropical Africa (Sub-Sahara)	(TA)	A-114
NEPAL	Indian Subcontinent	(IN)	A-115
NETHERLANDS	Western Europe (Industrialized)	(WE)	A- 72
NETHERLANDS ANTILLES	Latin America and the Caribbean	(LA)	A-115
NEW CALEDONIA	Asia East and South-East, Oceania	(AS)	A-115
NEW ZEALAND	Other developed countries	(OD)	A- 73
NICARAGUA	Latin America	(LA)	A- 74
NIGER	Tropical Africa (Sub-Sahara)	(TA)	A-115
NIGERIA	Tropical Africa (Sub-Sahara)	(TA)	A- 75
NORWAY	Western Europe (Industrialized)	(WE)	A- 76
OMAN	Western Asia (Near East)	(WA)	A-115
PAKISTAN	Indian Subcontinent	(IN)	A- 77
PANAMA	Latin America	(LA)	A- 78
PAPUA NEW GUINEA	Asia East and South-East, Oceania	(AS)	A-115
PARAGUAY	Latin America	(LA)	A- 79
PERU	Latin America	(LA)	A- 80
PHILIPPINES	South-East Asia	(AS)	A- 81
POLAND	Centrally planned Europe incl. USSR	(EE)	A- 82
PORTUGAL	Western Europe (South)	(WE)	A- 83
PUERTO RICO	Latin America and the Caribbean	(LA)	A-116
QATAR	Western Asia (Near East)	(WA)	A-116
REUNION	Tropical Africa (Sub-Sahara)	(TA)	A-116
ROMANIA	Centrally planned Europe incl. USSR	(EE)	A- 84
RWANDA	Tropical Africa (Sub-Sahara)	(TA)	A-116
SAMOA	Asia East and South-East, Oceania	(AS)	A-116
SAO TOME AND PRINCIPE	Tropical Africa (Sub-Sahara)	(TA)	A-116
SAUDI ARABIA	North Africa and Western Asia	(WA)	A- 85
SENEGAL	Tropical Africa (Sub-Sahara)	(TA)	A- 86
SEYCHELLES	Tropical Africa (Sub-Sahara)	(TA)	A-117
SIERRA LEONE	Tropical Africa (Sub-Sahara)	(TA)	A-117
SINGAPORE	South-East Asia	(AS)	A- 87
SOMALIA	Tropical Africa (Sub-Sahara)	(TA)	A-117
SOUTH AFRICA	Other developed countries	(OD)	A- 88
SPAIN	Western Europe (Industrialized)	(WE)	A- 89
SRI LANKA	Indian Subcontinent	(IN)	A- 90
SUDAN	Nort. Africa	(AN)	A-117
SURINAME	Latin America and the Caribbean	(LA)	A-117
SWAZILAND	Tropical Africa (Sub-Sahara)	(TA)	A-117
SWEDEN	Western Europe (Industrialized)	(WE)	A- 91
SWITZERLAND	Western Europe (Industrialized)	(WE)	A- 92
SYRIAN ARAB REPUBLIC	North Africa and Western Asia	(WA)	A- 93
TAIWAN PROVINCE	South-East Asia	(AS)	A- 94
THAILAND	South-East Asia	(AS)	A- 95
TOGO	Tropical Africa (Sub-Sahara)	(TA)	A-118
TONGA	Asia East and South-East, Oceania	(AS)	A-118
TRINIDAD AND TOBAGO	Latin America	(LA)	A- 96
TUNISIA	North Africa and Western Asia	(AN)	A- 97
TURKEY	North Africa and Western Asia	(WA)	A- 98
UGANDA	Tropical Africa (Sub-Sahara)	(TA)	A-118
UNION OF SOV. SOC. REPUBLICS	Centrally planned Europe incl. USSR	(EE)	A- 99
UNITED ARAB EMIRATES	Western Asia (Near East)	(WA)	A-118

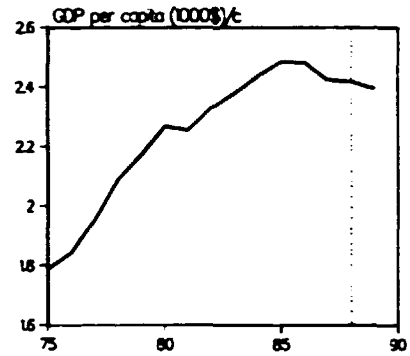
Country or territory	UNITAD region		Page
UNITED KINGDOM	Western Europe (Industrialized)	(WE)	A-100
UNITED REPUBLIC OF TANZANIA	Tropical Africa (Sub-Sahara)	(TA)	A-101
UNITED STATES	North America	(NA)	A-102
URUGUAY	Latin America	(LA)	A-103
VANUATU	Asia East and South-East, Oceania	(AS)	A-118
VENEZUELA	Latin America	(LA)	A-104
VIET NAM	Centrally planned Asia	(OA)	A-118
YEMEN (ARAB REPUBLIC)	Western Asia (Near East)	(WA)	A-119
YEMEN, DEMOCRATIC	Western Asia (Near East)	(WA)	A-119
YUGOSLAVIA	Western Europe (South)	(WE)	A-105
ZAIRE	Tropical Africa (Sub-Sahara)	(TA)	A-106
ZAMBIA	Tropical Africa (Sub-Sahara)	(TA)	A-107
ZIMBABWE	Tropical Africa (Sub-Sahara)	(TA)	A-108

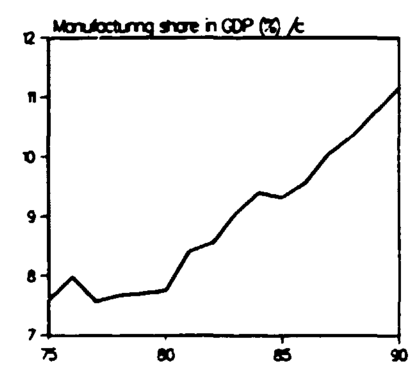


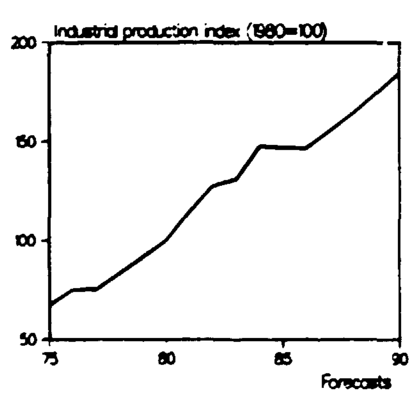


	1980	1985	1987
GDP: /na.c (millions of dollars)	42342	53959	56023
Per capita /na.c (dollars)	2268	2486	2425
Manufacturing share /na.c (%)	7.8	9.3	10.1 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	3286	5028	5631 /e
Value added (millions of dollars)	4477	6796 /e	9233 /e
Industrial production index	100	147	155 /e
Gross output (millions of dollars)	8794 /e	12566 /e	16398 /e
Employment (thousands)	329	420 /e	449 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	49 /e	46 /e	44 /e
Wages and salaries (%)	23 /e	25 /e	27 /e
Operating surplus (%)	28 /e	29 /e	29 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	26690 /e	29915 /e	36527 /e
Value added / worker	13589	16180 /e	20568 /e
Average wage	6056 /e	7602 /e	9886 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	13.77 /e	3.94 /e	3.26 /e
as a percentage of average θ in 1970-1975	261 /e	75 /e	62 /e
MVA growth rate / θ	0.65 /e	-0.11 /e	1.80 /e
Degree of specialization	17.2 /e	16.8 /e	16.8 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	76	1003 /e	1452 /e
313 Beverages	168	243 /e	322 /e
314 Tobacco products	206	313 /e	443 /e
321 Textiles	382	523 /e	613 /e
322 Wearing apparel	308	412 /e	478 /e
323 Leather and fur products	87	144 /e	207 /e
324 Footwear	100	144 /e	197 /e
331 Wood and wood products	109	138 /e	163 /e
332 Furniture and fixtures	51	64 /e	80 /e
341 Paper and paper products	127	221 /e	327 /e
342 Printing and publishing	16	14 /e	15 /e
351 Industrial chemicals	9	11 /e	13 /e
352 Other chemical products	42	34 /e	36 /e
353 Petroleum refineries	201	328 /e	437 /e
354 Miscellaneous petroleum and coal products	7	7 /e	7 /e
355 Rubber products	7	6 /e	6 /e
356 Plastic products	16	15 /e	18 /e
361 Pottery, china and earthenware	22	39 /e	58 /e
362 Glass and glass products	36	60 /e	87 /e
369 Other non-metal mineral products	438	762 /e	1124 /e
371 Iron and steel	440	762 /e	1051 /e
372 Non-ferrous metals	31	53 /e	78 /e
381 Metal products	328	521 /e	676 /e
382 Non-electrical machinery	148	259 /e	380 /e
383 Electrical machinery	148	234 /e	304 /e
384 Transport equipment	263	412 /e	559 /e
385 Professional and scientific equipment	14	20 /e	22 /e
390 Other manufacturing industries	33	56 /e	77 /e

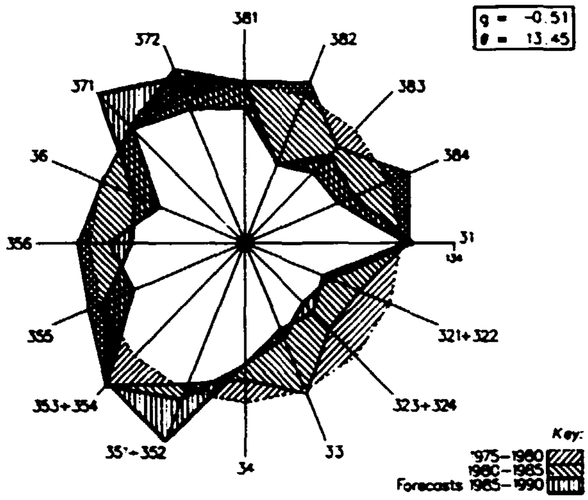
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



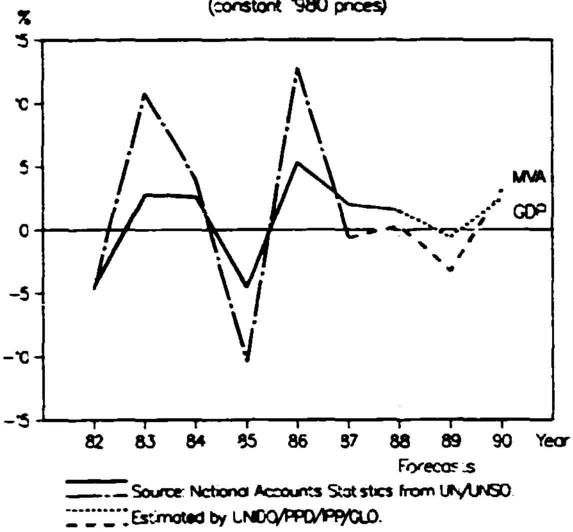




Industrial structural change
(Index of value added: 1975=100)



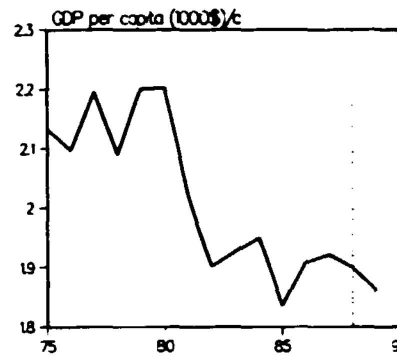
Annual growth rates of GDP and MVA
(constant 1980 prices)



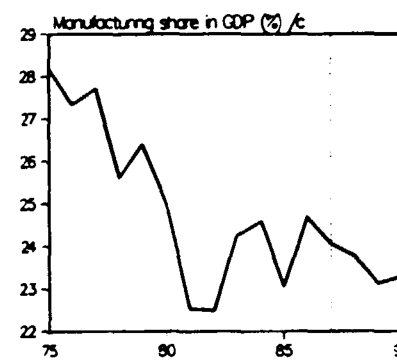
	1980	1985	1987
GDP: /na,c (millions of dollars)	62176	55689	59828
Per capita /na,c (dollars)	2202	1836	1921
Manufacturing share /na,c (%)	25.0	23.1	24.1
MANUFACTURING:			
Value added /na,c (millions of dollars)	15539	12846	14392
Value added (millions of dollars)	23158	27310	32700
Industrial production index	100	83	93
Gross output (millions of dollars)	43842	48780	66197
Employment (thousands)	1346	1127	1062 /e
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	47	44	51
Wages and salaries (%)	14 /e	11	11 /e
Operating surplus (%)	39 /e	44	39 /e
-PRODUCTIVITY:(dollars)			
Gross output / worker	32569	43272	62311 /e
Value added / worker	17203	24226	30781 /e
Average wage	4539 /e	4974	6674 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	4.12	6.19	3.27
as a percentage of average θ in 1970-1975	126	189	100
MVA growth rate / θ	-0.87	-1.62	-0.08
Degree of specialization	12.6	14.9	14.3
-VALUE ADDED:(millions of dollars)			
311 Food products	3745	4378	5118
313 Beverages	595	776	923
314 Tobacco products	301	399	457
321 Textiles	1672	2179	2507
322 Wearing apparel	906	721	727
323 Leather and fur products	286	289	311
324 Footwear	243	268	286
331 Wood and wood products	357	320	349
332 Furniture and fixtures	234	180	259
341 Paper and paper products	547	746	891
342 Printing and publishing	669	718	816
351 Industrial chemicals	866	1406	1725
352 Other chemical products	1139	1660	2026
353 Petroleum refineries	2781	3601	4006
354 Miscellaneous petroleum and coal products	113	139	188
355 Rubber products	289	369	459
356 Plastic products	419	668	564
361 Pottery, china and earthenware	190	186	218
362 Glass and glass products	197	208	288
369 Other non-metal mineral products	648	642	869
371 Iron and steel	1003	1305	1867
372 Non-ferrous metals	232	296	364
381 Metal products	1267	1619	2013
382 Non-electrical machinery	1318	1163	1360
383 Electrical machinery	866	948	1132
384 Transport equipment	2119	2138	2747
385 Professional and scientific equipment	81	96	160
390 Other manufacturing industries	97	93	113

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

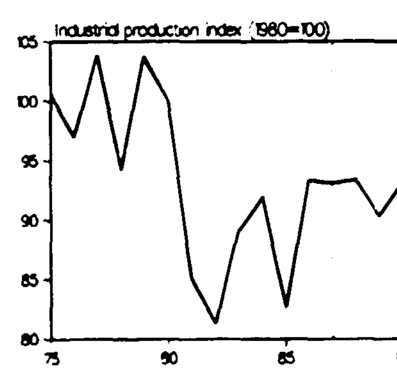
GDP per capita (1000$)/c



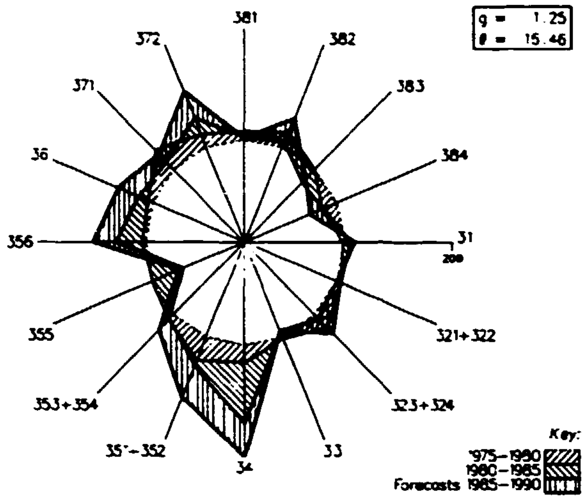
Manufacturing share in GDP (%) /c



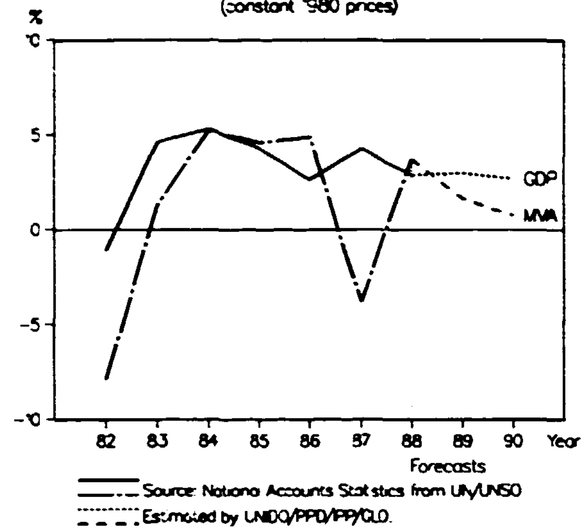
Industrial production index (1980=100)



Industrial structural change
(Index of value added: 1975=100)



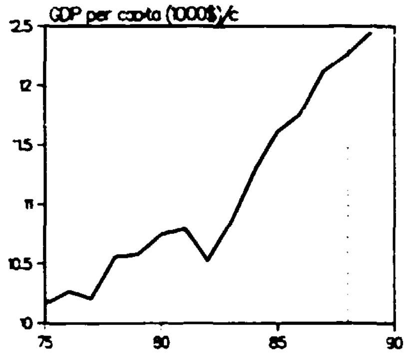
Annual growth rates of GDP and MVA
(constant 1980 prices)



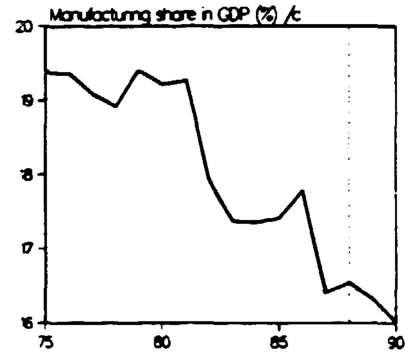
	1980	1985	1987
GDP: /na,c (millions of dollars)	157965	183007	195941
Per capita /na,c (dollars)	10749	11613	12123
Manufacturing share /na,c (%)	19.2	17.4	16.4
MANUFACTURING:			
Value added /na,c (millions of dollars)	30352	31863	32153
Value added (millions of dollars)	29173	27380	32823
Industrial production index	100	104	106
Gross output (millions of dollars)	75474	69276	83047
Employment (thousands)	1139	1014	1013 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	61	60	60 /e
Wages and salaries (%)	20	19	19 /e
Operating surplus (%)	18	21	20 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	66263	68320	81949 /e
Value added / worker	25613	27002	32389 /e
Average wage	13356	12979	15805 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.75 /e	2.83	2.46 /e
as a percentage of average θ in 1970-1975	79 /e	81	71 /e
MVA growth rate / θ	0.23 /e	1.22	1.31 /e
Degree of specialization	11.3 /e	12.4	12.3 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	3993	3715	4439 /e
313 Beverages	785	847	1006 /e
314 Tobacco products	248	179	206 /e
321 Textiles	1060	966	1068 /e
322 Wearing apparel	821	722	869 /e
323 Leather and fur products	93	76	86 /e
324 Footwear	223	206	211 /e
331 Wood and wood products	1062	1028	1191 /e
332 Furniture and fixtures	505	507	591 /e
341 Paper and paper products	744	703	786 /e
342 Printing and publishing	1818	2131	2622 /e
351 Industrial chemicals	969	909	951 /e
352 Other chemical products	1186	1191	1361 /e
353 Petroleum refineries	323	286	289 /e
354 Miscellaneous petroleum and coal products	30	25	23 /e
355 Rubber products	341	264	279 /e
356 Plastic products	831	808	972 /e
361 Pottery, china and earthenware	46	41	32 /e
362 Glass and glass products	246	264	267 /e
369 Other non-metal mineral products	1183	1086	1192 /e
371 Iron and steel	1920	1391	1980 /e
372 Non-ferrous metals	1473	1409	1530 /e
381 Metal products	2467	2041	2692 /e
382 Non-electrical machinery	2091	1676	2097 /e
383 Electrical machinery	1261	2030	2802 /e
384 Transport equipment	2830	2579	2694 /e
385 Professional and scientific equipment	290	279	327 /e
390 Other manufacturing industries	283	246	284 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

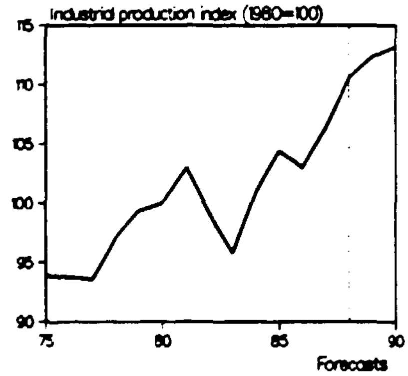
GDP per capita (1000$)/c

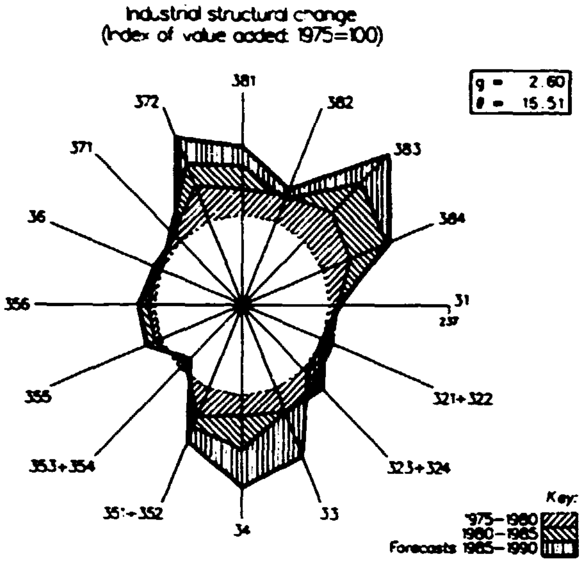


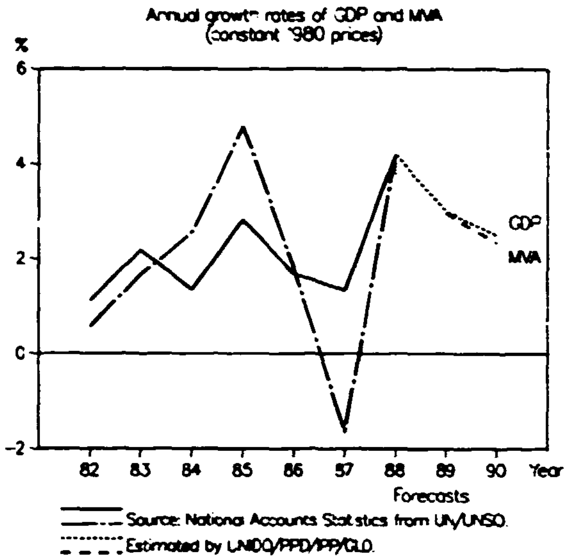
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

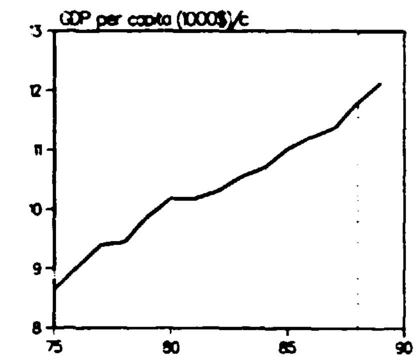


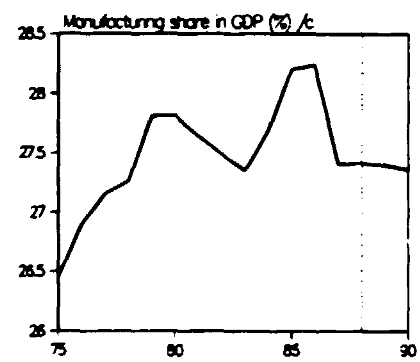


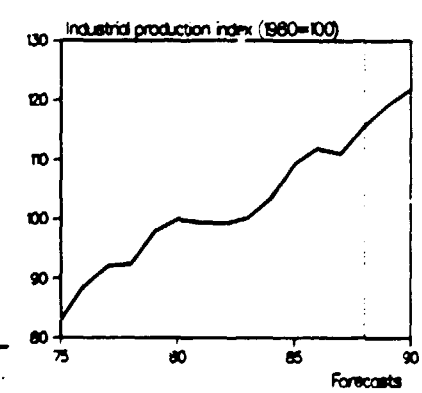


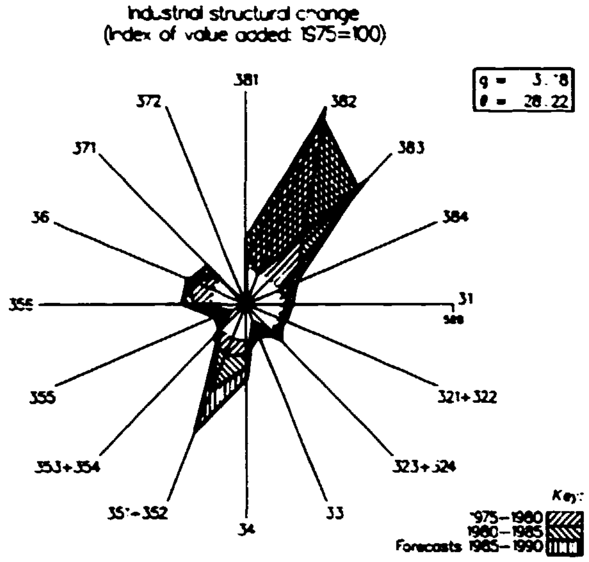
	1980	1985	1987
GDP: /na,c (millions of dollars)	76882	82654	85164
Per capita /na,c (dollars)	10182	11016	11363
Manufacturing share /na,c (%)	27.8	28.2	27.4
MANUFACTURING:			
Value added /na,c (millions of dollars)	21384	23313	23340
Value added (millions of dollars)	18086	15238	26168
Industrial production index	100	109	111
Gross output (millions of dollars)	54666	46025	77615
Employment (thousands)	824	775	749 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	67	67	66 /e
Wages and salaries (%)	19	18	18 /e
Operating surplus (%)	14	15	15 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	66365	59421	103642 /e
Value added / worker	21952	19673	34930 /e
Average wage	12799	10667	19117 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.66	2.97	2.98 /e
as a percentage of average θ in 1970-1975	84	97	97 /e
MVA growth rate / θ	0.84	1.87	-0.27 /e
Degree of specialization	11.4	11.9	11.3 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	1752	1616	2578 /e
313 Beverages	474	384	756 /e
314 Tobacco products	807	725	1215 /e
321 Textiles	904	662	1082 /e
322 Wearing apparel	512	347	572 /e
323 Leather and fur products	63	45	66 /e
324 Footwear	223	166	240 /e
331 Wood and wood products	192	298	425 /e
332 Furniture and fixtures	965	728	1458 /e
341 Paper and paper products	645	511	906 /e
342 Printing and publishing	726	597	1099 /e
351 Industrial chemicals	663	576	776 /e
352 Other chemical products	534	398	628 /e
353 Petroleum refineries	177	227	376 /e
354 Miscellaneous petroleum and coal products	36	26	40 /e
355 Rubber products	268	188	390 /e
356 Plastic products	281	216	376 /e
361 Pottery, china and earthenware	63	42	93 /e
362 Glass and glass products	244	238	399 /e
369 Other non-metal mineral products	894	716	1237 /e
371 Iron and steel	1226	1063	1613 /e
372 Non-ferrous metals	280	241	392 /e
381 Metal products	1642	1133	1878 /e
382 Non-electrical machinery	1786	1493	2626 /e
383 Electrical machinery	1616	1463	2703 /e
384 Transport equipment	943	989	1777 /e
385 Professional and scientific equipment	161	142	242 /e
390 Other manufacturing industries	143	130	217 /e

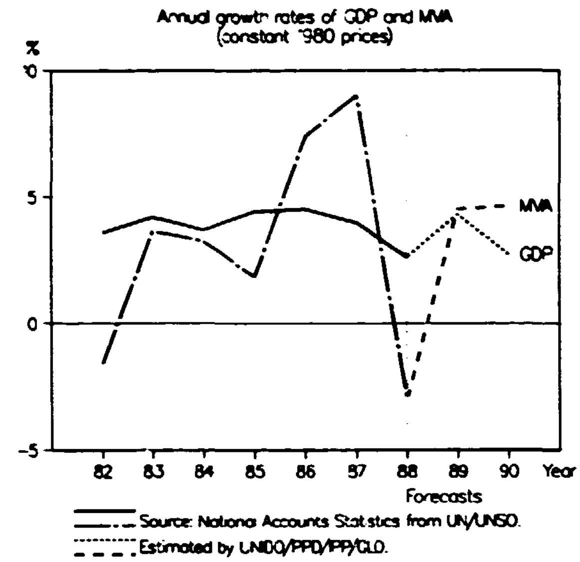
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





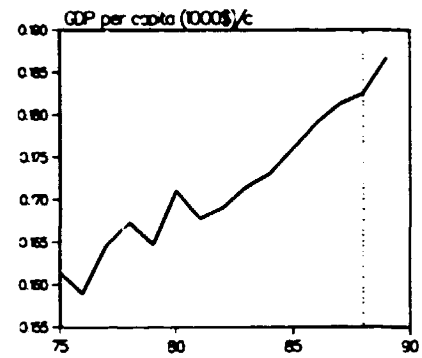


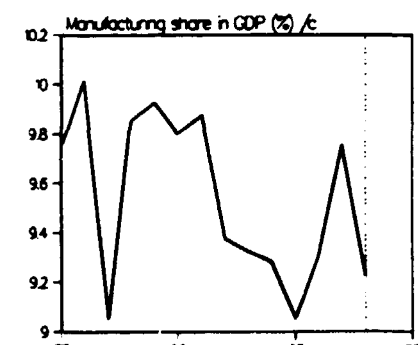


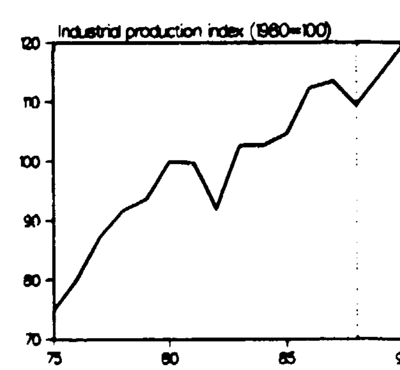


	1980	1985	1987
GDP: /na.c (millions of dollars)	15094	17799	19342
Per capita /na.c (dollars)	171	176	181
Manufacturing share /na.c (%)	9.8	9.1	9.8
MANUFACTURING:			
Value added /na.c (millions of dollars)	1479	1612	1887
Value added (millions of dollars)	834	848	1002
Industrial production index	100	105	114
Gross output (millions of dollars)	2253	2526	2940
Employment (thousands)	412	446 /e	487 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	63	66 /e	66 /e
Wages and salaries (%)	12	11 /e	11 /e
Operating surplus (%)	25	23 /e	23 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	5466	5659 /e	6034 /e
Value added / worker	2023	1899 /e	2067 /e
Average wage	634	617 /e	647 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.44 /e	4.36 /e	9.16 /e
as a percentage of average θ in 1970-1975	51 /e	155 /e	326 /e
MVA growth rate / θ	4.75 /e	0.44 /e	0.11 /e
Degree of specialization	34.0 /e	30.9 /e	32.5 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	78	119 /e	142 /e
313 Beverages	7	8 /e	9 /e
314 Tobacco products	111	124 /e	149 /e
321 Textiles	336	294 /e	342 /e
322 Wearing apparel	-	4 /e	6 /e
323 Leather and fur products	18	13 /e	14 /e
324 Footwear	4	6 /e	8 /e
331 Wood and wood products	3	3 /e	4 /e
332 Furniture and fixtures	1	2 /e	2 /e
341 Paper and paper products	23	22 /e	27 /e
342 Printing and publishing	6	7 /e	9 /e
351 Industrial chemicals	33	43 /e	52 /e
352 Other chemical products	97	90 /e	109 /e
353 Petroleum refineries	2	3 /e	3 /e
354 Miscellaneous petroleum and coal products	1	2 /e	2 /e
355 Rubber products	4	2 /e	2 /e
356 Plastic products	-	1 /e	1 /e
361 Pottery, china and earthenware	2	2 /e	3 /e
362 Glass and glass products	4	3 /e	3 /e
369 Other non-metal mineral products	14	8 /e	9 /e
371 Iron and steel	39	27 /e	33 /e
372 Non-ferrous metals	-	- /e	...
381 Metal products	9	12 /e	14 /e
382 Non-electrical machinery	4	22 /e	27 /e
383 Electrical machinery	19	11 /e	13 /e
384 Transport equipment	11	13 /e	16 /e
385 Professional and scientific equipment	7	5 /e	6 /e
390 Other manufacturing industries	1	1 /e	1 /e

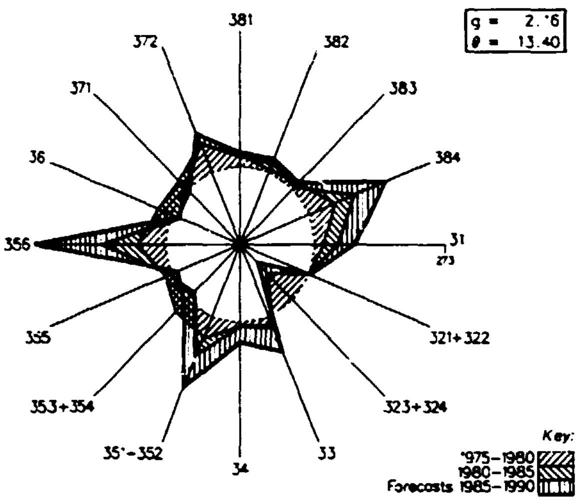
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



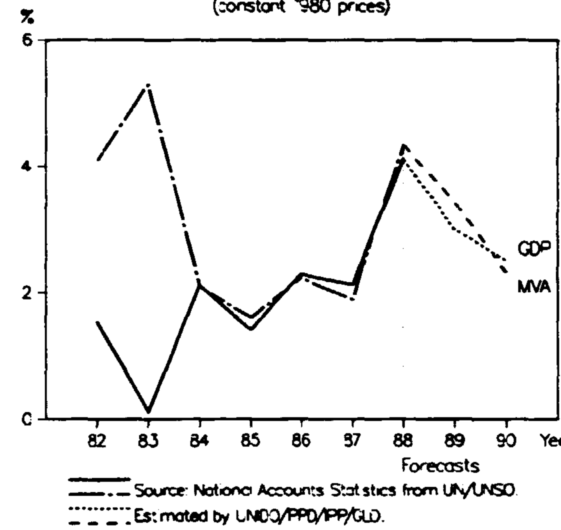




Industrial structural change
(Index of value added. 1975=100)

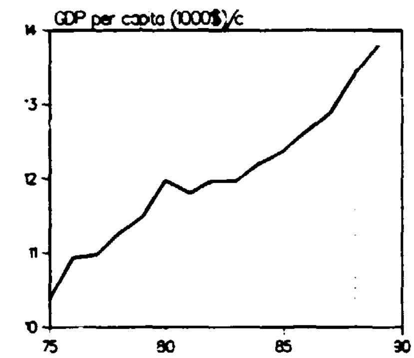


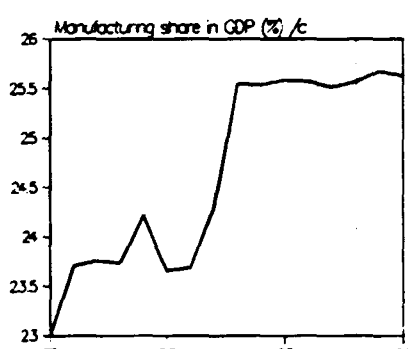
Annual growth rates of GDP and MVA
(constant 1980 prices)

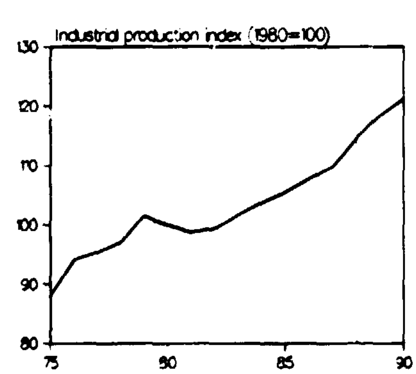


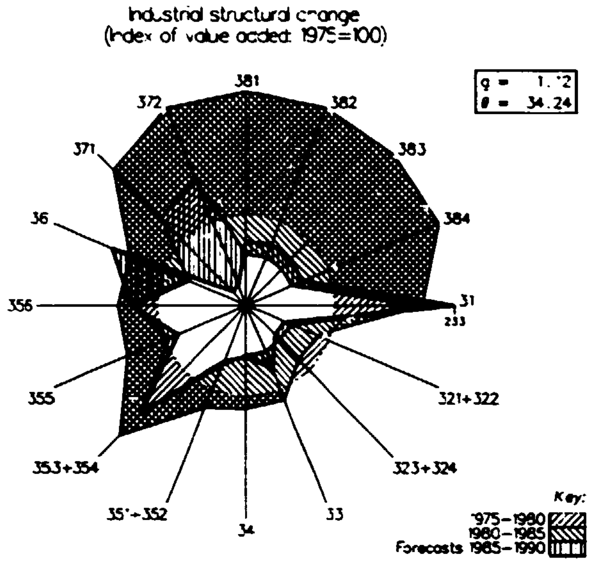
	1980	1985	1987
GDP: /na,c (millions of dollars)	118008	122541	128008
Per capita /na,c (dollars)	11977	12373	12905
Manufacturing share /na,c (%)	23.7	25.6	25.5
MANUFACTURING:			
Value added /na,c (millions of dollars)	27920	31353	32657
Value added (millions of dollars)	28089	17368	30166
Industrial production index	100	105	110
Gross output (millions of dollars)	86206	56463 /e	97267 /e
Employment (thousands)	868	753	725 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	67 /e	69 /e	69 /e
Wages and salaries (%)	16 /e	14 /e	14 /e
Operating surplus (%)	16 /e	17 /e	17 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	99316 /e	74984 /e	134077 /e
Value added / worker	32360 /e	23066 /e	41582 /e
Average wage	16145 /e	10646 /e	18428 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.24 /e	1.88 /e	2.11 /e
as a percentage of average θ in 1970-1975	66 /e	55 /e	62 /e
MVA growth rate / θ	-0.65 /e	0.85 /e	0.90 /e
Degree of specialization	12.8 /e	14.6 /e	15.0 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	3991	2885	5160 /e
313 Beverages	547	394	676 /e
314 Tobacco products	198	128	202 /e
321 Textiles	1443	920	1656 /e
322 Wearing apparel	670	381	618 /e
323 Leather and fur products	109	72	117 /e
324 Footwear	65	34	37 /e
331 Wood and wood products	226	111	211 /e
332 Furniture and fixtures	1122	576	1070 /e
341 Paper and paper products	612	404	743 /e
342 Printing and publishing	927	546	955 /e
351 Industrial chemicals	2401	1905	3448 /e
352 Other chemical products	663	492	916 /e
353 Petroleum refineries	510	169	395 /e
354 Miscellaneous petroleum and coal products	78	26	38 /e
355 Rubber products	191	125	211 /e
356 Plastic products	814	542	995 /e
361 Pottery, china and earthenware	117 /e	57 /e	87 /e
362 Glass and glass products	441 /e	216 /e	381 /e
369 Other non-metal mineral products	717 /e	351 /e	566 /e
371 Iron and steel	2267	940	1381 /e
372 Non-ferrous metals	486	379	618 /e
381 Metal products	2079	1244	2041 /e
382 Non-electrical machinery	2455	1468	2388 /e
383 Electrical machinery	2312	1383	2421 /e
384 Transport equipment	1883	1127	2091 /e
385 Professional and scientific equipment	196	117	212 /e
390 Other manufacturing industries	668	378	633 /e

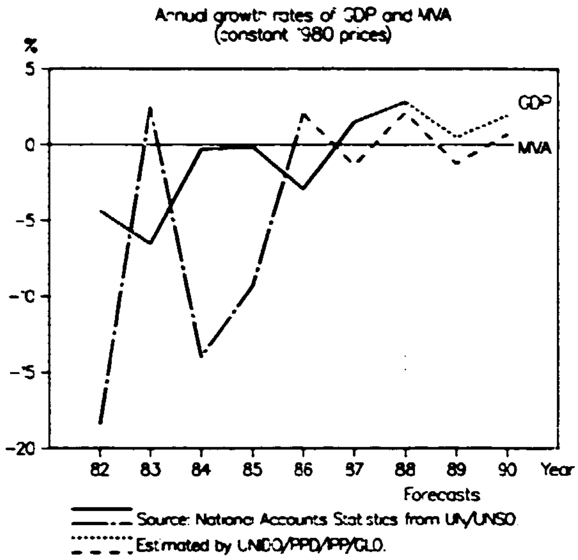
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





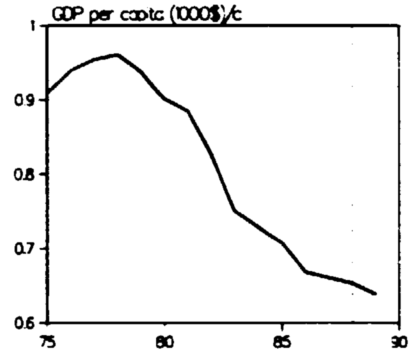


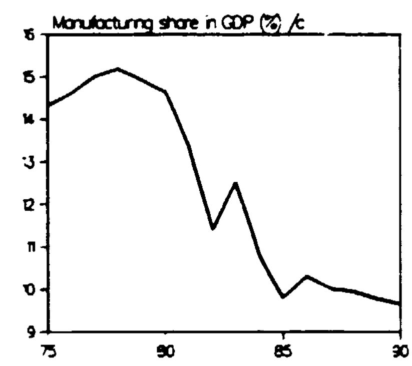


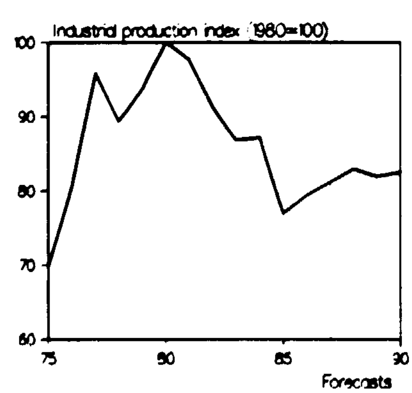


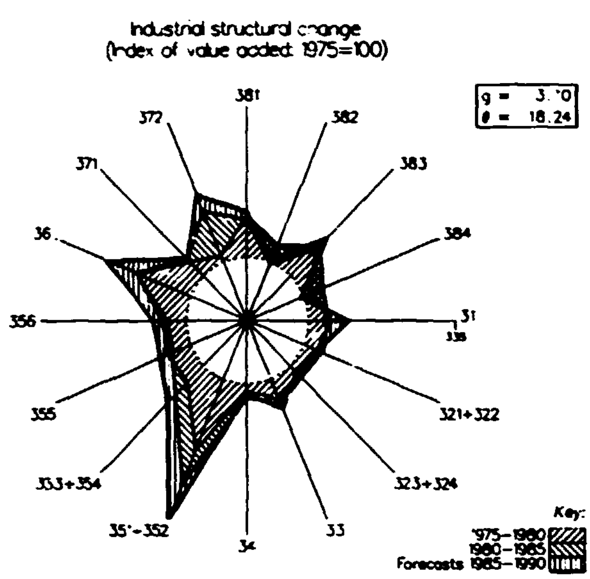
	1980	1985	1987
GDP: /na.c (millions of dollars)	5018	4508	4442
Per capita /na.c (dollars)	901	707	660
Manufacturing share /na.c (%)	14.6	9.8	10.0 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	734	442	445 /e
Value added (millions of dollars)	755	1055 /e	1089 /e
Industrial production index	100	77	81
Gross output (millions of dollars)	1852	2533 /e	2539 /e
Employment (thousands)	89	96 /e	100 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	59	58 /e	57 /e
Wages and salaries (%)	14	14 /e	14 /e
Operating surplus (%)	27	27 /e	29 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	20818	26501 /e	25290 /e
Value added / worker	8488	11040 /e	10847 /e
Average wage	2937	3767 /e	3591 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	4.10	5.11 /e	4.12 /e
as a percentage of average θ in 1970-1975	79	98 /e	79 /e
MVA growth rate / θ	1.64	-2.29 /e	0.56 /e
Degree of specialization	25.2	32.8 /e	32.9 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	217	311 /e	326 /e
313 Beverages	43	62 /e	65 /e
314 Tobacco products	21	30 /e	32 /e
321 Textiles	32	45 /e	47 /e
322 Wearing apparel	71	91 /e	86 /e
323 Leather and fur products	2	3 /e	3 /e
324 Footwear	13	19 /e	20 /e
331 Wood and wood products	14	17 /e	18 /e
332 Furniture and fixtures	15	19 /e	20 /e
341 Paper and paper products	1	2 /e	2 /e
342 Printing and publishing	9	13 /e	13 /e
351 Industrial chemicals	7	10 /e	11 /e
352 Other chemical products	27	38 /e	40 /e
353 Petroleum refineries	129	185 /e	197 /e
354 Miscellaneous petroleum and coal products	7	11 /e	12 /e
355 Rubber products	15	21 /e	23 /e
356 Plastic products	12	17 /e	18 /e
361 Pottery, china and earthenware	1	2 /e	2 /e
362 Glass and glass products	7	11 /e	11 /e
369 Other non-metal mineral products	32	43 /e	44 /e
371 Iron and steel	2	2 /e	2 /e
372 Non-ferrous metals	30	41 /e	32 /e
381 Metal products	20	27 /e	30 /e
382 Non-electrical machinery	8	11 /e	12 /e
383 Electrical machinery	4	6 /e	6 /e
384 Transport equipment	1	2 /e	2 /e
385 Professional and scientific equipment	1	1 /e	2 /e
390 Other manufacturing industries	12	15 /e	16 /e

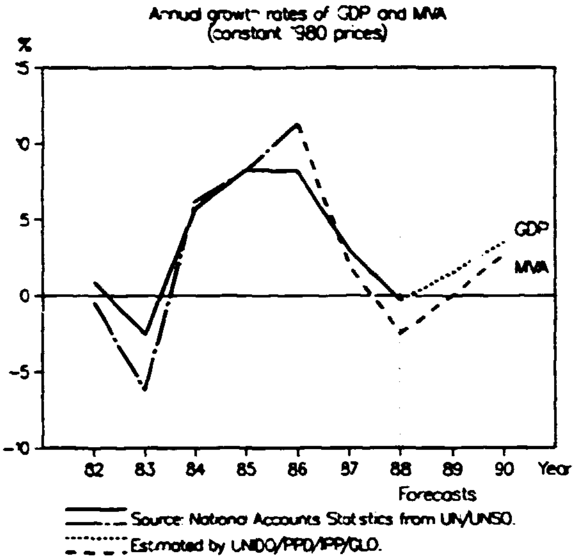
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.











	1980	1985	1987
GDP: /na,c (millions of dollars)	238472	259434	289119
Per capita /na,c (dollars)	1966	1914	2044
Manufacturing share /na,c (%)	28.5	25.2	25.7 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	67943	65361	74226 /e
Value added (millions of dollars)	71690	61307 /e	68657 /e
Industrial production index	100	101	112 /e
Gross output (millions of dollars)	176175	145235	196360 /e
Employment (thousands)	4449	4249 /e	4455 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	59	58 /e	56 /e
Wages and salaries (%)	7	6 /e	6 /e
Operating surplus (%)	34	36 /e	38 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	39599	34177 /e	44074 /e
Value added / worker	16114	14427 /e	19461 /e
Average wage	2762	2041 /e	2589 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.43 /e	3.44 /e	3.66 /e
as a percentage of average θ in 1970-1975	74 /e	74 /e	79 /e
MVA growth rate / θ	2.83 /e	2.39 /e	0.64 /e
Degree of specialization	11.2 /e	10.4 /e	11.0 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	7996	8643 /e	12664 /e
313 Beverages	1375	1437 /e	2095 /e
314 Tobacco products	495	434 /e	606 /e
321 Textiles	4860	3328 /e	4227 /e
322 Wearing apparel	2307	1530 /e	1986 /e
323 Leather and fur products	309	226 /e	288 /e
324 Footwear	986	753 /e	1082 /e
331 Wood and wood products	1903	1141 /e	1449 /e
332 Furniture and fixtures	1087	88[illegible] /e	875 /e
341 Paper and paper products	2238	1716 /e	2486 /e
342 Printing and publishing	1901	1643 /e	2429 /e
351 Industrial chemicals	3428	2452 /e	3577 /e
352 Other chemical products	3544	4160 /e	6148 /e
353 Petroleum refineries	3075	2804 /e	397[illegible] /e
354 Miscellaneous petroleum and coal products	1216	1061 /e	1619 /e
355 Rubber products	941	696 /e	924 /e
356 Plastic products	1994	1240 /e	1612 /e
361 Pottery, china and earthenware	190	99 /e	106 /e
362 Glass and glass products	568	362 /e	477 /e
369 Other non-metal mineral products	3447	3488 /e	5156 /e
371 Iron and steel	4128	3817 /e	5419 /e
372 Non-ferrous metals	1115	900 /e	1264 /e
381 Metal products	3699	3093 /e	4246 /e
382 Non-electrical machinery	7171	5238 /e	7682 /e
383 Electrical machinery	4636	4489 /e	6066 /e
384 Transport equipment	6626	4829 /e	6786 /e
385 Professional and scientific equipment	463	243 /e	281 /e
390 Other manufacturing industries	1216	794 /e	1161 /e

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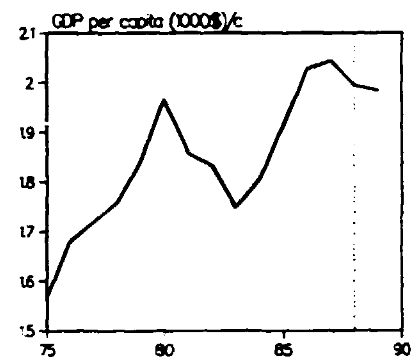

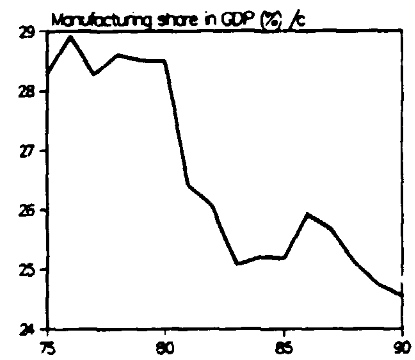

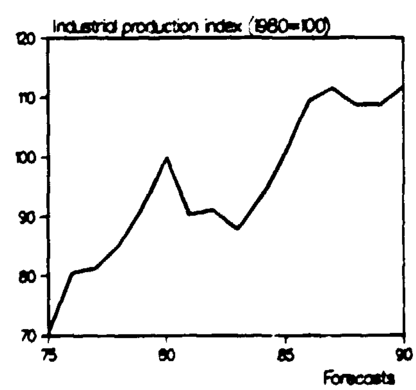

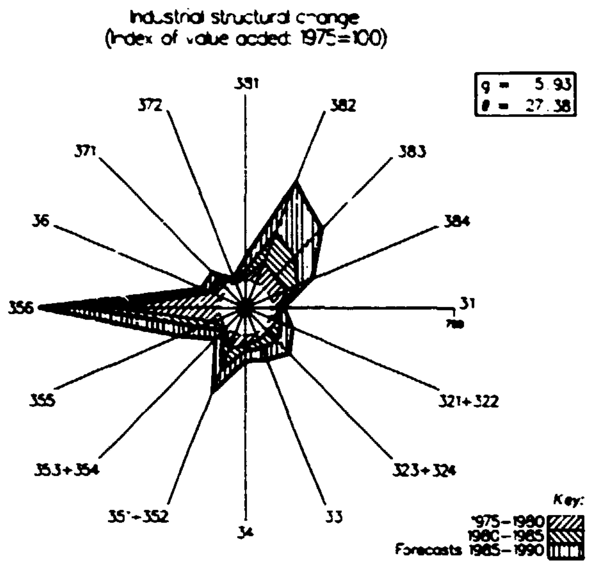

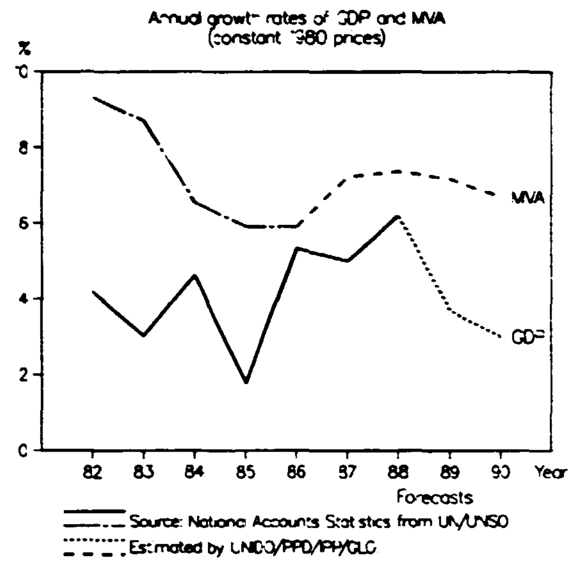

	1980	1985	1987
GDP: /na,c (millions of dollars)	19031	22837	25258
Per capita /na,c (dollars)	2147	2548	2811
Manufacturing share /na,c (%)	42.4	50.1	...
MANUFACTURING:			
Value added /na,c (millions of dollars)	8069	11433	...
Value added (millions of dollars)/c	11771	14755 /e	16326 /e
Industrial production index	100	125	139
Gross output (millions of dollars)	34035 /e	36675	29714 /e
Employment (thousands)	1260	1316	1342 /e
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	...	...	...
Wages and salaries (%)	...	...	...
Operating surplus (%)	...	...	...
-PRODUCTIVITY:(dollars)			
Gross output / worker	44333 /e	46763 /e	36986 /e
Value added / worker /c	9675 /e	11746 /e	12755 /e
Average wage	2629 /e	2704 /e	2241 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	7.85 /e	3.44 /e	3.14 /e
as a percentage of average θ in 1970-1975	239 /e	104 /e	95 /e
MVA growth rate / θ	0.85 /e	1.39 /e	1.43 /e
Degree of specialization	11.4 /e	11.8 /e	12.9 /e
-VALUE ADDED:(millions of dollars)/c			
311 Food products	1870	1945	1982
313 Beverages	308	357	336
314 Tobacco products	426	472	464
321 Textiles	904	1003	1093
322 Wearing apparel	517	626	760
323 Leather and fur products	84	110	117
324 Footwear	156	218	251
331 Wood and wood products	248	258	258
332 Furniture and fixtures	233	347	387
341 Paper and paper products	119	141	140
342 Printing and publishing	83	91	94
351 Industrial chemicals	404	573	537
352 Other chemical products	291	486	593
353 Petroleum refineries	...	...	...
354 Miscellaneous petroleum and coal products	126	140	160 /e
355 Rubber products	227	323	368
356 Plastic products	110	135 /e	133 /e
361 Pottery, china and earthenware	45	40	49
362 Glass and glass products	121	140	139
369 Other non-metal mineral products	469	507	521
371 Iron and steel	447	513	536
372 Non-ferrous metals	189	199	191 /e
381 Metal products	484	600	648
382 Non-electrical machinery	1463 /e	2401 /e	3049 /e
383 Electrical machinery	743	1241	1501
384 Transport equipment	567	726	755
385 Professional and scientific equipment	200 /e	309 /e	393 /e
390 Other manufacturing industries	937	863	881

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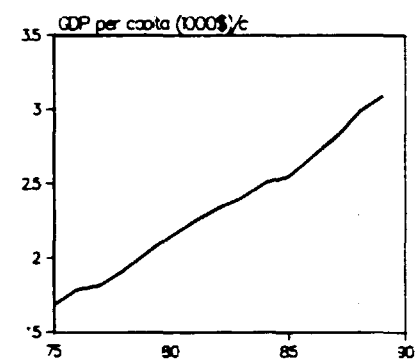

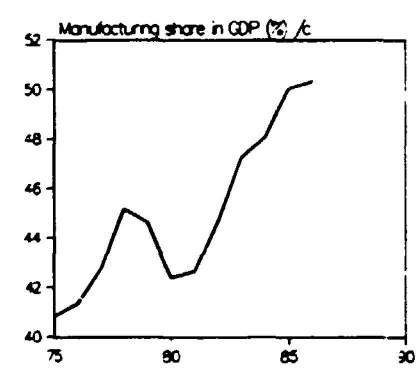

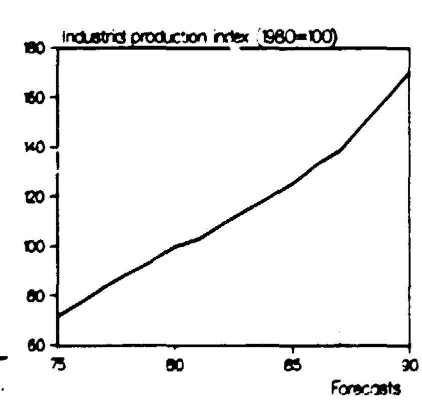

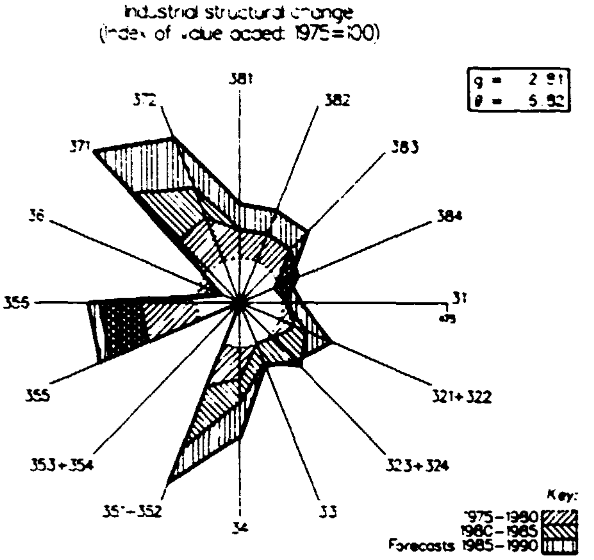

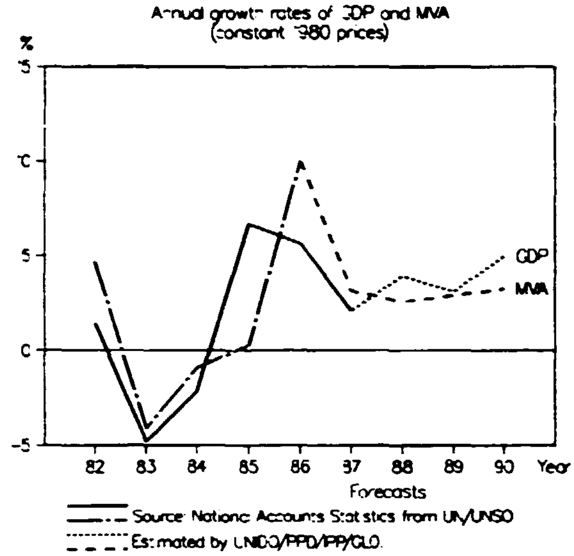

	1980	1985	1987
GDP: /na.c (millions of dollars)	1287	1388	1497
Per capita /na.c (dollars)	185	176	180
Manufacturing share /na.c (%)	11.0	10.4	10.9 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	141	144	164 /e
Value added (millions of dollars)	144	129 /e	192 /e
Industrial production index	100	110	125 /e
Gross output (millions of dollars)	391	295 /e	436 /e
Employment (thousands)	8	9 /e	9 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	63 /e	56 /e	56 /e
Wages and salaries (%)	8 /e	8 /e	8 /e
Operating surplus (%)	28 /e	36 /e	37 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	47326 /e	33344 /e	47907 /e
Value added / worker	17465 /e	14573 /e	21146 /e
Average wage	4021 /e	2570 /e	3637 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	5.54 /e	6.35 /e	5.57 /e
as a percentage of average θ in 1970-1975	79 /e	91 /e	80 /e
MVA growth rate / θ	0.20 /e	0.05 /e	0.57 /e
Degree of specialization	37 2 /e	35.8 /e	37.4 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	55	58 /e	86 /e
313 Beverages	29	21 /e	31 /e
314 Tobacco products	1	1 /e	2 /e
321 Textiles	20	18 /e	30 /e
322 Wearing apparel	2	2 /e	3 /e
323 Leather and fur products	2	1 /e	2 /e
324 Footwear	3	3 /e	5 /e
331 Wood and wood products	-	- /e	- /e
332 Furniture and fixtures	2	2 /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	1 /e
352 Other chemical products	-	- /e	- /e
353 Petroleum refineries	-	- /e	- /e
354 Miscellaneous petroleum and coal products	-	- /e	- /e
355 Rubber products	4	3 /e	4 /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	1 /e	1 /e
382 Non-electrical machinery	1	- /e	1 /e
383 Electrical machinery	1	1 /e	1 /e
384 Transport equipment	3	1 /e	2 /e
385 Professional and scientific equipment	-	- /e	- /e
390 Other manufacturing industries	12	11 /e	14 /e

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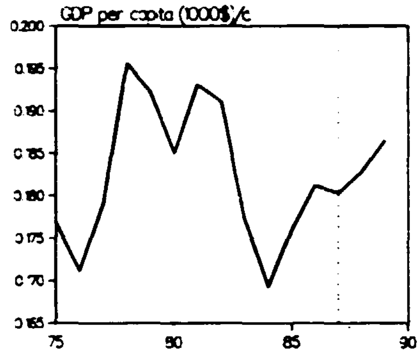
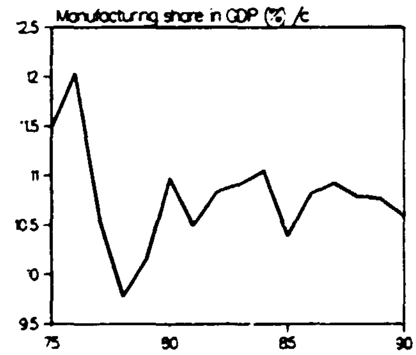
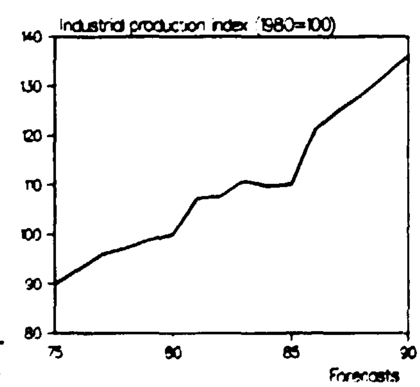
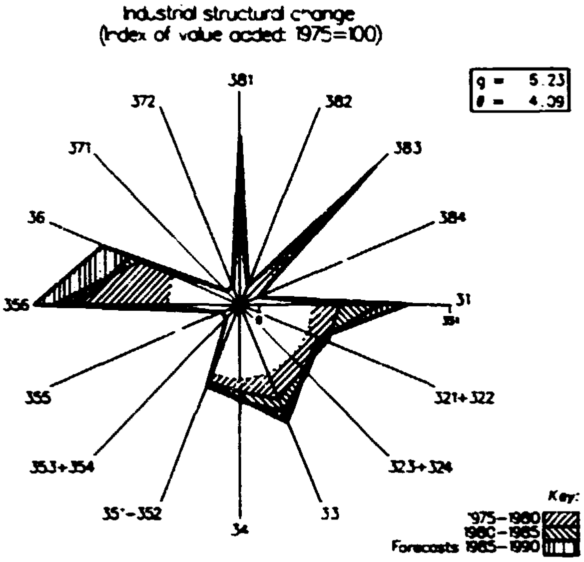
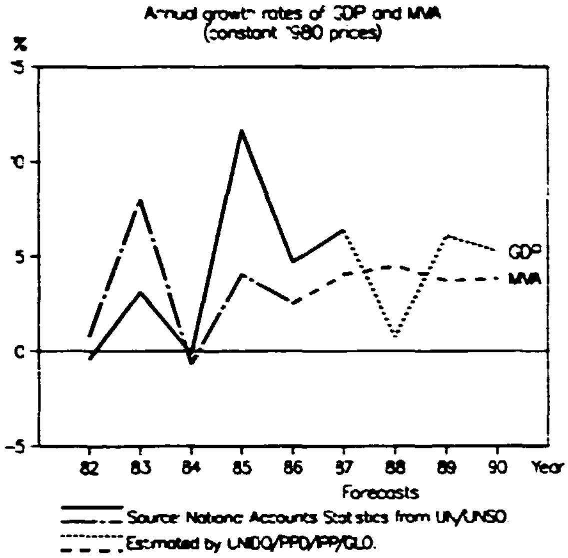




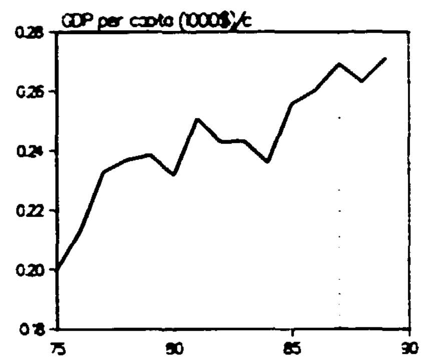


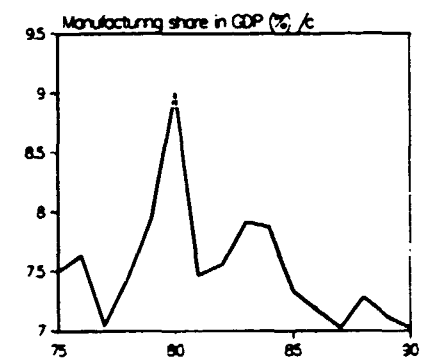


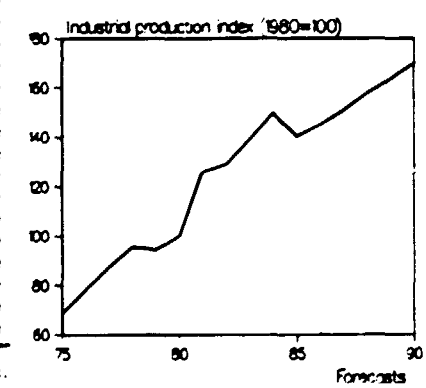


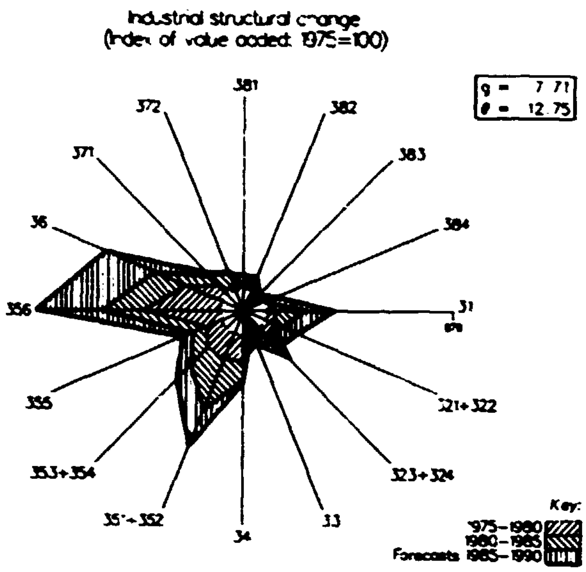
	1980	1985	1987
GDP: /na,c (millions of dollars)	951	1208	1346
Per capita /na,c (dollars)	232	256	269
Manufacturing share /na,c (%)	9.0	7.3	7.0 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	86	89	95 /e
Value added (millions of dollars)	56	77 /e	91 /e
Industrial production index	100	140	151 /e
Gross output (millions of dollars)	95	128 /e	144 /e
Employment (thousands)	3	5 /e	5 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	41 /e	40 /e	36 /e
Wages and salaries (%)	9 /e	10 /e	9 /e
Operating surplus (%)	51 /e	51 /e	55 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	27640 /e	27494 /e	31229 /e
Value added / worker	16370 /e	16631 /e	19852 /e
Average wage	2357 /e	2663 /e	2712 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.54 /e	1.72 /e	0.78 /e
as a percentage of average θ in 1970-1975	34 /e	38 /e	17 /e
MVA growth rate / θ	3.80 /e	-3.65 /e	5.15 /e
Degree of specialization	36.9 /e	41.0 /e	41.5 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	26 /e	32 /e	39 /e
313 Beverages	12 /e	19 /e	24 /e
314 Tobacco products	6 /e	9 /e	12 /e
321 Textiles	2	2 /e	2 /e
322 Wearing apparel	3	3 /e	3 /e
323 Leather and fur products	1	1 /e	1 /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	2 /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	3 /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

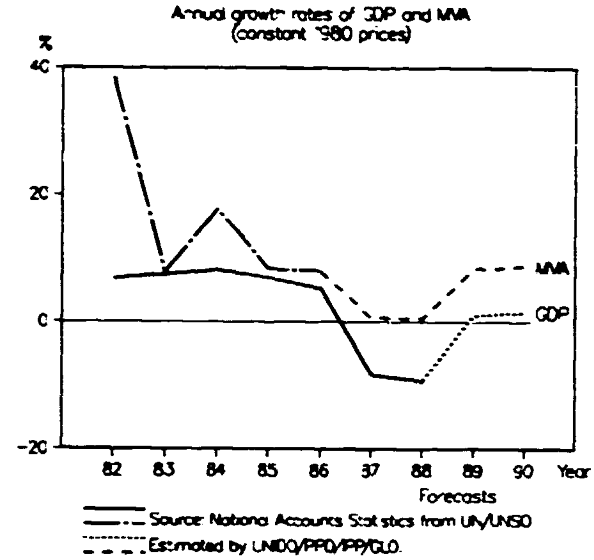
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





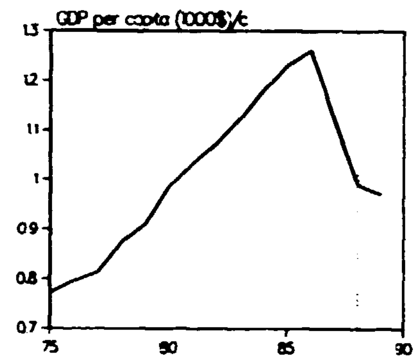


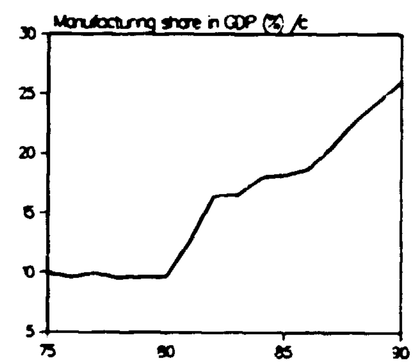


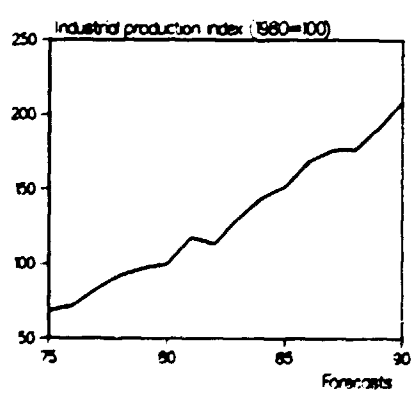


	1980	1985	1987
GDP: /na,c (millions of dollars)	8502	12137	11719
Per capita /na,c (dollars)	986	1229	1127
Manufacturing share /na,c (%)	9.7	18.2	20.5 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	822	2209	2401 /e
Value added (millions of dollars)	448 /e	446 /e	865 /e
Industrial production index	100	162	176 /e
Gross output (millions of dollars)	959 /e	923 /e	1722 /e
Employment (thousands)	28 /e	29 /e	30 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	53 /e	52 /e	50 /e
Wages and salaries (%)	16 /e	15 /e	15 /e
Operating surplus (%)	31 /e	33 /e	35 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	34564 /e	31839 /e	57763 /e
Value added / worker	16128 /e	15366 /e	29014 /e
Average wage	5534 /e	4762 /e	8608 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	9.27 /e	5.76 /e	2.66 /e
as a percentage of average θ in 1970-1975	114 /e	71 /e	33 /e
MVA growth rate / θ	0.35 /e	0.87 /e	1.63 /e
Degree of specialization	17.3 /e	27.0 /e	30.[illegible] /e
-VALUE ADDED: (millions of dollars)			
311 Food products	47 /e	42 /e	84 /e
313 Beverages	187 /e	224 /e	456 /e
314 Tobacco products	21 /e	11 /e	15 /e
321 Textiles	23 /e	11 /e	18 /e
322 Wearing apparel	7 /e	6 /e	9 /e
323 Leather and fur products	7 /e	9 /e	17 /e
324 Footwear	9 /e	4 /e	6 /e
331 Wood and wood products	5 /e	3 /e	5 /e
332 Furniture and fixtures	1 /e	1 /e	2 /e
341 Paper and paper products	5 /e	7 /e	14 /e
342 Printing and publishing	5 /e	6 /e	12 /e
351 Industrial chemicals	8 /e	9 /e	19 /e
352 Other chemical products	8 /e	4 /e	6 /e
353 Petroleum refineries	- /e	- /e	- /e
354 Miscellaneous petroleum and coal products	1 /e	2 /e	5 /e
355 Rubber products	2 /e	3 /e	6 /e
356 Plastic products	16 /e	19 /e	39 /e
361 Pottery, china and earthenware	5 /e	2 /e	4 /e
362 Glass and glass products	4 /e	2 /e	3 /e
369 Other non-metal mineral products	12 /e	14 /e	27 /e
371 Iron and steel	20 /e	20 /e	39 /e
372 Non-ferrous metals	14 /e	8 /e	15 /e
381 Metal products	14 /e	13 /e	21 /e
382 Non-electrical machinery	4 /e	4 /e	6 /e
383 Electrical machinery	4 /e	3 /e	5 /e
384 Transport equipment	2 /e	1 /e	2 /e
385 Professional and scientific equipment	- /e	- /e	- /e
390 Other manufacturing industries	13 /e	16 /e	32 /e

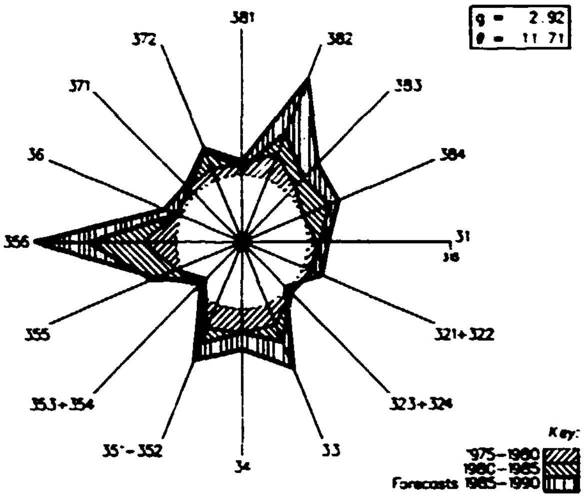
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



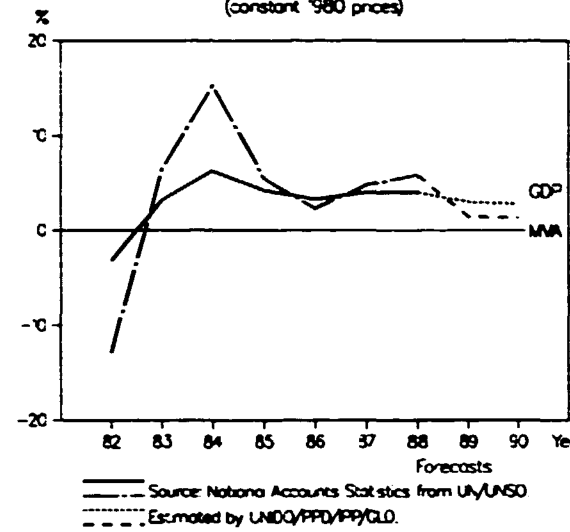




Industrial structural change
(Index of value added 1975=100)



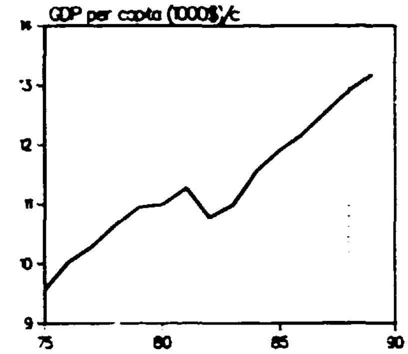
Annual growth rates of GDP and MVA
(constant 1980 prices)



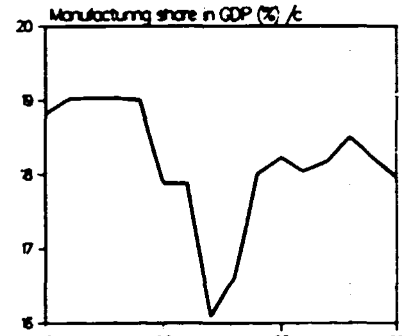
	1980	1985	1987
GDP: /na.c (millions of dollars)	263242	302115	324623
Per capita /na.c (dollars)	10995	11904	12548
Manufacturing share /na.c (%)	17.9	18.2	18.2
MANUFACTURING:			
Value added /na.c (millions of dollars)	47086	56062	59011
Value added (millions of dollars)	59803	74209	87787 /e
Industrial production index	100	112	120
Gross output (millions of dollars)	167211	211017	253253
Employment (thousands)	1853	1765	1825 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	64	65	65 /e
Wages and salaries (%)	17	16	16 /e
Operating surplus (%)	19	19	19 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	90238	119556	138766 /e
Value added / worker	32274	42045	48101 /e
Average wage	15296	19165	21983 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	4.95	2.83	4.68
as a percentage of average θ in 1970-1975	167	90	149
MVA growth rate / θ	-0.44	2.00	0.77
Degree of specialization	10.8	11.2	11.4
-VALUE ADDED: (millions of dollars)			
311 Food products	6142	8001	9338 /e
313 Beverages	1660	2189	2563 /e
314 Tobacco products	479	608	636 /e
321 Textiles	2130	2162	2616 /e
322 Wearing apparel	1604	1933	2334 /e
323 Leather and fur products	164	164	172 /e
324 Footwear	299	344	362 /e
331 Wood and wood products	2968	3236	4042 /e
332 Furniture and fixtures	1044	1332	1364 /e
341 Paper and paper products	5714	5410	6848 /e
342 Printing and publishing	3064	4517	5625 /e
351 Industrial chemicals	2164	2570	2783 /e
352 Other chemical products	2421	3755	4580 /e
353 Petroleum refineries	1531	1867	2280 /e
354 Miscellaneous petroleum and coal products	111	132	116 /e
355 Rubber products	873	1069	1314 /e
356 Plastic products	873	1664	1964 /e
361 Pottery, china and earthenware	43	29	39 /e
362 Glass and glass products	385	578	684 /e
369 Other non-metal mineral products	1497	1713	2264 /e
371 Iron and steel	2662	2906	3362 /e
372 Non-ferrous metals	2190	2284	2376 /e
381 Metal products	4414	4363	5318 /e
382 Non-electrical machinery	3962	4912	6281 /e
383 Electrical machinery	3849	4531	5392 /e
384 Transport equipment	6911	10088	10862 /e
385 Professional and scientific equipment	667	669	790 /e
390 Other manufacturing industries	932	1223	1421 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

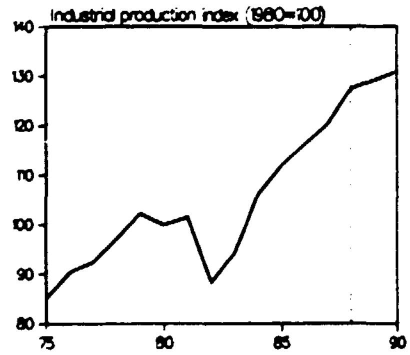
GDP per capita (1000$)/c



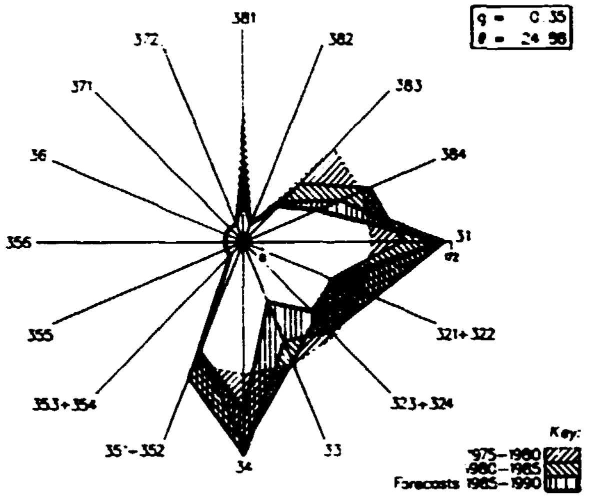
Manufacturing share in GDP (%) /c



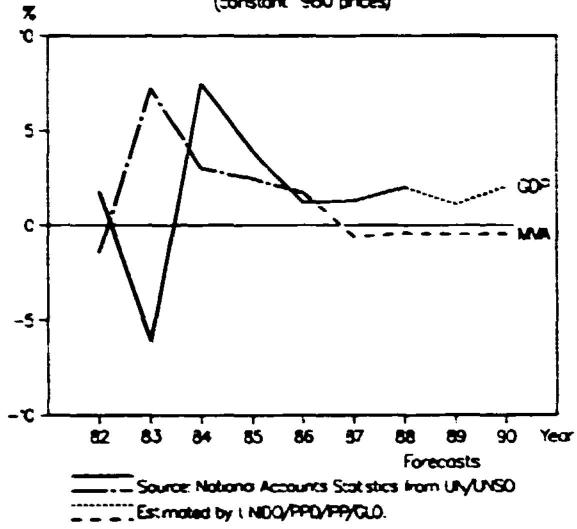
Industrial production index (1980=100)



Industrial structural change
(Index of value added: 1975=100)



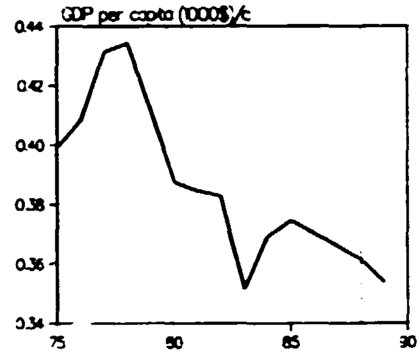
Annual growth rates of GDP and MVA
(constant 1980 prices)



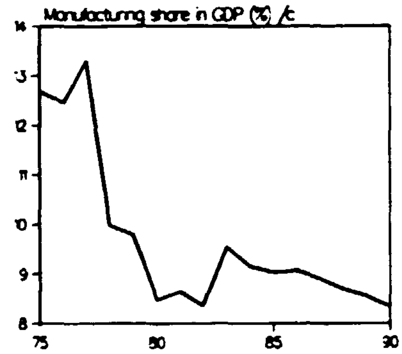
	1980	1985	1987
GDP: /na,c (millions of dollars)	891	965	989
Per capita /na,c (dollars)	387	375	366
Manufacturing share /na,c (%)	8.5	9.0	8.9 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	76	87	88 /e
Value added (millions of dollars)	35 /e	33	25 /e
Industrial production index	100	115	102
Gross output (millions of dollars)	98 /e	108	124 /e
Employment (thousands)	6 /e	8	6 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	64 /e	70 /e	80 /e
Wages and salaries (%)	16 /e	15 /e	18 /e
Operating surplus (%)	19 /e	15 /e	2 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	16898 /e	13866 /e	21940 /e
Value added / worker	6035 /e	4156 /e	4447 /e
Average wage	2749 /e	2030 /e	3946 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.75 /e	3.09 /e	5.04 /e
as a percentage of average θ in 1970-1975	60 /e	49 /e	80 /e
MVA growth rate / θ	2.80 /e	1.42 /e	-2.44 /e
Degree of specialization	37.4 /e	39.2 /e	40.6 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	5	8	10 /e
313 Beverages	3	4	5 /e
314 Tobacco products	4	6	8 /e
321 Textiles	5 /e	- /e	-11 /e
322 Wearing apparel	1 /e	- /e	-2 /e
323 Leather and fur products	- /e	- /e	- /e
324 Footwear	-	-	- /e
331 Wood and wood products	11 /e	8	6 /e
332 Furniture and fixtures	-	1	1 /e
341 Paper and paper products	-	-	- /e
342 Printing and publishing	1	2	2 /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	-	- /e
382 Non-electrical machinery	-	-	- /e
383 Electrical machinery	-	-	- /e
384 Transport equipment	2	1	1 /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 this Annex.

GDP per capita (1000$)/c



Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

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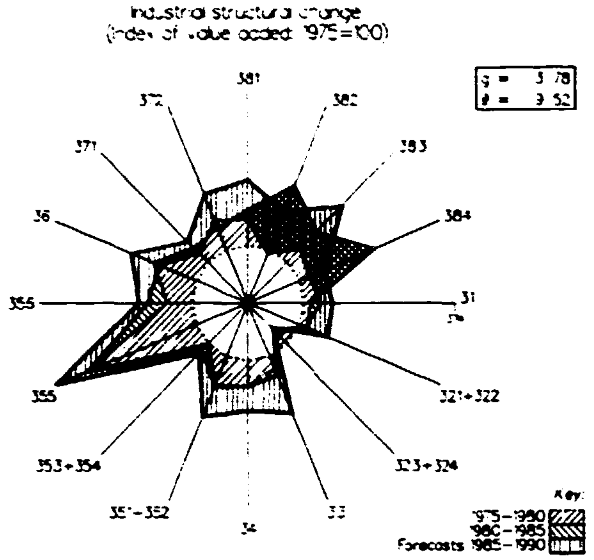
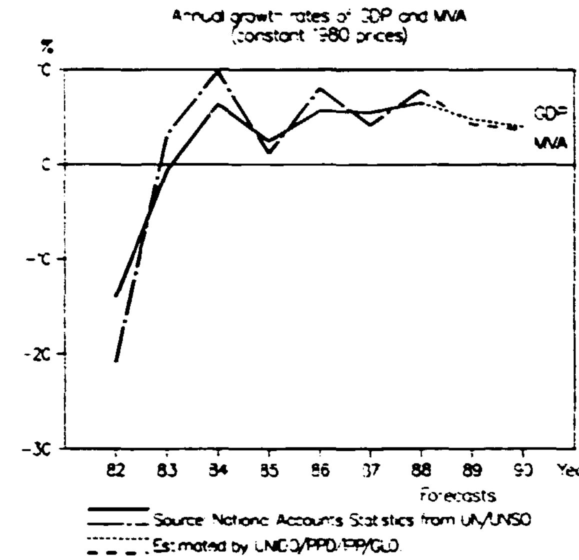
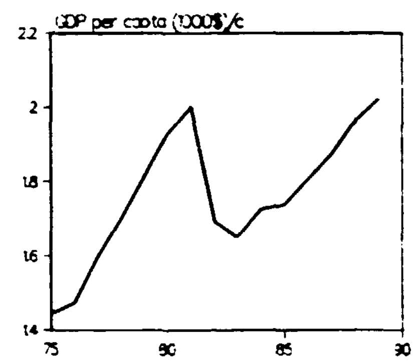
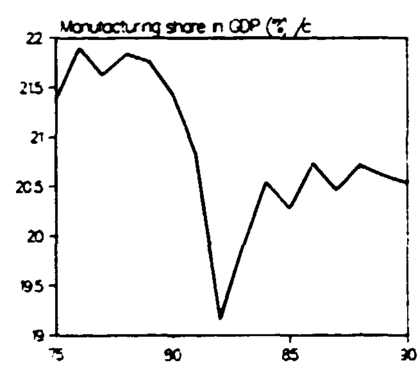


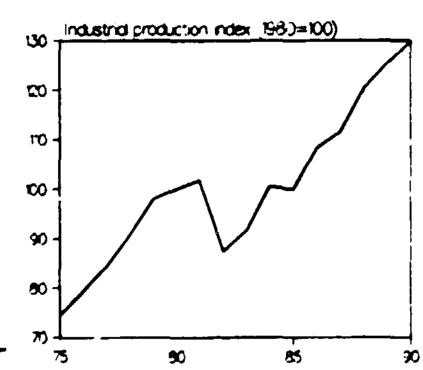


	1980	1985	1987
GDP: /na.c (millions of dollars)	21489	21075	23493
Per capita /na.c (dollars)	1928	1738	1874
Manufacturing share /na.c (%)	21.4	20.3	20.5
MANUFACTURING:			
Value added /na.c (millions of dollars)	4607	4275	4809
Value added (millions of dollars)	4991	4712	5585
Industrial production index	100	100	112
Gross output (millions of dollars)	10790	10477	12418
Employment (thousands)	206	185	194 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	54	55	55 /e
Wages and salaries (%)	9 /e	6	6 /e
Operating surplus (%)	38 /e	39	39 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	52264	56625	63917 /e
Value added / worker	24175	25468	28747 /e
Average wage	4444 /e	3498	3885 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	5.54 /e	1.76 /e	3.05 /e
as a percentage of average θ in 1970-1975	79 /e	25 /e	44 /e
MVA growth rate / θ	0.35 /e	-0.41 /e	0.97 /e
Degree of specialization	15.9 /e	20.4 /e	19.0 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	827	805	917 /e
313 Beverages	289	177	215 /e
314 Tobacco products	214	205	242 /e
321 Textiles	234	162	201 /e
322 Wearing apparel	111	83	100 /e
323 Leather and fur products	22	18	17 /e
324 Footwear	77	51	63 /e
331 Wood and wood products	153	143	177 /e
332 Furniture and fixtures	37	14	17 /e
341 Paper and paper products	281	278	345 /e
342 Printing and publishing	182	104	127 /e
351 Industrial chemicals	55	94	105 /e
352 Other chemical products	324	289	338 /e
353 Petroleum refineries	184	277	301 /e
354 Miscellaneous petroleum and coal products	27	47	59 /e
355 Rubber products	60	49	54 /e
356 Plastic products	50	63	72 /e
361 Pottery, china and earthenware	14	9	9 /e
362 Glass and glass products	38	27	33 /e
369 Other non-metal mineral products	146	115	139 /e
371 Iron and steel	188	226	247 /e
372 Non-ferrous metals	985	1175	1464 /e
381 Metal products	181	130	152 /e
382 Non-electrical machinery	96	60	51 /e
383 Electrical machinery	90	61	76 /e
384 Transport equipment	127	49	51 /e
385 Professional and scientific equipment	5	4	5 /e
390 Other manufacturing industries	13	7	8 /e

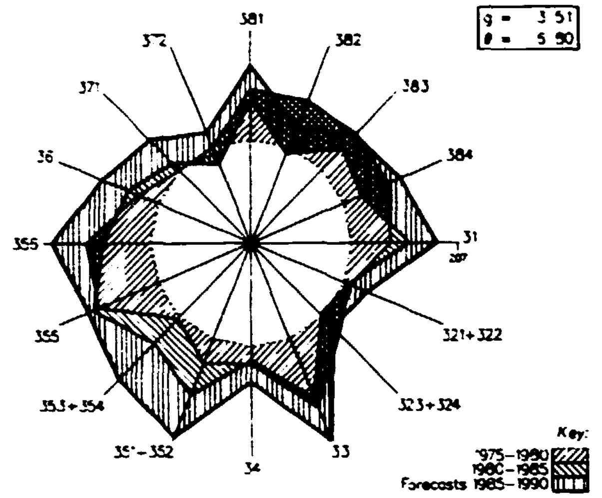
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



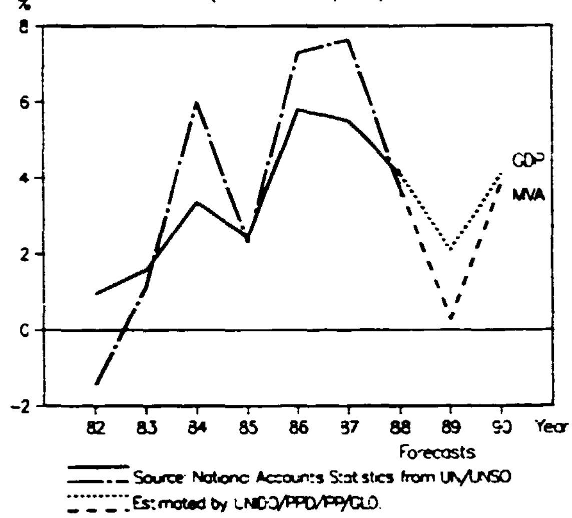




Industrial structural change
(Index of value added: 1975=100)



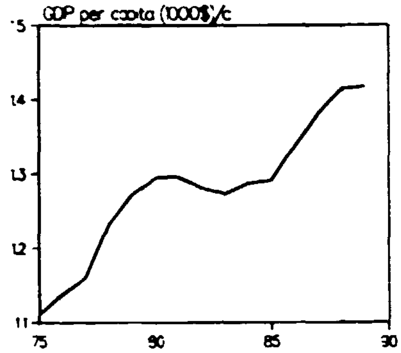
Annual growth rates of GDP and MVA
(constant 1980 prices)



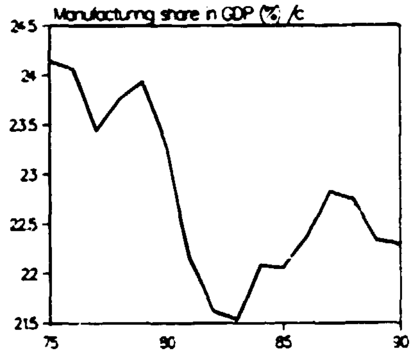
	1980	1985	1987
GDP: /na,c (millions of dollars)	33400	37081	41386
Per capita /na,c (dollars)	1295	1291	1382
Manufacturing share /na,c (%)	23.3	22.1	22.8
MANUFACTURING:			
Value added /na,c (millions of dollars)	7772	8178	9446
Value added (millions of dollars)	7131	6711	6289 /e
Industrial production index	100	108	122
Gross output (millions of dollars)	16453	16822	16801
Employment (thousands)	508	440	457 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	57	60	63 /e
Wages and salaries (%)	8	7	7 /e
Operating surplus (%)	35	33	31 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	32374	38224	36737 /e
Value added / worker	14031	15248	13753 /e
Average wage	2583	2724	2541 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.01	1.69	1.77
as a percentage of average θ in 1970-1975	85	48	50
MVA growth rate / θ	0.70	2.44	3.51
Degree of specialization	19.9	21.8	20.7
-VALUE ADDED: (millions of dollars)			
311 Food products	951	1166	1039 /e
313 Beverages	1021	1032	948 /e
314 Tobacco products	160	224	171 /e
321 Textiles	803	619	616 /e
322 Wearing apparel	241	206	202 /e
323 Leather and fur products	59	47	47 /e
324 Footwear	50	54	52 /e
331 Wood and wood products	60	46	43 /e
332 Furniture and fixtures	34	29	26 /e
341 Paper and paper products	227	274	265 /e
342 Printing and publishing	185	180	173 /e
351 Industrial chemicals	303	405	405 /e
352 Other chemical products	419	457	445 /e
353 Petroleum refineries	773	90	68 /e
354 Miscellaneous petroleum and coal products	17	28	27 /e
355 Rubber products	117	138	109 /e
356 Plastic products	141	169	169 /e
361 Pottery, china and earthenware	44	46	46 /e
362 Glass and glass products	76	92	91 /e
369 Other non-metal mineral products	232	264	254 /e
371 Iron and steel	217	209	208 /e
372 Non-ferrous metals	34	36	36 /e
381 Metal products	260	238	224 /e
382 Non-electrical machinery	120	114	113 /e
383 Electrical machinery	244	211	208 /e
384 Transport equipment	256	221	200 /e
385 Professional and scientific equipment	26	38	37 /e
390 Other manufacturing industries	72	78	69 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

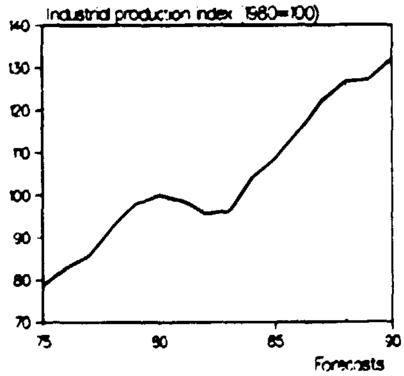
GDP per capita (1000$)/c

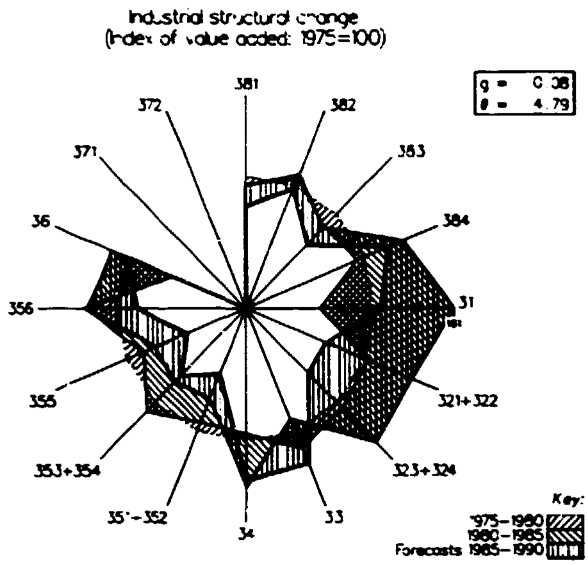


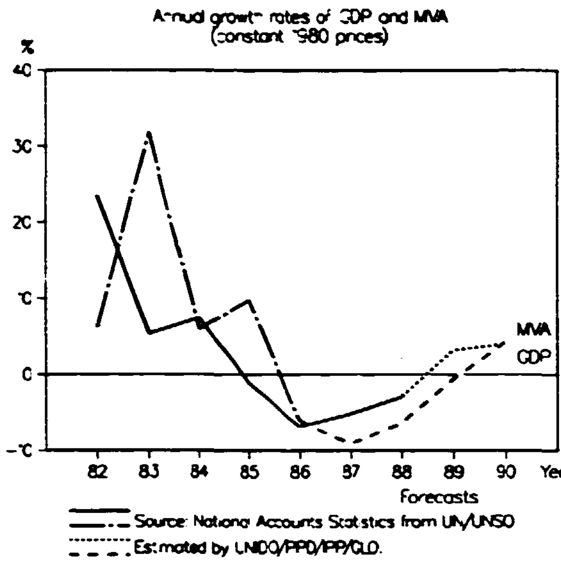
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

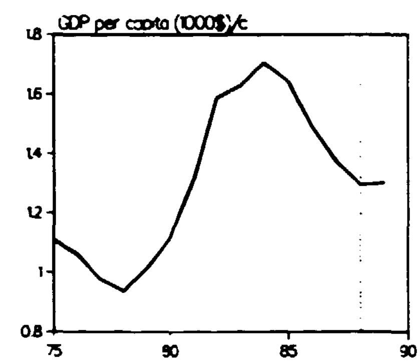


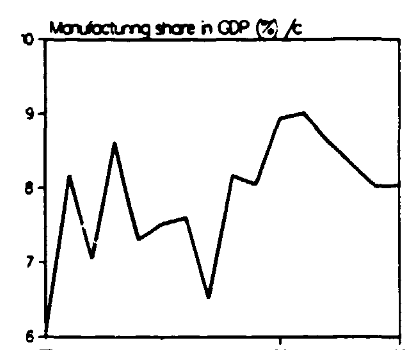


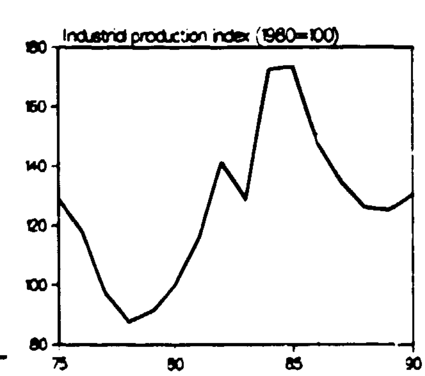


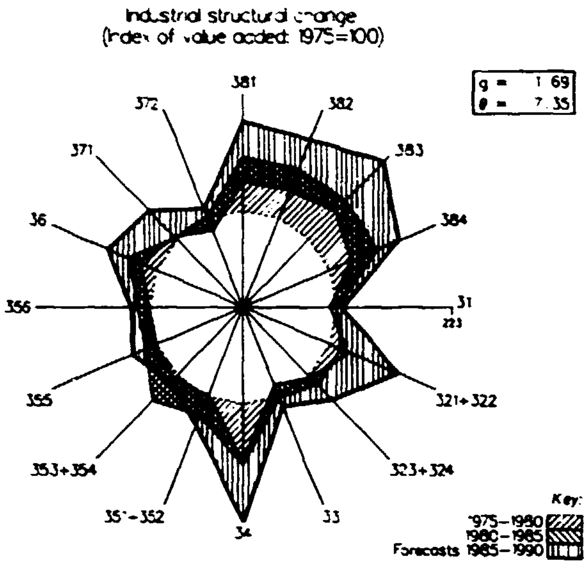
	1980	1985	1987
GDP: /na.c (millions of dollars)	1706	2860	2525
Per capita /na.c (dollars)	1115	1643	1374
Manufacturing share /na.c (%)	7.5	8.9	8.6 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	128	256	218 /e
Value added (millions of dollars)	60 /e	56	83 /e
Industrial production index	100	173	135 /e
Gross output (millions of dollars)	174 /e	170	284 /e
Employment (thousands)	5 /e	9	9 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	66 /e	67 /e	71 /e
Wages and salaries (%)	12 /e	16 /e	16 /e
Operating surplus (%)	22 /e	17 /e	13 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	32743 /e	19388 /e	31719 /e
Value added / worker	11276 /e	6368 /e	9221 /e
Average wage	4067 /e	3086 /e	5002 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	6.71 /e	2.34 /e	0.68 /e
as a percentage of average θ in 1970-1975	156 /e	54 /e	16 /e
MVA growth rate / θ	1.43 /e	0.20 /e	-13.08 /e
Degree of specialization	17.8 /e	33.7 /e	31.0 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	10 /e	10	13 /e
313 Beverages	10 /e	11	14 /e
314 Tobacco products	3 /e	3	5 /e
321 Textiles	4 /e	3 /e	5 /e
322 Wearing apparel	1 /e	1 /e	1 /e
323 Leather and fur products	- /e	- /e	- /e
324 Footwear	3 /e	2	4 /e
331 Wood and wood products	6 /e	6 /e	8 /e
332 Furniture and fixtures	3 /e	3 /e	4 /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	1 /e
352 Other chemical products	2 /e	2 /e	2 /e
353 Petroleum refineries	1 /e	1 /e	1 /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	- /e
362 Glass and glass products	- /e	- /e	1 /e
369 Other non-metal mineral products	1 /e	2 /e	3 /e
371 Iron and steel	- /e	-	- /e
372 Non-ferrous metals	- /e	-	- /e
381 Metal products	5 /e	5 /e	7 /e
382 Non-electrical machinery	2 /e	1 /e	2 /e
383 Electrical machinery	1 /e	1 /e	2 /e
384 Transport equipment	3 /e	2	4 /e
385 Professional and scientific equipment	- /e	-	- /e
390 Other manufacturing industries	- /e	-	- /e

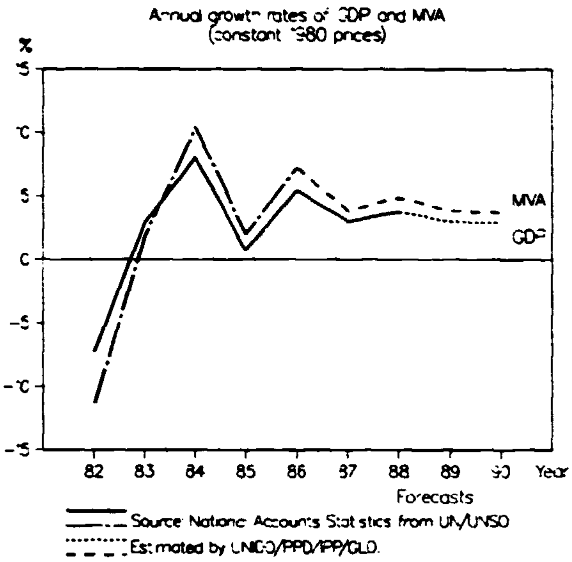
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





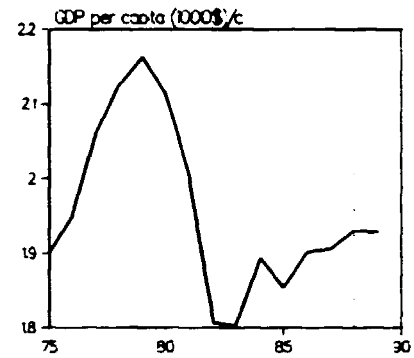


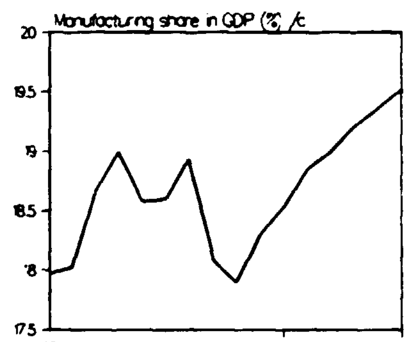


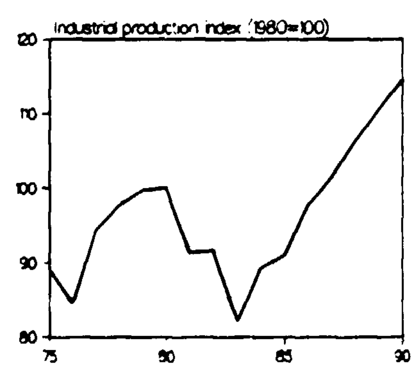


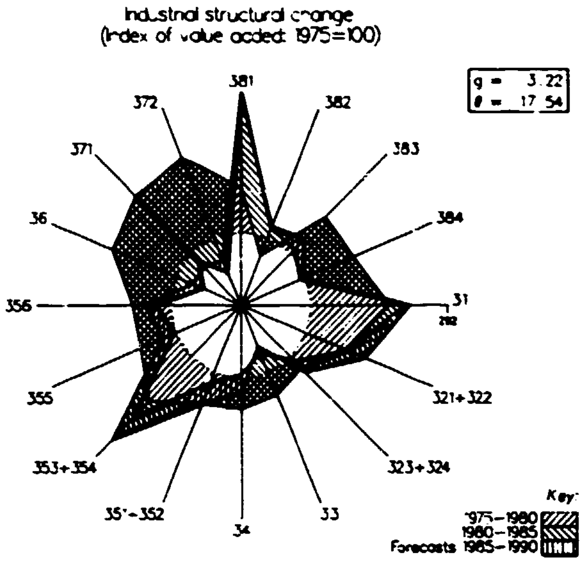
	1980	1985	1987
GDP: /na,c (millions of dollars)	4832	4900	5322
Per capita /na,c (dollars)	2114	1854	1906
Manufacturing share /na,c (%)	18.6	18.5	19.0 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	899	908	1011 /e
Value added (millions of dollars)	788	706 /e	826 /e
Industrial production index	100	91	101 /e
Gross output (millions of dollars)	2743	2555 /e	3025 /e
Employment (thousands)	...	...	...
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	71	72 /e	73 /e
Wages and salaries (%)	12	11 /e	11 /e
Operating surplus (%)	16	17 /e	16 /e
-PRODUCTIVITY:(dollars)			
Gross output / worker	...	...	...
Value added / worker	...	...	...
Average wage	...	...	...
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.41 /e	6.87 /e	2.56 /e
as a percentage of average θ in 1970-1975	262 /e	747 /e	279 /e
MVA growth rate / θ	0.11 /e	0.29 /e	1.50 /e
Degree of specialization	24.6 /e	25.6 /e	24.3 /e
-VALUE ADDED:(millions of dollars)			
311 Food products	241	224 /e	257 /e
313 Beverages	96	79 /e	90 /e
314 Tobacco products	24	22 /e	23 /e
321 Textiles	33	26 /e	30 /e
322 Wearing apparel	31	35 /e	39 /e
323 Leather and fur products	7	4 /e	4 /e
324 Footwear	10	8 /e	9 /e
331 Wood and wood products	30	26 /e	30 /e
332 Furniture and fixtures	26	13 /e	14 /e
341 Paper and paper products	20	23 /e	28 /e
342 Printing and publishing	18	13 /e	15 /e
351 Industrial chemicals	19	20 /e	21 /e
352 Other chemical products	40	52 /e	64 /e
353 Petroleum refineries	40	36 /e	44 /e
354 Miscellaneous petroleum and coal products	-	- /e	- /e
355 Rubber products	14	17 /e	20 /e
356 Plastic products	19	19 /e	24 /e
361 Pottery, china and earthenware	2	2 /e	2 /e
362 Glass and glass products	3	7 /e	8 /e
369 Other non-metal mineral products	25	16 /e	18 /e
371 Iron and steel	4	4 /e	4 /e
372 Non-ferrous metals	1	2 /e	2 /e
381 Metal products	18	12 /e	14 /e
382 Non-electrical machinery	8	13 /e	16 /e
383 Electrical machinery	25	20 /e	24 /e
384 Transport equipment	31	12 /e	12 /e
385 Professional and scientific equipment	-	- /e	- /e
390 Other manufacturing industries	2	3 /e	3 /e

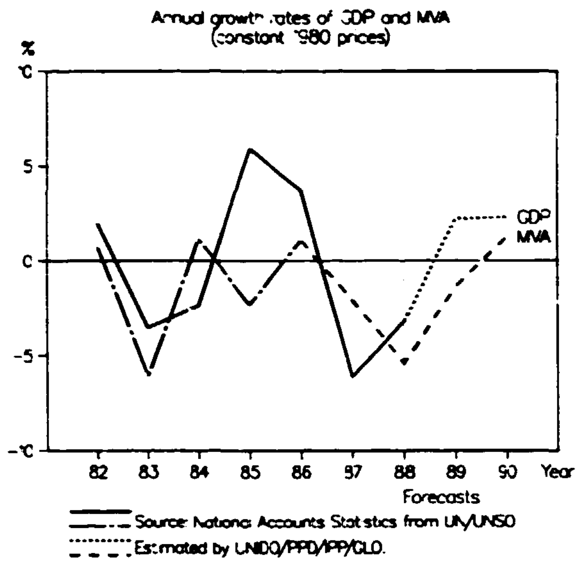
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





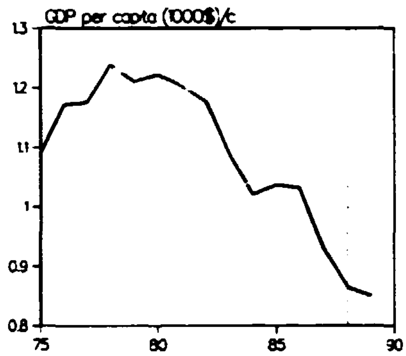


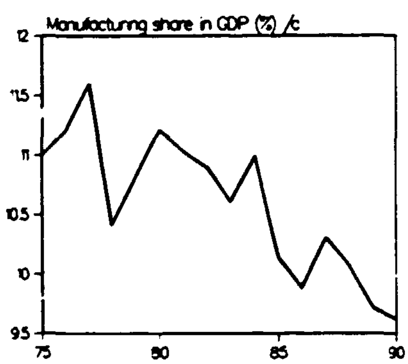


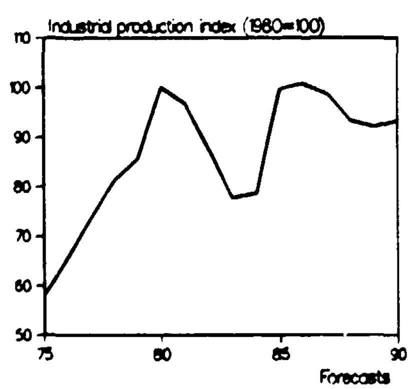


	1980	1985	1987
GDP: /na,c (millions of dollars)	10176	10632	10353
Per capita /na,c (dollars)	1222	1037	929
Manufacturing share /na,c (%)	11.2	10.1	10.3 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	1141	1078	1067 /e
Value added (millions of dollars)	1273	723	1271
Industrial production index	100	100	99 /e
Gross output (millions of dollars)	4006	2748	4798
Employment (thousands)	67	54	55
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	68 /e	74 /e	74 /e
Wages and salaries (%)	10 /e	10 /e	10 /e
Operating surplus (%)	22 /e	17 /e	16 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	59631 /e	50991 /e	86896 /e
Value added / worker	18950 /e	13677 /e	23433 /e
Average wage	5744 /e	5097 /e	9161 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	7.22 /e	6.70 /e	3.29 /e
as a percentage of average θ in 1970-1975	122 /e	113 /e	55 /e
MVA growth rate / θ	2.33 /e	3.99 /e	-0.63 /e
Degree of specialization	25.1 /e	32.9 /e	31.6 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	303 /e	135 /e	206 /e
313 Beverages	75	43 /e	83 /e
314 Tobacco products	66 /e	42 /e	83 /e
321 Textiles	169 /e	100 /e	174 /e
322 Wearing apparel	8 /e	5 /e	9 /e
323 Leather and fur products	3 /e	4 /e	8 /e
324 Footwear	8 /e	10 /e	19 /e
331 Wood and wood products	67 /e	23 /e	32 /e
332 Furniture and fixtures	21 /e	7 /e	10 /e
341 Paper and paper products	13 /e	...	...
342 Printing and publishing	23 /e	...	...
351 Industrial chemicals	22 /e	11 /e	19 /e
352 Other chemical products	53 /e	36 /e	72 /e
353 Petroleum refineries	181 /e	129 /e	234 /e
354 Miscellaneous petroleum and coal products	- /e	- /e	- /e
355 Rubber products	4	3 /e	5 /e
356 Plastic products	1 /e	- /e	- /e
361 Pottery, china and earthenware	2 /e	1 /e	2 /e
362 Glass and glass products	- /e	- /e	- /e
369 Other non-metal mineral products	27 /e	14 /e	22 /e
371 Iron and steel	5 /e	1 /e	2 /e
372 Non-ferrous metals	3 /e	- /e	1 /e
381 Metal products	70	36 /e	57 /e
382 Non-electrical machinery	3	1 /e	2 /e
383 Electrical machinery	20	10 /e	16 /e
384 Transport equipment	106	94 /e	183 /e
385 Professional and scientific equipment	-	- /e	- /e
390 Other manufacturing industries	20	16 /e	30 /e

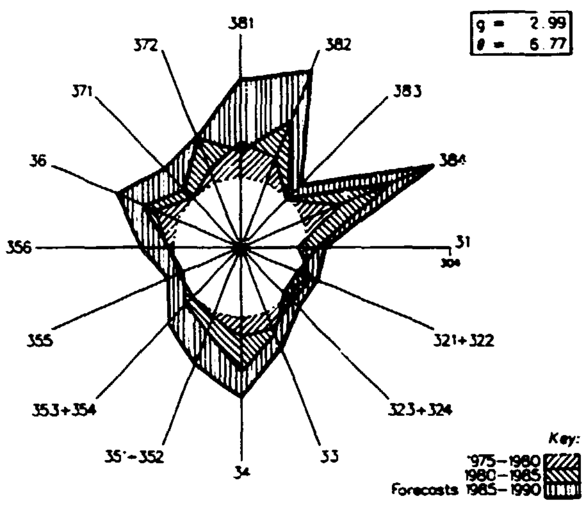
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



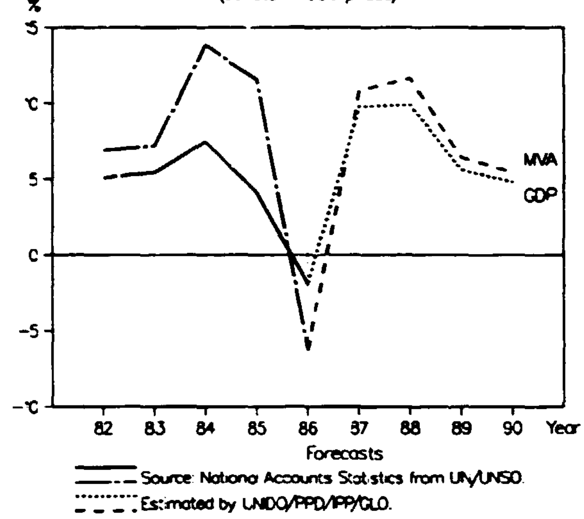




Industrial structural change
(Index of value added: 1975=100)



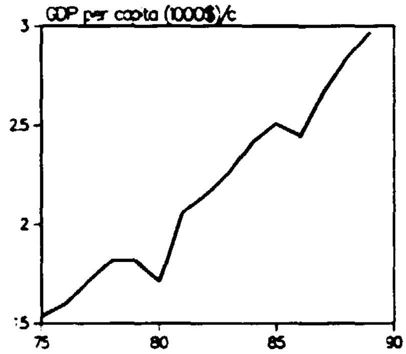
Annual growth rates of GDP and MVA
(constant 1980 prices)



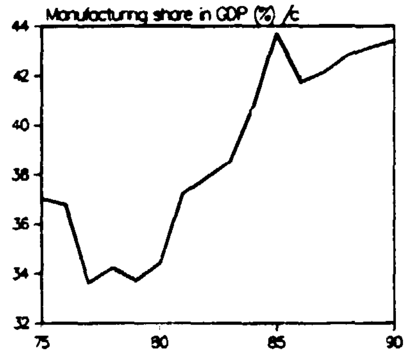
	1980	1985	1987
GDP: /na,c (millions of dollars)	16653	24937	26861 /e
Per capita /na,c (dollars)	1711	2507	2666 /e
Manufacturing share /na,c (%)	34.4	43.7	42.1 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	5735	10899	11321 /e
Value added (millions of dollars)	4935	5273	5877 /e
Industrial production index	100	129	124
Gross output (millions of dollars)	9725	12032	15020 /e
Employment (thousands)	501	654	678 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	49 /e	56 /e	61 /e
Wages and salaries (%)	13 /e	14 /e	13 /e
Operating surplus (%)	37 /e	30 /e	26 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	19420 /e	18386 /e	22168 /e
Value added / worker	9854 /e	8058 /e	8673 /e
Average wage	2506 /e	2514 /e	2970 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	7.81 /e	4.05 /e	4.06 /e
as a percentage of average θ in 1970-1975	162 /e	84 /e	84 /e
MVA growth rate / θ	-1.18 /e	1.11 /e	-0.83 /e
Degree of specialization	19.9 /e	22.5 /e	19.6 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	655	957	914 /e
313 Beverages	246	273	320 /e
314 Tobacco products	1806	2004	2343 /e
321 Textiles	103	162	198 /e
322 Wearing apparel	146	98	131 /e
323 Leather and fur products	63	32	37 /e
324 Footwear	79	48	55 /e
331 Wood and wood products	68	53	63 /e
332 Furniture and fixtures	48	43	49 /e
341 Paper and paper products	46	44	45 /e
342 Printing and publishing	96	59	66 /e
351 Industrial chemicals	178 /e	137 /e	151 /e
352 Other chemical products	245 /e	167 /e	178 /e
353 Petroleum refineries	...	...	...
354 Miscellaneous petroleum and coal products	...	...	...
355 Rubber products	35 /e	48 /e	61 /e
356 Plastic products	81 /e	48 /e	53 /e
361 Pottery, china and earthenware	8	8	10 /e
362 Glass and glass products	17	19	24 /e
369 Other non-metal mineral products	188	136	154 /e
371 Iron and steel	27	44	61 /e
372 Non-ferrous metals	41	43	70 /e
381 Metal products	108	92	98 /e
382 Non-electrical machinery	171 /e	231 /e	241 /e
383 Electrical machinery	60	58	88 /e
384 Transport equipment	178 /e	259 /e	229 /e
385 Professional and scientific equipment	13 /e	28 /e	22 /e
390 Other manufacturing industries	201	188	237 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

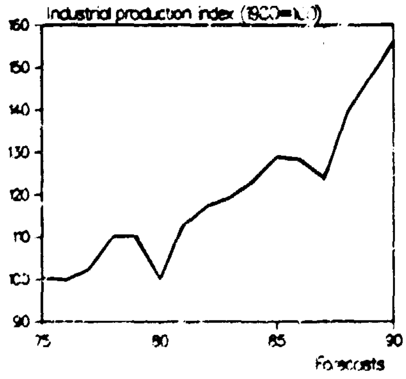
GDP per capita (1000$) /c

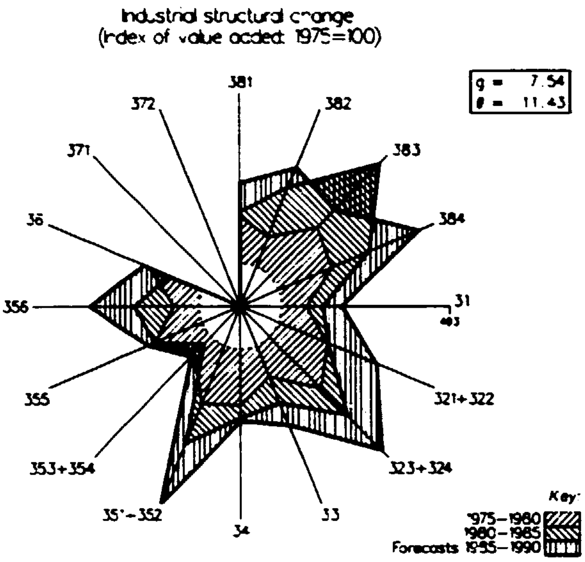


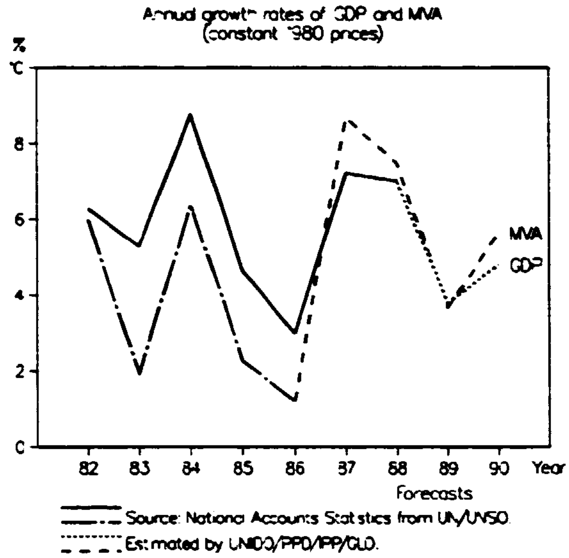
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

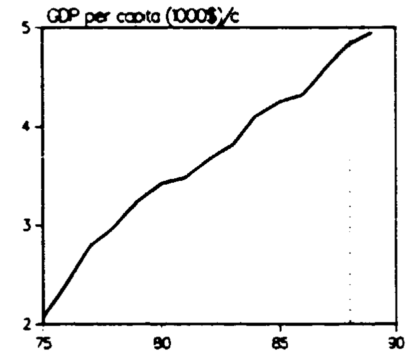


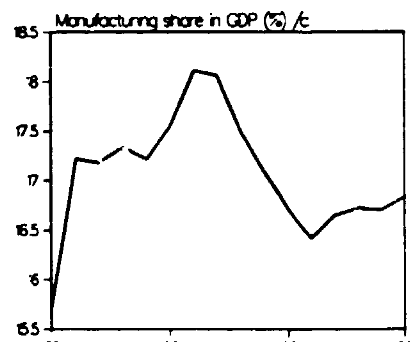


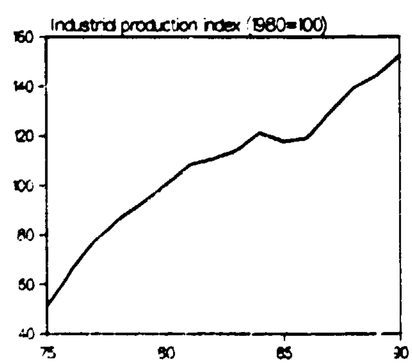


	1980	1985	1987
GDP: /na,c (millions of dollars)	2154	2827	3122
Per capita /na,c (dollars)	3419	4245	4584
Manufacturing share /na,c (%)	17.5	16.7	16.6 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	378	473	520 /e
Value added (millions of dollars)	406	378	537 /e
Industrial production index	100	118	129 /e
Gross output (millions of dollars)	1134	1122	1514 /e
Employment (thousands)	34	39	39 /e
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	64	66	65 /e
Wages and salaries (%)	13	16	17 /e
Operating surplus (%)	22	18	19 /e
-PRODUCTIVITY:(dollars)			
Gross output / worker	33325	28963	38673 /e
Value added / worker	11923	9762	13716 /e
Average wage	4479	4579	6458 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.27 /e	6.10 /e	6.63 /e
as a percentage of average θ in 1970-1975	34 /e	90 /e	98 /e
MVA growth rate / θ	3.38 /e	-0.48 /e	1.31 /e
Degree of specialization	12.2 /e	11.1 /e	12.1 /e
-VALUE ADDED:(millions of dollars)			
311 Food products	42	49	76 /e
313 Beverages	37	29	43 /e
314 Tobacco products	36	26	38 /e
321 Textiles	16	14	22 /e
322 Wearing apparel	53	64	66 /e
323 Leather and fur products	5	6	8 /e
324 Footwear	21	19	23 /e
331 Wood and wood products	19	23	33 /e
332 Furniture and fixtures	17	22	31 /e
341 Paper and paper products	11	9	11 /e
342 Printing and publishing	15	18	22 /e
351 Industrial chemicals	3	2	3 /e
352 Other chemical products	12	12	15 /e
353 Petroleum refineries	6	5	6 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	3	2	3 /e
356 Plastic products	11	11	16 /e
361 Pottery, china and earthenware	-	1	1 /e
362 Glass and glass products	-	-	- /e
369 Other non-metal mineral products	44	24	41 /e
371 Iron and steel	-	-	- /e
372 Non-ferrous metals	-	-	- /e
381 Metal products	23	26	38 /e
382 Non-electrical machinery	11	12	16 /e
383 Electrical machinery	5	6	9 /e
384 Transport equipment	8	4	5 /e
385 Professional and scientific equipment	-	-	- /e
390 Other manufacturing industries	7	7	11 /e

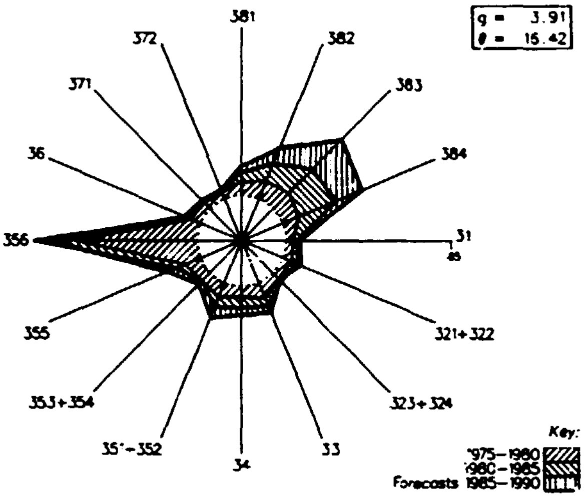
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



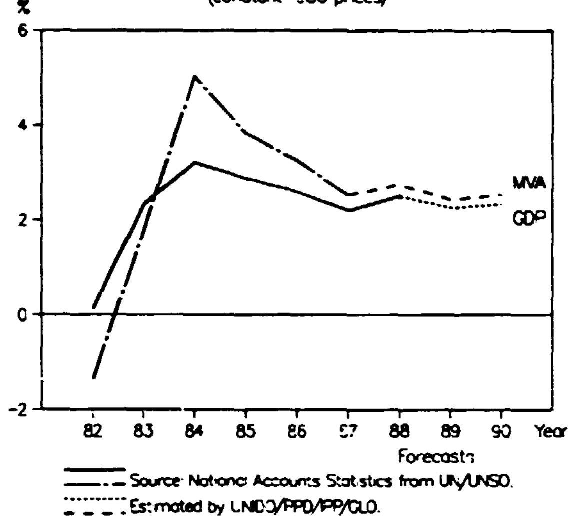




Industrial structural change
(Index of value added: 1975=100)



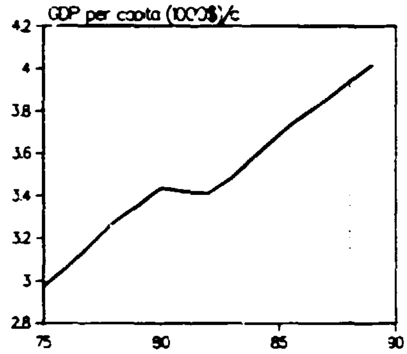
Annual growth rates of GDP and MVA
(constant 1980 prices)



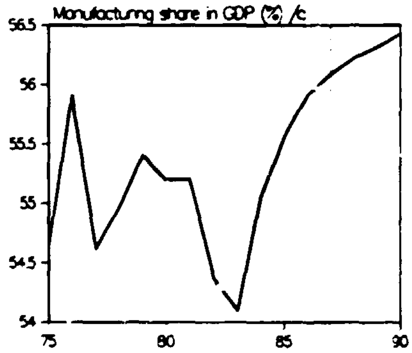
	1980	1985	1987
GDP: /na,c (millions of dollars)	52602	57166	59941
Per capita /na,c (dollars)	3435	3688	3851
Manufacturing share /na,c (%)	55.2	55.6	56.1
MANUFACTURING:			
Value added /na,c (millions of dollars)	29036	31761	33620
Value added (millions of dollars)	22411	19809	23655 /e
Industrial production index	100	121	129
Gross output (millions of dollars)	53983	68299	87096
Employment (thousands)	2518	2588	2612 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	58	71	73 /e
Wages and salaries (%)	13	12	11 /e
Operating surplus (%)	28	17	16 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	21439	26391	33342 /e
Value added / worker	8900	7654	9056 /e
Average wage	2889	3110	3802 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	0.71 /e	1.05 /e	0.98 /e
as a percentage of average θ in 1970-1975	62 /e	93 /e	87 /e
MVA growth rate / θ	5.02 /e	3.98 /e	2.48 /e
Degree of specialization	16.0 /e	17.9 /e	18.2 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	1639	1379	1642 /e
313 Beverages	371	316	356 /e
314 Tobacco products	43	35	41 /e
321 Textiles	1433	1284	1502 /e
322 Wearing apparel	353	357	421 /e
323 Leather and fur products	122	104	130 /e
324 Footwear	390	370	413 /e
331 Wood and wood products	505	392	462 /e
332 Furniture and fixtures	273	246	242 /e
341 Paper and paper products	509	435	493 /e
342 Printing and publishing	177	156	175 /e
351 Industrial chemicals	1644	1306	1432 /e
352 Other chemical products	232	197	242 /e
353 Petroleum refineries	648	590	902 /e
354 Miscellaneous petroleum and coal products	166	112	138 /e
355 Rubber products	279	239	290 /e
356 Plastic products	65	51	61 /e
361 Pottery, china and earthenware	59	58	62 /e
362 Glass and glass products	550	398	415 /e
369 Other non-metal mineral products	1007	739	832 /e
371 Iron and steel	2285	1987	2932 /e
372 Non-ferrous metals	426	324	369 /e
381 Metal products	1033	893	1056 /e
382 Non-electrical machinery	4499	4281	4726 /e
383 Electrical machinery	1112	1264	1580 /e
384 Transport equipment	2186	1991	2388 /e
385 Professional and scientific equipment	122	102	92 /e
390 Other manufacturing industries	291	212	262 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

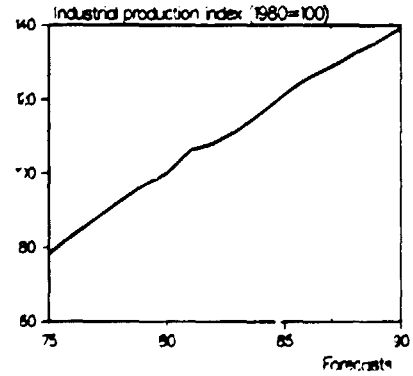
GDP per capita (1000$)/c



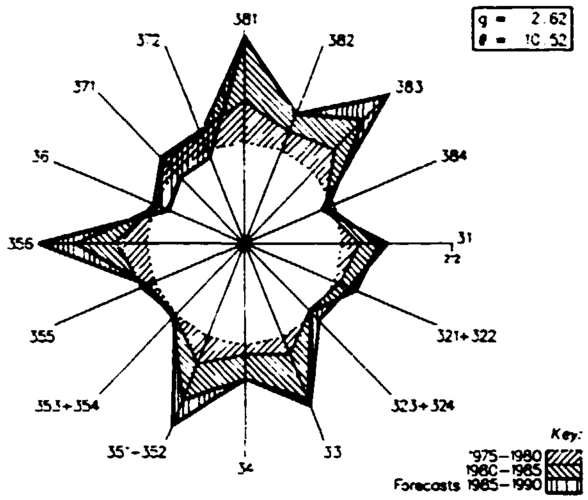
Manufacturing share in GDP (%) /c



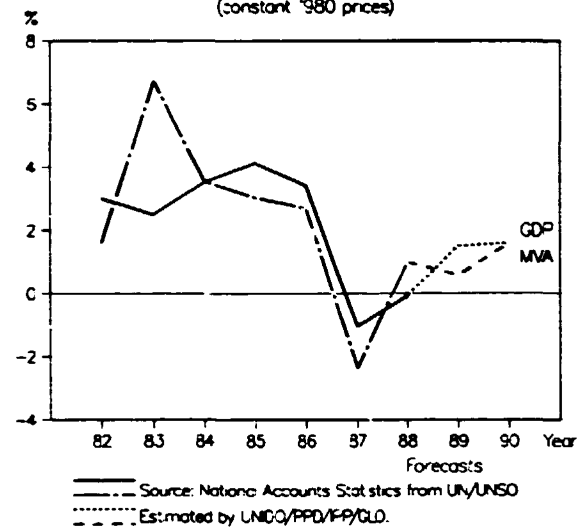
Industrial production index (1980=100)



Industrial structural change
(index of value added: 1975=100)



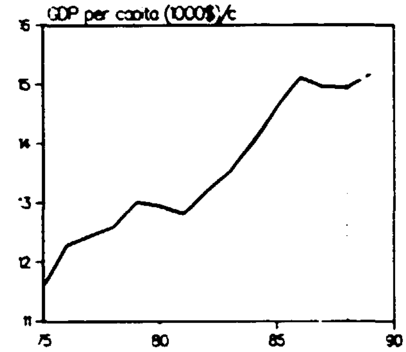
Annual growth rates of GDP and MVA
(constant 1980 prices)



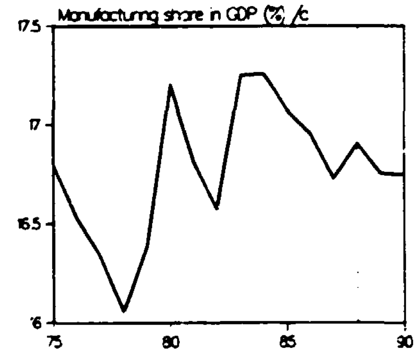
	1980	1985	1987
GDP: /na.c (millions of dollars)	66321	748+9	76598
Per capita /na.c (dollars)	12943	14610	14958
Manufacturing share /na.c (%)	17.2	17.1	16.7
MANUFACTURING:			
Value added /na.c (millions of dollars)	11411	12780	12814
Value added (millions of dollars)	12774	11184	18807
Industrial production index	100	121	122
Gross output (millions of dollars)	31526	27652	44968
Employment (thousands)	381	405	403 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	59	60	58 /e
Wages and salaries (%)	23	21	22 /e
Operating surplus (%)	18	19	19 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	82745	68311	111515 /e
Value added / worker	33526	27629	46639 /e
Average wage	19040	14310	25053 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.91	2.10	1.82
as a percentage of average θ in 1970-1975	83	60	52
MVA growth rate / θ	-0.07	1.97	-1.81
Degree of specialization	15.4	16.1	16.1
-VALUE ADDED: (millions of dollars)			
311 Food products	2344	2022	3436 /e
313 Beverages	490	386	629 /e
314 Tobacco products	109	95	170 /e
321 Textiles	423	375	594 /e
322 Wearing apparel	231	199	319 /e
323 Leather and fur products	30	20	29 /e
324 Footwear	52	43	70 /e
331 Wood and wood products	285	219	434 /e
332 Furniture and fixtures	330	371	591 /e
341 Paper and paper products	315	275	495 /e
342 Printing and publishing	941	752	1344 /e
351 Industrial chemicals	551	498	854 /e
352 Other chemical products	586	618	1085 /e
353 Petroleum refineries	65	55	67 /e
354 Miscellaneous petroleum and coal products	99	63	146 /e
355 Rubber products	73	59	101 /e
356 Plastic products	267	297	484 /e
361 Pottery, china and earthenware	87	41	61 /e
362 Glass and glass products	98	60	100 /e
369 Other non-metal mineral products	627	478	885 /e
371 Iron and steel	175	124	206 /e
372 Non-ferrous metals	71	45	72 /e
381 Metal products	912	882	1497 /e
382 Non-electrical machinery	1718	1476	2364 /e
383 Electrical machinery	712	631	1078 /e
384 Transport equipment	663	589	813 /e
385 Professional and scientific equipment	284	304	545 /e
390 Other manufacturing industries	219	211	361 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

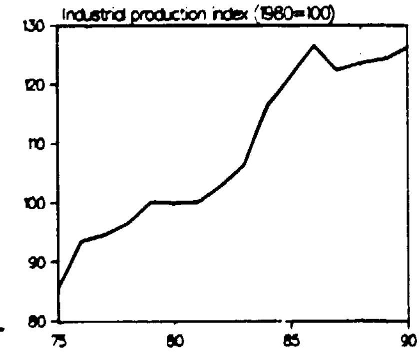
GDP per capita (1000$)/c



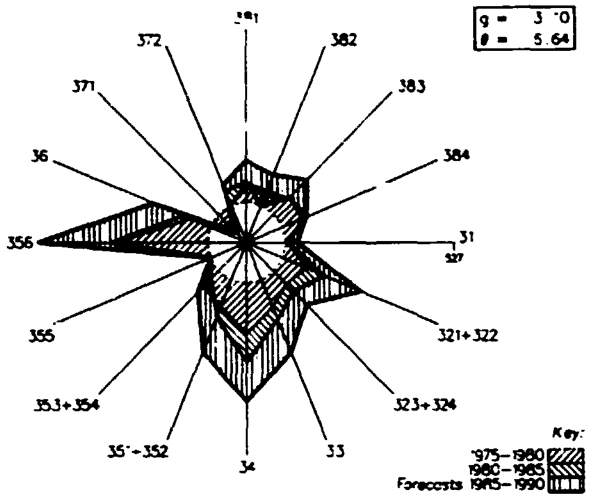
Manufacturing share in GDP (%) /c



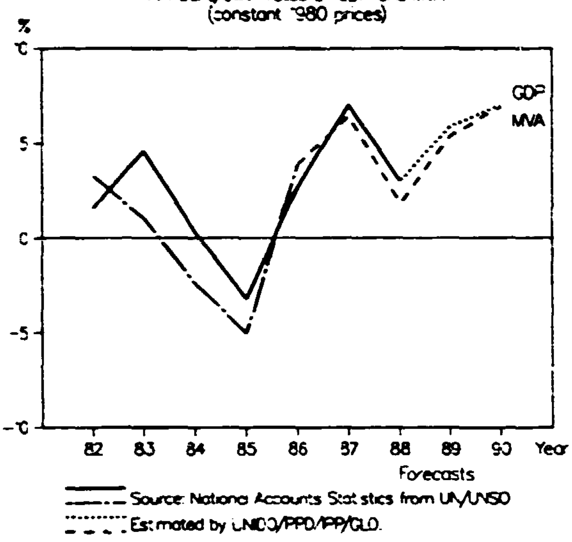
Industrial production index (1980=100)



Industrial structural change
(Index of value added: 1975=100)



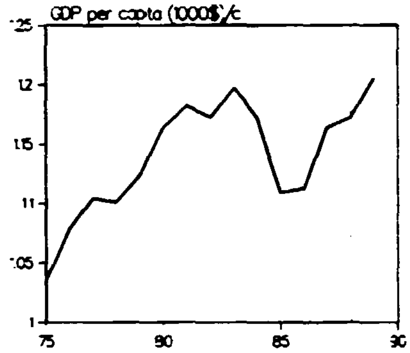
Annual growth rates of GDP and MVA
(constant 1980 prices)



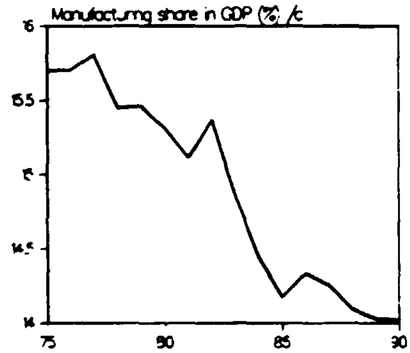
	1980	1985	1987
GDP: /na,c (millions of dollars)	6631	7114	7818
Per capita /na,c (dollars)	1164	1109	1164
Manufacturing share /na,c (%)	15.3	14.2	14.3 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	1015	1008	1115 /e
Value added (millions of dollars)	1013	869 /e	974 /e
Industrial production index	100	105	116 /e
Gross output (millions of dollars)	2376	1894 /e	2195 /e
Employment (thousands)	146	140 /e	143 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	57	54 /e	56 /e
Wages and salaries (%)	11	8 /e	7 /e
Operating surplus (%)	31	38 /e	37 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	16284	13512 /e	15319 /e
Value added / worker	6940	6197 /e	6795 /e
Average wage	1867	1107 /e	1112 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.82 /e	3.18 /e	0.77 /e
as a percentage of average θ in 1970-1975	192 /e	216 /e	52 /e
MVA growth rate / θ	-0.15 /e	-2.21 /e	8.36 /e
Degree of specialization	40.0 /e	36.4 /e	35.1 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	510	315 /e	373 /e
313 Beverages	103	135 /e	138 /e
314 Tobacco products	50	51 /e	46 /e
321 Textiles	29	32 /e	29 /e
322 Wearing apparel	13	9 /e	10 /e
323 Leather and fur products	11	8 /e	9 /e
324 Footwear	13	15 /e	18 /e
331 Wood and wood products	2	3 /e	3 /e
332 Furniture and fixtures	11	13 /e	16 /e
341 Paper and paper products	19	25 /e	30 /e
342 Printing and publishing	14	15 /e	15 /e
351 Industrial chemicals	18	18 /e	16 /e
352 Other chemical products	41	32 /e	36 /e
353 Petroleum refineries	66	76 /e	92 /e
354 Miscellaneous petroleum and coal products	1	- /e	- /e
355 Rubber products	7	6 /e	7 /e
356 Plastic products	21	12 /e	12 /e
361 Pottery, china and earthenware	1	1 /e	1 /e
362 Glass and glass products	3	5 /e	6 /e
369 Other non-metal mineral products	32	34 /e	40 /e
371 Iron and steel	11	15 /e	17 /e
372 Non-ferrous metals	1	1 /e	1 /e
381 Metal products	21	33 /e	40 /e
382 Non-electrical machinery	5	3 /e	4 /e
383 Electrical machinery	7	8 /e	9 /e
384 Transport equipment	-	- /e	- /e
385 Professional and scientific equipment	1	1 /e	1 /e
390 Other manufacturing industries	2	2 /e	2 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

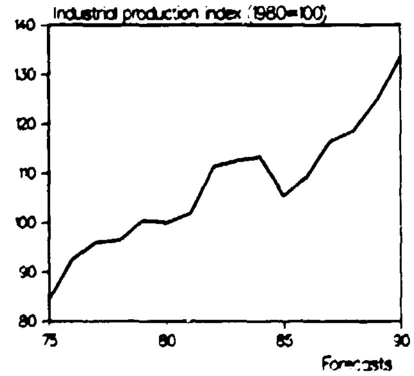
GDP per capita (1000$) /c

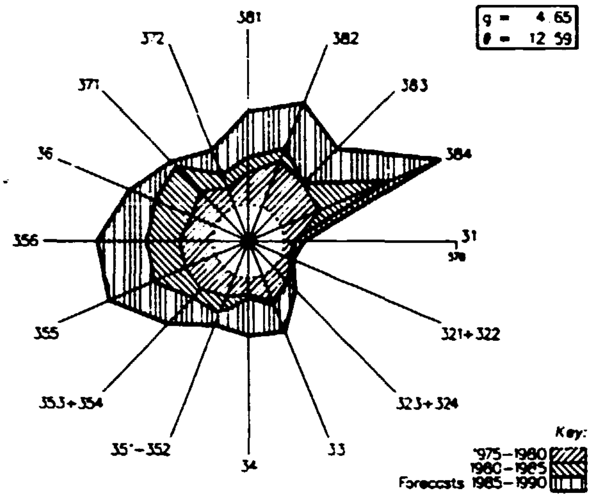


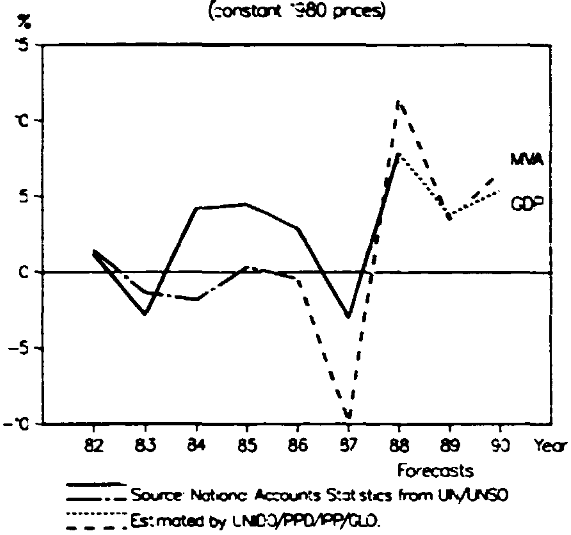
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

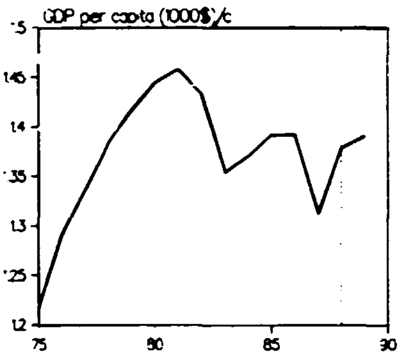


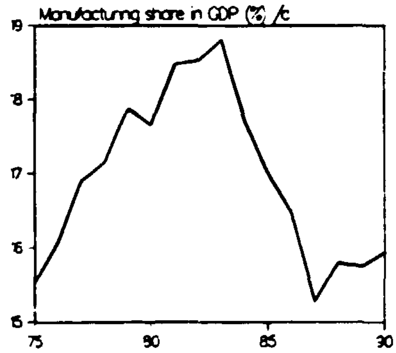


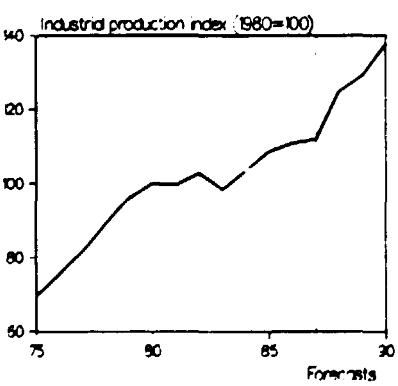


	1980	1985	1987
GDP: /na,c (millions of dollars)	11733	13056	13029
Per capita /na,c (dollars)	1444	1392	1313
Manufacturing share /na,c (%)	17.7	17.0	15.3 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	2072	2221	1992 /e
Value added (millions of dollars)	1289	1259	1005 /e
Industrial production index	100	109	112
Gross output (millions of dollars)	3571	4379	3437 /e
Employment (thousands)	112	97	102 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	64	71	71 /e
Wages and salaries (%)	14	11	11 /e
Operating surplus (%)	22	17	19 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	31961	45209	33683 /e
Value added / worker	11536	12993	9851 /e
Average wage	4547	5171	3561 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.76 /e	2.59 /e	2.38 /e
as a percentage of average θ in 1970-1975	92 /e	135 /e	125 /e
MVA growth rate / θ	2.27 /e	1.84 /e	0.37 /e
Degree of specialization	27.2 /e	24.9 /e	25.5 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	294	328	240 /e
313 Beverages	96	65	38 /e
314 Tobacco products	46	17	19 /e
321 Textiles	134	146	118 /e
322 Wearing apparel	20	15	10 /e
323 Leather and fur products	7	6	5 /e
324 Footwear	6	7	6 /e
331 Wood and wood products	35	18	16 /e
332 Furniture and fixtures	28	23	14 /e
341 Paper and paper products	42	41	35 /e
342 Printing and publishing	40	21	31 /e
351 Industrial chemicals	25	32	32 /e
352 Other chemical products	90	27	56 /e
353 Petroleum refineries	29	38	15 /e
354 Miscellaneous petroleum and coal products	4	14	14 /e
355 Rubber products	25	29	19 /e
356 Plastic products	34	57	44 /e
361 Pottery, china and earthenware	7	15	11 /e
362 Glass and glass products	9	15	11 /e
369 Other non-metal mineral products	100	101	83 /e
371 Iron and steel	25	56	34 /e
372 Non-ferrous metals	5	10	8 /e
381 Metal products	93	78	61 /e
382 Non-electrical machinery	4	7	4 /e
383 Electrical machinery	59	58	54 /e
384 Transport equipment	23	23	17 /e
385 Professional and scientific equipment	[illegible]	9	7 /e
390 Other manufacturing industries	[illegible]	5	3 /e

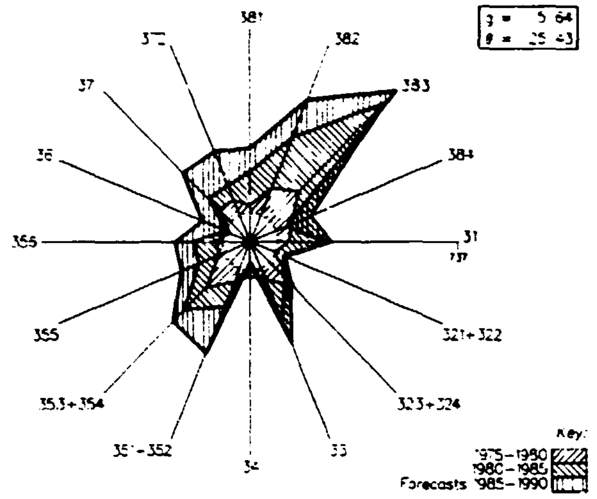
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



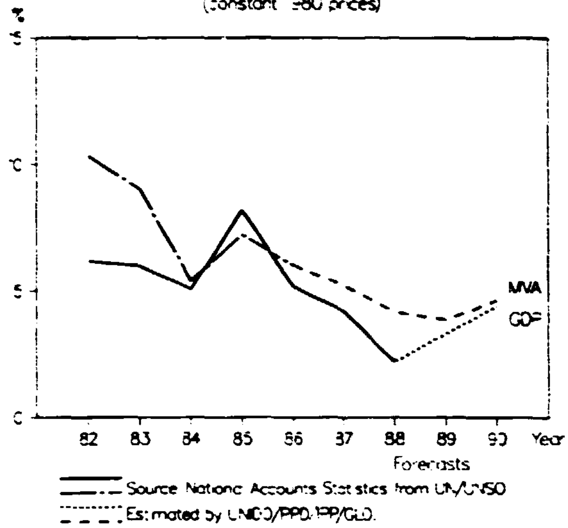




Industrial structural change
(index of value added 1975=100)



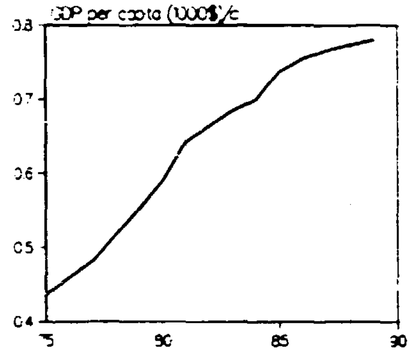
Annual growth rates of GDP and MVA
(constant 1980 prices)



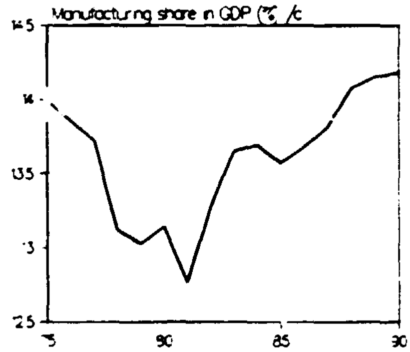
	1980	1985	1987
GDP: /na.c (millions of dollars)	24499	35076	38436
Per capita /na.c (dollars)	590	737	766
Manufacturing share /na.c (%)	13.1	13.6	13.8 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	3220	4760	5303 /e
Value added (millions of dollars)	2243	5649 /e	9266 /e
Industrial production index	100	162	164
Gross output (millions of dollars)	8856	22038 /e	36919 /e
Employment (thousands)	868	999 /e	[illegible]69 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	75	74 /e	75 /e
Wages and salaries (%)	14	16 /e	16 /e
Operating surplus (%)	11	10 /e	9 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	10205	22058 /e	34860 /e
Value added / worker	2585	5654 /e	8751 /e
Average wage	1473	3473 /e	5447 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.51	4.12	5.48
as a percentage of average θ in 1970-1975	76	125	166
MVA growth rate / θ	3.11	2.92	-0.61
Degree of specialization	22.5	25.1	23.1
-VALUE ADDED: (millions of dollars)			
311 Food products	391	1029 /e	1771 /e
313 Beverages	18	99 /e	154 /e
314 Tobacco products	26	-2 /e	-2 /e
321 Textiles	641	1357 /e	2033 /e
322 Wearing apparel	7	81 /e	140 /e
323 Leather and fur products	3	17 /e	25 /e
324 Footwear	28	50 /e	74 /e
331 Wood and wood products	11	26 /e	44 /e
332 Furniture and fixtures	9	31 /e	49 /e
341 Paper and paper products	54	86 /e	147 /e
342 Printing and publishing	50	117 /e	179 /e
351 Industrial chemicals	87	328 /e	564 /e
352 Other chemical products	110	638 /e	1103 /e
353 Petroleum refineries	50	129 /e	225 /e
354 Miscellaneous petroleum and coal products	77	88 /e	151 /e
355 Rubber products	16	44 /e	59 /e
356 Plastic products	42	88 /e	151 /e
361 Pottery, china and earthenware	8	21 /e	32 /e
362 Glass and glass products	22	60 /e	103 /e
369 Other non-metal mineral products	99	345 /e	548 /e
371 Iron and steel	112	8 /e	9 /e
372 Non-ferrous metals	81	14 /e	20 /e
381 Metal products	53	209 /e	336 /e
382 Non-electrical machinery	68	228 /e	394 /e
383 Electrical machinery	88	273 /e	470 /e
384 Transport equipment	82	259 /e	448 /e
385 Professional and scientific equipment	5	19 /e	24 /e
390 Other manufacturing industries	2	9 /e	15 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

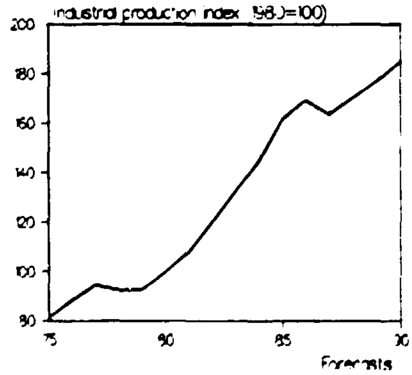
GDP per capita (1000$)/c



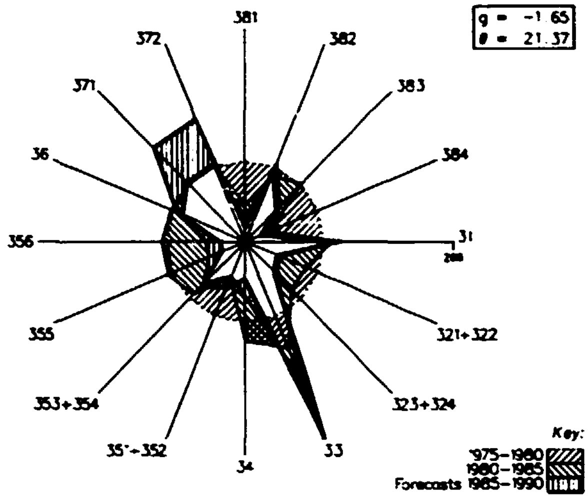
Manufacturing share in GDP (%)/c



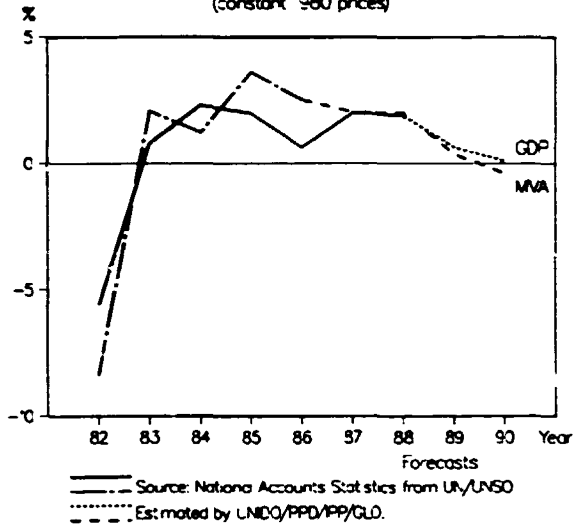
Industrial production index (1980=100)



Industrial structural change
(Index of value added: 1975=100)



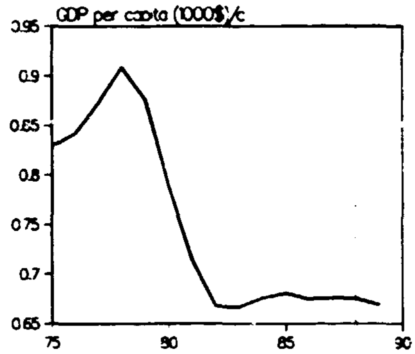
Annual growth rates of GDP and MVA
(constant 1980 prices)



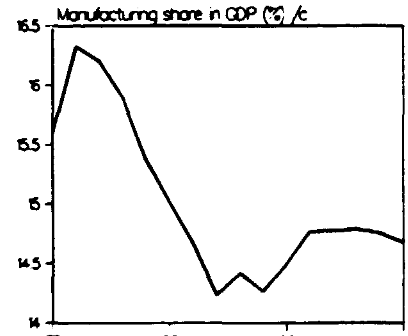
	1980	1985	1987
GDP: /na.c (millions of dollars)	3567	3247	3333
Per capita /na.c (dollars)	788	681	676
Manufacturing share /na.c (%)	15.0	14.5	14.8 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	536	471	492 /e
Value added (millions of dollars)	448	393	490 /e
Industrial production index	100	83	87 /e
Gross output (millions of dollars)	1130	860	1075 /e
Employment (thousands)	39	25	25 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	50	54	54 /e
Wages and salaries (%)	12	9 /e	9 /e
Operating surplus (%)	27	37 /e	37 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	28857	34129	42786 /e
Value added / worker	11427	15696	19493 /e
Average wage	3583	3048 /e	3641 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	10.47 /e	2.93 /e	1.11 /e
as a percentage of average θ in 1970-1975	126 /e	35 /e	13 /e
MVA growth rate / θ	-1.91 /e	0.30 /e	1.84 /e
Degree of specialization	22.7 /e	28.7 /e	29.1 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	78	55	64 /e
313 Beverages	63	59	74 /e
314 Tobacco products	26	29	34 /e
321 Textiles	62	40	43 /e
322 Wearing apparel	16	10	12 /e
323 Leather and fur products	5	5	6 /e
324 Footwear	13	1	1 /e
331 Wood and wood products	1	-	- /e
332 Furniture and fixtures	3	4	5 /e
341 Paper and paper products	40	24	33 /e
342 Printing and publishing	8	8	10 /e
351 Industrial chemicals	4	7	9 /e
352 Other chemical products	46	57	76 /e
353 Petroleum refineries	14	20	28 /e
354 Miscellaneous petroleum and coal products	2	-	1 /e
355 Rubber products	4	3	3 /e
356 Plastic products	13	15	21 /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	-	-	- /e
369 Other non-metal mineral products	11	13	18 /e
371 Iron and steel	9	7	9 /e
372 Non-ferrous metals	1	1	1 /e
381 Metal products	10	12	15 /e
382 Non-electrical machinery	6	7	10 /e
383 Electrical machinery	9	12	14 /e
384 Transport equipment	1	-	- /e
385 Professional and scientific equipment	-	1	1 /e
390 Other manufacturing industries	4	2	3 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

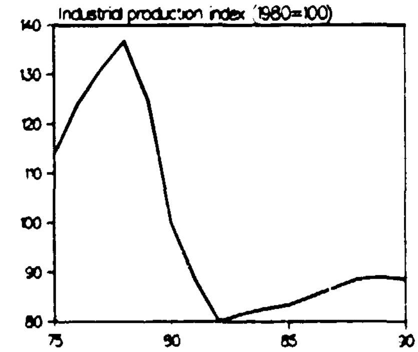
GDP per capita (1000$)/c



Manufacturing share in GDP (%) /c

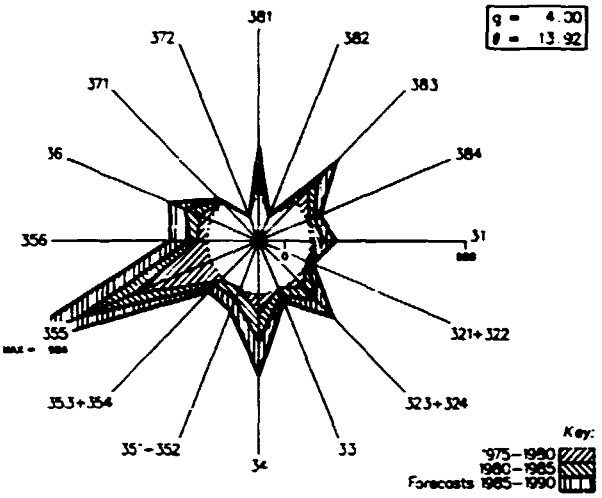


Industrial production index (1980=100)

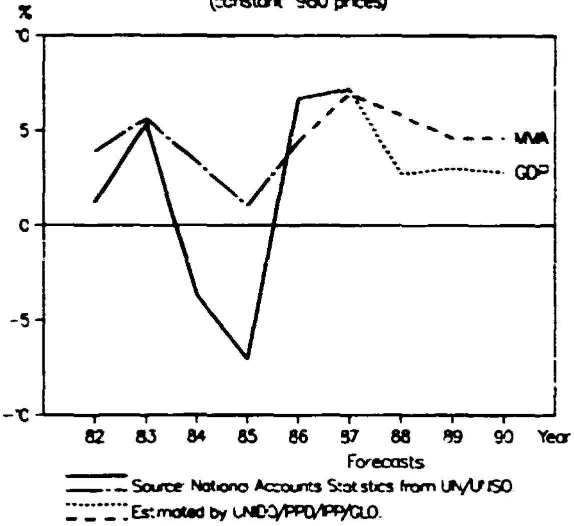


ETHIOPIA

Industrial structural change
(index of value added: 1975=100)



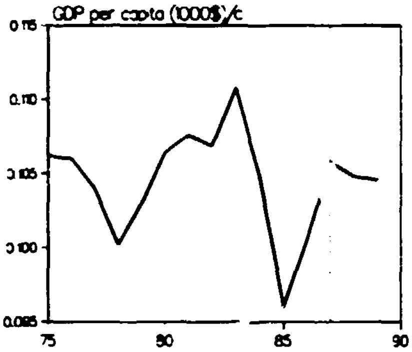
Annual growth rates of GDP and MVA
(constant 1980 prices)



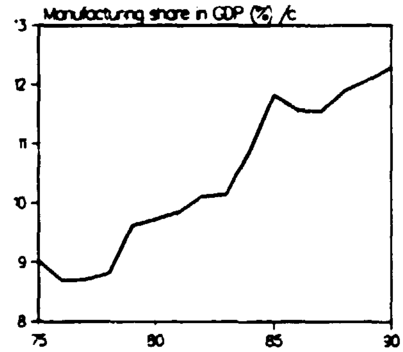
	1980	1985	1987
GDP: /na,c (billions of dollars)	4123	4057	4638
Per capita /na,c (dollars)	106	96	106
Manufacturing share /na,c (%)	9.7	11.8	11.5 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	401	480	536 /e
Value added (millions of dollars)	459	689 /e	662 /e
Industrial production index	100	117	131 /e
Gross output (millions of dollars)	1016	1622 /e	1609 /e
Employment (thousands)	76	93 /e	99 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	55	58 /e	59 /e
Wages and salaries (%)	3	8 /e	8 /e
Operating surplus (%)	37	34 /e	33 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	13300	17414 /e	16272 /e
Value added / worker	6009	7396 /e	6693 /e
Average wage	1082	1437 /e	1251 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	5.90	5.10 /e	0.88 /e
as a percentage of average θ in 1970-1975	129	112 /e	19 /e
MVA growth rate / θ	2.21	0.20 /e	7.86 /e
Degree of specialization	19.2	16.6 /e	16.5 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	110	162 /e	161 /e
313 Beverages	83	135 /e	134 /e
314 Tobacco products	30	41 /e	35 /e
321 Textiles	106	112 /e	107 /e
322 Wearing apparel	3	12 /e	12 /e
323 Leather and fur products	14	15 /e	15 /e
324 Footwear	10	13 /e	12 /e
331 Wood and wood products	8	8 /e	7 /e
332 Furniture and fixtures	2	4 /e	4 /e
341 Paper and paper products	9	11 /e	11 /e
342 Printing and publishing	11	19 /e	19 /e
351 Industrial chemicals	1	2 /e	2 /e
352 Other chemical products	13	26 /e	26 /e
353 Petroleum refineries	20	64 /e	55 /e
354 Miscellaneous petroleum and coal products	-	- /e	- /e
355 Rubber products	8	16 /e	15 /e
356 Plastic products	3	11 /e	9 /e
361 Pottery, china and earthenware	-	- /e	- /e
362 Glass and glass products	2	4 /e	3 /e
369 Other non-metal mineral products	8	13 /e	11 /e
371 Iron and steel	9	12 /e	11 /e
372 Non-ferrous metals	-	- /e	- /e
381 Metal products	7	12 /e	12 /e
382 Non-electrical machinery	-	- /e	- /e
383 Electrical machinery	-	1 /e	1 /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.

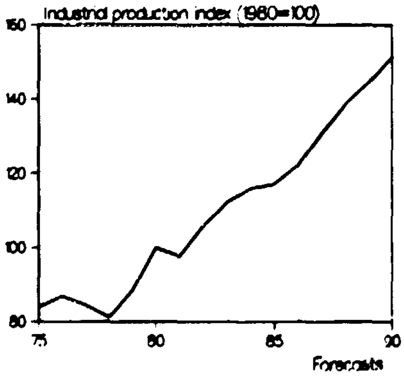
GDP per capita (1000$) /c



Manufacturing share in GDP (%) /c

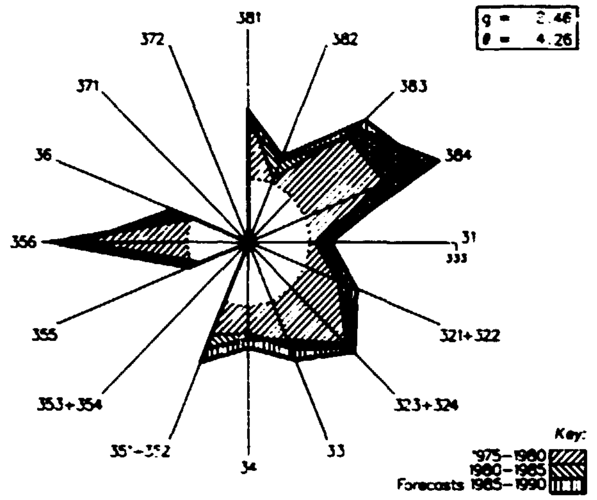


Industrial production index (1980=100)

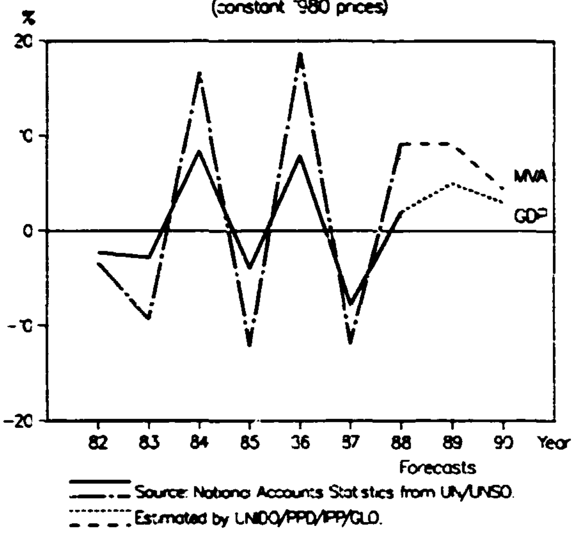


FIJI

Industrial structural change (Index of value added: 1975=100)



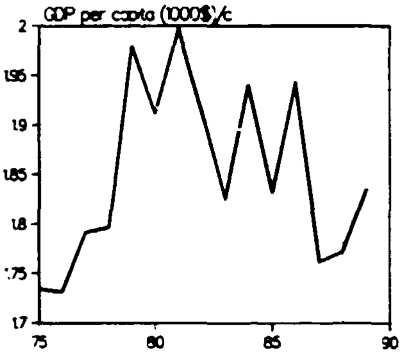
Annual growth rates of GDP and MVA (constant 1980 prices)



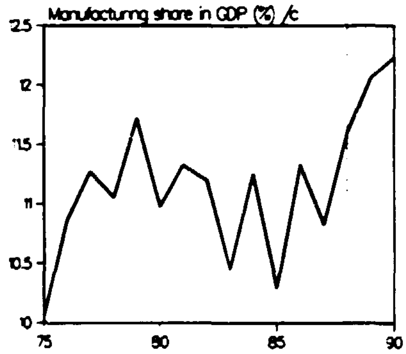
	1980	1985	1987
GDP: /na,c (millions of dollars)	1204	1268	1262
Per capita /na,c (dollars)	1912	1832	1762
Manufacturing share /na,c (%)	11.0	10.3	10.8
MANUFACTURING:			
Value added /na,c (millions of dollars)	132	131	137
Value added (millions of dollars)	120	93	79
Industrial production index	100	89	84
Gross output (millions of dollars)	489	368	395
Employment (thousands)	13	14 /e	14 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	75	75 /e	80 /e
Wages and salaries (%)	11	15 /e	14 /e
Operating surplus (%)	14	11 /e	6 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	38543	26913 /e	27820 /e
Value added / worker	9446	6793 /e	5625 /e
Average wage	4114	3947 /e	3980 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.41 /e	1.86 /e	2.75 /e
as a percentage of average θ in 1970-1975	129 /e	100 /e	148 /e
MVA growth rate / θ	1.63 /e	-3.63 /e	-3.98 /e
Degree of specialization	36.6 /e	34.3 /e	38.6 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	71	42 /e	35 /e
313 Beverages	6	7 /e	6 /e
314 Tobacco products	2	2 /e	1 /e
321 Textiles	-	- /e	- /e
322 Wearing apparel	2	5 /e	5 /e
323 Leather and fur products	-	- /e	- /e
324 Footwear	-	- /e	- /e
331 Wood and wood products	7	5 /e	4 /e
332 Furniture and fixtures	3	3 /e	3 /e
341 Paper and paper products	2	2 /e	2 /e
342 Printing and publishing	4	5 /e	4 /e
351 Industrial chemicals	-	- /e	- /e
352 Other chemical products	4	6 /e	5 /e
353 Petroleum refineries	-	- /e	- /e
354 Miscellaneous petroleum and coal products	-	- /e	- /e
355 Rubber products	1	1 /e	1 /e
356 Plastic products	2	1 /e	1 /e
361 Pottery, china and earthenware	-	- /e	- /e
362 Glass and glass products	-	- /e	- /e
369 Other non-metal mineral products	6	6 /e	5 /e
371 Iron and steel	-	- /e	- /e
372 Non-ferrous metals	-	- /e	- /e
381 Metal products	6	4 /e	3 /e
382 Non-electrical machinery	1	- /e	- /e
383 Electrical machinery	-	1 /e	1 /e
384 Transport equipment	2	1 /e	1 /e
385 Professional and scientific equipment	-	- /e	- /e
390 Other manufacturing industries	-	1 /e	1 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

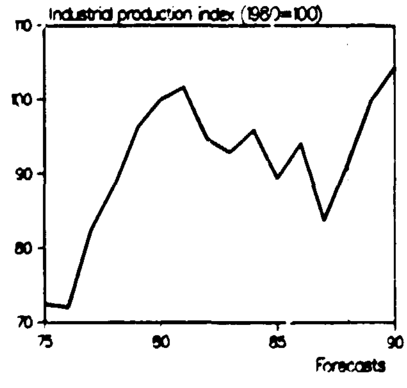
GDP per capita (1000$) /c



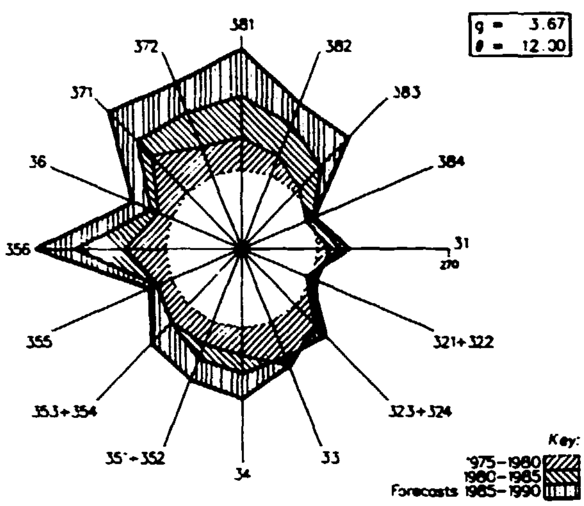
Manufacturing share in GDP (%) /c



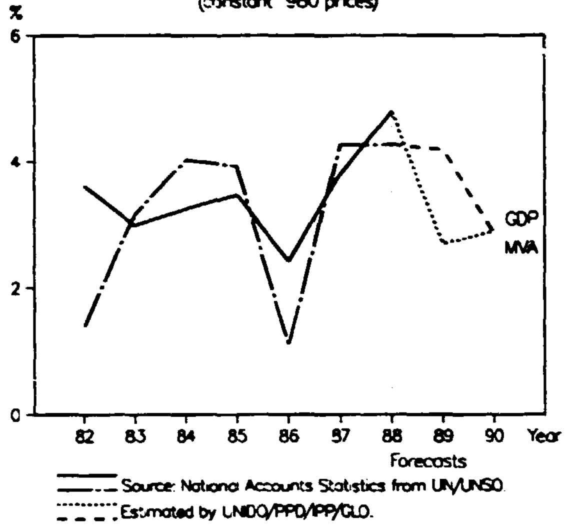
Industrial production index (1980=100)



Industrial structural change
(Index of value added: 1975=100)



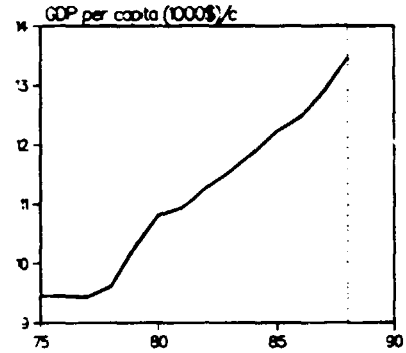
Annual growth rates of GDP and MVA
(constant 1980 prices)



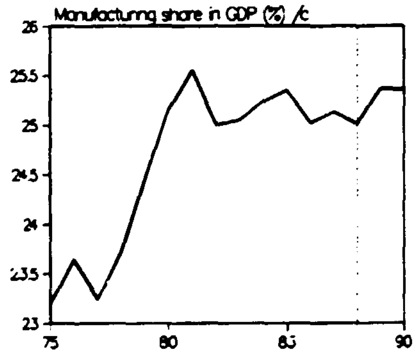
	1980	1985	1987
GDP: /na,c (millions of dollars)	51696	59902	63694
Per capita /na,c (dollars)	10813	12217	12899
Manufacturing share /na,c (%)	25.1	25.3	25.1
MANUFACTURING:			
Value added /na,c (millions of dollars)	12998	15184	16008
Value added (millions of dollars)	14343	13598	19062
Industrial production index	100	115	122
Gross output (millions of dollars)	40839	36968	59463
Employment (thousands)	531	496	475 /e
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	65	63	68 /e
Wages and salaries (%)	15	16	15 /e
Operating surplus (%)	20	21	17 /e
-PRODUCTIVITY:(dollars)			
Gross output / worker	76910	74563	125289 /e
Value added / worker	27012	27426	40164 /e
Average wage	11904	11888	19043 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.69	3.26	2.07
as a percentage of average θ in 1970-1975	65	78	50
MVA growth rate / θ	3.04	1.03	2.04
Degree of specialization	13.1	13.4	13.6
-VALUE ADDED:(millions of dollars)			
311 Food products	1402	1418	1909 /e
313 Beverages	225	227	384 /e
314 Tobacco products	46	68	90 /e
321 Textiles	469	310	411 /e
322 Wearing apparel	499	434	636 /e
323 Leather and fur products	54	37	66 /e
324 Footwear	134	106	138 /e
331 Wood and wood products	1196	662	964 /e
332 Furniture and fixtures	257	215	294 /e
341 Paper and paper products	2088	1846	2665 /e
342 Printing and publishing	1080	1223	1343 /e
351 Industrial chemicals	555	561	934 /e
352 Other chemical products	349	371	466 /e
353 Petroleum refineries	445	384	635 /e
354 Miscellaneous petroleum and coal products	46	47	41 /e
355 Rubber products	106	84	127 /e
356 Plastic products	164	168	272 /c
361 Pottery, china and earthenware	46	40	56 /e
362 Glass and glass products	106	77	118 /e
369 Other non-metal mineral products	434	432	642 /e
371 Iron and steel	544	463	664 /e
372 Non-ferrous metals	142	103	175 /e
381 Metal products	756	766	1195 /e
382 Non-electrical machinery	1469	1618	2116 /e
383 Electrical machinery	694	763	1443 /e
384 Transport equipment	823	915	1110 /c
385 Professional and scientific equipment	110	166	221 /e
390 Other manufacturing industries	107	111	172 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

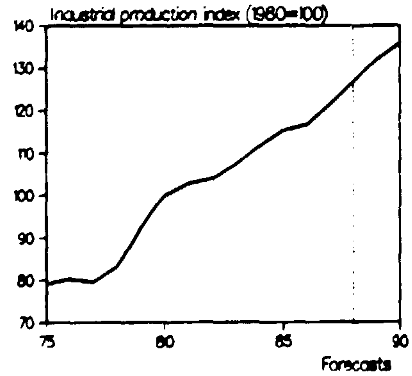
GDP per capita (1000$) /c

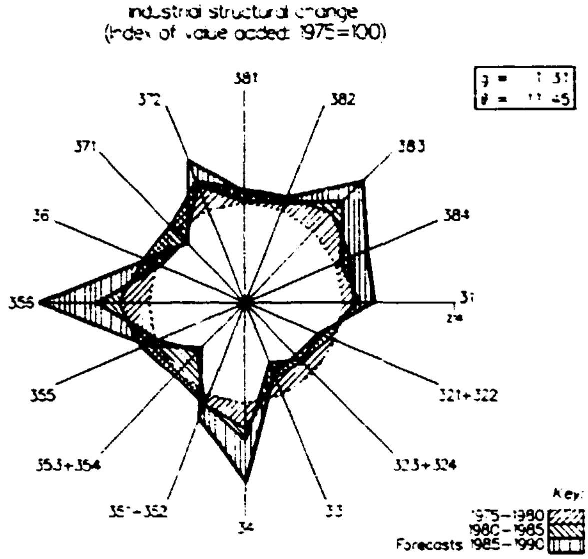


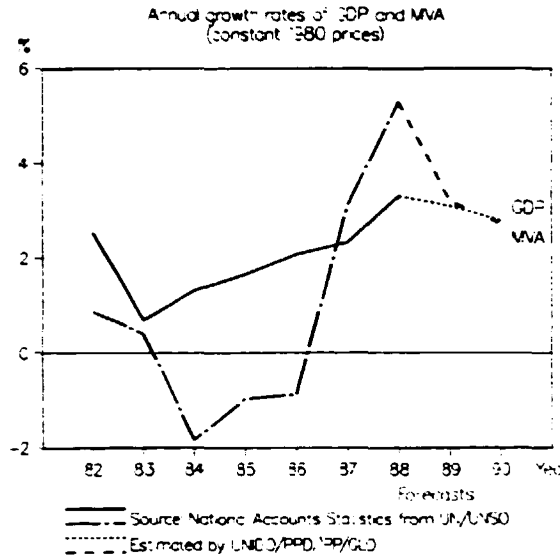
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

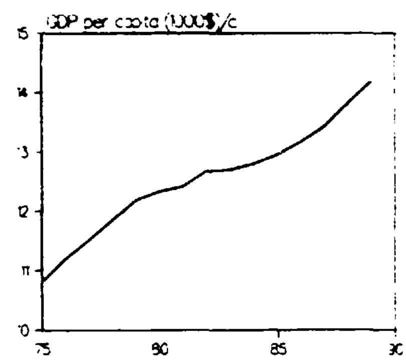


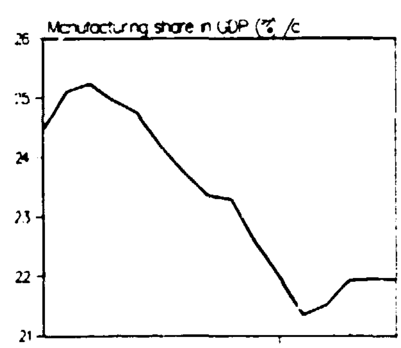


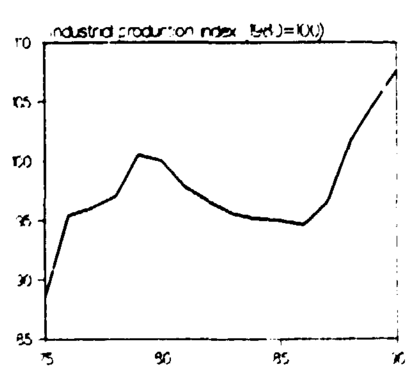


	1980	1985	1987
GDP: /na,c (millions of dollars)	664529	715031	746918
Per capita /na,c (dollars)	12333	12960	13435
Manufacturing share /na,c (%)	24.2	22.0	21.5
MANUFACTURING:			
Value added /na,c (millions of dollars)	160795	157263	160712
Value added (millions of dollars)	170066	130884	211354
Industrial production index	100	95	96
Gross output (millions of dollars)	429531	311518	508955
Employment (thousands)	5058	4434	4278 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	60	58	58 /e
Wages and salaries (%)	.	.	.
Operating surplus (%)	.	.	
-PRODUCTIVITY: (dollars)			
Gross output / worker	84921	70257	118959 /e
Value added / worker	33623	29518	49400 /e
Average wage		...	...
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.05	1.08 /e	1.48 /e
as a percentage of average θ in 1970-1975	65	34 /e	47 /e
MVA growth rate / θ	-0.27	-0.16 /e	1.33 /e
Degree of specialization	13.0	13.5 /e	13.7 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	20823	17863	30495 /e
313 Beverages	4023	3472	5828 /e
314 Tobacco products	1751	1636	2304 /e
321 Textiles	6389	4352	6406 /e
322 Wearing apparel	3975	2938	4515 /e
323 Leather and fur products	734	579	906 /e
324 Footwear	1727	890	1360 /e
331 Wood and wood products	1751	890	1453 /e
332 Furniture and fixtures	1727	968	1562 /e
341 Paper and paper products	4117	3472	6022 /e
342 Printing and publishing	4165	3517	5785 /e
351 Industrial chemicals	9158	7357	12433 /e
352 Other chemical products	5679	4196	6563 /e
353 Petroleum refineries	9773	9917	15012 /e
354 Miscellaneous petroleum and coal products	118	78	128 /e
355 Rubber products	3147	1870	3045 /e
356 Plastic products	2982	2504	3990 /e
361 Pottery, china and earthenware	639	367	567 /e
362 Glass and glass products	1988	1336	2069 /e
369 Other non-metal mineral products	4046	2193	3682 /e
371 Iron and steel	8968	6322	9470 /e
372 Non-ferrous metals	3005	2148	3600 /e
381 Metal products	8779	5799	9268 /e
382 Non-electrical machinery	21633	17551	26264 /e
383 Electrical machinery	13322	9939	16013 /e
384 Transport equipment	21533	15715	27749 /e
385 Professional and scientific equipment	1798	14[illegible]3	2274 /e
390 Other manufacturing industries	2414	1603	2595 /e

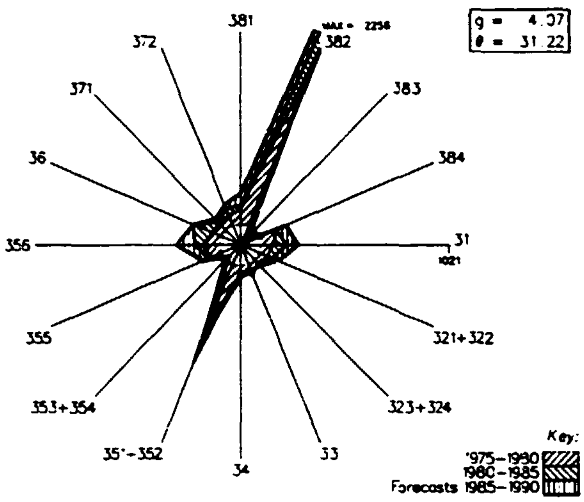
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



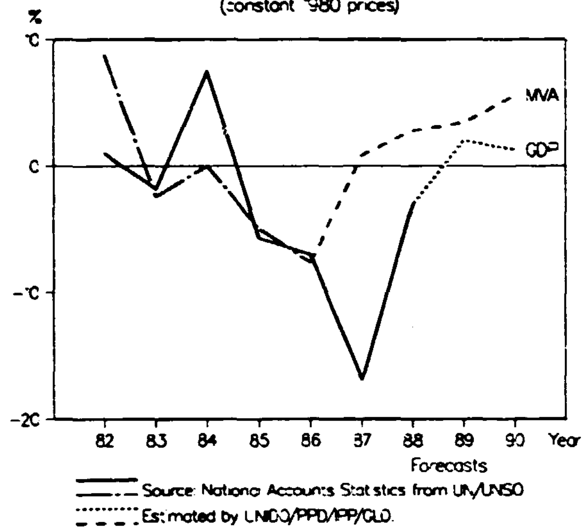




Industrial structural change
(Index of value added 1975=100)



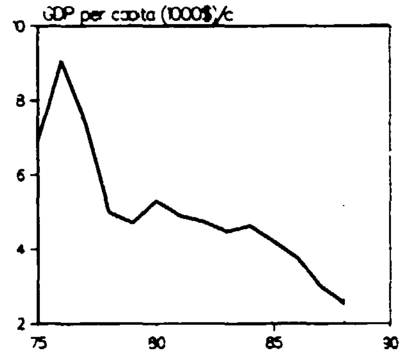
Annual growth rates of GDP and MVA
(constant 1980 prices)



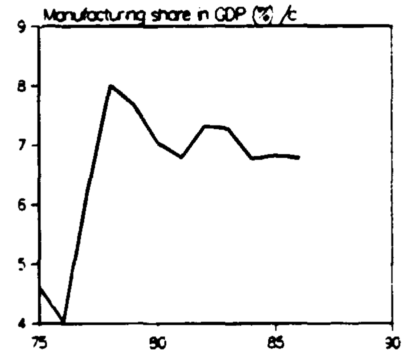
	1980	1985	1987
GDP: /na,c (millions of dollars)	4281	4150	3207
Per capita /na,c (dollars)	5305	4209	3028
Manufacturing share /na,c (%)	7.0	6.8	...
MANUFACTURING:			
Value added /na,c (millions of dollars)	301	283	..
Value added (millions of dollars)	224	180 /e	274 /e
Industrial production index	100	110 /e	111 /e
Gross output (millions of dollars)	690	571	927
Employment (thousands)	18	18	19
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	68	70 /e	72 /e
Wages and salaries (%)	16	17 /e	17 /e
Operating surplus (%)	16	13 /e	11 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	38481	32223 /e	49975 /e
Value added / worker	12470	9737 /e	14061 /e
Average wage	6283	5581 /e	8732 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	7.71 /e	4.60 /e	8.06 /e
as a percentage of average θ in 1970-1975	115 /e	69 /e	120 /e
MVA growth rate / θ	2.32 /e	0.74 /e	0.10 /e
Degree of specialization	17.1 /e	15.4 /e	15.0 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	18	18 /e	27 /e
313 Beverages	19	12 /e	16 /e
314 Tobacco products	17	10 /e	14 /e
321 Textiles	3	1 /e	2 /e
322 Wearing apparel	5	4 /e	7 /e
323 Leather and fur products	1	- /e	1 /e
324 Footwear	1	- /e	1 /e
331 Wood and wood products	64	27 /e	36 /e
332 Furniture and fixtures	9	4 /e	5 /e
341 Paper and paper products	2	2 /e	3 /e
342 Printing and publishing	3	3 /e	6 /e
351 Industrial chemicals	6	7 /e	13 /e
352 Other chemical products	3	3 /e	6 /e
353 Petroleum refineries	18	19 /e	35 /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	24 /e
371 Iron and steel	3	4 /e	5 /e
372 Non-ferrous metals	3	4 /e	5 /e
381 Metal products	13	16 /e	23 /e
382 Non-electrical machinery	2	1 /e	2 /e
383 Electrical machinery	8	10 /e	14 /e
384 Transport equipment	11	13 /e	19 /e
385 Professional and scientific equipment	1	1 /e	1 /e
390 Other manufacturing industries	5	6 /e	8 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

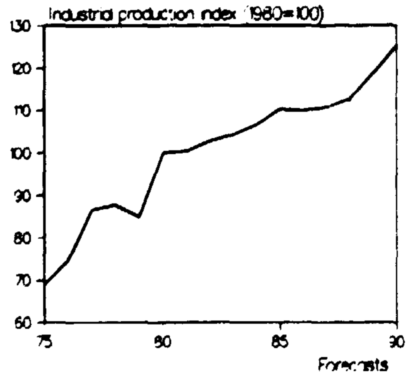
GDP per capita (1000$) /c

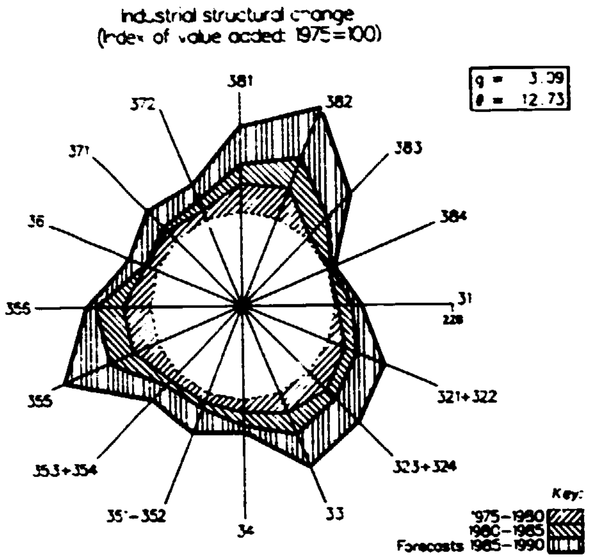


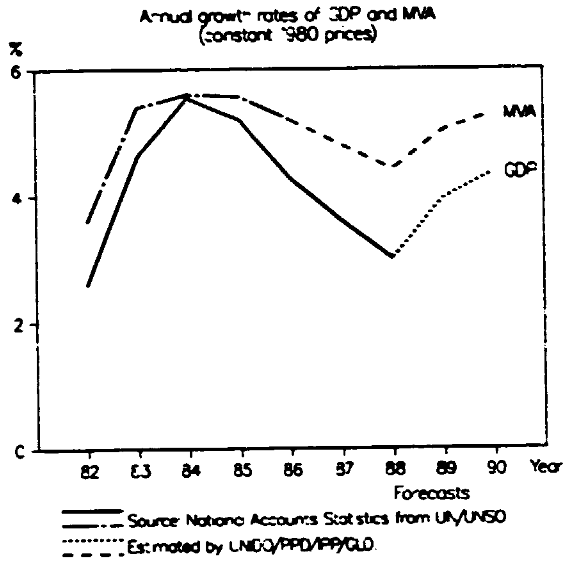
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

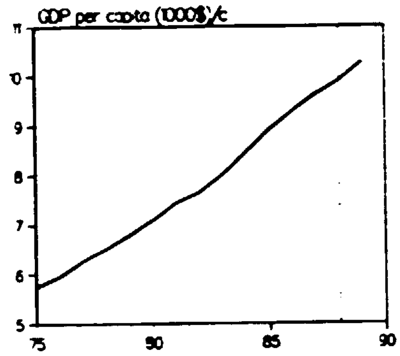


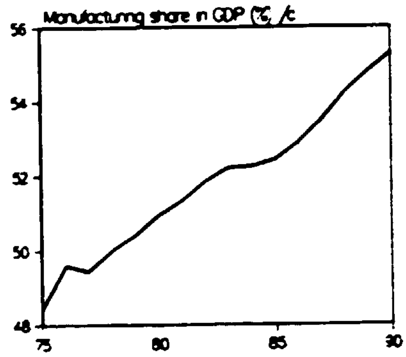


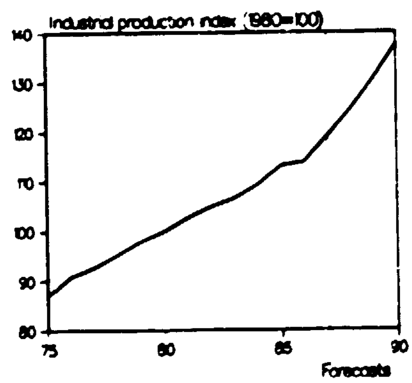


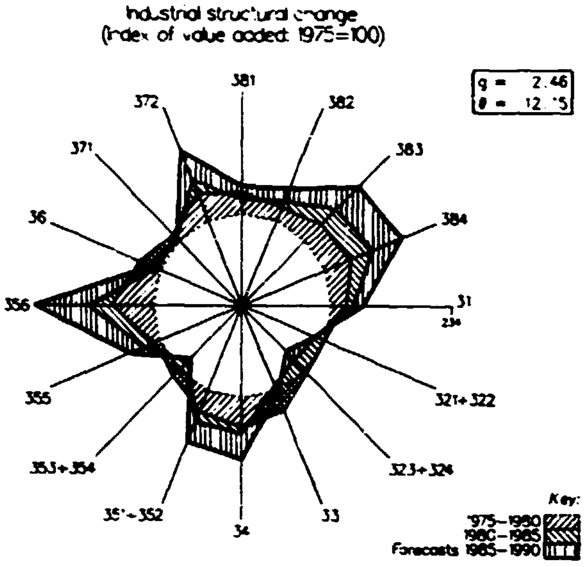
	1980	1985	1987
GDP: /na,c (millions of dollars)	118723	148286	160203
Per capita /na,c (dollars)	7093	8909	9626
Manufacturing share /na,c (%)	50.9	52.4	53.5 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	60486	77756	85725 /e
Value added (millions of dollars)/c	76600	86665 /e	91220 /e
Industrial production index	100	113	119
Gross output (millions of dollars)	123830	172941	300958 /e
Employment (thousands)	2895	2988	2991 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	...	...	...
Wages and salaries (%)	...	...	...
Operating surplus (%)	...	...	...
-PRODUCTIVITY: (dollars)			
Gross output / worker	42774 /e	57877 /e	100606 /e
Value added / worker /c	26460 /e	29004 /e	30493 /e
Average wage	6322 /e	5238 /e	8776 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.72 /e	1.66 /e	1.81 /e
as a percentage of average θ in 1970-1975	88 /e	85 /e	93 /e
MVA growth rate / θ	1.26 /e	2.08 /e	2.54 /e
Degree of specialization	13.2 /e	14.0 /e	14.4 /e
-VALUE ADDED: (millions of dollars)/c			
311 Food products	6043	7070	7070
313 Beverages	1040	1176	1030
314 Tobacco products	254	201	206
321 Textiles	6276	7092	7594
322 Wearing apparel	2199	2419	2529
323 Leather and fur products	839	931	990
324 Footwear	631	700	744
331 Wood and wood products	1178	1413	1496
332 Furniture and fixtures	1081	1297	1373
341 Paper and paper products	931	1098	1173
342 Printing and publishing	727	765 /e	684 /e
351 Industrial chemicals	8697	9219	9741
352 Other chemical products	1220	1306	1354
353 Petroleum refineries	2853	3062	3081
354 Miscellaneous petroleum and coal products	141	138	145
355 Rubber products	3202	3939	4291
356 Plastic products	1528	1880	1819
361 Pottery, china and earthenware	616	604	610
362 Glass and glass products	473	463	464
369 Other non-metal mineral products	1768	1839	1927
371 Iron and steel	2861	2783	2942
372 Non-ferrous metals	884	981	998
381 Metal products	3171	3679	3864
382 Non-electrical machinery	9860	12637	13632
383 Electrical machinery	7480	9424	10247
384 Transport equipment	6898	7036	7311
385 Professional and scientific equipment	3264	3036	3296
390 Other manufacturing industries	608	589	619 /e

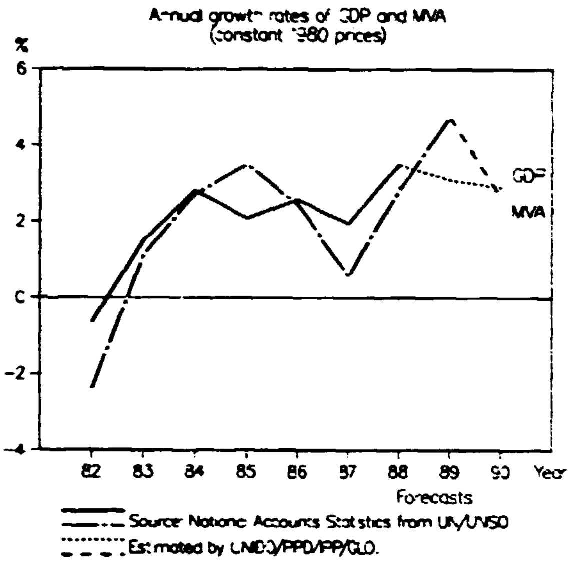
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





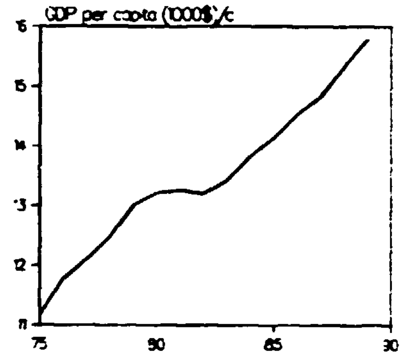


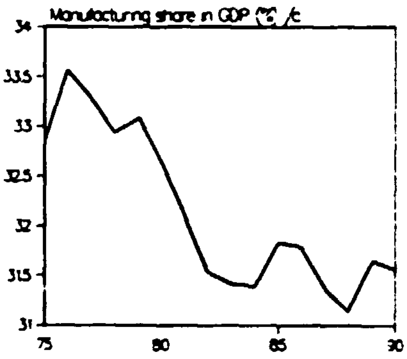


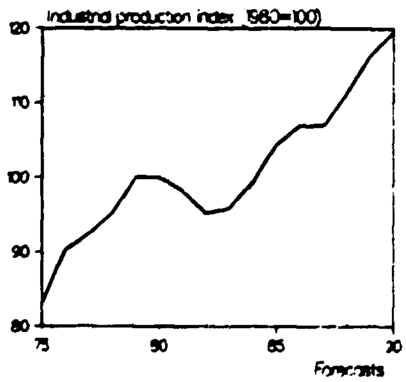


	1980	1985	1987
GDP: /na.c (millions of dollars)	813498	862492	901920
Per capita /na.c (dollars)	13213	14133	14831
Manufacturing share /na.c (%)	32.6	31.8	31.4
MANUFACTURING:			
Value added /na.c (millions of dollars)	265589	274510	282822
Value added (millions of dollars)	265588	224008	383024 /e
Industrial production index	100	104	107
Gross output (millions of dollars)	632161	490046	791185
Employment (thousands)	7229	6614	6656 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	58	54	52 /e
Wages and salaries (%)	21	19	21 /e
Operating surplus (%)	21	27	27 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	87448	74092	117972 /e
Value added / worker	36739	33869	57337 /e
Average wage	18471	14124	24870 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.90	2.25	1.11
as a percentage of average θ in 1970-1975	71	84	41
MVA growth rate / θ	-0.04	2.28	0.07
Degree of specialization	14.2	16.3	16.5
-VALUE ADDED: (millions of dollars)			
311 Food products	18570	10830	17877 /e
313 Beverages	6452	5047	8344 /e
314 Tobacco products	6909	5720	9422 /e
321 Textiles	6964	5508	9062 /e
322 Wearing apparel	4934	2803	4384 /e
323 Leather and fur products	935	501	863 /e
324 Footwear	1206	726	970 /e
331 Wood and wood products	4485	2184	3162 /e
332 Furniture and fixtures	5648	3084	5590 /e
341 Paper and paper products	5099	6221	9426 /e
342 Printing and publishing	6150	4139	6859 /e
351 Industrial chemicals	13944	16570	28316 /e
352 Other chemical products	8003	11597	19991 /e
353 Petroleum refineries	14637	10126	16594 /e
354 Miscellaneous petroleum and coal products	990	985	1496 /e
355 Rubber products	3201	2880	5114 /e
356 Plastic products	6096	5638	9863 /e
361 Pottery, china and earthenware	1304	671	969 /e
362 Glass and glass products	2492	1917	3299 /e
369 Other non-metal mineral products	7937	4722	7746 /e
371 Iron and steel	18872	9638	13622 /e
372 Non-ferrous metals	2608	3412	5966 /e
381 Metal products	14455	14188	24933 /e
382 Non-electrical machinery	34263	33812	58064 /e
383 Electrical machinery	30601	28492	50599 /e
384 Transport equipment	31232	29078	50866 /e
385 Professional and scientific equipment	6206	3446	6412 /e
390 Other manufacturing industries	1700	1175	2226 /e

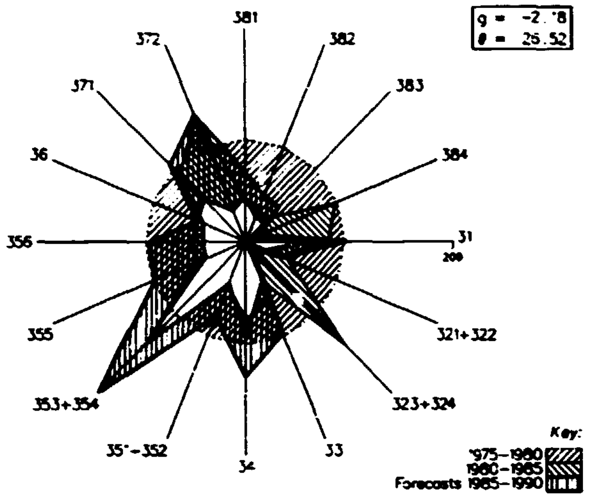
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



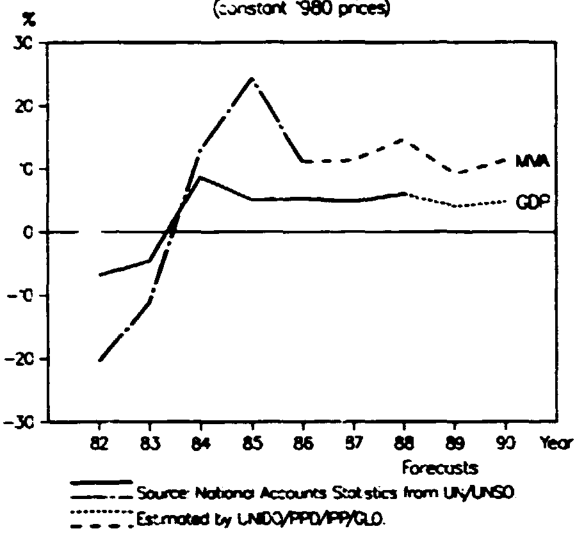




Industrial structural change
(Index of value added: 1975=100)



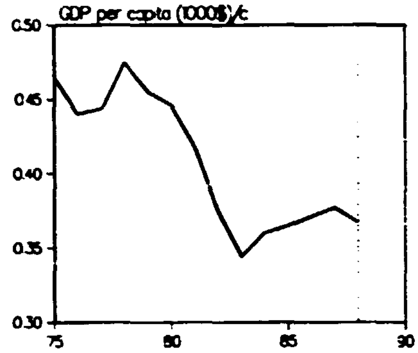
Annual growth rates of GDP and MVA
(constant 1980 prices)



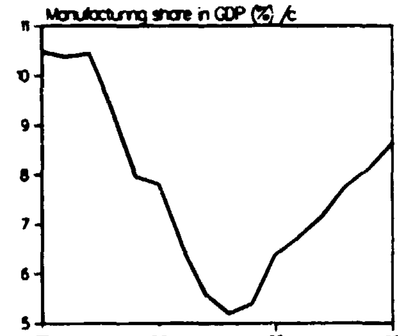
	1980	1985	1987
GDP: /na,c (millions of dollars)	4788	4686	5167
Per capita /na,c (dollars)	446	365	377
Manufacturing share /na,c (%)	7.8	6.4	7.2 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	374	299	370 /e
Value added (millions of dollars)	271	174 /e	147 /e
Industrial production index	100	70	86 /e
Gross output (millions of dollars)	544	308 /e	248 /e
Employment (thousands)	80	63 /e	69 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	50	44 /e	41 /e
Wages and salaries (%)	10	10 /e	10 /e
Operating surplus (%)	40	47 /e	49 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	6783	4872 /e	3612 /e
Value added / worker	3382	2747 /e	2137 /e
Average wage	652	481 /e	365 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	13.91 /e	8.39 /e	0.89 /e
as a percentage of average θ in 1970-1975	401 /e	242 /e	20 /e
MVA growth rate / θ	-1.66 /e	1.72 /e	20.65 /e
Degree of specialization	21.4 /e	22.1 /e	21.9 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	22	17 /e	13 /e
313 Beverages	41	30 /e	27 /e
314 Tobacco products	36	40 /e	34 /e
321 Textiles	24	9 /e	9 /e
322 Wearing apparel	3	1 /e	1 /e
323 Leather and fur products	1	- /e	- /e
324 Footwear	1	- /e	- /e
331 Wood and wood products	17	14 /e	12 /e
332 Furniture and fixtures	2	1 /e	1 /e
341 Paper and paper products	1	1 /e	- /e
342 Printing and publishing	5	4 /e	4 /e
351 Industrial chemicals	2	1 /e	1 /e
352 Other chemical products	10	7 /e	7 /e
353 Petroleum refineries	49	13 /e	10 /e
354 Miscellaneous petroleum and coal products	-	- /e	- /e
355 Rubber products	5	2 /e	2 /e
356 Plastic products	1	2 /e	1 /e
361 Pottery, china and earthenware	1	- /e	- /e
362 Glass and glass products	-	- /e	- /e
369 Other non-metal mineral products	6	10 /e	8 /e
371 Iron and steel	1	1 /e	1 /e
372 Non-ferrous metals	31	13 /e	12 /e
381 Metal products	7	4 /e	3 /e
382 Non-electrical machinery	-	- /e	- /e
383 Electrical machinery	2	1 /e	- /e
384 Transport equipment	3	2 /e	2 /e
385 Professional and scientific equipment	1	- /e	- /e
390 Other manufacturing industries	-	- /e	- /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

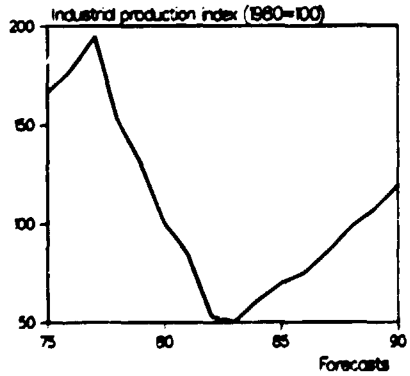
GDP per capita (1000$)/c



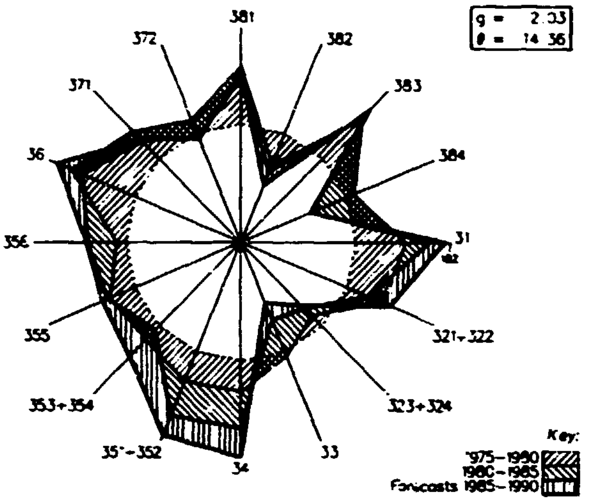
Manufacturing share in GDP (%) /c



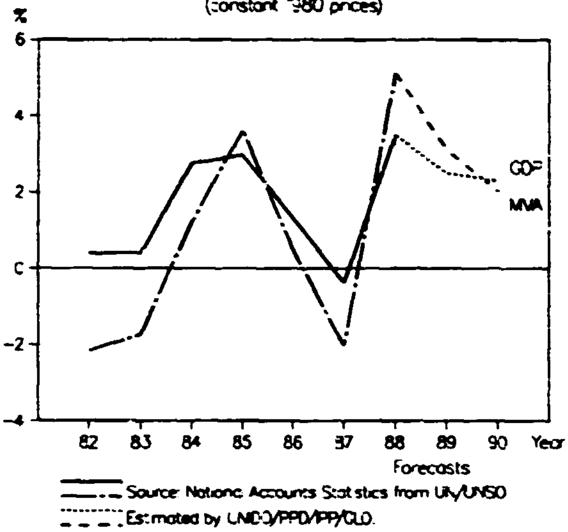
Industrial production index (1980=100)



Industrial structural change
(Index of value added: 1975=100)



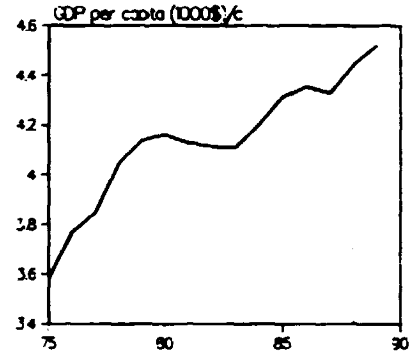
Annual growth rates of GDP and MVA
(constant 1980 prices)



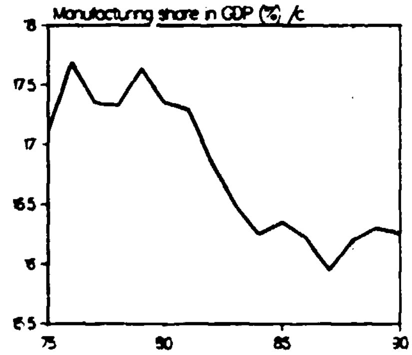
	1980	1985	1987
GDP: /na.c (millions of dollars)	40147	42843	43249
Per capita /na.c (dollars)	4163	4312	4328
Manufacturing share /na.c (%)	17.4	16.4	16.0
MANUFACTURING:			
Value added /na.c (millions of dollars)	6968	7006	6899
Value added (millions of dollars)	7716	5740	8165
Industrial production index	100	98	96
Gross output (millions of dollars)	25291	19764	28081
Employment (thousands)	474	437	437 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	69	71	71 /e
Wages and salaries (%)	12	13 /e	14 /e
Operating surplus (%)	19	16 /e	15 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	53372	45258 /e	64251 /e
Value added / worker	16283	13145 /e	18669 /e
Average wage	6303	5807 /e	9052 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.08	3.78	1.49 /e
as a percentage of average θ in 1970-1975	61	75	29 /e
MVA growth rate / θ	0.12	0.65	-1.36 /e
Degree of specialization	11.0	11.5	11.9 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	1083	935	1253 /e
313 Beverages	256	239	351 /e
314 Tobacco products	140	125	167 /e
321 Textiles	1070	767	1133 /e
322 Wearing apparel	444	326	467 /e
323 Leather and fur products	89	68	100 /e
324 Footwear	120	118	156 /e
331 Wood and wood products	268	121	214 /e
332 Furniture and fixtures	135	114	124 /e
341 Paper and paper products	'75	155	240 /e
342 Printing and publishing	199	148	184 /e
351 Industrial chemicals	189	194	263 /e
352 Other chemical products	329	273	374 /e
353 Petroleum refineries	152	120	191 /e
354 Miscellaneous petroleum and coal products	32	20	37 /e
355 Rubber products	67	58	83 /e
356 Plastic products	216	143	217 /e
361 Pottery, china and earthenware	86	37	66 /e
362 Glass and glass products	54	28	48 /e
369 Other non-metal mineral products	569	368	520 /e
371 Iron and steel	200	133	173 /e
372 Non-ferrous metals	245	163	222 /e
381 Metal products	552	406	585 /e
382 Non-electrical machinery	181	116	142 /e
383 Electrical machinery	342	274	373 /e
384 Transport equipment	535	225	364 /e
385 Professional and scientific equipment	8	6	6 /e
390 Other manufacturing industries	89	73	106 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

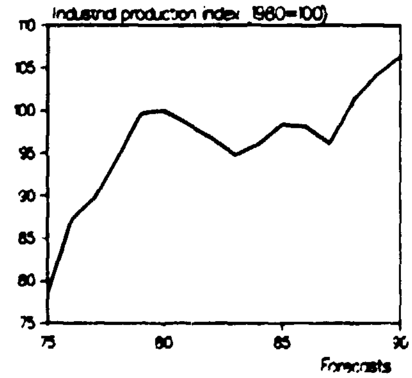
GDP per capita (1000$)/c

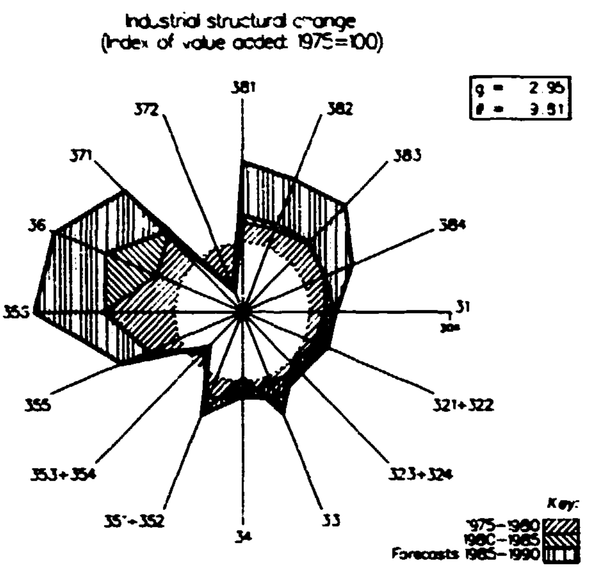


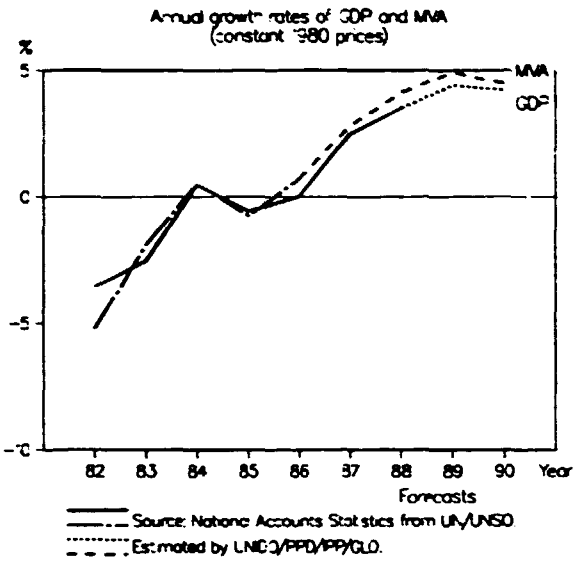
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

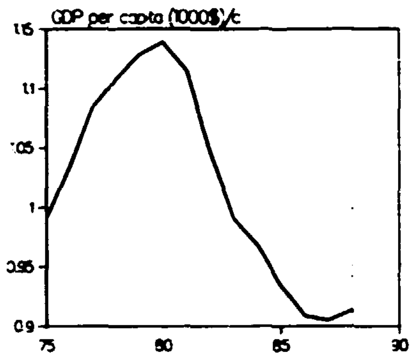


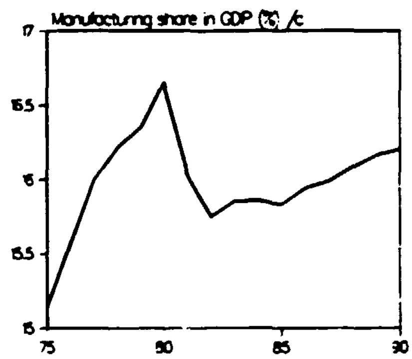


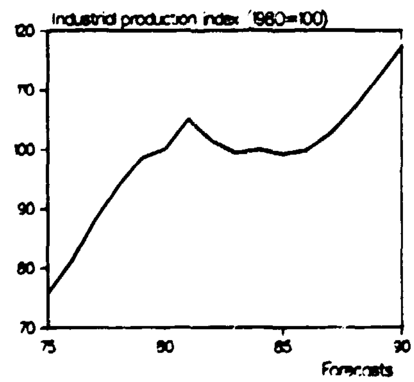


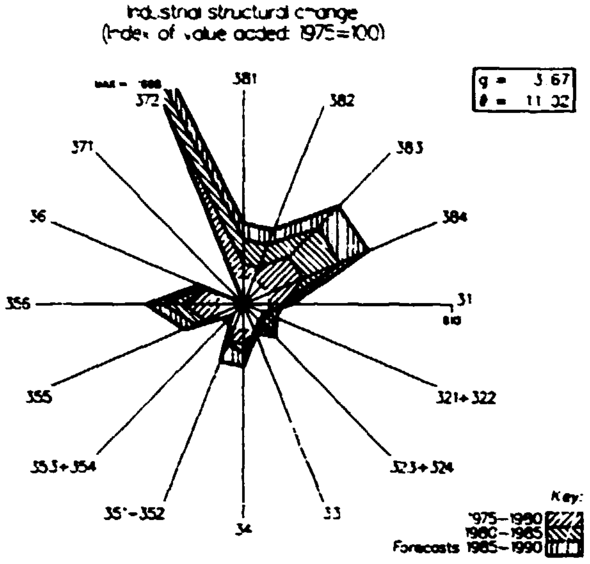
	1980	1985	1987
GDP: /na,c (millions of dollars)	7879	7446	7634
Per capita /na,c (dollars)	1139	936	905
Manufacturing share /na,c (%)	16.7	15.8	16.0 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	1312	1179	1221 /e
Value added (millions of dollars)	794	878	652 /e
Industrial production index	100	99	103 /e
Gross output (millions of dollars)	1968	2161	1536 /e
Employment (thousands)	82	76	76 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	60	59	58 /e
Wages and salaries (%)	9	9 /e	9 /e
Operating surplus (%)	31	31 /e	33 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	23872	28535	20137 /e
Value added / worker	9631	11598	8555 /e
Average wage	2166	2654 /e	1882 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.32 /e	4.47 /e	1.75 /e
as a percentage of average θ in 1970-1975	51 /e	171 /e	67 /e
MVA growth rate / θ	1.12 /e	-0.17 /e	1.61 /e
Degree of specialization	25.4 /e	25.1 /e	24.9 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	234	251	190 /e
313 Beverages	91	90	68 /e
314 Tobacco products	14	15	12 /e
321 Textiles	45	71	57 /e
322 Wearing apparel	19	13	9 /e
323 Leather and fur products	3	3	2 /e
324 Footwear	15	12	9 /e
331 Wood and wood products	10	6	4 /e
332 Furniture and fixtures	4	3	2 /e
341 Paper and paper products	19	21	17 /e
342 Printing and publishing	34	34	24 /e
351 Industrial chemicals	28	28	18 /e
352 Other chemical products	110	121	93 /e
353 Petroleum refineries	14	9	6 /e
354 Miscellaneous petroleum and coal products	2	1	1 /e
355 Rubber products	21	23	17 /e
356 Plastic products	19	37	31 /e
361 Pottery, china and earthenware	2	6	4 /e
362 Glass and glass products	22	17	11 /e
369 Other non-metal mineral products	34	42	31 /e
371 Iron and steel	16	21	17 /e
372 Non-ferrous metals	1	1	1 /e
381 Metal products	23	23	16 /e
382 Non-electrical machinery	6	4	3 /e
383 Electrical machinery	25	19	13 /e
384 Transport equipment	8	3	2 /e
385 Professional and scientific equipment	1	1	1 /e
390 Other manufacturing industries	4	3	3 /e

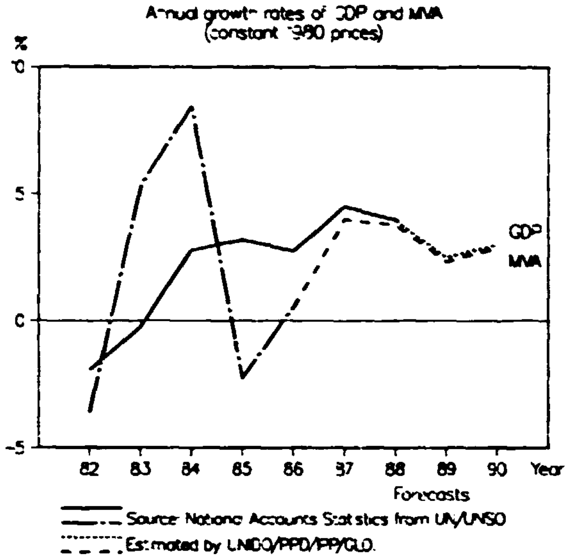
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





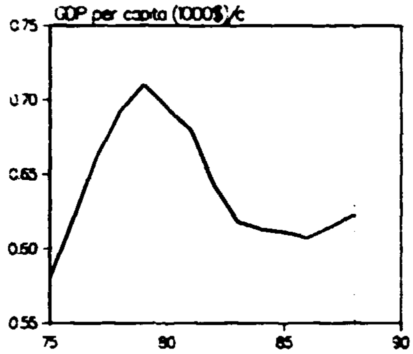


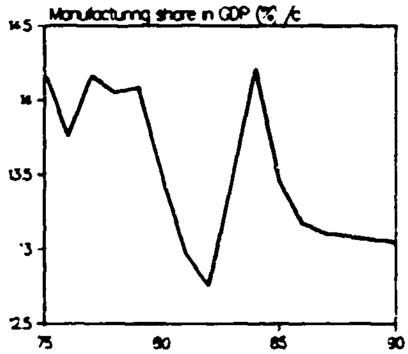


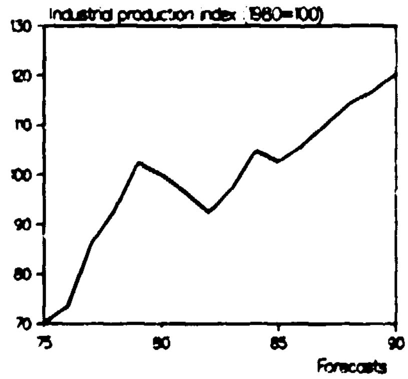


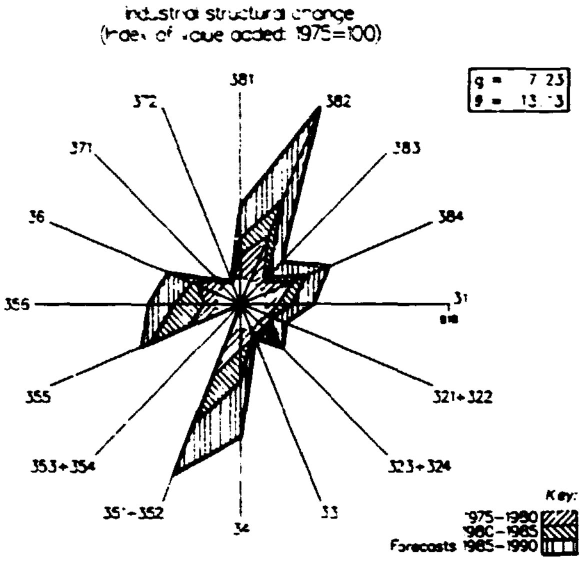
	1980	1985	1987
GDP: /na.c (millions of dollars)	2544	2680	2877
Per capita /na.c (dollars)	695	611	615
Manufacturing share /na.c (%)	12.5	13.5	13.1 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	344	361	377 /e
Value added (millions of dollars)	311 /e	452 /e	529 /e
Industrial production index	100	103	110 /e
Gross output (millions of dollars)	1153 /e	1657 /e	1968 /e
Employment (thousands)	55	75 /e	82 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	73 /e	73 /e	73 /e
Wages and salaries (%)	9 /e	11 /e	11 /e
Operating surplus (%)	18 /e	16 /e	16 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	20957 /e	22189 /e	24037 /e
Value added / worker	5650 /e	6064 /e	6456 /e
Average wage	1979 /e	2451 /e	2666 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	7.25	3.15	0.86 /e
as a percentage of average θ in 1970-1975	124	54	14 /e
MVA growth rate / θ	-0.32	-0.64	4.70 /e
Degree of specialization	22.9	23.5	24.2 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	86	130 /e	158 /e
313 Beverages	68	107 /e	124 /e
314 Tobacco products	22	34 /e	37 /e
321 Textiles	12	10 /e	9 /e
322 Wearing apparel	10	16 /e	19 /e
323 Leather and fur products	3	3 /e	3 /e
324 Footwear	4	2 /e	2 /e
331 Wood and wood products	20	25 /e	27 /e
332 Furniture and fixtures	6	9 /e	11 /e
341 Paper and paper products	5	7 /e	9 /e
342 Printing and publishing	6	7 /e	8 /e
351 Industrial chemicals	1	3 /e	3 /e
352 Other chemical products	13	19 /e	23 /e
353 Petroleum refineries	2	1 /e	1 /e
354 Miscellaneous petroleum and coal products	- /e	- /e	- /e
355 Rubber products	5 /e	6 /e	6 /e
356 Plastic products	11 /e	16 /e	18 /e
361 Pottery, china and earthenware	1 /e	1 /e	1 /e
362 Glass and glass products	- /e	- /e	- /e
369 Other non-metal mineral products	15 /e	20 /e	24 /e
371 Iron and steel	- /e	- /e	- /e
372 Non-ferrous metals	-	- /e	- /e
381 Metal products	14 /e	21 /e	26 /e
382 Non-electrical machinery	1 /e	1 /e	1 /e
383 Electrical machinery	6 /e	8 /e	9 /e
384 Transport equipment	2 /e	3 /e	3 /e
385 Professional and scientific equipment	- /e	- /e	- /e
390 Other manufacturing industries	2	3 /e	4 /e

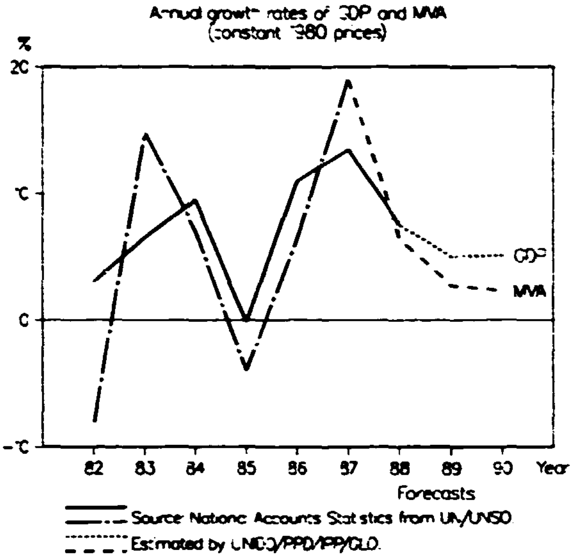
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





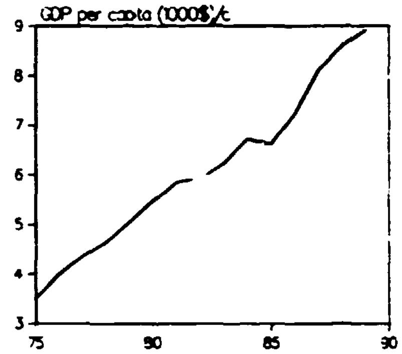


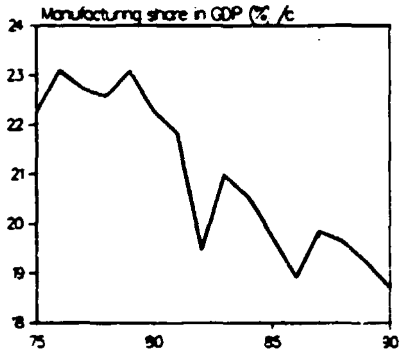


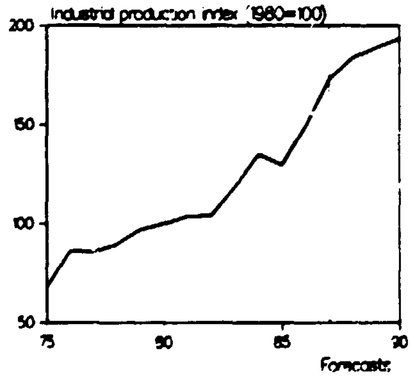


	1980	1985	1987
GDP: /na.c (millions of dollars)	27526	36121	45499
Per capita /na.c (dollars)	5462	6619	8105
Manufacturing share /na.c (%)	22.3	19.7	19.8
MANUFACTURING:			
Value added /na.c (millions of dollars)	6134	7132	9031
Value added (millions of dollars)	7343	6570	10115 /e
Industrial production index	100	130	173
Gross output (millions of dollars)	22187	22835	36749 /e
Employment (thousands)	924	917	989 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	67	71	72 /e
Wages and salaries (%)	17	18	16 /e
Operating surplus (%)	16	11	12 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	24003	24901	37165 /e
Value added / worker	7945	7164	10229 /e
Average wage	4134	4539	5791 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	5.92	5.29	4.21
as a percentage of average θ in 1970-1975	86	77	61
MVA growth rate / θ	0.55	-0.73	3.65
Degree of specialization	24.8	22.8	23.4
-VALUE ADDED: (millions of dollars)			
311 Food products	161	171	197
313 Beverages	99	125	104
314 Tobacco products	81	127	73
321 Textiles	1027	964	1764
322 Wearing apparel	1920	1694	2277
323 Leather and fur products	43	26	57 /e
324 Footwear	69	62	81 /e
331 Wood and wood products	45	32	39 /e
332 Furniture and fixtures	62	54	66 /e
341 Paper and paper products	110	90	239
342 Printing and publishing	290	350	450
351 Industrial chemicals	40	30	48 /e
352 Other chemical products	77	77	91 /e
353 Petroleum refineries	-	-	- /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	29	17	19
356 Plastic products	663	612	936
361 Pottery, china and earthenware	6	5	8 /e
362 Glass and glass products	10	17	20 /e
369 Other non-metal mineral products	55	33	86 /e
371 Iron and steel	31	14	17 /e
372 Non-ferrous metals	35	22	42 /e
381 Metal products	638	460	679
382 Non-electrical machinery	188	236	313
383 Electrical machinery	987	752	1609
384 Transport equipment	176	157	160
385 Professional and scientific equipment	387	289	365
390 Other manufacturing industries	260	263	374

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.







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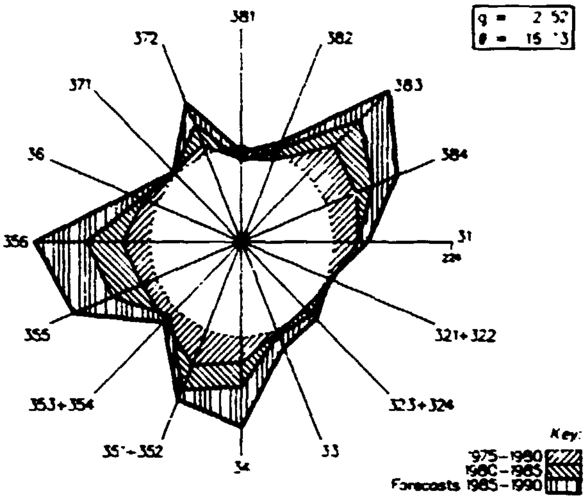
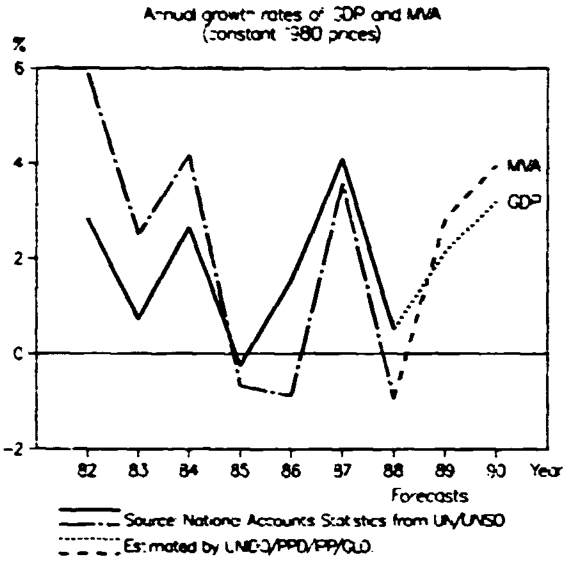
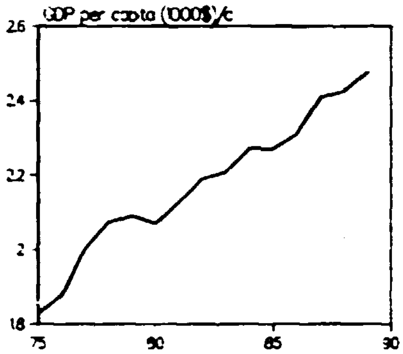
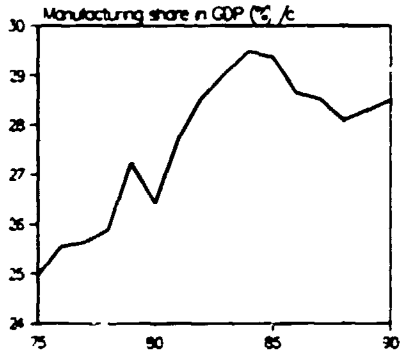


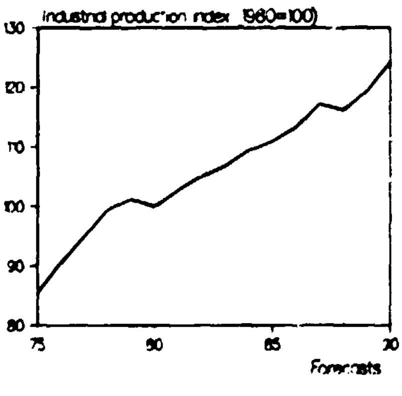


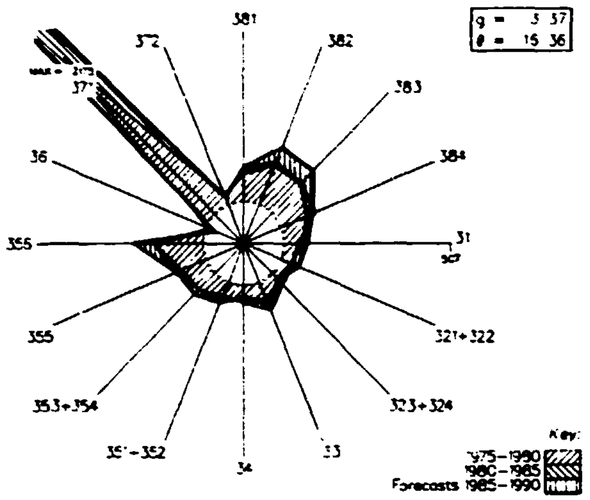
	1980	1985	1987
GDP: /na,c (millions of dollars)	22165	24184	25562
Per capita /na,c (dollars)	2069	2271	2410
Manufacturing share /na,c (%)	26.4	29.4	28.5
MANUFACTURING:			
Value added /na,c (millions of dollars)	5856	7101	7290
Value added (millions of dollars)	5907	5356	6663
Industrial production index	100	111	117
Gross output (millions of dollars)	24898	21690	26970
Employment (thousands)	1384	1278	1266 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	76	75	75 /e
Wages and salaries (%)	8	8	8 /e
Operating surplus (%)	16	16	16 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	17990	16972	21209 /e
Value added / worker	4268	4191	5261 /e
Average wage	1437	1403	1787 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.75	1.92	2.27 /e
as a percentage of average θ in 1970-1975	66	72	85 /e
MVA growth rate / θ	-0.68	0.74	1.57 /e
Degree of specialization	9.9	10.4	10.4 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	555	281	208 /e
313 Beverages	83	107	129 /e
314 Tobacco products	27	28	35 /e
321 Textiles	353	325	376 /e
322 Wearing apparel	194	158	201 /e
323 Leather and fur products	48	39	45 /e
324 Footwear	79	85	106 /e
331 Wood and wood products	81	42	63 /e
332 Furniture and fixtures	101	92	122 /e
341 Paper and paper products	94	106	149 /e
342 Printing and publishing	83	94	132 /e
351 Industrial chemicals	417	320	344 /e
352 Other chemical products	242	303	387 /e
353 Petroleum refineries	155	195	176 /e
354 Miscellaneous petroleum and coal products	-	-	1 /e
355 Rubber products	55	71	101 /e
356 Plastic products	61	80	102 /e
361 Pottery, china and earthenware	57	46	62 /e
362 Glass and glass products	70	71	93 /e
369 Other non-metal mineral products	204	161	208 /e
371 Iron and steel	370	200	271 /e
372 Non-ferrous metals	215	54	37 /e
381 Metal products	214	215	297 /e
382 Non-electrical machinery	497	569	739 /e
383 Electrical machinery	665	758	1061 /e
384 Transport equipment	486	507	676 /e
385 Professional and scientific equipment	272	287	411 /e
390 Other manufacturing industries	237	164	202 /e

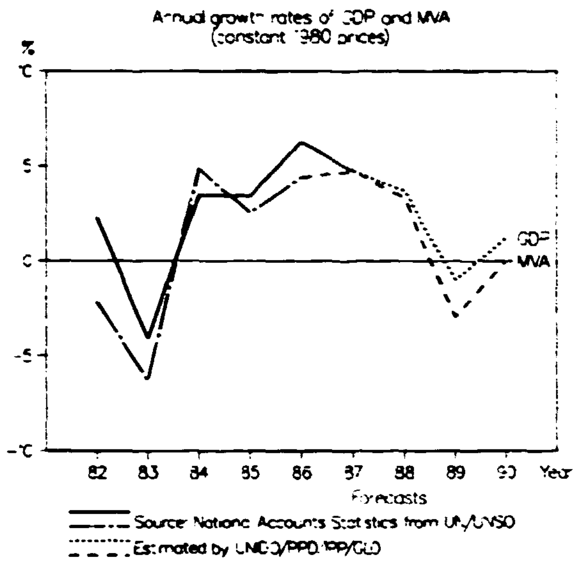
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex





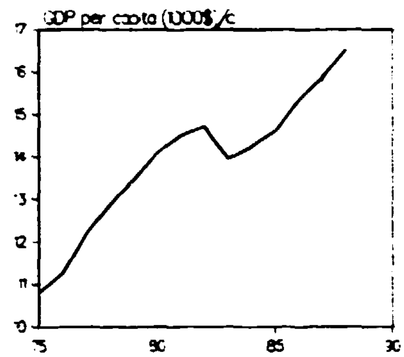


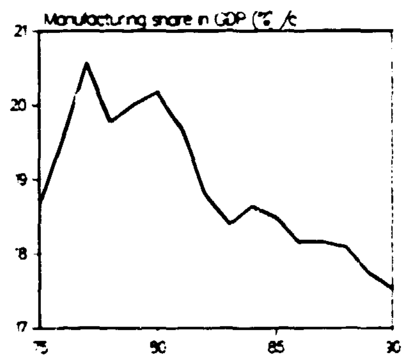


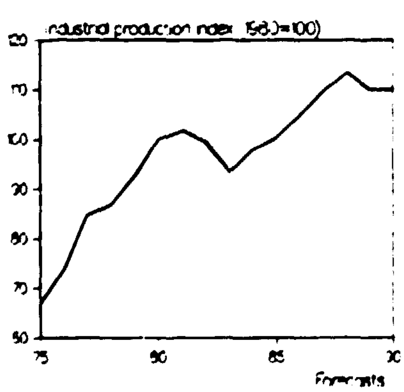


	1980	1985	1987
GDP: /na.c (millions of dollars)	3229	3536	3937
Per capita /na.c (dollars)	14101	14613	15873
Manufacturing share /na.c (%)	20.2	18.5	18.2 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	652	654	715 /e
Value added (millions of dollars)	665	479	797 /e
Industrial production index	100	100	110 /e
Gross output (millions of dollars)	1838	1502	2472 /e
Employment (thousands)	26	28	29 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	64 /e	68 /e	68 /e
Wages and salaries (%)	20 /e	19 /e	18 /e
Operating surplus (%)	17 /e	13 /e	14 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	69467 /e	53799 /e	85817 /e
Value added / worker	25131 /e	17167 /e	27669 /e
Average wage	13812 /e	10533 /e	15778 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.80 /e	3.69 /e	1.68 /e
as a percentage of average θ in 1970-1975	66 /e	64 /e	29 /e
MVA growth rate / θ	2.05 /e	0.69 /e	2.82 /e
Degree of specialization	13.9 /e	13.5 /e	13.6 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	330	230	383 /e
313 Beverages	6	7	12 /e
314 Tobacco products	...	...	...
321 Textiles	27	21	35 /e
322 Wearing apparel	15	9	14 /e
323 Leather and fur products	8	6	10 /e
324 Footwear	1	1	1 /e
331 Wood and wood products	-	-	- /e
332 Furniture and fixtures	40	22	36 /e
341 Paper and paper products	4	4	7 /e
342 Printing and publishing	32	33	54 /e
351 Industrial chemicals	10	11	20 /e
352 Other chemical products	9	7	10 /e
353 Petroleum refineries	-	-	- /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	5	5	10 /e
356 Plastic products	9	9	16 /e
361 Pottery, china and earthenware	1	-	1 /e
362 Glass and glass products	2	2	3 /e
369 Other non-metal mineral products	18	16	26 /e
371 Iron and steel	5	10	13 /e
372 Non-ferrous metals	48	16	29 /e
381 Metal products	19 /e	12 /e	19 /e
382 Non-electrical machinery	36 /e	24 /e	41 /e
383 Electrical machinery	15	15	27 /e
384 Transport equipment	21	13	21 /e
385 Professional and scientific equipment	1	1	3 /e
390 Other manufacturing industries	3	3	5 /e

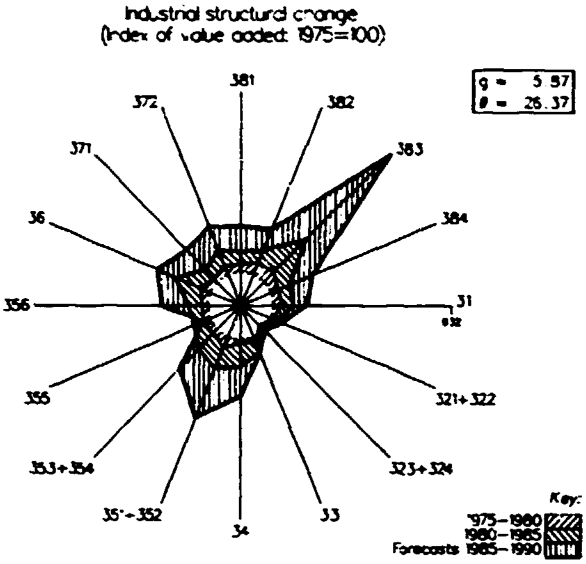
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

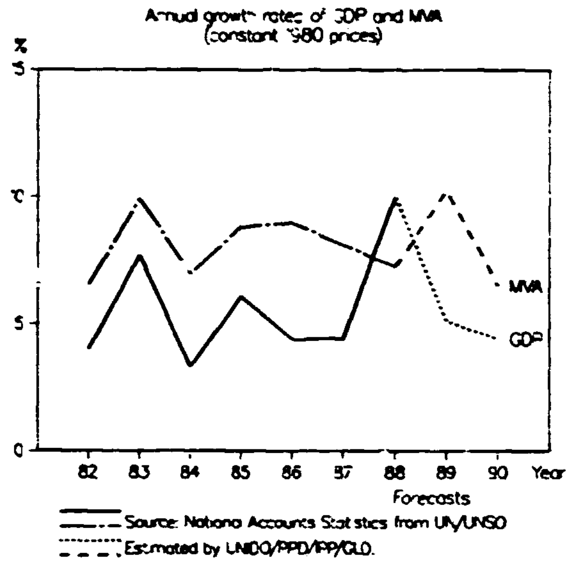






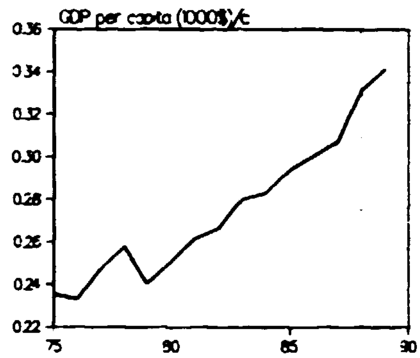
INDIA

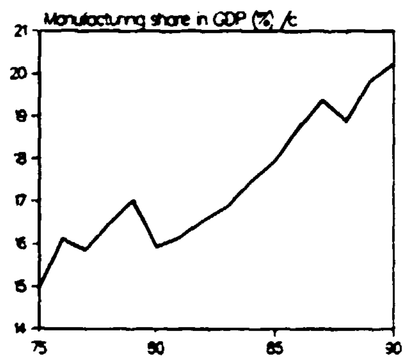


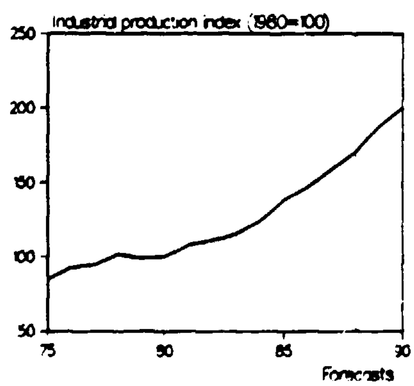


	1980	1985	1987
GDP: /na,c (millions of dollars)	172723	225988	246307
Per capita /na,c (dollars)	251	294	307
Manufacturing share /na,c (%)	15.9	17.9	19.4
MANUFACTURING:			
Value added /na,c (millions of dollars)	27626	40527	47738
Value added (millions of dollars)	13086	16607	22252
Industrial production index	100	138	159
Gross output (millions of dollars)	71387	89782	105209 /e
Employment (thousands)	6992	6936 /e	7134 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	82	82 /e	79 /e
Wages and salaries (%)	9	9 /e	9 /e
Operating surplus (%)	9	10 /e	12 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	10210	12945 /e	14748 /e
Value added / worker	1872	2394 /e	3119 /e
Average wage	949	1142 /e	1359 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.37 /e	4.14 /e	9.79 /e
as a percentage of average θ in 1970-1975	78 /e	136 /e	322 /e
MVA growth rate / θ	0.29 /e	2.68 /e	0.83 /e
Degree of specialization	15.4 /e	14.0 /e	15.2 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	899	1543 /e	2096 /e
313 Beverages	99	163 /e	221 /e
314 Tobacco products	196	262 /e	324 /e
321 Textiles	2642	2429 /e	3318 /e
322 Wearing apparel	62	97 /e	133 /e
323 Leather and fur products	48	69 /e	94 /e
324 Footwear	37	56 /e	76 /e
331 Wood and wood products	74	91 /e	125 /e
332 Furniture and fixtures	8	7 /e	9 /e
341 Paper and paper products	296	340 /e	466 /e
342 Printing and publishing	256	349 /e	454 /e
351 Industrial chemicals	778	1266 /e	1699 /e
352 Other chemical products	1062	1145 /e	1568 /e
353 Petroleum refineries	203	235 /e	291 /e
354 Miscellaneous petroleum and coal products	151	130 /e	166 /e
355 Rubber products	234	456 /e	493 /e
356 Plastic products	93	122 /e	151 /e
361 Pottery, china and earthenware	47	53 /e	73 /e
362 Glass and glass products	67	73 /e	92 /e
369 Other non-metal mineral products	399	810 /e	1103 /e
371 Iron and steel	1489	1693 /e	2087 /e
372 Non-ferrous metals	81	165 /e	212 /e
381 Metal products	421	460 /e	626 /e
382 Non-electrical machinery	1130	1609 /e	2061 /e
383 Electrical machinery	1061	1637 /e	2087 /e
384 Transport equipment	1088	1438 /e	1948 /e
385 Professional and scientific equipment	92	116 /e	168 /e
390 Other manufacturing industries	72	102 /e	129 /e

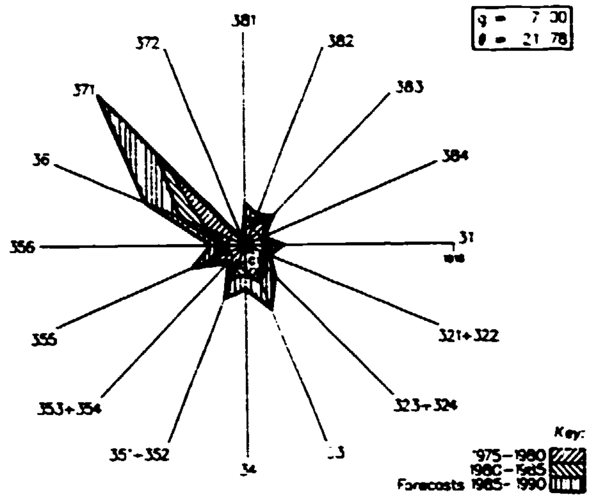
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



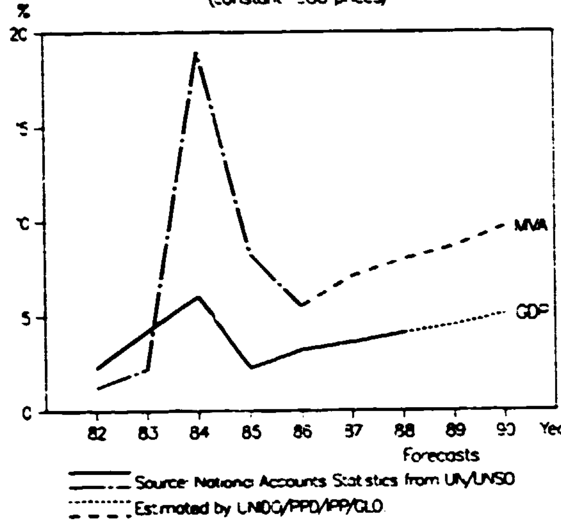




Industrial structural change
(Index of value added: 1975=100)



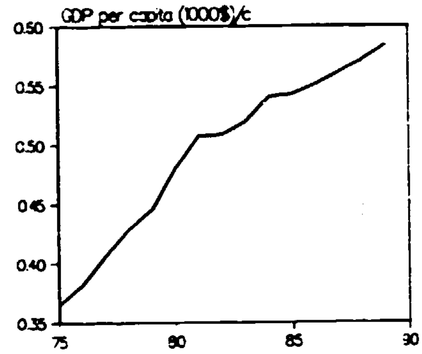
Annual growth rates of GDP and MVA
(constant 1980 prices)



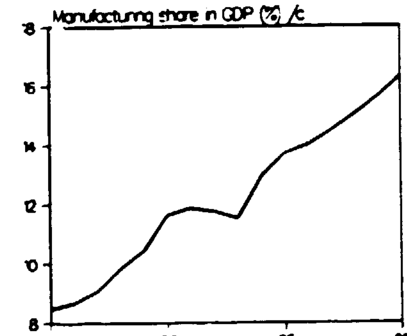
	1980	1985	1987
GDP: /na,c (millions of dollars)	72482	90366	96611
Per capita /na,c (dollars)	480	543	561
Manufacturing share /na,c (%)	11.6	13.7	14.5 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	8434	12382	13989 /e
Value added (millions of dollars)	4376	8097 /e	7097 /e
Industrial production index	100	108	122 /e
Gross output (millions of dollars)	12738	22171 /e	19549 /e
Employment (thousands)	963	1656 /e	1719 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	66	63	64 /e
Wages and salaries (%)	6	7	7 /e
Operating surplus (%)	29	30	29 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	11293	12517	10664 /e
Value added / worker	3528	3916	3455 /e
Average wage	743	929	777 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	4.58 /e	3.94 /e	5.99 /e
as a percentage of average θ in 1970-1975	187 /e	161 /e	244 /e
MVA growth rate / θ	3.15 /e	-0.09 /e	1.18 /e
Degree of specialization	29.1 /e	23.6 /e	22.2 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	376	870	728 /e
313 Beverages	51	77	70 /e
314 Tobacco products	649	741	770 /e
321 Textiles	420	687	761 /e
322 Wearing apparel	15	106	116 /e
323 Leather and fur products	5	14	21 /e
324 Footwear	26	31	30 /e
331 Wood and wood products	239	612	653 /e
332 Furniture and fixtures	6	18	19 /e
341 Paper and paper products	51	110	67 /e
342 Printing and publishing	51	92	124 /e
351 Industrial chemicals	145	428	327 /e
352 Other chemical products	241	388	309 /e
353 Petroleum refineries	978	1611	1157 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	164	328	189 /e
356 Plastic products	25	175	85 /e
361 Pottery, china and earthenware	8	24	23 /e
362 Glass and glass products	36	98	84 /e
369 Other non-metal mineral products	200	262	221 /e
371 Iron and steel	107	469	510 /e
372 Non-ferrous metals	-	- /e	- /e
381 Metal products	118	278	241 /e
382 Non-electrical machinery	63	76	49 /e
383 Electrical machinery	180	246	180 /e
384 Transport equipment	217	331	345 /e
385 Professional and scientific equipment	2	4	3 /e
390 Other manufacturing industries	13	24	24 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

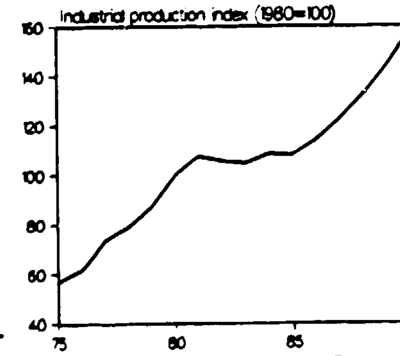
GDP per capita (1000$) /c



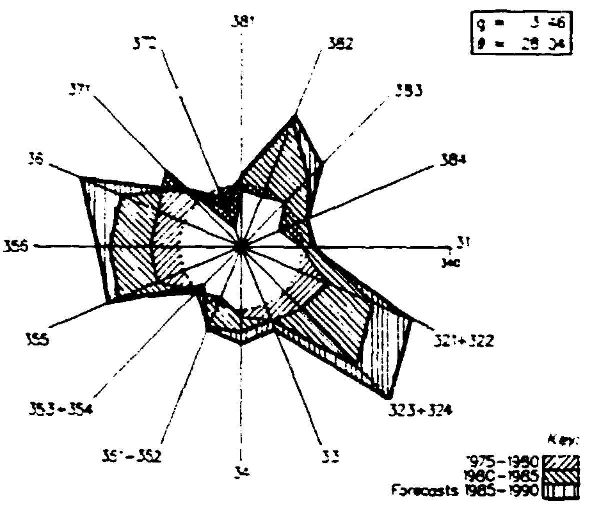
Manufacturing share in GDP (%) /c



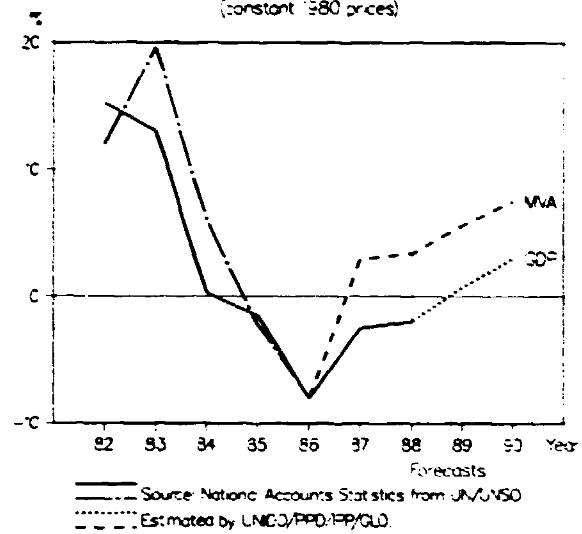
Industrial production index (1980=100)



Industrial structural change
(Index of value added: 1975=100)



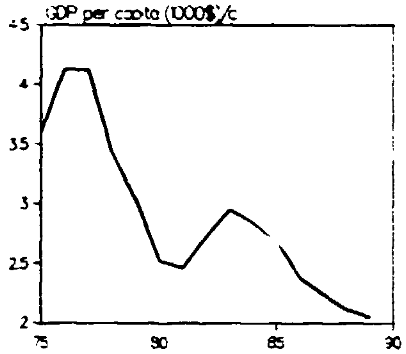
Annual growth rates of GDP and MVA
(constant 1980 prices)



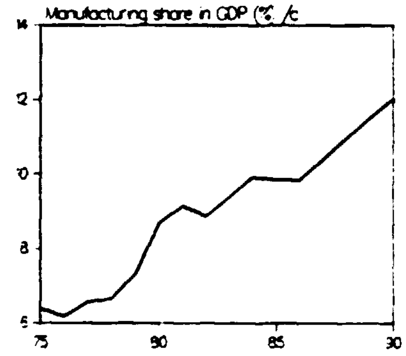
	1980	1985	1987
GDP: /na.c (millions of dollars)	98081	128079	114890
Per capita /na.c (dollars)	2521	2689	2239
Manufacturing share /na.c (%)	8.7	9.9	10.4 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	8528	12620	11957 /e
Value added (millions of dollars)	8185	11639 /e	21071 /e
Industrial production index	100	137	129 /e
Gross output (millions of dollars)	15869	24430 /e	44324 /e
Employment (thousands)	470	601 /e	629 /e
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	48	52 /e	52 /e
Wages and salaries (%)	29	25 /e	21 /e
Operating surplus (%)	23	23 /e	26 /e
-PRODUCTIVITY:(dollars)			
Gross output / worker	33753	40640 /e	70476 /e
Value added / worker	17409	19363 /e	33504 /e
Average wage	9667	9962 /e	14979 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	6.54 /e	3.41 /e	3.87 /e
as a percentage of average θ in 1970-1975	89 /e	46 /e	53 /e
MVA growth rate / θ	1.89 /e	-0.39 /e	0.76 /e
Degree of specialization	19.3 /e	18.4 /c	18.7 /e
-VALUE ADDED:(millions of dollars)			
311 Food products	930	1069 /e	1639 /e
313 Beverages	145	244 /e	471 /e
314 Tobacco products	190	84 /e	127 /e
321 Textiles	1329	2360 /e	4983 /e
322 Wearing apparel	78	73 /e	116 /e
323 Leather and fur products	36	83 /e	173 /e
324 Footwear	100	187 /e	387 /e
331 Wood and wood products	68	114 /e	184 /e
332 Furniture and fixtures	33	50 /e	106 /e
341 Paper and paper products	135	280 /e	590 /e
342 Printing and publishing	80	113 /e	237 /e
351 Industrial chemicals	93	213 /e	304 /e
352 Other chemical products	278	597 /e	923 /e
353 Petroleum refineries	1652	61 /e	92 /e
354 Miscellaneous petroleum and coal products	2	14 /e	29 /e
355 Rubber products	93	197 /e	421 /e
356 Plastic products	198	303 /e	641 /e
361 Pottery, china and earthenware	45	61 /e	94 /e
362 Glass and glass products	115	180 /e	278 /e
369 Other non-metal mineral products	819	1235 /e	1903 /e
371 Iron and steel	367	714 /e	1160 /e
372 Non-ferrous metals	48	222 /e	472 /e
381 Metal products	319	507 /e	783 /e
382 Non-electrical machinery	206	678 /e	1043 /e
383 Electrical machinery	391	699 /e	1091 /e
384 Transport equipment	399	1211 /e	2576 /e
385 Professional and scientific equipment	24	66 /e	135 /e
390 Other manufacturing industries	11	28 /e	66 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this annex.

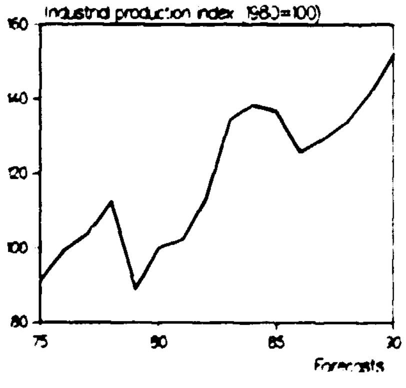
GDP per capita (1000$)/c



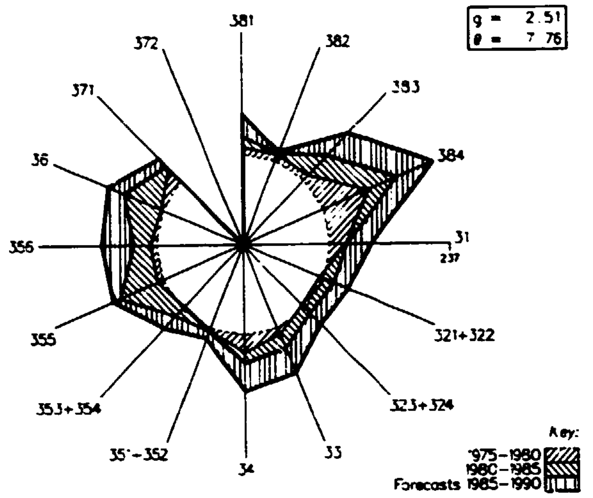
Manufacturing share in GDP (%) /c



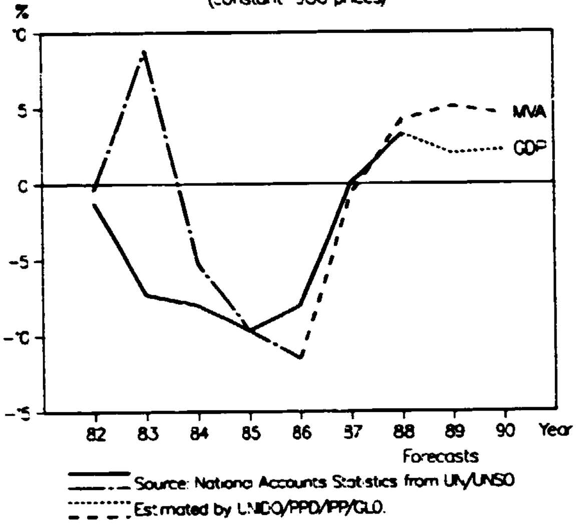
Industrial production index (1980=100)



Industrial structural change
(Index of value added: 1975=100)



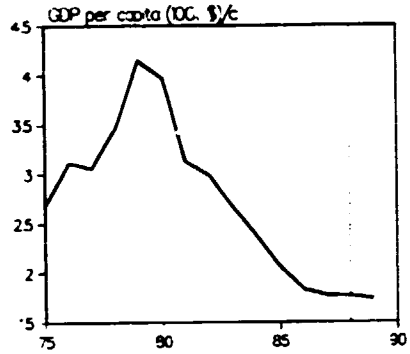
Annual growth rates of GDP and MVA
(constant 1980 prices)



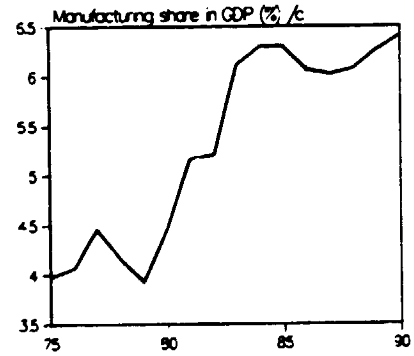
	1980	1985	1987
GDP: /na,c (millions of dollars)	52749	32831	30194
Per capita /na,c (dollars)	3969	2065	1770
Manufacturing share /na,c (%)	4.5	6.3	6.0 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	2363	2070	1818 /e
Value added (millions of dollars)	1760 /e	3676	4983 /e
Industrial production index	100	115	118 /e
Gross output (millions of dollars)	4630 /e	7162	8670 /e
Employment (thousands)	177	174	184 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	62 /e	49 /e	43 /e
Wages and salaries (%)	14 /e	13 /e	14 /e
Operating surplus (%)	24 /e	39 /e	44 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	26516 /e	41090 /e	47073 /e
Value added / worker	10101 /e	21088 /e	27057 /e
Average wage	3700	5242 /e	6406 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	7.93 /e	2.84 /e	1.31 /e
as a percentage of average θ in 1970-1975	106 /e	38 /e	18 /e
MVA growth rate / θ	-2.33 /e	1.23 /e	0.18 /e
Degree of specialization	13.6 /e	13.6 /e	13.7 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	184 /e	396	384 /e
313 Beverages	62 /e	125	142 /e
314 Tobacco products	86 /e	140	175 /e
321 Textiles	190 /e	248	293 /e
322 Wearing apparel	37 /e	53	53 /e
323 Leather and fur products	26 /e	1	1 /e
324 Footwear	13 /e	81	95 /e
331 Wood and wood products	1 /e	1	1 /e
332 Furniture and fixtures	9 /e	13	19 /e
341 Paper and paper products	38 /e	52	112 /e
342 Printing and publishing	23 /e	33	63 /e
351 Industrial chemicals	61 /e	151	227 /e
352 Other chemical products	144 /e	389	625 /e
353 Petroleum refineries	329 /e	868	1319 /e
354 Miscellaneous petroleum and coal products	23 /e	40	66 /e
355 Rubber products	5 /e	10	17 /e
356 Plastic products	12 /e	33	49 /e
361 Pottery, china and earthenware	1 /e	1	1 /e
362 Glass and glass products	19 /e	35	43 /e
369 Other non-metal mineral products	197 /e	566	701 /e
371 Iron and steel	4 /e	20 /e	26 /e
372 Non-ferrous metals	- /e	- /e	- /e
381 Metal products	47 /e	47	101 /e
382 Non-electrical machinery	129 /e	149	180 /e
383 Electrical machinery	109 /e	186	210 /e
384 Transport equipment	10 /e	40	79 /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.

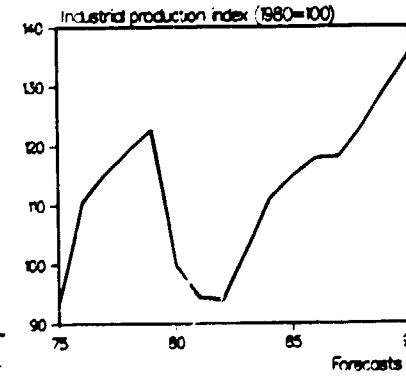
GDP per capita (100 $)/c

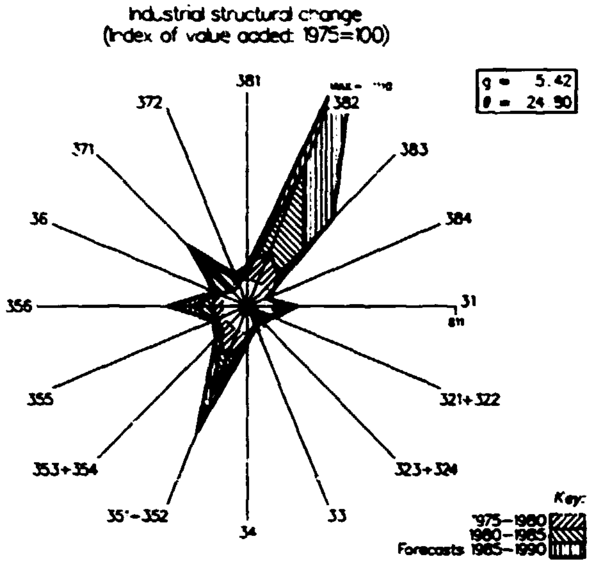


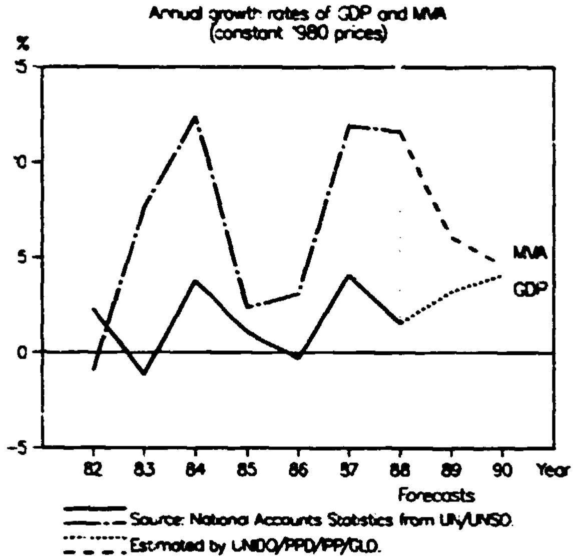
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

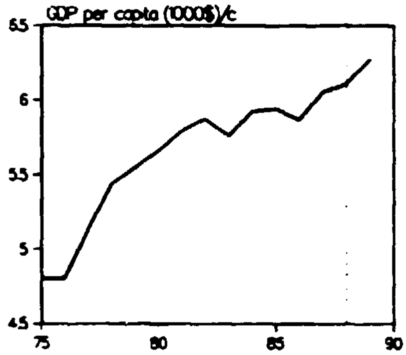


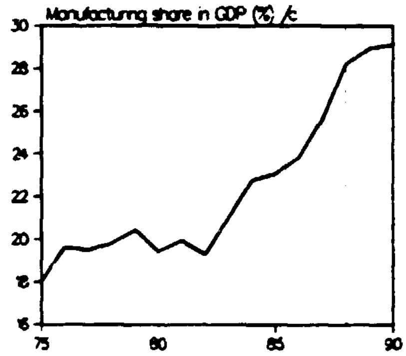


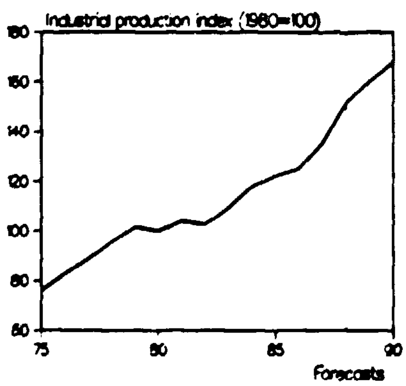


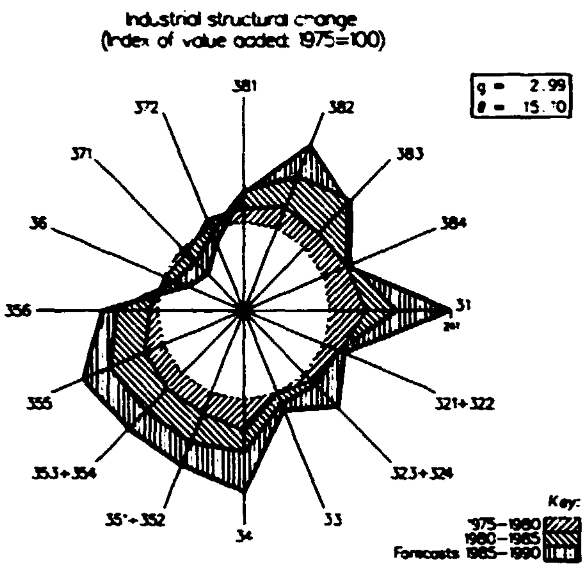
	1980	1985	1987
GDP: /na,c (millions of dollars)	19261	21107	21898
Per capita /na,c (dollars)	5662	5941	6052
Manufacturing share /na,c (%)	19.4	23.1	25.6
MANUFACTURING:			
Value added /na,c (millions of dollars)	3744	4867	5615
Value added (millions of dollars)	5700	6140 /e	9838 /e
Industrial production index	100	122	136
Gross output (millions of dollars)	15906	15836 /e	25584 /e
Employment (thousands)	225	189	190 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	64	61 /e	62 /e
Wages and salaries (%)	16	13 /e	12 /e
Operating surplus (%)	20	26 /e	26 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	70785	83609 /e	134485 /e
Value added / worker	25369	32417 /e	51713 /e
Average wage	11067	10656 /e	16501 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.86	2.83	3.33
as a percentage of average θ in 1970-1975	138	102	119
MVA growth rate / θ	-0.42	1.29	2.54
Degree of specialization	16.0	18.5	20.6
-VALUE ADDED: (millions of dollars)			
311 Food products	1264	1201	2011 /e
313 Beverages	325	308	464 /e
314 Tobacco products	83	84	110 /e
321 Textiles	266	177	251 /e
322 Wearing apparel	147	112	166 /e
323 Leather and fur products	28	11	12 /e
324 Footwear	42	22	25 /e
331 Wood and wood products	93	74 /e	111 /e
332 Furniture and fixtures	59	36 /e	57 /e
341 Paper and paper products	105	80	133 /e
342 Printing and publishing	265	206	321 /e
351 Industrial chemicals	236	336 /e	513 /e
352 Other chemical products	536	748 /e	1145 /e
353 Petroleum refineries	22	18	27 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	62	53	77 /e
356 Plastic products	113	126	195 /e
361 Pottery, china and earthenware	28	24 /e	30 /e
362 Glass and glass products	109	96 /e	126 /e
369 Other non-metal mineral products	322	275 /e	373 /e
371 Iron and steel	31	34 /e	51 /e
372 Non-ferrous metals	15	10 /e	17 /e
381 Metal products	336	226	312 /e
382 Non-electrical machinery	449	869	1624 /e
383 Electrical machinery	337	577	932 /e
384 Transport equipment	190	122	176 /e
385 Professional and scientific equipment	168	274	476 /e
390 Other manufacturing industries	79	64 /e	94 /e

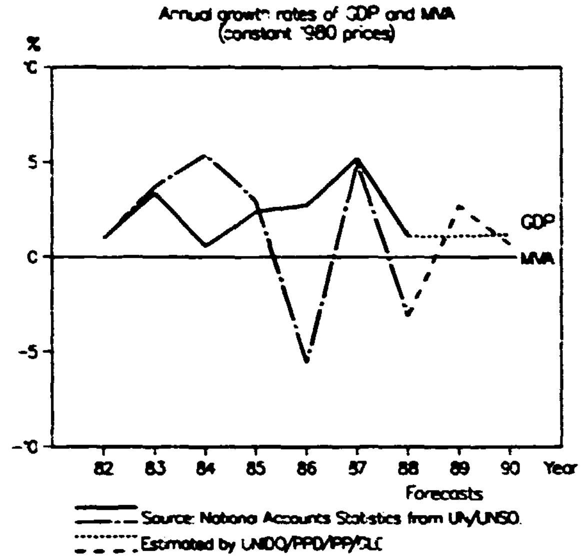
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





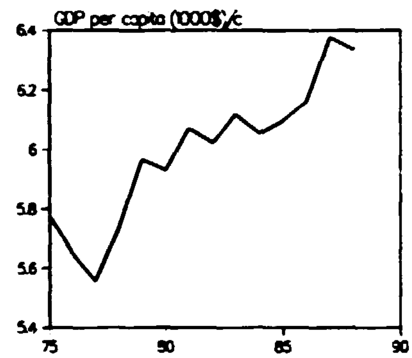


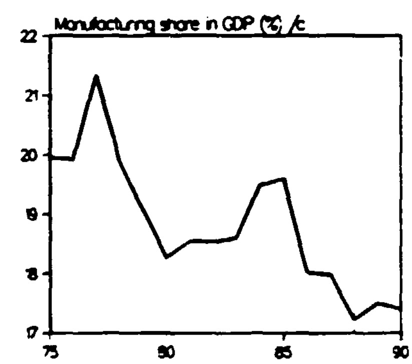


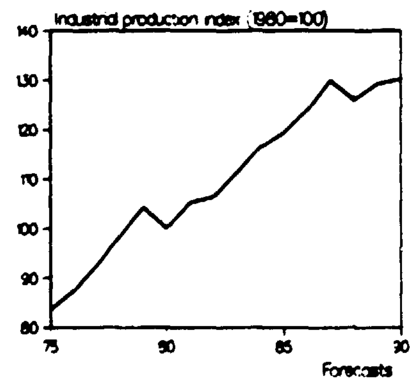


	1980	1985	1987
GDP: /na.c (millions of dollars)	23000	25809	27888
Per capita /na.c (dollars)	5929	6086	6377
Manufacturing share /na.c (%)	18.3	19.6	18.0
MANUFACTURING:			
Value added /na.c (millions of dollars)	4200	5059	5015
Value added (millions of dollars)	6490	7686	10963
Industrial production index	100	119	130
Gross output (millions of dollars)	14332	14431	19704 /e
Employment (thousands)	259	278	287 /e
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	55	47 /e	44 /e
Wages and salaries (%)	24	15	16 /e
Operating surplus (%)	21	38 /e	39 /e
-PRODUCTIVITY:(dollars)			
Gross output / worker	55422	51873	68621 /e
Value added / worker	25096	27663 /e	38180 /e
Average wage	13433	7861	11205 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.79	2.86	0.66 /e
as a percentage of average θ in 1970-1975	54	87	20 /e
MVA growth rate / θ	-2.29	0.86	7.50 /e
Degree of specialization	13.7	14.5	14.2 /e
-VALUE ADDED:(millions of dollars)			
311 Food products	706	978 /e	1435 /e
313 Beverages	66	80 /e	107 /e
314 Tobacco products	24	19 /e	21 /e
321 Textiles	422	247 /e	322 /e
322 Wearing apparel	293	200 /e	288 /e
323 Leather and fur products	18	12 /e	16 /e
324 Footwear	38	57 /e	80 /e
331 Wood and wood products	112	93 /e	122 /e
332 Furniture and fixtures	90	76 /e	99 /e
341 Paper and paper products	150	165 /e	240 /e
342 Printing and publishing	184	360 /e	511 /e
351 Industrial chemicals	256	343 /e	506 /e
352 Other chemical products	250	288 /e	412 /e
353 Petroleum refineries	93	136 /e	206 /e
354 Miscellaneous petroleum and coal products	93	136 /e	206 /e
355 Rubber products	104	78 /e	103 /e
356 Plastic products	212	261 /e	381 /e
361 Pottery, china and earthenware	26	15 /e	17 /e
362 Glass and glass products	30	18 /e	21 /e
369 Other non-metal mineral products	239	279 /e	370 /e
371 Iron and steel	148	103 /e	136 /e
372 Non-ferrous metals	61	50 /e	64 /e
381 Metal products	1050	1327 /e	1975 /e
382 Non-electrical machinery	246	230 /e	329 /e
383 Electrical machinery	831	1498 /e	2163 /e
384 Transport equipment	610	500 /e	616 /e
385 Professional and scientific equipment	66	98 /e	142 /e
390 Other manufacturing industries	63	62 /e	73 /e

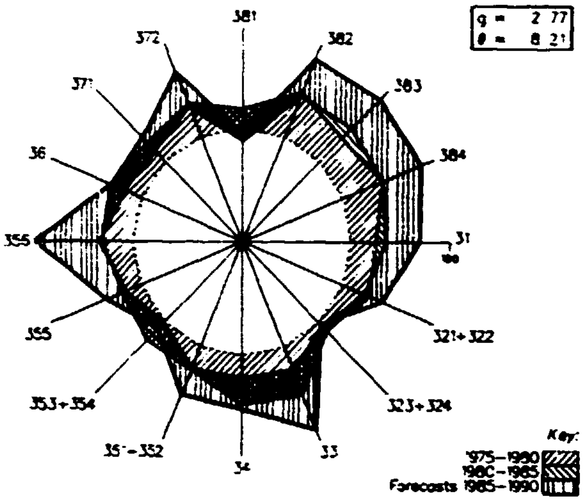
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



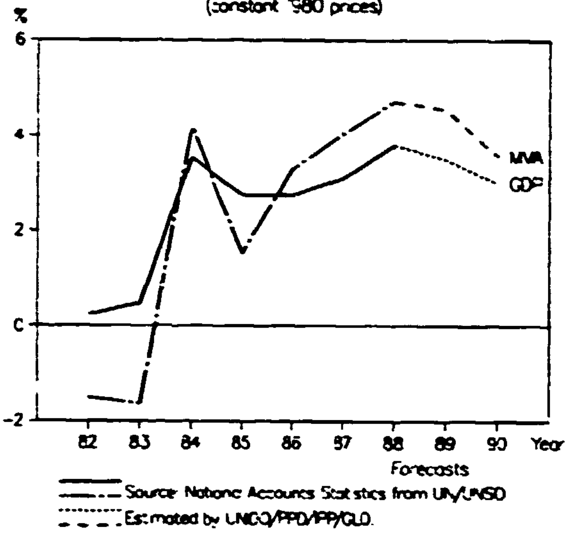




Industrial structural change (Index of value added: 1975=100)



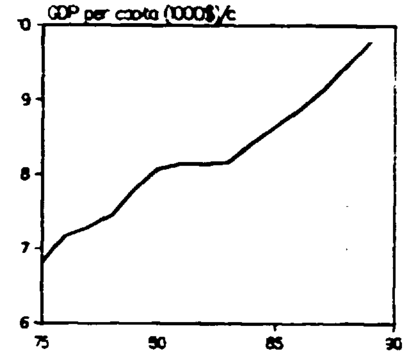
Annual growth rates of GDP and MVA (constant 1980 prices)



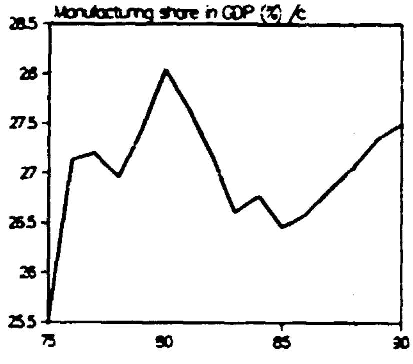
	1980	1985	1987
GDP: /na,c (millions of dollars)	455873	493974	523304
Per capita /na,c (dollars)	8078	8547	9142
Manufacturing share /na,c (%)	28.0	26.5	26.8
MANUFACTURING:			
Value added /na,c (millions of dollars)	127865	130691	140445
Value added (millions of dollars)	97032	64726	113477 /e
Industrial production index	100	96	102
Gross output (millions of dollars)	250912	212912	371995
Employment (thousands)	3333	2875	2811 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	61	70	69 /e
Wages and salaries (%)	15	13	13 /e
Operating surplus (%)	24	17	18 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	75281	74056	132318 /e
Value added / worker	29112	22513	40364 /e
Average wage	10926	9556	17026 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.83	4.09	2.68 /e
as a percentage of average θ in 1970-1975	96	139	87 /e
MVA growth rate / θ	2.11	0.11	1.57 /e
Degree of specialization	7.7	8.2	8.3 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	6362	3618	6396 /e
313 Beverages	1672	1354	2517 /e
314 Tobacco products	307	224	347 /e
321 Textiles	6716	5062	8915 /e
322 Wearing apparel	3197	2322	4065 /e
323 Leather and fur products	718	560	926 /e
324 Footwear	1495	1260	2046 /e
331 Wood and wood products	1318	786	1319 /e
332 Furniture and fixtures	1936	1257	2494 /e
341 Paper and paper products	2260	1661	2919 /e
342 Printing and publishing	3017	2271	3867 /e
351 Industrial chemicals	5983	3994	7269 /e
352 Other chemical products	4439	2696	4101 /e
353 Petroleum refineries	1275	1065	1851 /e
354 Miscellaneous petroleum and coal products	58	42	46 /e
355 Rubber products	1832	1107	2006 /e
356 Plastic products	1465	1729	3391 /e
361 Pottery, china and earthenware	1897	1139	2301 /e
362 Glass and glass products	1116	666	1183 /e
369 Other non-metal mineral products	3667	2043	2989 /e
371 Iron and steel	8364	3846	6259 /e
372 Non-ferrous metals	1315	875	1569 /e
381 Metal products	5687	3405	5366 /e
382 Non-electrical machinery	9326	8914	16157 /e
383 Electrical machinery	8436	5612	10410 /e
384 Transport equipment	10280	6172	11443 /e
385 Professional and scientific equipment	2032	660	916 /e
390 Other manufacturing industries	871	297	460 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

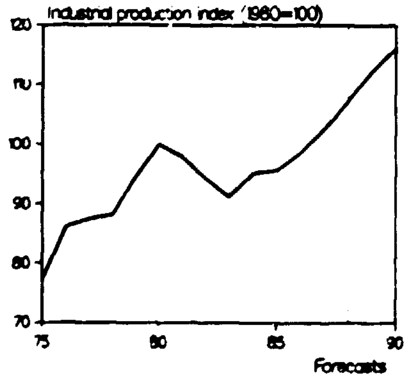
GDP per capita (1000$)/c



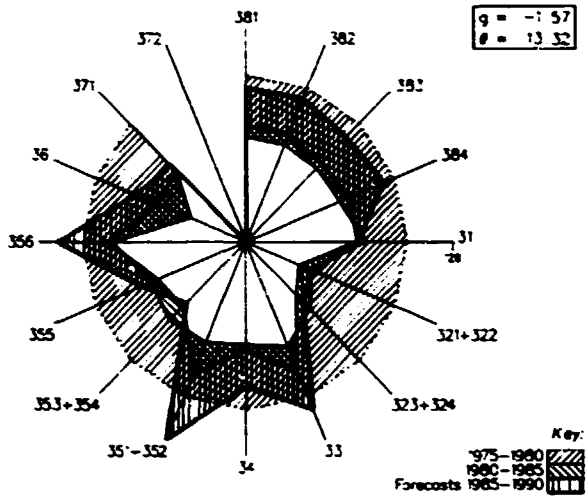
Manufacturing share in GDP (%) /c



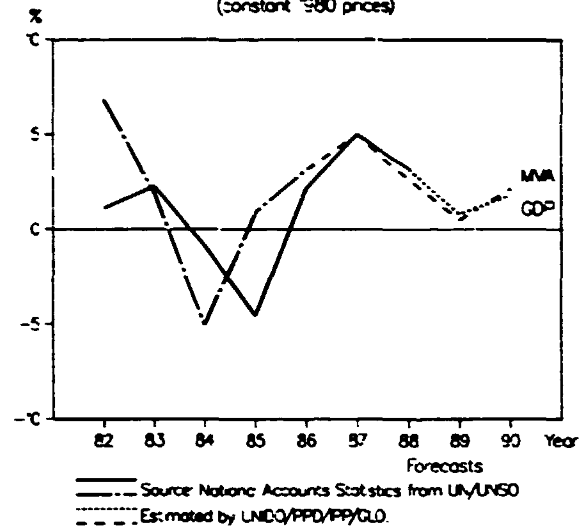
Industrial production index (1980=100)



Industrial structural change
(Index of value added 1975=100)



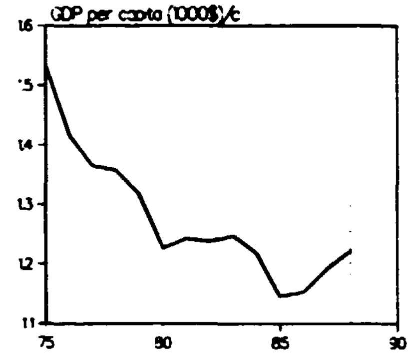
Annual growth rates of GDP and MVA
(constant 1980 prices)



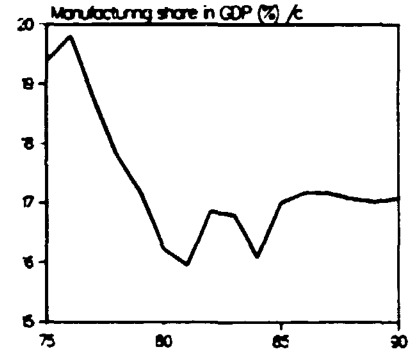
	1980	1985	1987
GDP: /na.c (millions of dollars)	2667	2678	2872
Per capita /na.c (dollars)	1227	1145	1192
Manufacturing share /na.c (%)	16.2	17.0	17.2 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	433	455	493 /e
Value added (millions of dollars)	435 /e	345 /e	462 /e
Industrial production index	100	101	113 /e
Gross output (millions of dollars)	2161 /e	2009 /e	2836 /e
Employment (thousands)	44	48 /e	51 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	80 /e	83 /e	84 /e
Wages and salaries (%)	9 /e	7 /e	7 /e
Operating surplus (%)	10 /e	10 /e	9 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	48936 /e	41697 /e	56551 /e
Value added / worker	9816 /e	7133 /e	9014 /e
Average wage	4608 /e	2969 /e	3798 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	8.35 /e	5.06 /e	1.58 /e
as a percentage of average θ in 1970-1975	166 /e	101 /e	31 /e
MVA growth rate / θ	-1.40 /e	1.07 /e	3.14 /e
Degree of specialization	19.1 /e	18.6 /e	17.1 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	78	80 /e	107 /e
313 Beverages	63	47 /e	62 /e
314 Tobacco products	61	46 /e	68 /e
321 Textiles	3	2 /e	3 /e
322 Wearing apparel	15	11 /e	15 /e
323 Leather and fur products	2	2 /e	3 /e
324 Footwear	8	4 /e	5 /e
331 Wood and wood products	3	2 /e	2 /e
332 Furniture and fixtures	12	13 /e	19 /e
341 Paper and paper products	3 /e	12 /e	17 /e
342 Printing and publishing	18 /e	10 /e	11 /e
351 Industrial chemicals	9 /e	8 /e	10 /e
352 Other chemical products	27 /e	28 /e	40 /e
353 Petroleum refineries	55	26 /e	38 /e
354 Miscellaneous petroleum and coal products	9 /e	9 /e	13 /e
355 Rubber products	2 /e	1 /e	2 /e
356 Plastic products	2 /e	1 /e	2 /e
361 Pottery, china and earthenware	1 /e	1 /e	1 /e
362 Glass and glass products	2 /e	3 /e	4 /e
369 Other non-metal mineral products	9 /e	14 /e	19 /e
371 Iron and steel	12 /e	4 /e	6 /e
372 Non-ferrous metals	- /e	- /e	- /e
381 Metal products	14 /e	6 /e	7 /e
382 Non-electrical machinery	3 /e	1 /e	2 /e
383 Electrical machinery	7 /e	3 /e	4 /e
384 Transport equipment	15 /e	6 /e	8 /e
385 Professional and scientific equipment	- /e	- /e	- /e
390 Other manufacturing industries	4	3 /e	4 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

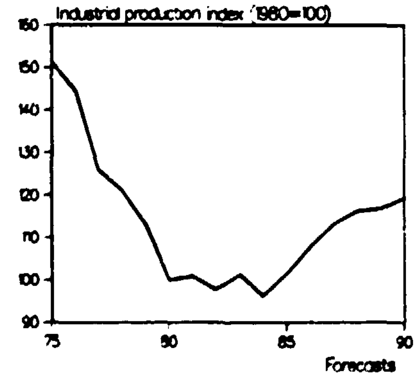
GDP per capita (1000$)/c



Manufacturing share in GDP (%) /c

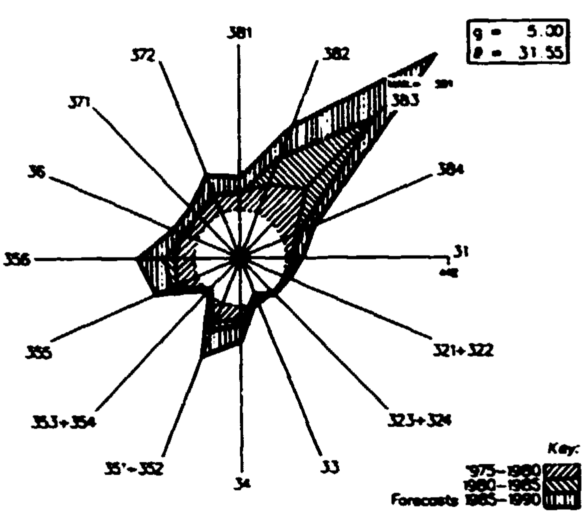


Industrial production index (1980=100)

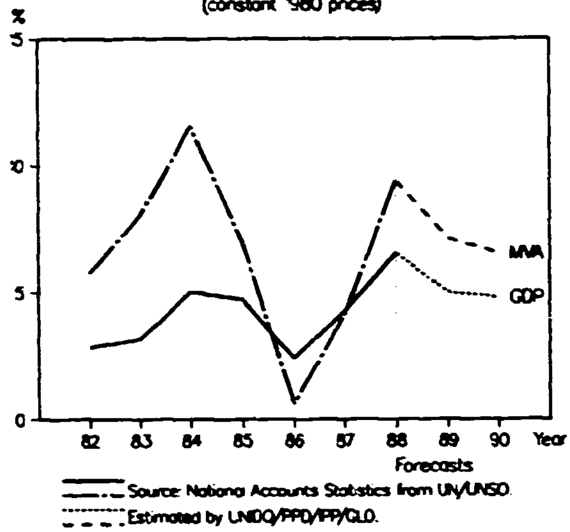


JAPAN

Industrial structural change
(Index of value added: 1975=100)



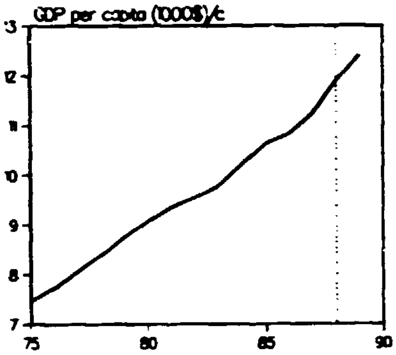
Annual growth rates of GDP and MVA
(constant 1980 prices)



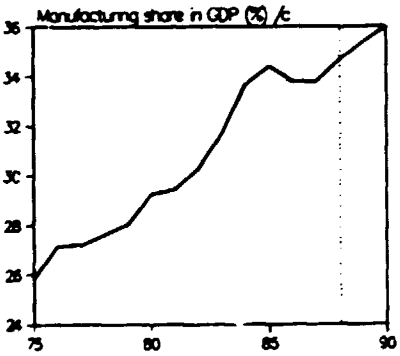
	1980	1985	1987
GDP: /na,c (millions of dollars)	1059262	1283335	1388686
Per capita /na,c (dollars)	9068	10628	11235
Manufacturing share /na,c (%)	29.2	34.4	33.8
MANUFACTURING:			
Value added /na,c (millions of dollars)	309747	441537	462488
Value added (millions of dollars)	338234	4:2505	686944
Industrial production index	100	119	123
Gross output (millions of dollars)	970669	1106291	1826122
Employment (thousands)	10253	10646	10650 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	65	63	62 /e
Wages and salaries (%)	12	13	14 /e
Operating surplus (%)	23	24	24 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	94662	103916	171469 /e
Value added / worker	33086	38747	65442 /e
Average wage	11522	13653	23782 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	4.26	1.71	2.03
as a percentage of average θ in 1970-1975	127	51	60
MVA growth rate / θ	1.17	2.18	1.57
Degree of specialization	13.5	17.7	18.3
-VALUE ADDED: (millions of dollars)			
311 Food products	25899	32032	57062 /e
313 Beverages	5015	6307	9662 /e
314 Tobacco products	1888	700	1438 /e
321 Textiles	15436	16259	24361 /e
322 Wearing apparel	5156	5622	10384 /e
323 Leather and fur products	886	981	1686 /e
324 Footwear	897	858	1136 /e
331 Wood and wood products	8997	6888	12516 /e
332 Furniture and fixtures	3788	3756	6982 /e
341 Paper and paper products	9310	9759	17306 /e
342 Printing and publishing	17099	20789	38477 /e
351 Industrial chemicals	13809	16811	31758 /e
352 Other chemical products	15471	19758	36878 /e
353 Petroleum refineries	6620	4586	6239 /e
354 Miscellaneous petroleum and coal products	1063	713	1372 /e
355 Rubber products	4150	5077	8683 /e
356 Plastic products	9478	13670	24237 /e
361 Pottery, china and earthenware	1623	1627	2863 /e
362 Glass and glass products	2876	4029	6636 /e
369 Other non-metal mineral products	12566	12321	22333 /e
371 Iron and steel	28444	26224	36362 /e
372 Non-ferrous metals	7458	5236	7839 /e
381 Metal products	22409	26366	46823 /e
382 Non-electrical machinery	38270	53680	86607 /e
383 Electrical machinery	38868	63176	106166 /e
384 Transport equipment	32107	46158	71768 /e
385 Professional and scientific equipment	5685	6972	11862 /e
390 Other manufacturing industries	5178	6610	11148 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

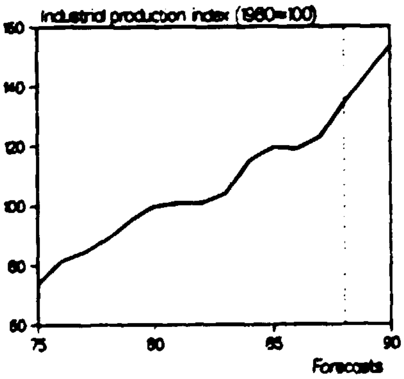
GDP per capita (1000$)/c

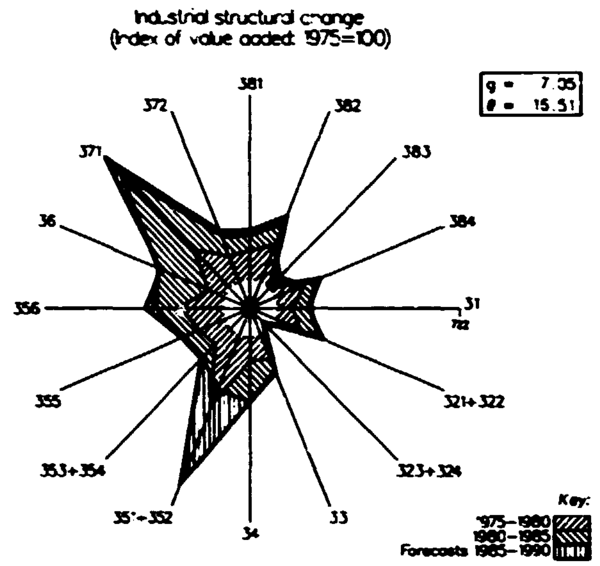


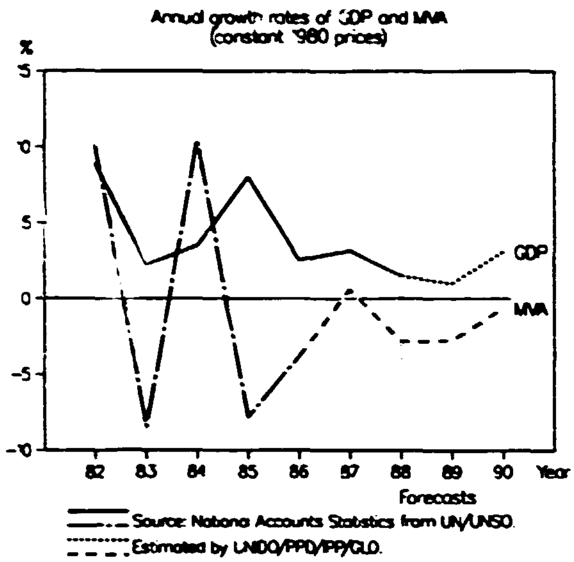
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

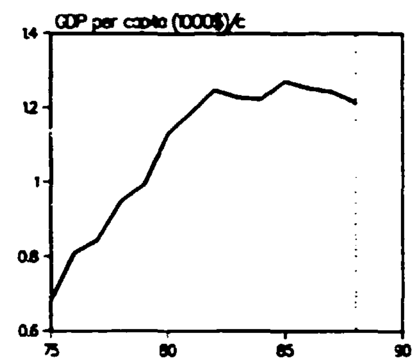


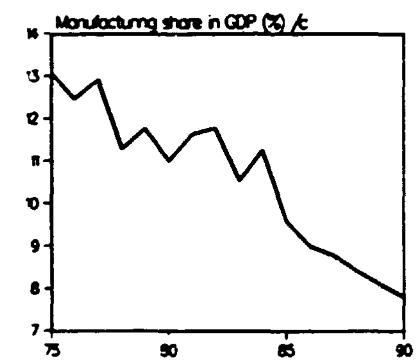


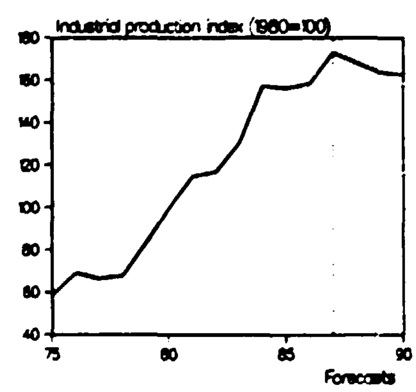


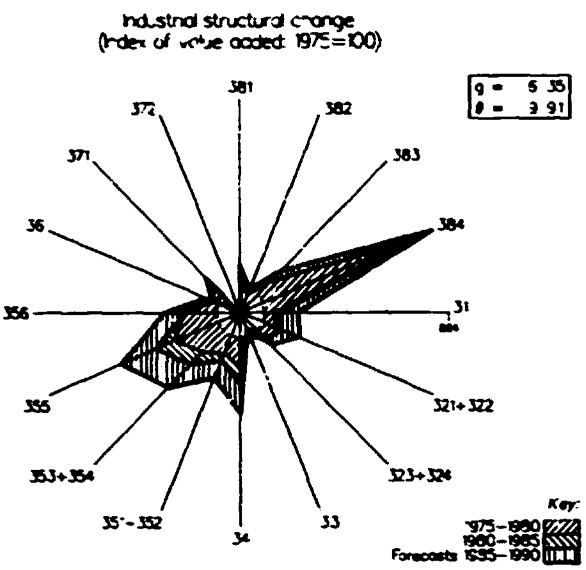
	1980	1985	1987
GDP: /na,c (millions of dollars)	3303	4458	4716
Per capita /na,c (dollars)	1130	1271	1244
Manufacturing share /na,c (%)	11.0	9.6	8.8 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	363	428	414 /e
Value added (millions of dollars)	398	580	752
Industrial production index	100	156	173
Gross output (millions of dollars)	917	1997	2246 /e
Employment (thousands)	25	42	44 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	57 /e	71 /e	67 /e
Wages and salaries (%)	12 /e	9 /e	10 /e
Operating surplus (%)	32 /e	20 /e	24 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	37178 /e	47681 /e	51217 /e
Value added / worker	16121 /e	13841 /e	17166 /e
Average wage	4358 /e	4326 /e	5013 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	8.24 /e	4.68 /e	1.60 /e
as a percentage of average θ in 1970-1975	96 /e	55 /e	19 /e
MVA growth rate / θ	2.47 /e	-0.13 /e	5.81 /e
Degree of specialization	20.0 /e	26.4 /e	24.4 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	24	48	62 /e
313 Beverages	20	27	32 /e
314 Tobacco products	63	92	118 /e
321 Textiles	10	14	13 /e
322 Wearing apparel	8	10	16 /e
323 Leather and fur products	2	1	3 /e
324 Footwear	8	8	5 /e
331 Wood and wood products	1	1	1 /e
332 Furniture and fixtures	17	17	23 /e
341 Paper and paper products	9	9	14 /e
342 Printing and publishing	7	11	20 /e
351 Industrial chemicals	1 /e	2 /e	1 /e
352 Other chemical products	23 /e	40 /e	55 /e
353 Petroleum refineries	53	87	91 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	-	-	- /e
356 Plastic products	12	13	18 /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	2	2	3 /e
369 Other non-metal mineral products	98	126	165 /e
371 Iron and steel	12 /e	10 /e	26 /e
372 Non-ferrous metals	4 /e	2 /e	5 /e
381 Metal products	24 /e	29 /e	37 /e
382 Non-electrical machinery	4 /e	5 /e	8 /e
383 Electrical machinery	2	2	3 /e
384 Transport equipment	-	1	1 /e
385 Professional and scientific equipment	-	-	- /e
390 Other manufacturing industries	7	23	33 /e

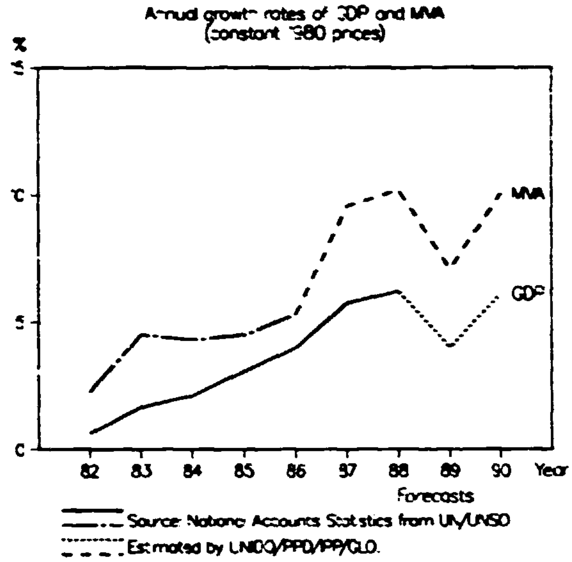
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





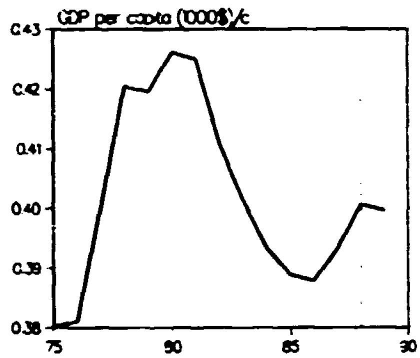


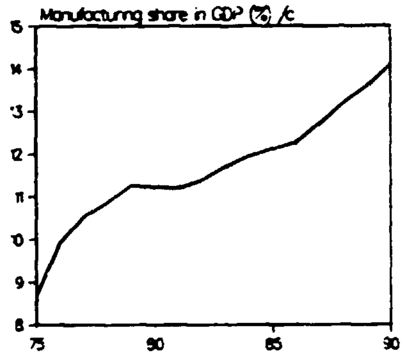


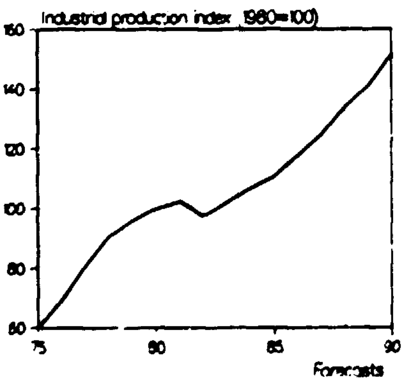


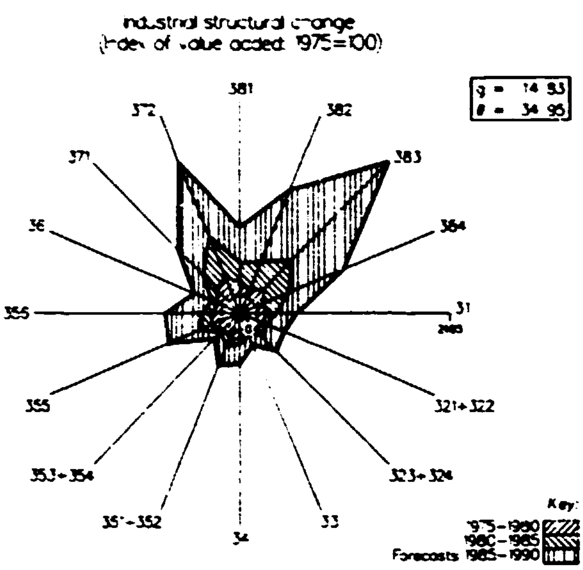
	1980	1985	1987
GDP: /na,c (millions of dollars)	7088	7916	8706
Per capita /na,c (dollars)	426	389	393
Manufacturing share /na,c (%)	11.2	12.1	12.7 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	796	960	1107 /e
Value added (millions of dollars)	887	640	787 /e
Industrial production index	100	111	125 /e
Gross output (millions of dollars)	4634	3866	5235 /e
Employment (thousands)	162	191	205
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	81	83	85 /e
Wages and salaries (%)	8	8	7 /e
Operating surplus (%)	11	9	8 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	28630	20190	25135 /e
Value added / worker	5482	3342	3807 /e
Average wage	2363	1586	1781 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	4.04	2.58	0.29 /e
as a percentage of average θ in 1970-1975	99	63	7 /e
MVA growth rate / θ	1.07	1.36	19.90 /e
Degree of specialization	14.6	16.8	17.1 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	259	166	213 /e
313 Beverages	66	60	70 /e
314 Tobacco products	24	20	22 /e
321 Textiles	68	45	62 /e
322 Wearing apparel	13	17	20 /e
323 Leather and fur products	7	2	3 /e
324 Footwear	13	5	6 /e
331 Wood and wood products	23	13	16 /e
332 Furniture and fixtures	20	11	14 /e
341 Paper and paper products	34	26	34 /e
342 Printing and publishing	28	22	26 /e
351 Industrial chemicals	20	16	19 /e
352 Other chemical products	56	56	65 /e
353 Petroleum refineries	13	12	13 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	37	25	33 /e
356 Plastic products	8	5	8 /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	3	3	4 /e
369 Other non-metal mineral products	29	15	18 /e
371 Iron and steel	11a	6a	8a/e
372 Non-ferrous metals	-a	-a	-a/e
381 Metal products	66	20	24 /e
382 Non-electrical machinery	22	9	10 /e
383 Electrical machinery	40	41	48 /e
384 Transport equipment	45	32	36 /e
385 Professional and scientific equipment	-	-	- /e
390 Other manufacturing industries	4	10	13 /e

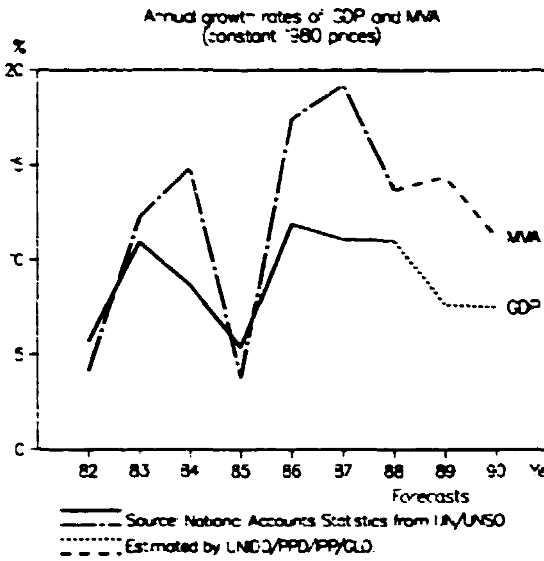
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.











	1980	1985	1987
GDP: /na.c (millions of dollars)	62419	90009	111841
Per capita /na.c (dollars)	1637	2192	2655
Manufacturing share /na.c (%)	29.6	30.7	34.6
MANUFACTURING:			
Value added /na.c (millions of dollars)	18462	27666	38734
Value added (millions of dollars)	19520	30731	49044
Industrial production index	100	171	255
Gross output (millions of dollars)	59725	88541	143691
Employment (thousands)	2015	2395	2614 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	67	66	66 /e
Wages and salaries (%)	10	9	8 /e
Operating surplus (%)	23	25	27 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	29645	36963	54960 /e
Value added / worker	9689	12829	18759 /e
Average wage	2837	3476	4134 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	6.87	2.59	5.47
as a percentage of average θ in 1970-1975	93	35	74
MVA growth rate / θ	-0.47	1.76	3.80
Degree of specialization	10.4	12.3	15.5
-VALUE ADDED: (millions of dollars)			
311 Food products	1526	2048	3266 /e
313 Beverages	571	764	1217 /e
314 Tobacco products	1143	1442	2303 /e
321 Textiles	2649	3296	5247 /e
322 Wearing apparel	905	1293	2067 /e
323 Leather and fur products	138	270	431 /e
324 Footwear	112	211	339 /e
331 Wood and wood products	239	262	416 /e
332 Furniture and fixtures	100	203	324 /e
341 Paper and paper products	426	682	1088 /e
342 Printing and publishing	440	732	1165 /e
351 Industrial chemicals	998	1275	2028 /e
352 Other chemical products	1016	1422	2269 /e
353 Petroleum refineries	757	1079	1708 /e
354 Miscellaneous petroleum and coal products	211	291	461 /e
355 Rubber products	667	910	1454 /e
356 Plastic products	369	709	1131 /e
361 Pottery, china and earthenware	89	107	171 /e
362 Glass and glass products	198	307	490 /e
369 Other non-metal mineral products	838	1064	1695 /e
371 Iron and steel	1266	2040	3262 /e
372 Non-ferrous metals	265	334	536 /e
381 Metal products	635	1237	1978 /e
382 Non-electrical machinery	672	1453	2327 /e
383 Electrical machinery	1587	3621	5797 /e
384 Transport equipment	1162	2791	4468 /e
385 Professional and scientific equipment	214	290	464 /e
0 Other manufacturing industries	367	598	954 /e

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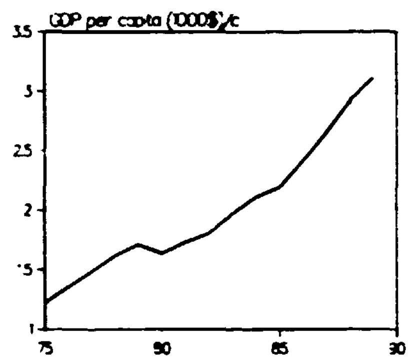

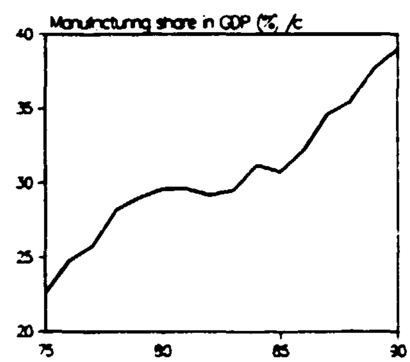

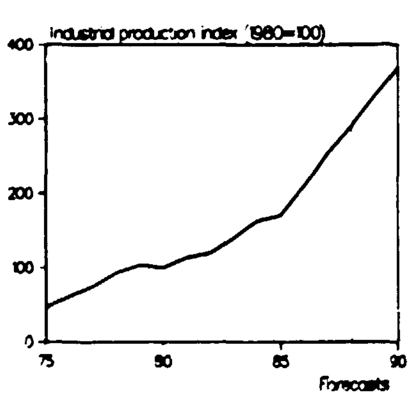

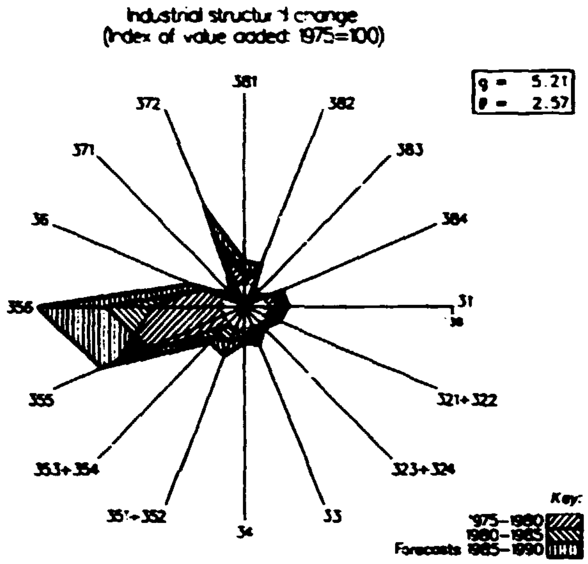

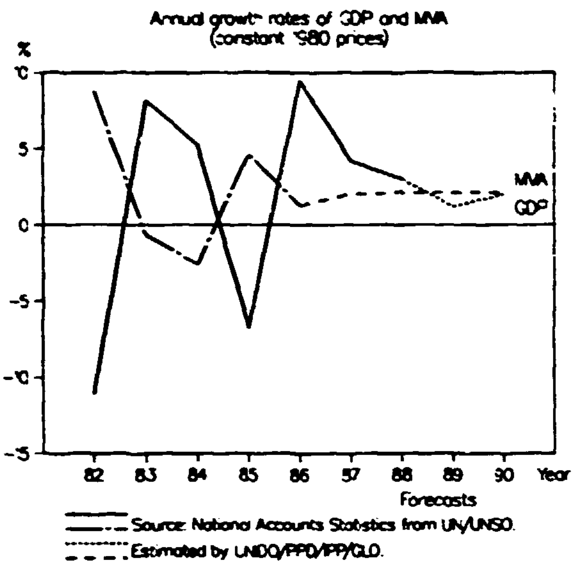

	1980	1985	1987
GDP: /na,c (millions of dollars)	28670	21911	24987
Per capita /na,c (dollars)	20836	12806	13427
Manufacturing share /na,c (%)	5.5	7.7	7.0 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	1581	1689	1745 /e
Value added (millions of dollars)	1752	1250 /e	1524 /e
Industrial production index	100	141	159 /e
Gross output (millions of dollars)	6218 /e	7410 /e	9237 /e
Employment (thousands)	43 /e	47 /e	51 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	72 /e	83 /e	84 /e
Wages and salaries (%)	6 /e	8 /e	7 /e
Operating surplus (%)	22 /e	9 /e	9 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	144834 /e	156322 /e	181294 /e
Value added / worker	40802 /e	26369 /e	29915 /e
Average wage	9037 /e	11728 /e	13410 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.50 /e	2.78 /e	0.44 /e
as a percentage of average θ in 1970-1975	196 /e	156 /e	25 /e
MVA growth rate / θ	-2.21 /e	4.71 /e	8.10 /e
Degree of specialization	40.2 /e	48.2 /e	47.8 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	96	112 /e	143 /e
313 Beverages	20	28 /e	32 /e
314 Tobacco products	-	- /e	- /e
321 Textiles	7	11 /e	14 /e
322 Wearing apparel	84	83 /e	104 /e
323 Leather and fur products	-	- /e	- /e
324 Footwear	-	- /e	- /e
331 Wood and wood products	40	26 /e	26 /e
332 Furniture and fixtures	41	39 /e	38 /e
341 Paper and paper products	5	13 /e	17 /e
342 Printing and publishing	40	60 /e	60 /e
351 Industrial chemicals	118	103 /e	126 /e
352 Other chemical products	13	17 /e	16 /e
353 Petroleum refineries	915	334 /e	421 /e
354 Miscellaneous petroleum and coal products	1	1 /e	1 /e
355 Rubber products	5	4 /e	5 /e
356 Plastic products	24	41 /e	52 /e
361 Pottery, china and earthenware	2	3 /e	3 /e
362 Glass and glass products	2	3 /e	3 /e
369 Other non-metal mineral products	143	147 /e	188 /e
371 Iron and steel	7	7 /e	6 /e
372 Non-ferrous metals	-	2 /e	2 /e
381 Metal products	99	141 /e	179 /e
382 Non-electrical machinery	10	14 /e	18 /e
383 Electrical machinery	22	16 /e	16 /e
384 Transport equipment	45	36 /e	42 /e
385 Professional and scientific equipment	8	6 /e	6 /e
390 Other manufacturing industries	7	8 /e	6 /e

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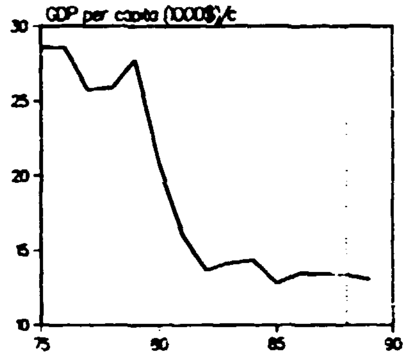

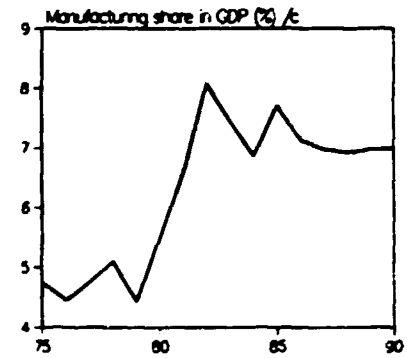

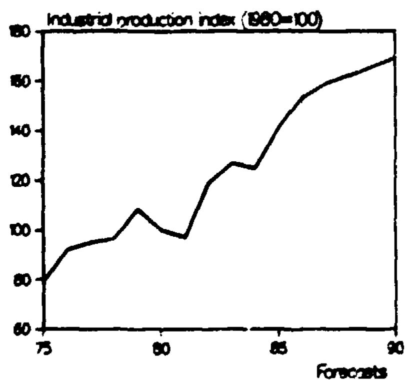

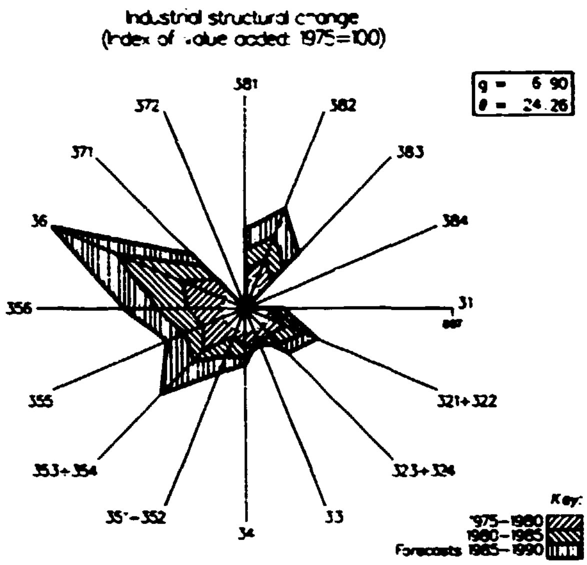

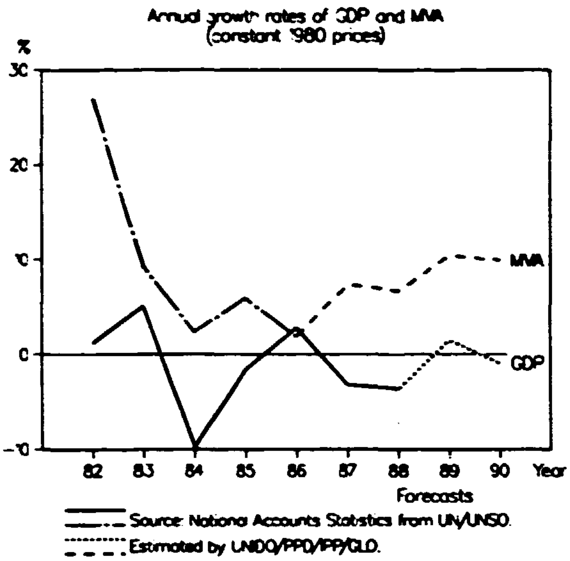

	1980	1985	1987
GDP: /na,c (millions of dollars)	36692	27360	27225
Per capita /na,c (dollars)	11692	7225	6686
Manufacturing share /na,c (%)	2.0	4.1	4.5 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	723	1122	1227 /e
Value added (millions of dollars)	357 /e	603 /e	...
Industrial production index	100	143	157 /e
Gross output (millions of dollars)	1176 /e	2205 /e	...
Employment (thousands)	18 /e	22 /e	24 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	70 /e	73 e	...
Wages and salaries (%)	13 /e	13 /e	...
Operating surplus (%)	17 /e	14 /e	...
-PRODUCTIVITY: (dollars)			
Gross output / worker	64346 /e	100786 /e	...
Value added / worker	19559 /e	27581 /e	...
Average wage	8309 /e	13318 /e	...
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.77 /e	4.62 /e	1.77 /e
as a percentage of average θ in 1970-1975	49 /e	80 /e	31 /e
MVA growth rate / θ	2.68 /e	2.84 /e	4.14 /e
Degree of specialization	28.2 /e	26.9 /e	28.9 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	36	59 /e	...
313 Beverages	17	28 /e	...
314 Tobacco products	65	110 /e	...
321 Textiles	14	27 /e	...
322 Wearing apparel	5 /e	4 /e	...
323 Leather and fur products	7	16 /e	...
324 Footwear	14	30 /e	...
331 Wood and wood products	3 /e	3 /e	...
332 Furniture and fixtures	1 /e	2 /e	...
341 Paper and paper products	3	6 /e	...
342 Printing and publishing	-	7 /e	...
351 Industrial chemicals	36	55 /e	...
352 Other chemical products	21	41 /e	...
353 Petroleum refineries	81	76 /e	...
354 Miscellaneous petroleum and coal products	-	- /e	...
355 Rubber products	-	- /e	...
356 Plastic products	2	3 /e	...
361 Pottery, china and earthenware	1	1 /e	...
362 Glass and glass products	-	- /e	...
369 Other non-metal mineral products	61	111 /e	...
371 Iron and steel	-	- /e	...
372 Non-ferrous metals	-	- /e	...
381 Metal products	3	6 /e	...
382 Non-electrical machinery	-	- /e	...
383 Electrical machinery	-	1 /e	...
384 Transport equipment	-	- /e	...
385 Professional and scientific equipment	-	- /e	...
390 Other manufacturing industries	9	19 /e	...

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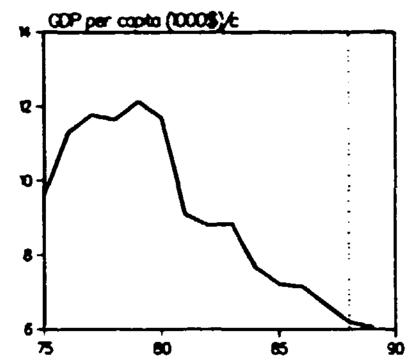
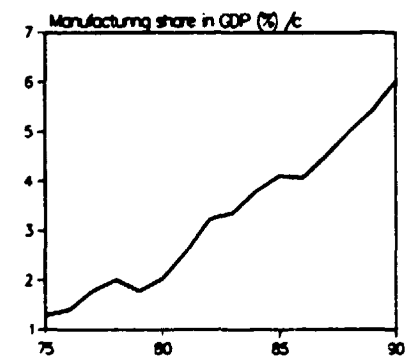
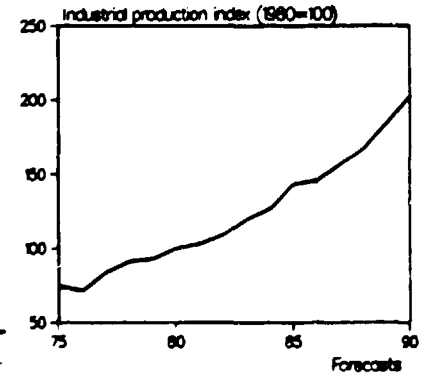
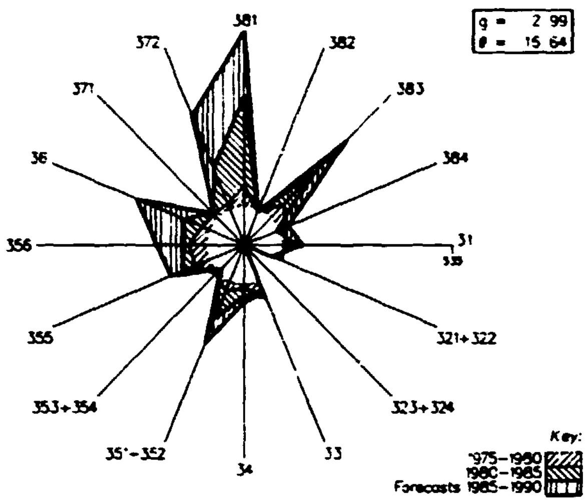


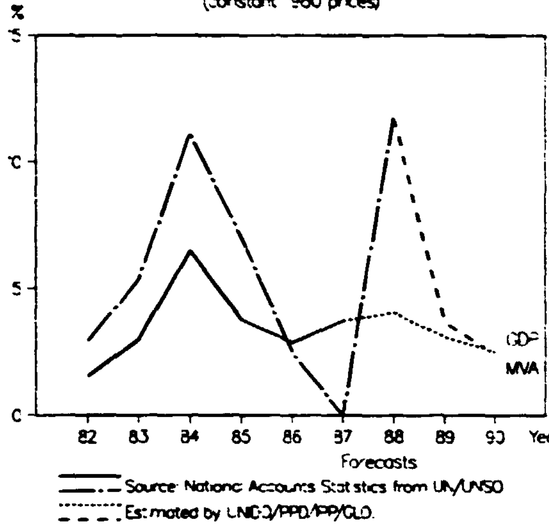




Industrial structural change
(Index of value added 1975=100)



Annual growth rates of GDP and MVA
(constant 1980 prices)



	1980	1985	1987
GDP: /na.c (millions of dollars)	4546	5243	5594
Per capita /na.c (dollars)	12454	14247	15202
Manufacturing share /na.c (%)	28.4	30.2	29.0
MANUFACTURING:			
Value added /na.c (millions of dollars)	1293	1584	1623
Value added (millions of dollars)	1174	994 /e	1561
Industrial production index	100	118	120
Gross output (millions of dollars)	3269	2883 /e	4616
Employment (thousands)	38	34	32
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	64 /e	66 /e	66 /e
Wages and salaries (%)	23 /e	16 /e	17 /e
Operating surplus (%)	13 /e	19 /e	17 /e
-PRODUCTIVITY:(dollars)			
Gross output / worker	86605 /e	83813 /e	136957 /e
Value added / worker	31098 /e	28891 /e	45494 /e
Average wage	20109 /e	14295 /e	23962 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.50 /e	9.06 /e	2.78 /e
as a percentage of average θ in 1970-1975	97 /e	585 /e	179 /e
MVA growth rate / θ	-1.07 /e	0.81 /e	0.00 /e
Degree of specialization	34.0 /e	29.0 /e	25.5 /e
-VALUE ADDED:(millions of dollars)			
311 Food products	31	21	32 /e
313 Beverages	33	26 /e	43 /e
314 Tobacco products	9	7 /e	12 /e
321 Textiles	24	14x	21 /e
322 Wearing apparel	5	3x	5 /e
323 Leather and fur products	-	-x	...
324 Footwear	-	-x	...
331 Wood and wood products	2 /e	1 /e	2 /e
332 Furniture and fixtures	2 /e	2 /e	3 /e
341 Paper and paper products	7 /e	6 /e	9 /e
342 Printing and publishing	25 /e	20 /e	34 /e
351 Industrial chemicals	39 /e	28 /e	50 /e
352 Other chemical products	3	20 /e	40 /e
353 Petroleum refineries	-	- /e	- /e
354 Miscellaneous petroleum and coal products	3 /e	2 /e	2 /e
355 Rubber products	114 /e	102 /e	165 /e
356 Plastic products	17 /e	13 /e	24 /e
361 Pottery, china and earthenware	26	23s	39 /e
362 Glass and glass products	-	-s	.
369 Other non-metal mineral products	44	39s	66 /e
371 Iron and steel	592	493	690 /e
372 Non-ferrous metals	32	48	106 /e
381 Metal products	24	27	50 /e
382 Non-electrical machinery	98	76	120 /e
383 Electrical machinery	19	14 /e	25 /e
384 Transport equipment	21	10	21 /e
385 Professional and scientific equipment	2	1 /e	2 /e
390 Other manufacturing industries	-	- /e	- /e

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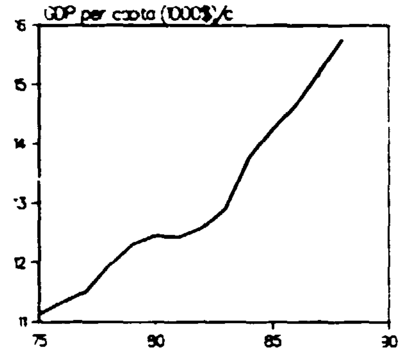
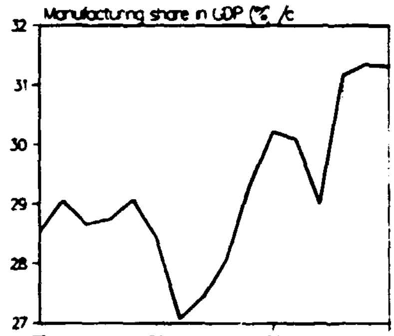
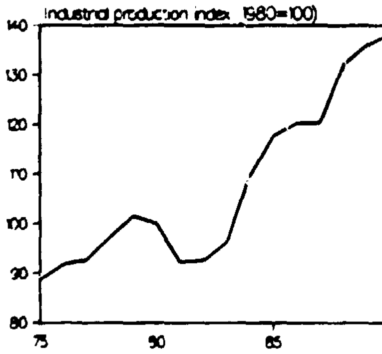
GDP per capita (1000$)/c

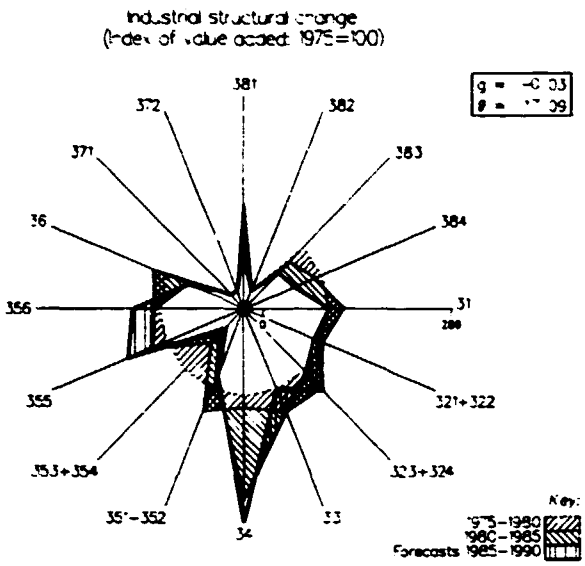


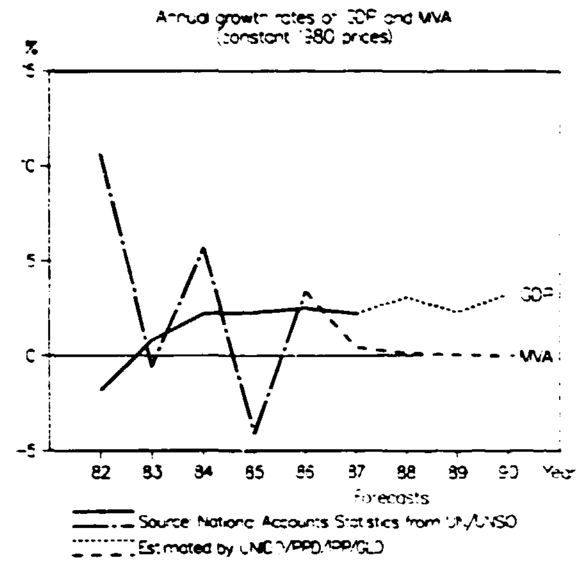
Manufacturing share in GDP (%)/c



Industrial production index 1980=100)

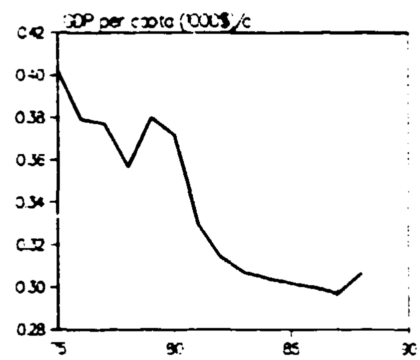


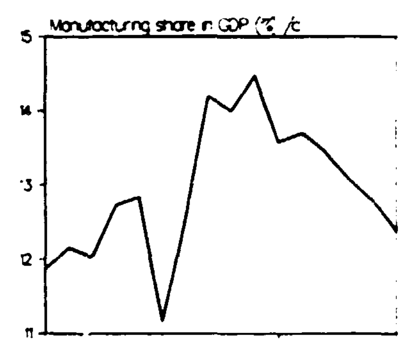


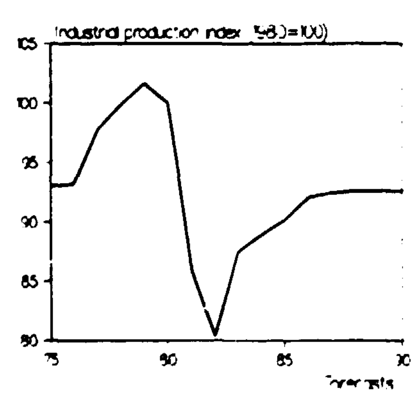


	1980	1985	1987
GDP: /na.c (millions of dollars)	3265	3086	3232
Per capita /na.c (dollars)	372	302	297
Manufacturing share /na.c (%)	11.2	13.6	13.5 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	365	419	435 /e
Value added (millions of dollars)	221	138 /e	111 /e
Industrial production index	100	90	92 /e
Gross output (millions of dollars)	569	337 /e	277 /e
Employment (thousands)	40	48 /e	51 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	61	59 /e	60 /e
Wages and salaries (%)	15	16 /e	16 /e
Operating surplus (%)	24	25 /e	24 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	14117	7044 /e	5405 /e
Value added / worker	5482	2877 /e	2164 /e
Average wage	2095	1117 /e	865 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.83 /e	8.03 /e	2.27 /e
as a percentage of average θ in 1970-1975	30 /e	133 /e	38 /e
MVA growth rate / θ	-0.89 /e	0.17 /e	0.19 /e
Degree of specialization	25.3 /e	26.5 /e	28.3 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	23	45	32 /e
313 Beverages	34	16	15 /e
314 Tobacco products	3	3	2 /e
321 Textiles	67	16	13 /e
322 Wearing apparel	19	11	11 /e
323 Leather and fur products	3	1	1 /e
324 Footwear	8	5	4 /e
331 Wood and wood products	3	1	1 /e
332 Furniture and fixtures	1	-	- /e
341 Paper and paper products	4	2	2 /e
342 Printing and publishing	6	2	2 /e
351 Industrial chemicals	1	1	1 /e
352 Other chemical products	10	10	7 /e
353 Petroleum refineries	11	7 /e	6 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	1	1	1 /e
356 Plastic products	2	1	1 /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	2	-	- /e
369 Other non-metal mineral products	2	1	1 /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	3	3 /e
385 Professional and scientific equipment	-	-	- /e
390 Other manufacturing industries	3	2	2 /e

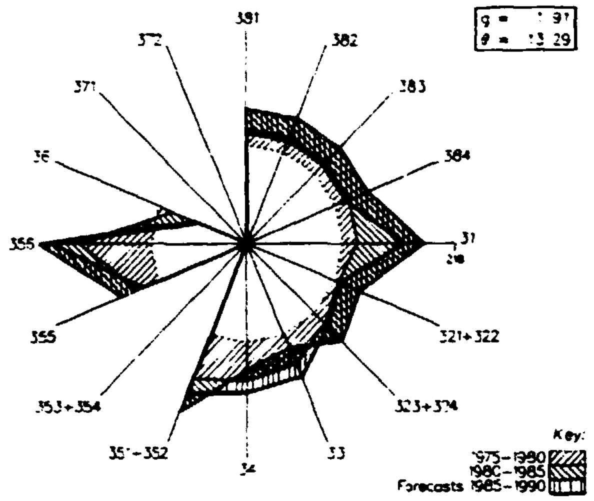
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



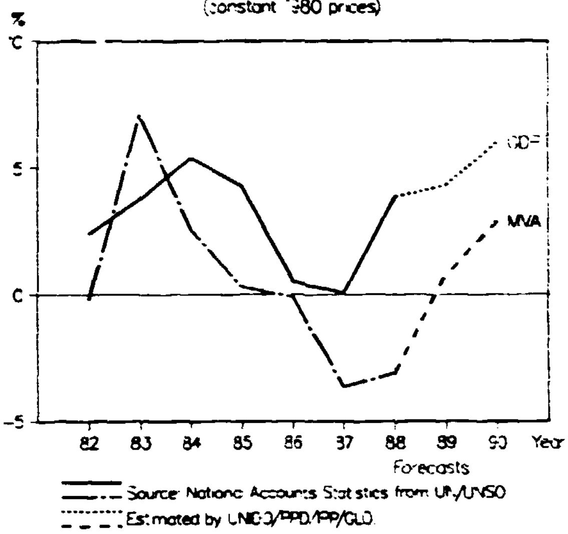




Industrial structural change
(index of value added: 1975=100)



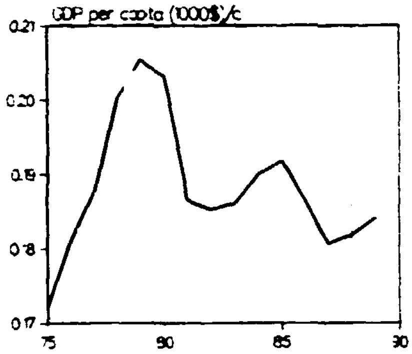
Annual growth rates of GDP and MVA
(constant 1980 prices)



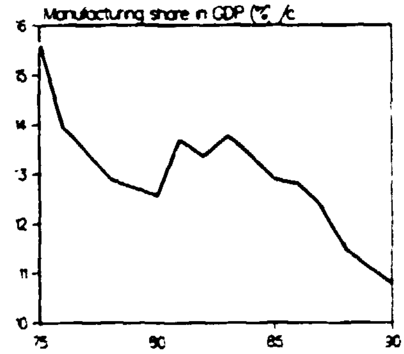
	1980	1985	1987
GDP: /na.c (millions of dollars)	1238	1369	377
Per capita /na.c (dollars)	203	192	181
Manufacturing share /na.c (%)	12.6	12.9	12.3
MANUFACTURING:			
Value added /na.c (millions of dollars)	155	177	170
Value added (millions of dollars)	122	89	97
Industrial production index	100	130	116
Gross output (millions of dollars)	340	254	277
Employment (thousands)	39	38 /e	41 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	64	65 /e	65 /e
Wages and salaries (%)	12	14 /e	15 /e
Operating surplus (%)	24	21 /e	20 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	8783	6732 /e	6817 /e
Value added / worker	3156	2353 /e	2383 /e
Average wage	1046	950 /e	1018 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	5.45 /e	14.20 /e	2.90 /e
as a percentage of average θ in 1970-1975	120 /e	314 /e	64 /e
MVA growth rate / θ	-0.06 /e	1.01 /e	-0.73 /e
Degree of specialization	16.3 /e	22.2 /e	20.5 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	54	32 /e	32 /e
313 Beverages	8	7 /e	9 /e
314 Tobacco products	9	4 /e	4 /e
321 Textiles	12	10 /e	10 /e
322 Wearing apparel	2	2 /e	3 /e
323 Leather and fur products	-	- /e	- /e
324 Footwear	-	-1 /e	-1 /e
331 Wood and wood products	2	4 /e	5 /e
332 Furniture and fixtures	1	[illegible]	1 /e
341 Paper and paper products	2	[illegible]	2 /e
342 Printing and publishing	[illegible]	[illegible] /e	5 /e
351 Industrial chemicals	2	[illegible] /e	3 /e
352 Other chemical products	5	6 /e	8 /e
353 Petroleum refineries	-	- /e	- /e
354 Miscellaneous petroleum and coal products	-	/e	- /e
355 Rubber products	1	1 /e	1 /e
356 Plastic products	2	2 /e	2 /e
361 Pottery, china and earthenware	-	- /e	- /e
362 Glass and glass products	-	- /e	- /e
369 Other non-metal mineral products	3	3 /e	3 /e
371 Iron and steel	-	- /e	- /e
372 Non-ferrous metals	-	- /e	- /e
381 Metal products	6	5 /e	6 /e
382 Non-electrical machinery	-	2 /e	2 /e
383 Electrical machinery	5	1 /e	1 /e
384 Transport equipment	-	1 /e	1 /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

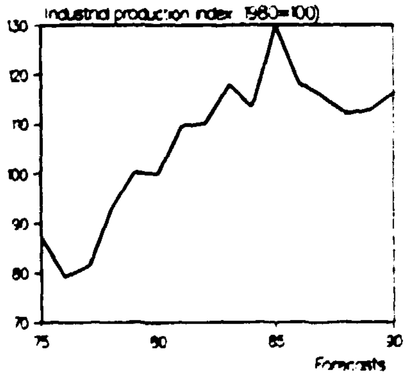
GDP per capita (1000$)/c

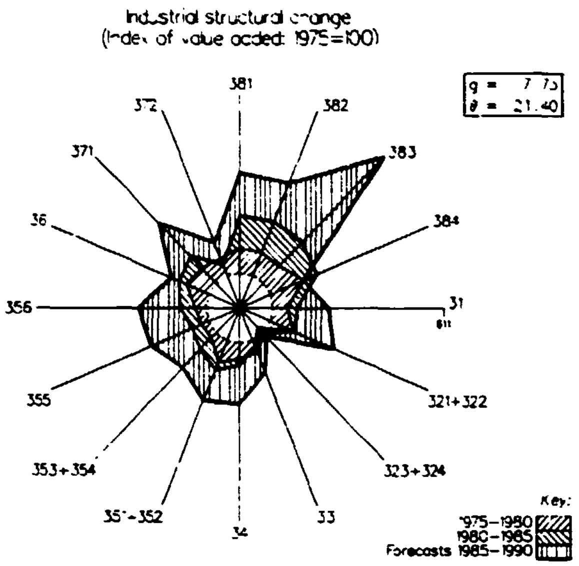


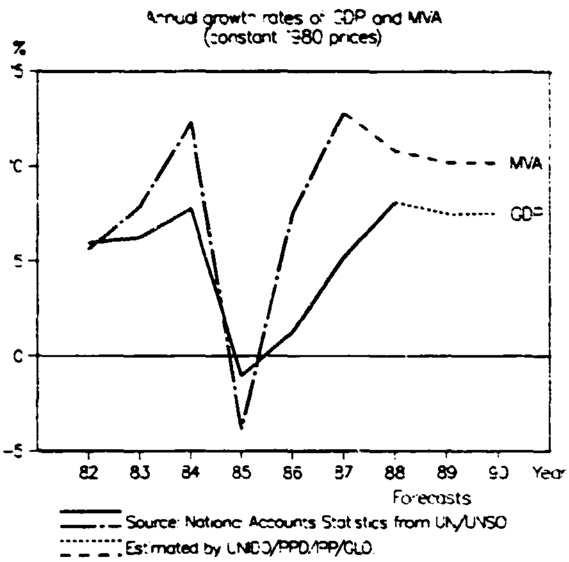
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

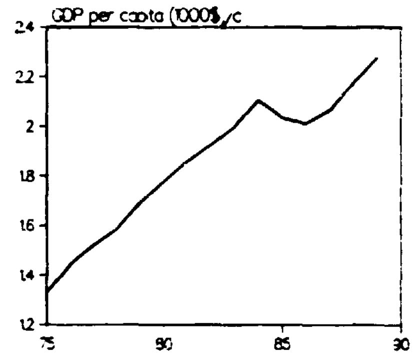


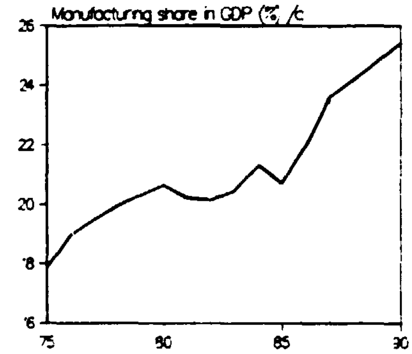


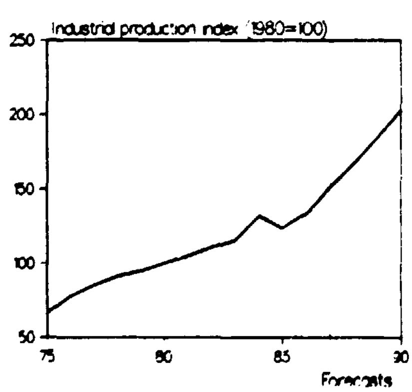


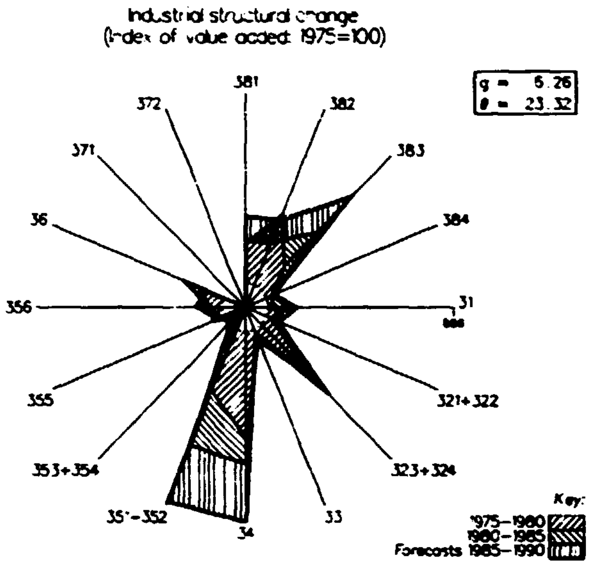
	1980	1985	1987
GDP: /na,c (millions of dollars)	24487	31439	33473
Per capita /na,c (dollars)	1779	2035	2067
Manufacturing share /na,c (%)	20.6	20.7	23.6
MANUFACTURING:			
Value added /na,c (millions of dollars)	5054	6511	7899
Value added (millions of dollars)	3701	4879	5799
Industrial production index	100	123	151
Gross output (millions of dollars)	14465	18359	20466 /e
Employment (thousands)	499	473	496 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	74 /e	73	72 /e
Wages and salaries (%)	7 /e	8	8 /e
Operating surplus (%)	18 /e	19	20 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	28983 /e	38789	41279 /e
Value added / worker	7416 /e	10308	11696 /e
Average wage	2078 /e	3084	3269 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.82 /e	8.89 /e	6.51 /e
as a percentage of average θ in 1970-1975	54 /e	170 /e	124 /e
MVA growth rate / θ	1.93 /e	-0.70 /e	1.97 /e
Degree of specialization	14.1 /e	16.5 /e	19.6 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	672 /e	703	882 /e
313 Beverages	109 /e	122	152 /e
314 Tobacco products	101 /e	205	256 /e
321 Textiles	185 /e	133	164 /e
322 Wearing apparel	61 /e	100	124 /e
323 Leather and fur products	3 /e	2	3 /e
324 Footwear	10 /e	5	6 /e
331 Wood and wood products	392 /e	263	280 /e
332 Furniture and fixtures	33 /e	40	50 /e
341 Paper and paper products	36 /e	55	68 /e
342 Printing and publishing	151 /e	197	218 /e
351 Industrial chemicals	80 /e	616	776 /e
352 Other chemical products	121 /e	153	190 /e
353 Petroleum refineries	116 /e	137	172 /e
354 Miscellaneous petroleum and coal products	2 /e	21	25 /e
355 Rubber products	301 /e	250	283 /e
356 Plastic products	71 /e	92	116 /e
361 Pottery, china and earthenware	10 /e	13	13 /e
362 Glass and glass products	25 /e	23	29 /e
369 Other non-metal mineral products	172 /e	297	307 /e
371 Iron and steel	80 /e	153	184 /e
372 Non-ferrous metals	26 /e	35	40 /e
381 Metal products	148 /e	147	184 /e
382 Non-electrical machinery	122 /e	99	99 /e
383 Electrical machinery	472 /e	738	839 /e
384 Transport equipment	156 /e	211	250 /e
385 Professional and scientific equipment	24 /e	30	38 /e
390 Other manufacturing industries	23 /e	39	49 /e

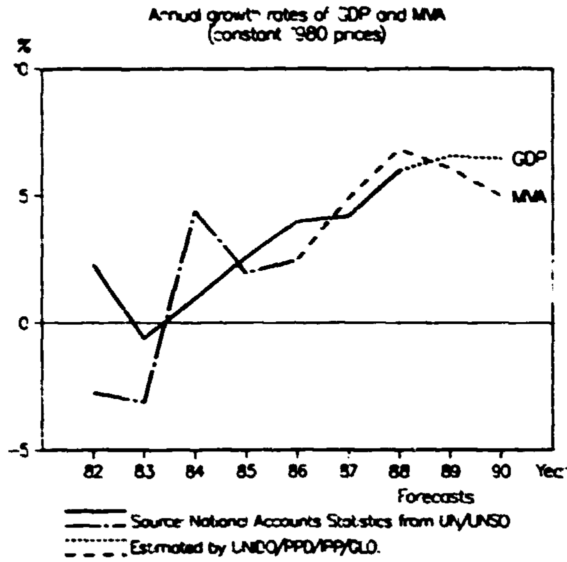
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





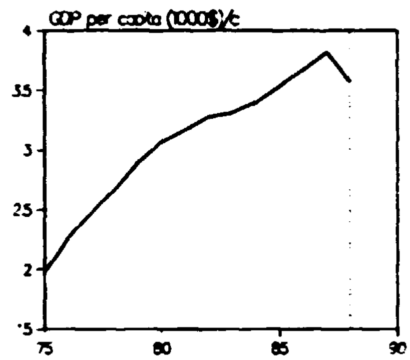


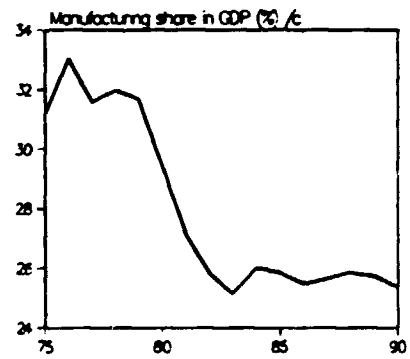


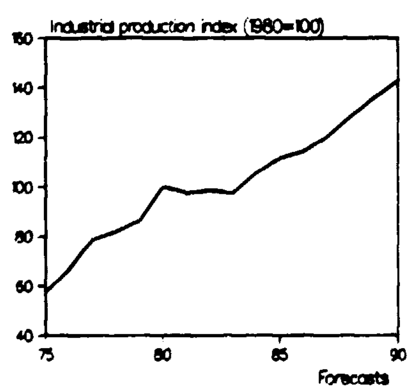


	1980	1985	1987
GDP: /na.c (millions of dollars)	1120	1218	1320
Per capita /na.c (dollars)	3068	3530	3814
Manufacturing share /na.c (%)	29.4	25.9	25.6 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	330	315	339 /e
Value added (millions of dollars)	302	265	409 /e
Industrial production index	100	112	120 /e
Gross output (millions of dollars)	706	650	995 /e
Employment (thousands)	29	26	26 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	57	59	59 /e
Wages and salaries (%)	22	20	21 /e
Operating surplus (%)	21	20	20 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	24517	25438	37664 /e
Value added / worker	10481	10390	15468 /e
Average wage	5283	5199	7799 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	7.30	4.68 /e	1.45 /e
as a percentage of average θ in 1970-1975	71	45 /e	14 /e
MVA growth rate / θ	2.21	1.21 /e	3.37 /e
Degree of specialization	16.9	16.6 /e	16.9 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	20	25	39 /e
313 Beverages	20	22	33 /e
314 Tobacco products	8	8	11 /e
321 Textiles	17	8	11 /e
322 Wearing apparel	88	65	104 /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	12 /e
341 Paper and paper products	2	3	5 /e
342 Printing and publishing	22	17	26 /e
351 Industrial chemicals	1	2	4 /e
352 Other chemical products	5	6	9 /e
353 Petroleum refineries	-	-	- /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	10	7	11 /e
356 Plastic products	6	4	5 /e
361 Pottery, china and earthenware	1	-	- /e
362 Glass and glass products	2	1	1 /e
369 Other non-metal mineral products	6	7	10 /e
371 Iron and steel	-	-	- /e
372 Non-ferrous metals	-	-	- /e
381 Metal products	14	10	15 /e
382 Non-electrical machinery	5	8	12 /e
383 Electrical machinery	22	31	50 /e
384 Transport equipment	6	3	5 /e
385 Professional and scientific equipment	12	12	20 /e
390 Other manufacturing industries	8	5	8 /e

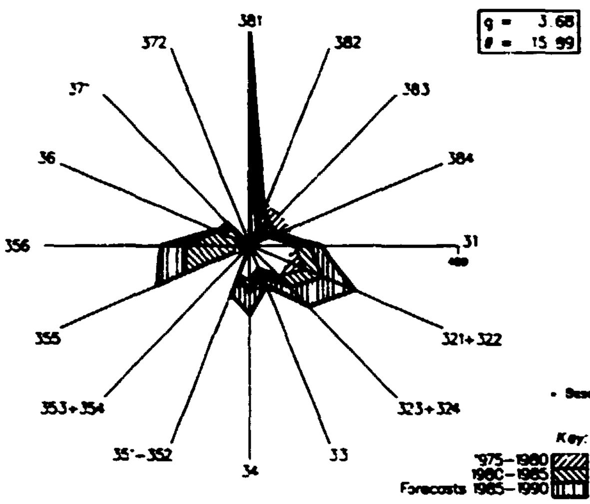
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



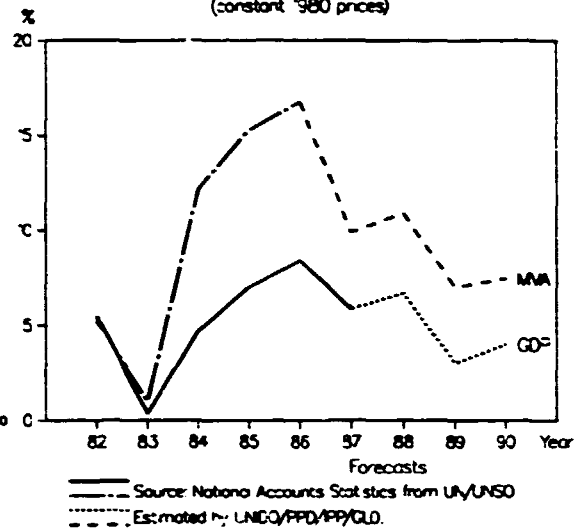




Industrial structural change
(Index of value added: 1975=100)

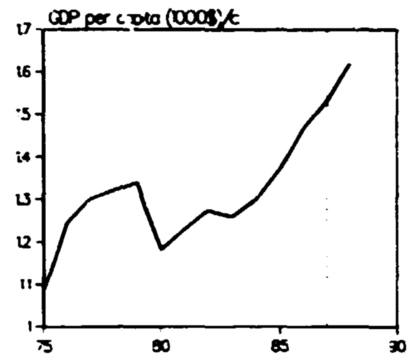


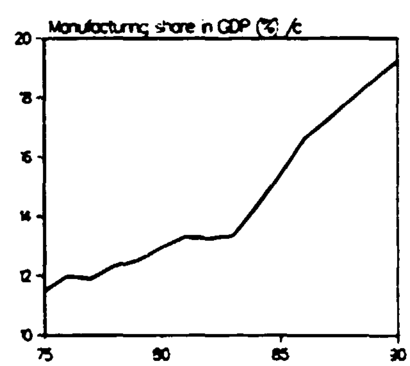
Annual growth rates of GDP and MVA
(constant 1980 prices)

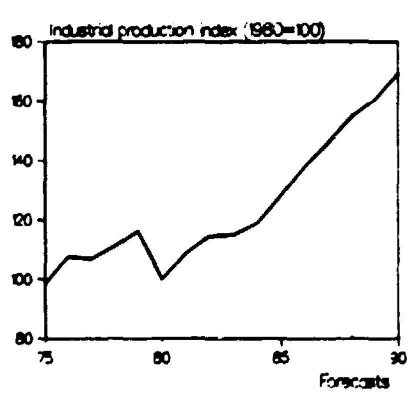


	1980	1985	1987
GDP: /na.c (millions of dollars)	1132	1422	1632
Per capita /na.c (dollars)	1181	1371	1532
Manufacturing share /na.c (%)	13.0	15.4	17.2 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	147	219	281 /e
Value added (millions of dollars)	136	172	238 /e
Industrial production index	100	128	146 /e
Gross output (millions of dollars)	633	729	1026
Employment (thousands)	43	74	81
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	79	76	77 /e
Wages and salaries (%)	11	11	11 /e
Operating surplus (%)	10	13	13 /e
-PRODUCTIVITY:(dollars)			
Gross output / worker	14745	9786	12725 /e
Value added / worker	3163	2312	2949 /e
Average wage	1654	1066	1369 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	8.50 /e	1.88 /e	3.84 /e
as a percentage of average θ in 1970-1975	107 /e	24 /e	48 /e
MVA growth rate / θ	-1.65 /e	4.18 /e	1.49 /e
Degree of specialization	20.6 /e	22.0 /e	21.4 /e
-VALUE ADDED:(millions of dollars)			
311 Food products	36	43	57 /e
313 Beverages	10	7	9 /e
314 Tobacco products	2	4	5 /e
321 Textiles	9	10	14 /e
322 Wearing apparel	28	68	97 /e
323 Leather and fur products	1	1	2 /e
324 Footwear	2	2	2 /e
331 Wood and wood products	1	1	2 /e
332 Furniture and fixtures	2	1	2 /e
341 Paper and paper products	1	2	2 /e
342 Printing and publishing	5	4	5 /e
351 Industrial chemicals	3	3	3 /e
352 Other chemical products	4	4	6 /e
353 Petroleum refineries	-	-	- /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	1	1	1 /e
356 Plastic products	1	2	2 /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	-	-	- /e
369 Other non-metal mineral products	6	4	6 /e
371 Iron and steel	3	2	2 /e
372 Non-ferrous metals	-	-	- /e
381 Metal products	5	3	4 /e
382 Non-electrical machinery	3	1	1 /e
383 Electrical machinery	3	2	3 /e
384 Transport equipment	2	1	2 /e
385 Professional and scientific equipment	2	3	5 /e
390 Other manufacturing industries	4	5	7 /e

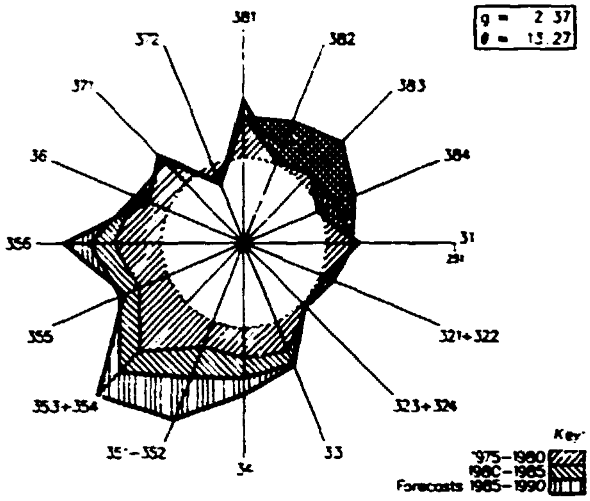
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



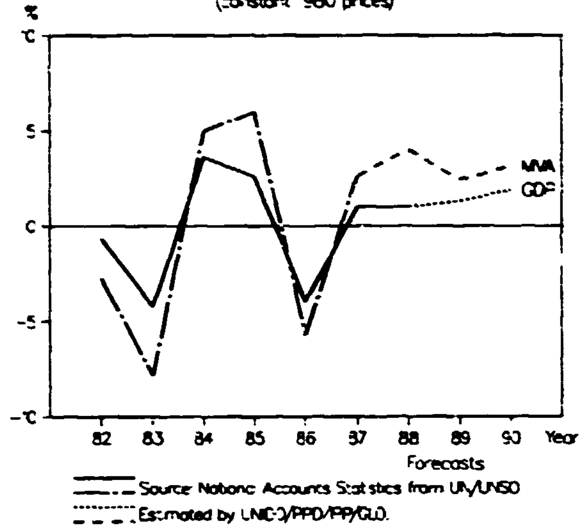




Industrial structural change
(Index of value added: 1975=100)



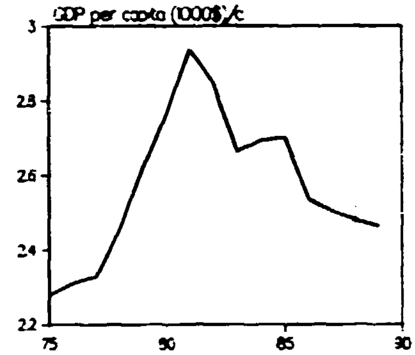
Annual growth rates of GDP and MVA
(constant 1980 prices)



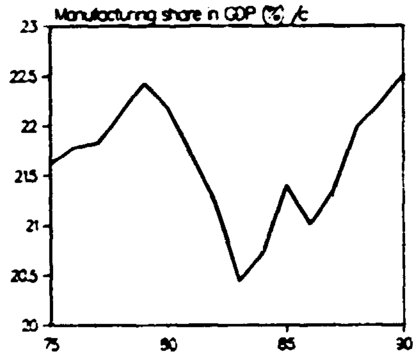
	1980	1985	1987
GDP: /na.c (millions of dollars)	194766	214366	207944
Per capita /na.c (dollars)	2766	2701	2504
Manufacturing share /na.c (%)	22.2	21.4	21.3
MANUFACTURING:			
Value added /na.c (millions of dollars)	43200	45870	44394
Value added (millions of dollars)	43048	45273	35592
Industrial production index	100	102	98
Gross output (millions of dollars)	102047	104471	82132
Employment (thousands)	2417	2252 /e	2137 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	58	57 /e	57 /e
Wages and salaries (%)	14	9 /e	8 /e
Operating surplus (%)	28	35 /e	35 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	42221	46399 /e	38436 /e
Value added / worker	17811	20107 /e	16657 /e
Average wage	5846	4067 /e	3101 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.45	3.34	2.03
as a percentage of average θ in 1970-1975	96	131	79
MVA growth rate / θ	1.99	2.32	1.89
Degree of specialization	10.5	10.4	10.7
-VALUE ADDED: (millions of dollars)			
311 Food products	6989	6880 /e	5439 /e
313 Beverages	2723	2774 /e	2063 /e
314 Tobacco products	623	760 /e	623 /e
321 Textiles	3133	2987 /e	2122 /e
322 Wearing apparel	1277	1081 /e	734 /e
323 Leather and fur products	366	389 /e	336 /e
324 Footwear	845	670 /e	489 /e
331 Wood and wood products	919	807 /e	595 /e
332 Furniture and fixtures	784	449 /e	303 /e
341 Paper and paper products	1189	1193 /e	866 /e
342 Printing and publishing	1050	1193 /e	889 /e
351 Industrial chemicals	2235	3081 /e	2711 /e
352 Other chemical products	2235	2616 /e	2170 /e
353 Petroleum refineries	1917	4458 /e	4169 /e
354 Miscellaneous petroleum and coal products	222	460 /e	406 /e
355 Rubber products	767	1018 /e	906 /e
356 Plastic products	754	771 /e	646 /e
361 Pottery, china and earthenware	383	419 /e	325 /e
362 Glass and glass products	566	633 /e	430 /e
369 Other non-metal mineral products	1464	1250 /e	848 /e
371 Iron and steel	2070	2393 /e	1868 /e
372 Non-ferrous metals	562	513 /e	402 /e
381 Metal products	1961	1745 /e	1263 /e
382 Non-electrical machinery	2074	1621 /e	1061 /e
383 Electrical machinery	1900	1699 /e	1172 /e
384 Transport equipment	2980	2681 /e	1968 /e
385 Professional and scientific equipment	305	360 /e	311 /e
390 Other manufacturing industries	784	774 /e	609 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

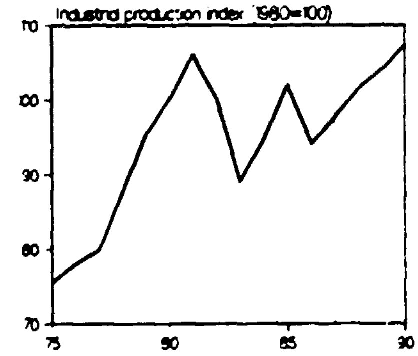
GDP per capita (1000$) /c



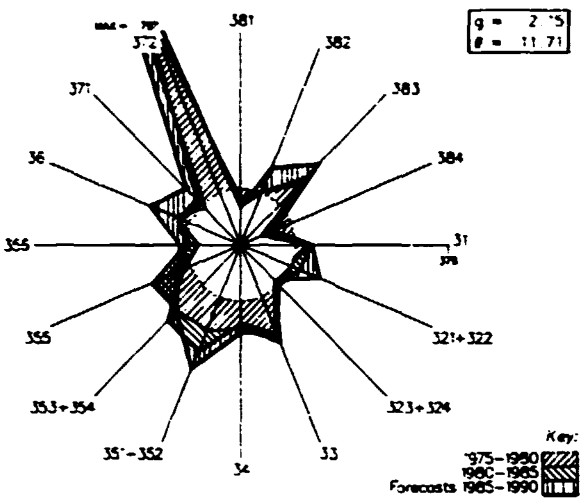
Manufacturing share in GDP (%) /c



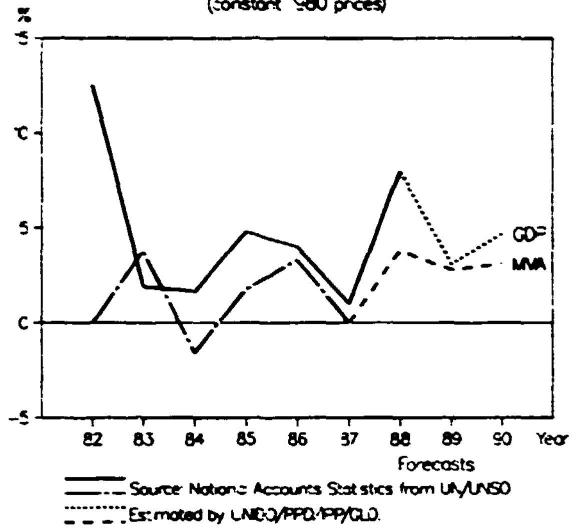
Industrial production index (1980=100)



Industrial structural change
(Index of value added 1975=100)



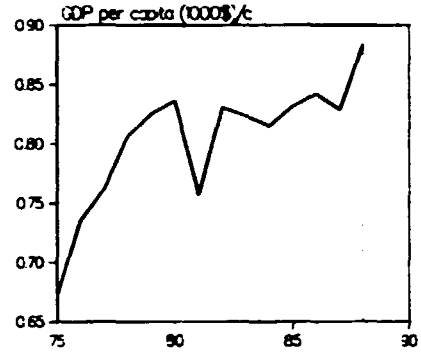
Annual growth rates of GDP and MVA
(constant 1980 prices)



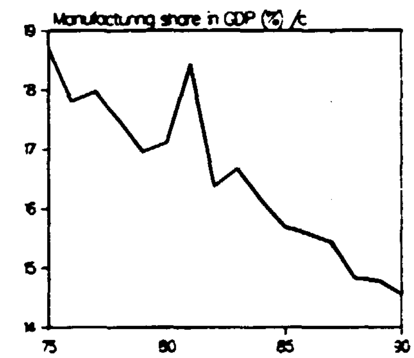
	1980	1985	1987
GDP: /na.c (millions of dollars)	16203	18390	19316
Per capita /na.c (dollars)	836	831	829
Manufacturing share /na.c (%)	17.1	15.7	15.4
MANUFACTURING:			
Value added /na.c (millions of dollars)	2774	2884	2980
Value added (millions of dollars)	1724	1080 /e	1492 /e
Industrial production index	100	104	108
Gross output (millions of dollars)	7352	4759 /e	6782 /e
Employment (thousands)	193	181 /e	187 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	77	77 /e	78 /e
Wages and salaries (%)	12	11 /e	11 /e
Operating surplus (%)	12	12 /e	11 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	38067	26271 /e	36320 /e
Value added / worker	8925	5961 /e	7989 /e
Average wage	4511	2831 /e	3828 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.06 /e	3.72 /e	8.68 /e
as a percentage of average θ in 1970-1975	101 /e	123 /e	287 /e
MVA growth rate / θ	0.37 /e	0.91 /e	0.10 /e
Degree of specialization	21.7 /e	23.4 /e	21.7 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	304	216 /e	309 /e
313 Beverages	62	32 /e	42 /e
314 Tobacco products	38	30 /e	45 /e
321 Textiles	202	128 /e	171 /e
322 Wearing apparel	32	32 /e	60 /e
323 Leather and fur products	15	9 /e	11 /e
324 Footwear	24	21 /e	32 /e
331 Wood and wood products	30	27 /e	41 /e
332 Furniture and fixtures	19	6 /e	6 /e
341 Paper and paper products	64	30 /e	41 /e
342 Printing and publishing	26	21 /e	30 /e
351 Industrial chemicals	127	67 /e	121 /e
352 Other chemical products	97	61 /e	84 /e
353 Petroleum refineries	179	108 /e	122 /e
354 Miscellaneous petroleum and coal products	-	- /e	- /e
355 Rubber products	34	20 /e	27 /e
356 Plastic products	20	6 /e	8 /e
361 Pottery, china and earthenware	6	1 /e	2 /e
362 Glass and glass products	10	1 /e	2 /e
369 Other non-metal mineral products	154	108 /e	167 /e
371 Iron and steel	7	6 /e	9 /e
372 Non-ferrous metals	8	3 /e	4 /e
381 Metal products	110	60 /e	81 /e
382 Non-electrical machinery	30	13 /e	16 /e
383 Electrical machinery	61	33 /e	44 /e
384 Transport equipment	62	19 /e	24 /e
385 Professional and scientific equipment	1	1 /e	1 /e
390 Other manufacturing industries	2	1 /e	1 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

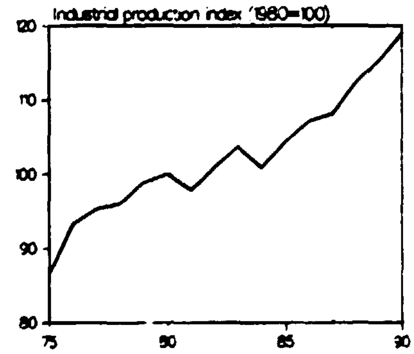
GDP per capita (1000$)/c

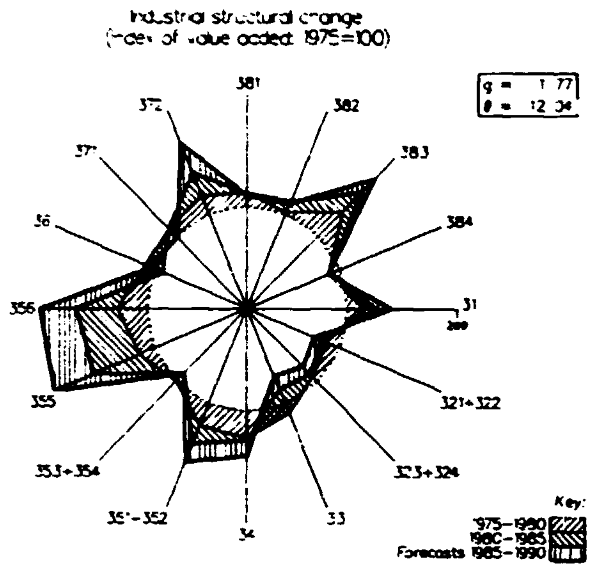


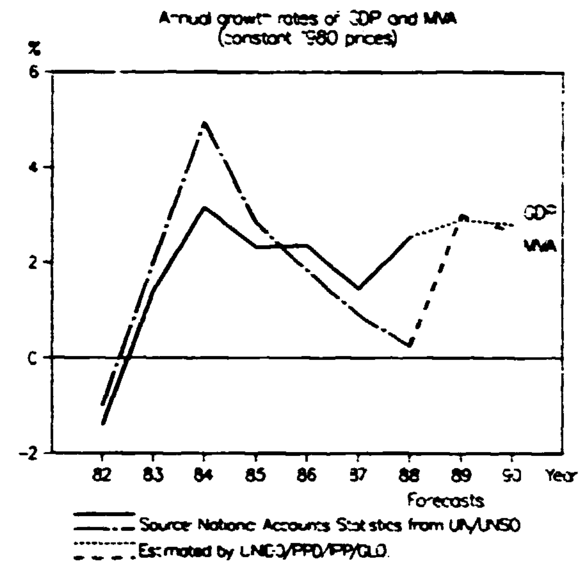
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

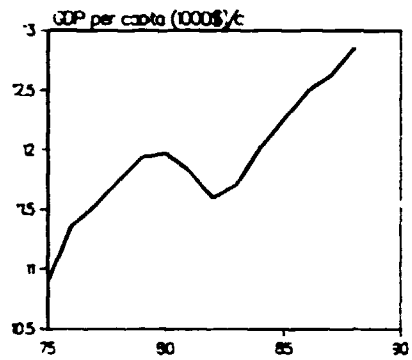


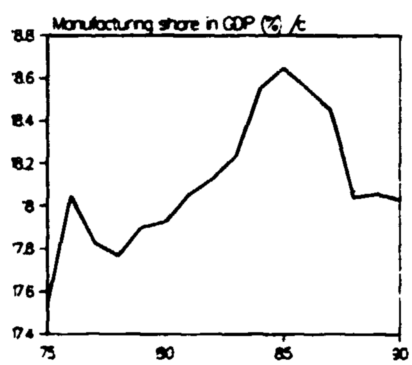


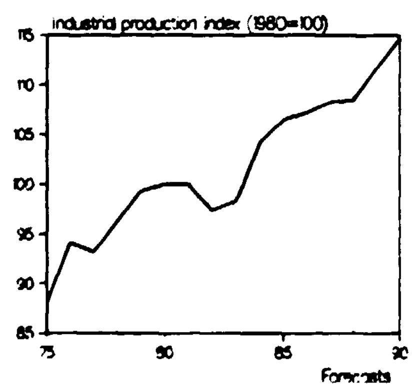


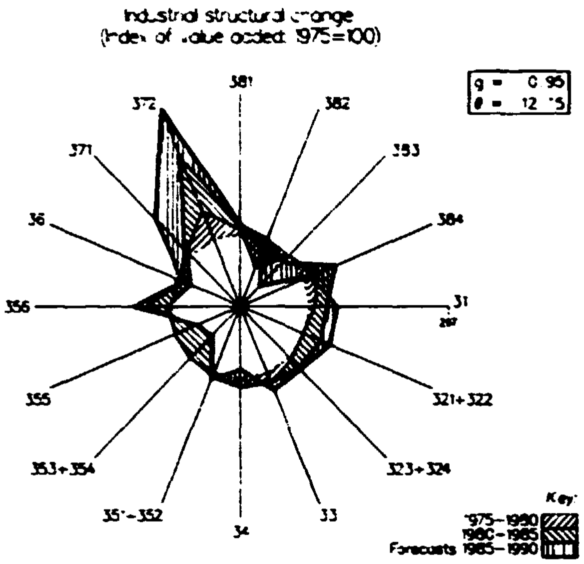
	1980	1985	1987
GDP: /na,c (millions of dollars)	169386	177505	184301
Per capita /na.c (dollars)	11970	12254	12627
Manufacturing share /na.c (%)	17.9	18.6	18.5
MANUFACTURING:			
Value added /na,c (millions of dollars)	30365	33098	34008
Value added (millions of dollars)	29080	21945 /e	35750 /e
Industrial production index	100	106	108
Gross output (millions of dollars)	109517	86375	147295
Employment (thousands)	945	839	[illegible] /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	73	75 /e	76 /e
Wages and salaries (%)	15	12 /e	12 /e
Operating surplus (%)	11	13 /e	13 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	115997	102950 /e	175124 /e
Value added / worker	30772	26156 /e	42504 /e
Average wage	17892	12859 /e	20336 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.36 /e	1.80 /e	1.94 /e
as a percentage of average θ in 1970-1975	56 /e	74 /e	80 /e
MVA growth rate / θ	0.51 /e	1.23 /e	0.47 /e
Degree of specialization	15.0 /e	16.1 /e	15.7 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	4562	3580	6024 /e
313 Beverages	654	451	755 /e
314 Tobacco products	282	206	343 /e
321 Textiles	734	502	772 /e
322 Wearing apparel	372	166	253 /e
323 Leather and fur products	68	42	60 /e
324 Footwear	118	66	103 /e
331 Wood and wood products	594	319 /e	514 /e
332 Furniture and fixtures	418	229 /e	407 /e
341 Paper and paper products	806	605	991 /e
342 Printing and publishing	2480	1742	3016 /e
351 Industrial chemicals	2263	2167 /e	3296 /e
352 Other chemical products	913	743 /e	1131 /e
353 Petroleum refineries	533	533	933 /e
354 Miscellaneous petroleum and coal products	101	100 /e	170 /e
355 Rubber products	156	92 /e	130 /e
356 Plastic products	472	389 /e	619 /e
361 Pottery, china and earthenware	15	6 /e	9 /e
362 Glass and glass products	176	107 /e	186 /e
369 Other non-metal mineral products	1081	860 /e	1084 /e
371 Iron and steel	734	563 /e	806 /e
372 Non-ferrous metals	518	482 /e	769 /e
381 Metal products	2455	1762	2883 /e
382 Non-electrical machinery	2369	1796	2897 /e
383 Electrical machinery	3687	2943	4617 /e
384 Transport equipment	1927	1226	2093 /e
385 Professional and scientific equipment	382	317	594 /e
390 Other manufacturing industries	211	166 /e	296 /e

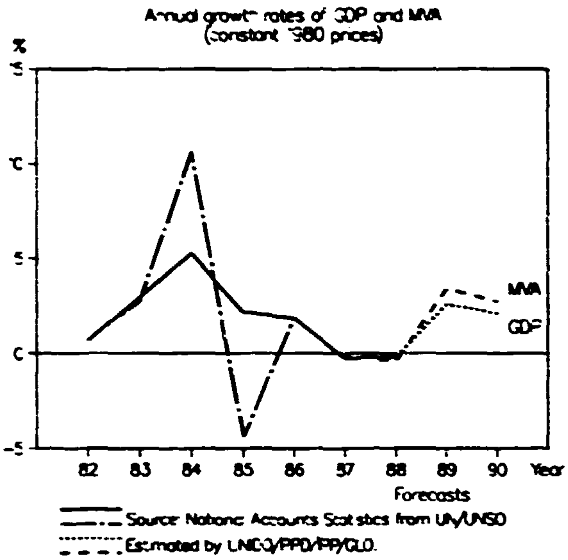
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





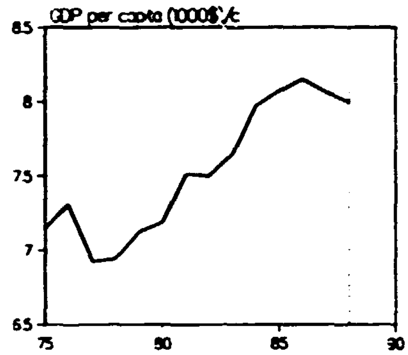


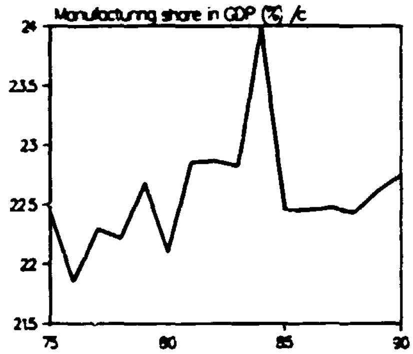


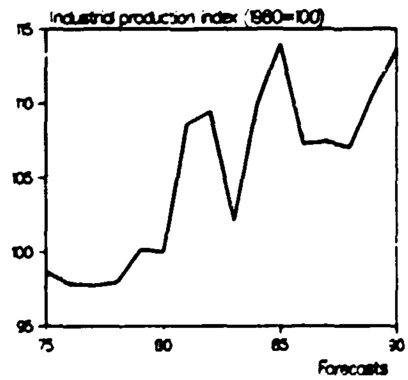


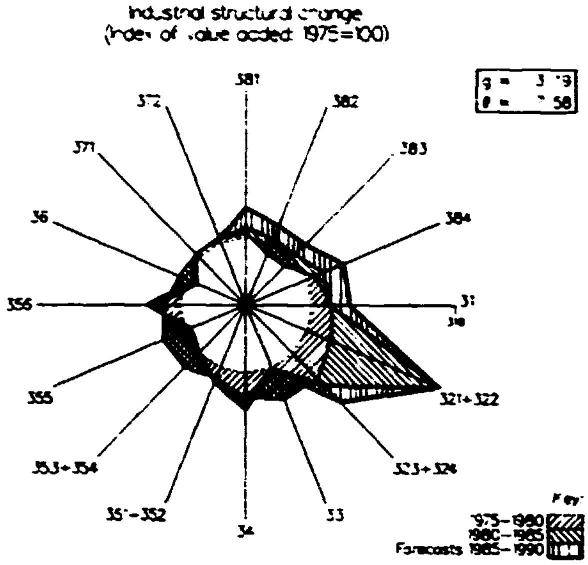
	1980	1985	1987
GDP: /na.c (millions of dollars)	22389	26213	26530
Per capita /na.c (dollars)	7190	8070	8062
Manufacturing share /na.c (%)	22.1	22.5	22.5 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	4948	5886	5984 /e
Value added (millions of dollars)	4756	4657	7432 /e
Industrial production index	100	114	107 /e
Gross output (millions of dollars)	14790	15399	24406 /e
Employment (thousands)	285	289	278 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	68	70	70 /e
Wages and salaries (%)	21	18	17 /e
Operating surplus (%)	11	12	13 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	51964	53220	87936 /e
Value added / worker	16711	16096	26778 /e
Average wage	11050	9604	15314 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.82 /e	3.85 /e	1.18 /e
as a percentage of average θ in 1970-1975	97 /e	133 /e	41 /e
MVA growth rate / θ	-0.06 /e	0.96 /e	0.11 /e
Degree of specialization	14.1 /e	15.1 /e	15.9 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	1098	1082	1866 /e
313 Beverages	110	88	132 /e
314 Tobacco products	30	24	40 /e
321 Textiles	222	193	283 /e
322 Wearing apparel	186	169	259 /e
323 Leather and fur products	45	42	69 /e
324 Footwear	56	50	75 /e
331 Wood and wood products	253	263	396 /e
332 Furniture and fixtures	92	90	143 /e
341 Paper and paper products	266	276	424 /e
342 Printing and publishing	294	326	514 /e
351 Industrial chemicals	140	134	209 /e
352 Other chemical products	155	142	229 /e
353 Petroleum refineries	26	-1	-1 /e
354 Miscellaneous petroleum and coal products	9	7	11 /e
355 Rubber products	96	70	116 /e
356 Plastic products	110	138	227 /e
361 Pottery, china and earthenware	13	10	16 /e
362 Glass and glass products	44	36	66 /e
369 Other non-metal mineral products	114	132	219 /e
371 Iron and steel	93	71	116 /e
372 Non-ferrous metals	82	101	175 /e
381 Metal products	371	404	639 /e
382 Non-electrical machinery	236	264	415 /e
383 Electrical machinery	239	200	263 /e
384 Transport equipment	318	274	434 /e
385 Professional and scientific equipment	14	20	33 /e
390 Other manufacturing industries	45	48	74 /e

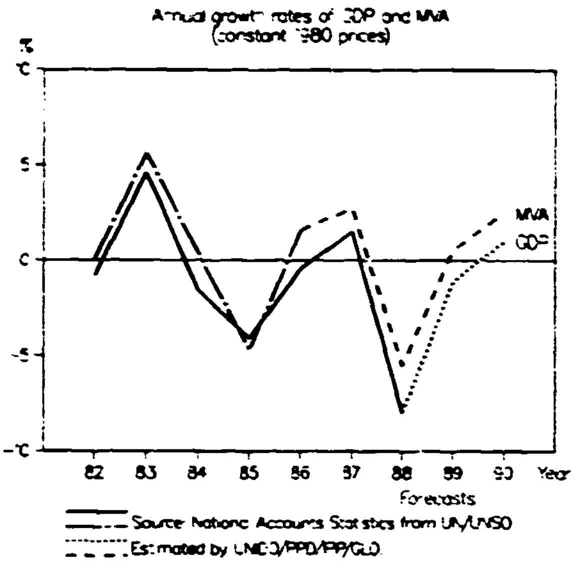
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





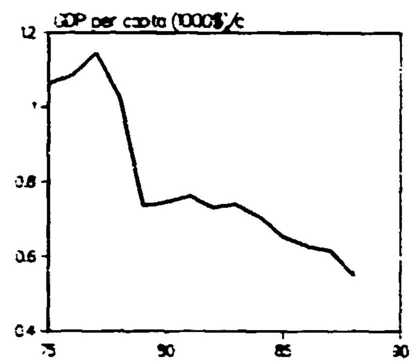


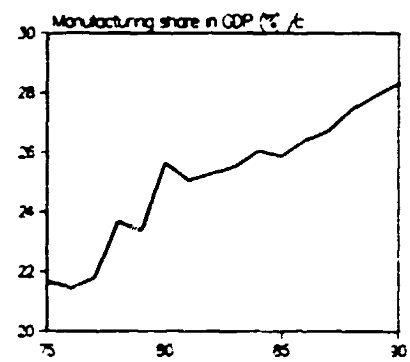


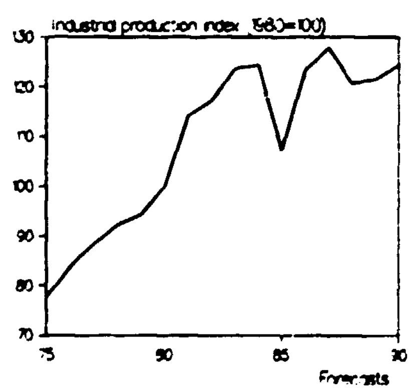


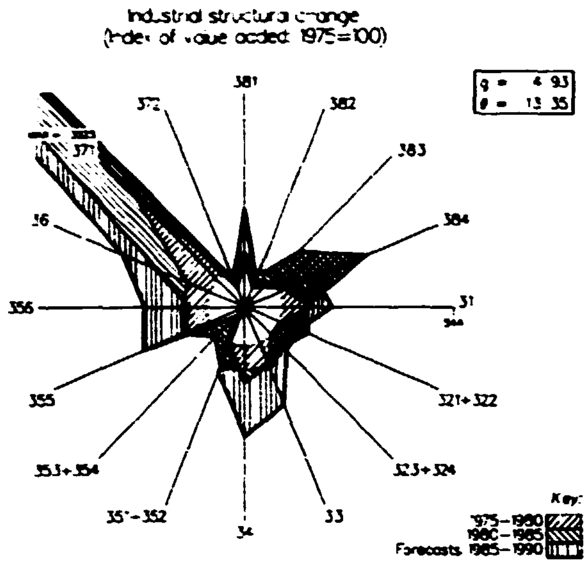
	1980	1985	1987
GDP: /na.c (millions of dollars)	2070	2136	2159
Per capita /na.c (dollars)	747	653	616
Manufacturing share /na.c (%)	25.6	25.9	26.7 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	531	553	577 /e
Value added (millions of dollars)	354	1646 e	4660 /e
Industrial production index	100	107	128 /e
Gross output (millions of dollars)	895	2863 /e	8508
Employment (thousands)	34	45 /e	46
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	60	46 /e	45 /e
Wages and salaries (%)	12	11 /e	12 /e
Operating surplus (%)	28	43 /e	43 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	26354	63736 /e	185804 /e
Value added / worker	10431	34425 /e	101613 /e
Average wage	3040	7098 /e	21894 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.48 /e	4.12 /e	1.25 /e
as a percentage of average θ in 1970-1975	51 /e	143 /e	43 /e
MVA growth rate / θ	4.13 /e	-3.32 /e	2.99 /e
Degree of specialization	32.0 /e	31.6 /e	35.5 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	76	298 /e	766 /e
313 Beverages	70	362 /e	1230 /e
314 Tobacco products	40	126 /e	411 /e
321 Textiles	14	98 /e	261 /e
322 Wearing apparel	6	32 /e	94 /e
323 Leather and fur products	4	11 /e	31 /e
324 Footwear	6	49 /e	164 /e
331 Wood and wood products	4	11 /e	28 /e
332 Furniture and fixtures	1	6 /e	15 /e
341 Paper and paper products	1	5 /e	14 /e
342 Printing and publishing	6	37 /e	110 /e
351 Industrial chemicals	16	41 /e	115 /e
352 Other chemical products	21	109 /e	362 /e
353 Petroleum refineries	52	157 /e	460 /e
354 Miscellaneous petroleum and coal products	-	5 /e	7 /e
355 Rubber products	2	10 /e	31 /e
356 Plastic products	7	47 /e	151 /e
361 Pottery, china and earthenware	-	2 /e	5 /e
362 Glass and glass products	-	2 /e	7 /e
369 Other non-metal mineral products	10	22 /e	61 /e
371 Iron and steel	-	1 /e	4 /e
372 Non-ferrous metals	-	- /e	- /e
381 Metal products	13	89 /e	265 /e
382 Non-electrical machinery	1	4 /e	12 /e
383 Electrical machinery	2	10 /e	27 /e
384 Transport equipment	1	6 /e	20 /e
385 Professional and scientific equipment	1	3 /e	7 /e
390 Other manufacturing industries	1	2 /e	4 /e

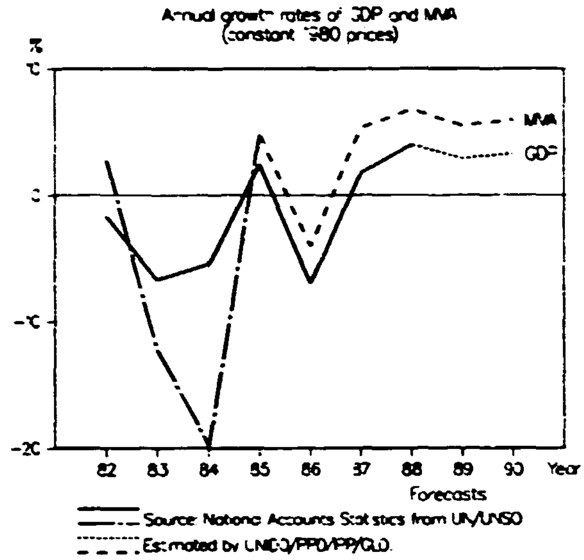
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





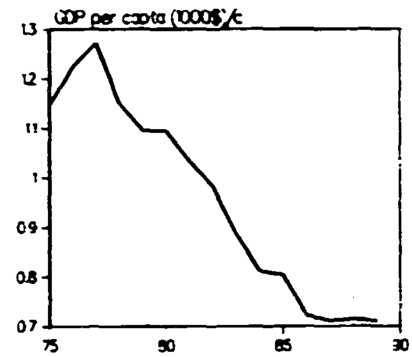


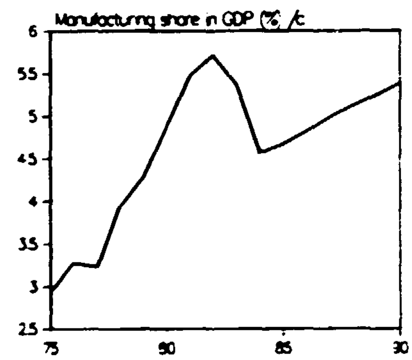


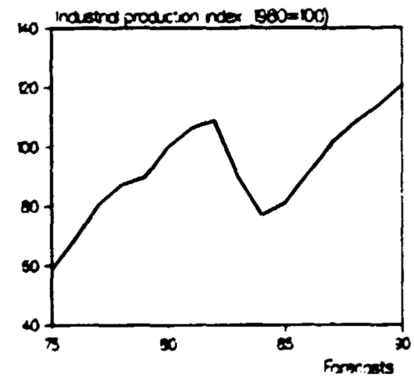


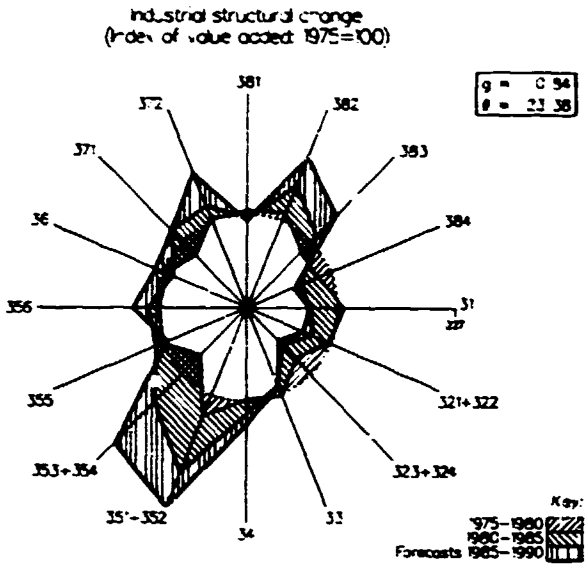
	1980	1985	1987
GDP: /na.c (millions of dollars)	88222	76520	72434
Per capita /na.c (dollars)	1095	804	711
Manufacturing share /na.c (%)	4.9	4.7	5.0
MANUFACTURING:			
Value added /na.c (millions of dollars)	4304	3574	3612
Value added (millions of dollars)	8980	6783	1567 /e
Industrial production index	100	81	101
Gross output (millions of dollars)	17573	15456	4038
Employment (thousands)	432	328 /e	343 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	49 /e	56 /e	61 /e
Wages and salaries (%)	11 /e	9 /e	9 /e
Operating surplus (%)	40 /e	35 /e	30 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	40658 /e	48200 /e	11995 /e
Value added / worker	20777 /e	21178 /e	4663 /e
Average wage	4545 /e	4339 /e	1020 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	11.26 /e	7.66 /e	22.39 /e
as a percentage of average θ in 1970-1975	108 /e	73 /e	214 /e
MVA growth rate / θ	1.01 /e	0.65 /e	0.49 /e
Degree of specialization	20.6 /e	19.8 /e	16.5 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	554	761 /e	167 /e
313 Beverages	992	1308 /e	313 /e
314 Tobacco products	357	192 /e	42 /e
321 Textiles	866	951 /e	214 /e
322 Wearing apparel	13	15 /e	4 /e
323 Leather and fur products	45	95 /e	22 /e
324 Footwear	43	67 /e	15 /e
331 Wood and wood products	328	24 /e	5 /e
332 Furniture and fixtures	206	64 /e	13 /e
341 Paper and paper products	141	180 /e	43 /e
342 Printing and publishing	278	155 /e	42 /e
351 Industrial chemicals	113	58 /e	13 /e
352 Other chemical products	984	602 /e	142 /e
353 Petroleum refineries	265 /e	269 /e	53 /e
354 Miscellaneous petroleum and coal products	25 /e	25 /e	6 /e
355 Rubber products	96	116 /e	27 /e
356 Plastic products	366	114 /e	26 /e
361 Pottery, china and earthenware	1	- /e	- /e
362 Glass and glass products	90	36 /e	9 /e
369 Other non-metal mineral products	321	466 /e	96 /e
371 Iron and steel	10	93 /e	24 /e
372 Non-ferrous metals	123	129	42 /e
381 Metal products	519	526 /e	124 /e
382 Non-electrical machinery	86	72 /e	20 /e
383 Electrical machinery	169	149 /e	36 /e
384 Transport equipment	1948	288 /e	66 /e
385 Professional and scientific equipment	-	-1 /e	- /e
390 Other manufacturing industries	49	29 /e	7 /e

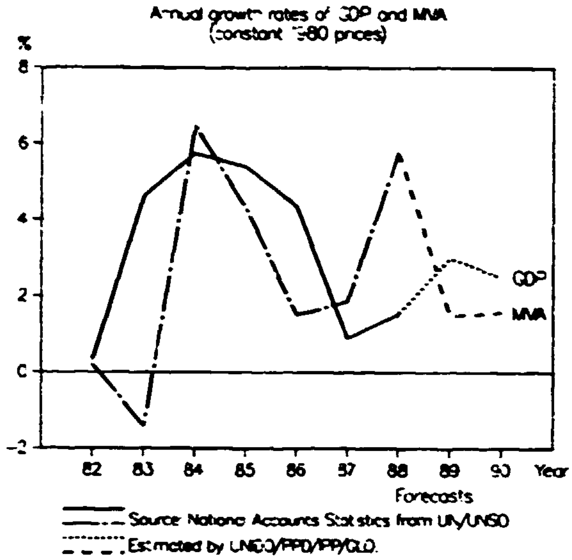
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





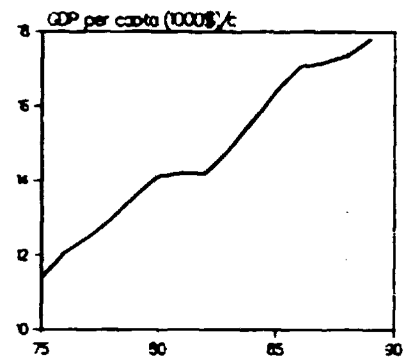


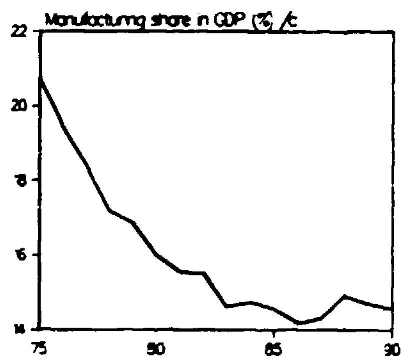


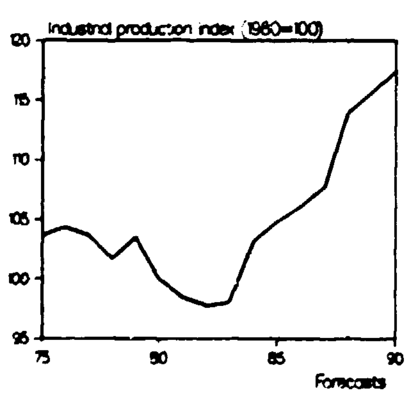


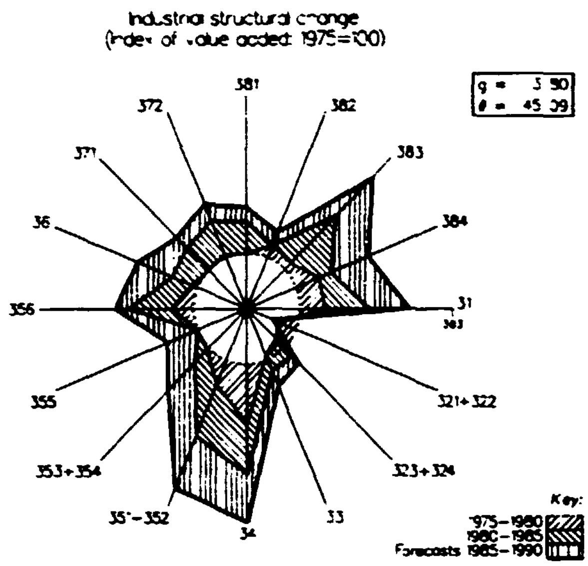
	1980	1985	1987
GDP: /na.c (millions of dollars)	57713	68117	71720
Per capita /na.c (dollars)	14121	16398	17166
Manufacturing share /na.c (%)	16.0	14.6	14.3
MANUFACTURING:			
Value added /na.c (millions of dollars)	9240	9929	10265
Value added (millions of dollars)	9772	8106	12804
Industrial production index	100	105	108
Gross output (millions of dollars)	31787	27968	41376
Employment (thousands)	354	312	314 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	69	71	69 /e
Wages and salaries (%)	18	16	17 /e
Operating surplus (%)	13	12	13 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	89818	89612	131653 /e
Value added / worker	27611	25973	40741 /e
Average wage	15916	14784	22969 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	4.16	3.36	2.64
as a percentage of average θ in 1970-1975	110	89	70
MVA growth rate / θ	-0.81	0.46	0.60
Degree of specialization	14.5	13.7	13.8
-VALUE ADDED: (millions of dollars)			
311 Food products	1476	1275	2104 /e
313 Beverages	292	297	523 /e
314 Tobacco products	33	26	38 /e
321 Textiles	213	126	188 /e
322 Wearing apparel	101	69	80 /e
323 Leather and fur products	18	9	14 /e
324 Footwear	24	9	14 /e
331 Wood and wood products	587	365	612 /e
332 Furniture and fixtures	196	164	272 /e
341 Paper and paper products	452	400	571 /e
342 Printing and publishing	668	717	1212 /e
351 Industrial chemicals	452	422	552 /e
352 Other chemical products	227	184	295 /e
353 Petroleum refineries	103	24	22 /e
354 Miscellaneous petroleum and coal products	63	58	71 /e
355 Rubber products	51	38	60 /e
356 Plastic products	170	147	262 /e
361 Pottery, china and earthenware	26	17	28 /e
362 Glass and glass products	65	50	77 /e
369 Other non-metal mineral products	281	215	390 /e
371 Iron and steel	386	276	374 /e
372 Non-ferrous metals	743	560	768 /e
381 Metal products	595	465	782 /e
382 Non-electrical machinery	933	1079	1689 /e
383 Electrical machinery	547	498	903 /e
384 Transport equipment	1000	565	769 /e
385 Professional and scientific equipment	32	38	64 /e
390 Other manufacturing industries	69	42	70 /e

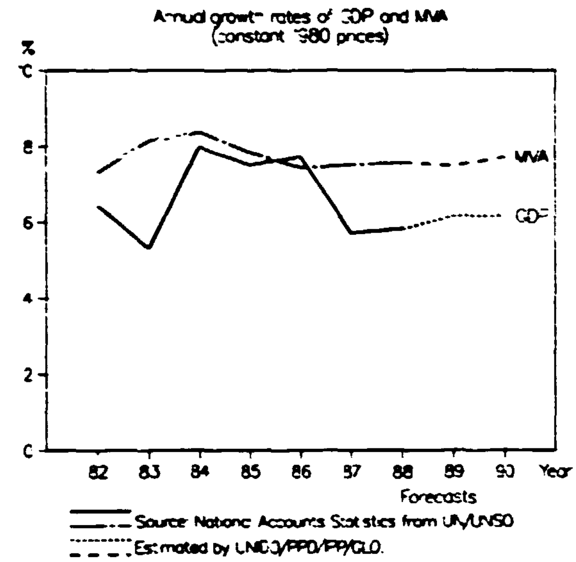
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





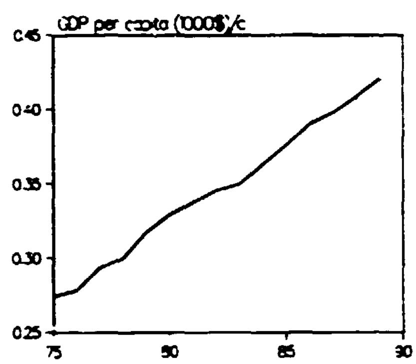


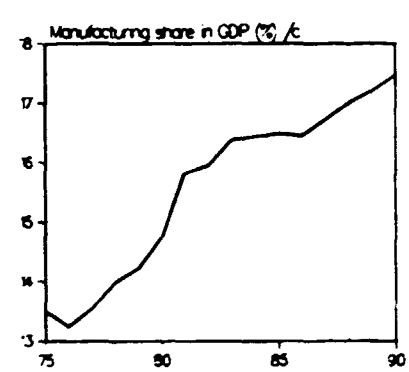


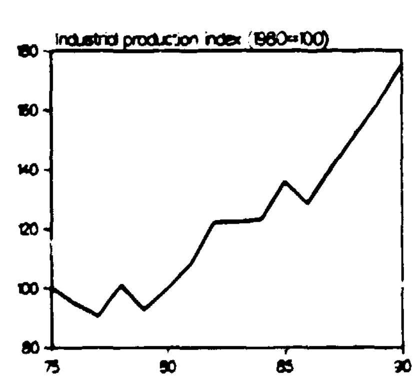


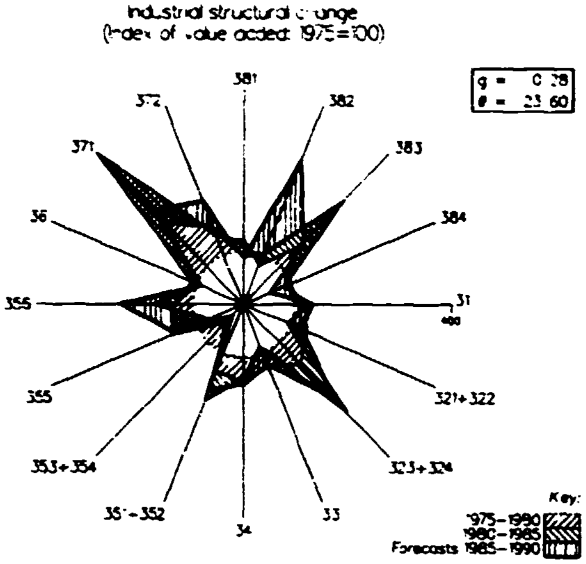
	1980	1985	1987
GDP: /na,c (millions of dollars)	28077	38801	44188
Per capita /na,c (dollars)	329	376	398
Manufacturing share /na,c (%)	14.7	16.5	16.7
MANUFACTURING:			
Value added /na,c (millions of dollars)	4138	6397	7390
Value added (millions of dollars)	2423	3224	3677
Industrial production index	100	136	141
Gross output (millions of dollars)	7144	9848	11125
Employment (thousands)	452	477 /e	484 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	66	67 /e	67 /e
Wages and salaries (%)	7	6 /e	6 /e
Operating surplus (%)	27	26 /e	27 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	15807	20651 /e	22983 /e
Value added / worker	5361	6760 /e	7597 /e
Average wage	1122	1308 /e	1391 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.26 /e	4.52 /e	3.73 /e
as a percentage of average θ in 1970-1975	31 /e	113 /e	93 /e
MVA growth rate / θ	6.16 /e	2.24 /e	2.55 /e
Degree of specialization	25.2 /e	23.6 /e	23.8 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	431	575 /e	666 /e
313 Beverages	45	70 /e	83 /e
314 Tobacco products	300	420 /e	494 /e
321 Textiles	483	499 /e	528 /e
322 Wearing apparel	7	20 /e	24 /e
323 Leather and fur products	41	46 /e	54 /e
324 Footwear	4	4 /e	4 /e
331 Wood and wood products	4	8 /e	9 /e
332 Furniture and fixtures	3	4 /e	4 /e
341 Paper and paper products	29	33 /e	37 /e
342 Printing and publishing	24	34 /e	36 /e
351 Industrial chemicals	127	322 /e	380 /e
352 Other chemical products	156	232 /e	272 /e
353 Petroleum refineries	158	94 /e	92 /e
354 Miscellaneous petroleum and coal products	9	16 /e	19 /e
355 Rubber products	28	51 /e	58 /e
356 Plastic products	12	18 /e	22 /e
361 Pottery, china and earthenware	5	7 /e	9 /e
362 Glass and glass products	11	12 /e	13 /e
369 Other non-metal mineral products	171	217 /e	257 /e
371 Iron and steel	99	151 /e	178 /e
372 Non-ferrous metals	1	1 /e	[illegible] /e
381 Metal products	38	37 /e	42 /e
382 Non-electrical machinery	43	107 /e	126 /e
383 Electrical machinery	78	124 /e	146 /e
384 Transport equipment	97	106 /e	109 /e
385 Professional and scientific equipment	6	7 /e	7 /e
390 Other manufacturing industries	11	9 /e	9 /e

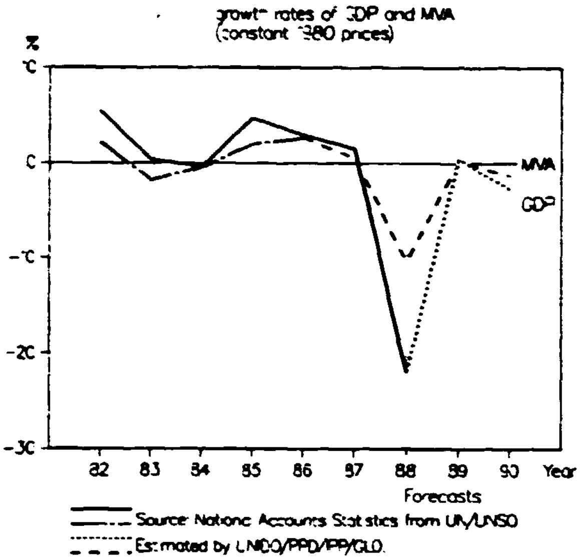
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





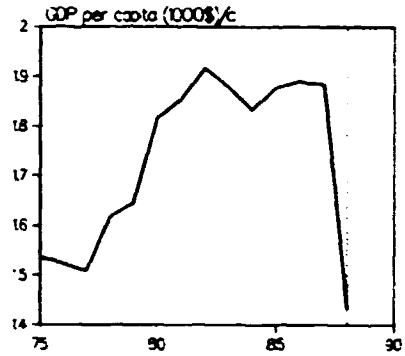


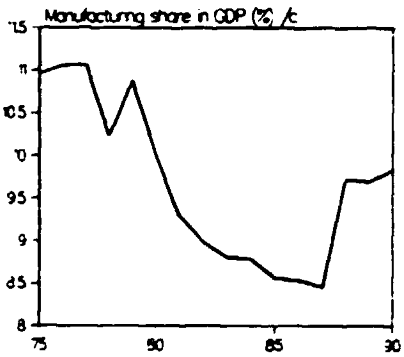


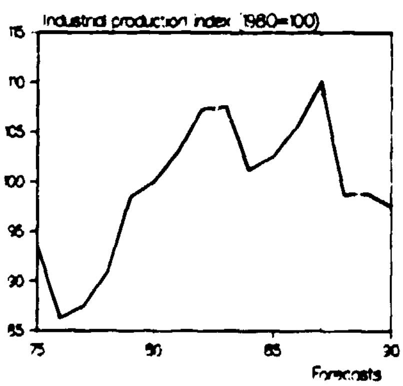


	1980	1985	1987
GDP: /na.c (millions of dollars)	3559	4094	4278
Per capita /na.c (dollars)	1816	1878	1884
Manufacturing share /na.c (%)	10.0	8.6	8.5 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	356	351	362 /e
Value added (millions of dollars)	477	593	647 /e
Industrial production index	100	103	110
Gross output (millions of dollars)	1473	1749	1878 /e
Employment (thousands)	31	34	36 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	68	66	66 /e
Wages and salaries (%)	8	11	12 /e
Operating surplus (%)	24	22	23 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	46756	50787	52449 /e
Value added / worker	15159	17211	18068 /e
Average wage	3805	5789	6191 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.25 /e	3.35 /e	4.26 /e
as a percentage of average θ in 1970-1975	72 /e	74 /e	94 /e
MVA growth rate / θ	0.48 /e	0.41 /e	1.01 /e
Degree of specialization	25.4 /e	26.0 /e	24.7 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	155	181	207 /e
313 Beverages	52	60	64 /e
314 Tobacco products	26	30	33 /e
321 Textiles	4	3	3 /e
322 Wearing apparel	31	27	28 /e
323 Leather and fur products	4	4	4 /e
324 Footwear	7	9	10 /e
331 Wood and wood products	8	8	8 /e
332 Furniture and fixtures	8	11	11 /e
341 Paper and paper products	20	19	20 /e
342 Printing and publishing	22	36	41 /e
351 Industrial chemicals	4	11	13 /e
352 Other chemical products	26	42	49 /e
353 Petroleum refineries	27	37	32 /e
354 Miscellaneous petroleum and coal products	-	3	4 /e
355 Rubber products	2	2	2 /e
356 Plastic products	12	21	25 /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	1	7	8 /e
369 Other non-metal mineral products	31	29	29 /e
371 Iron and steel	5	4	4 /e
372 Non-ferrous metals	2	3	4 /e
381 Metal products	19	21	24 /e
382 Non-electrical machinery	1	1	1 /e
383 Electrical machinery	3	4	3 /e
384 Transport equipment	4	13	15 /e
385 Professional and scientific equipment	1	2	3 /e
390 Other manufacturing industries	2	3	3 /e

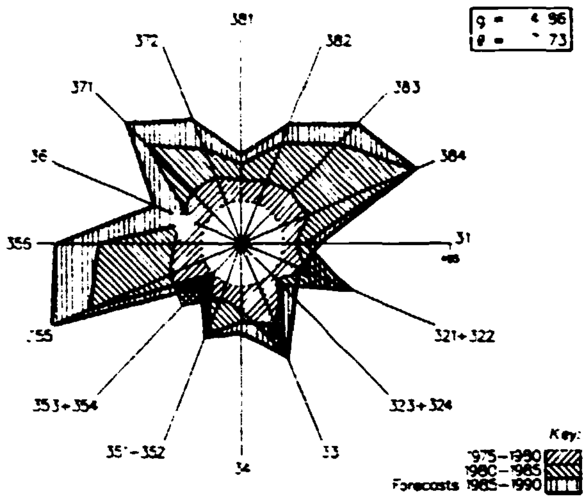
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



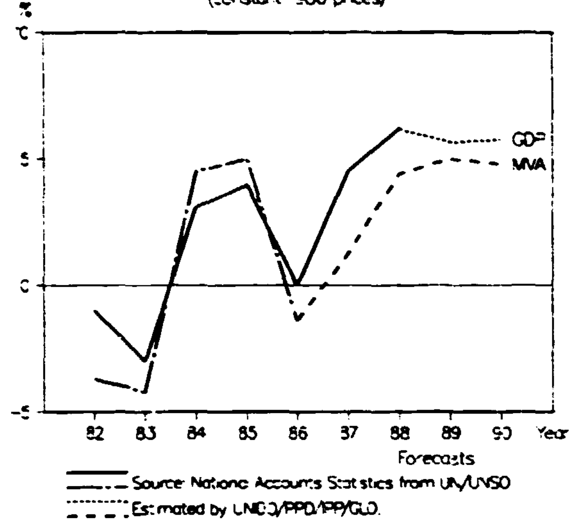




Industrial structural change
(Index of value added: 1975=100)



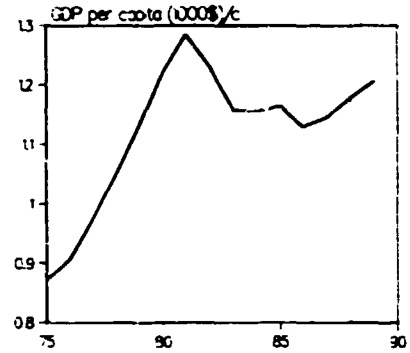
Annual growth rates of GDP and MVA
(constant 1980 prices)



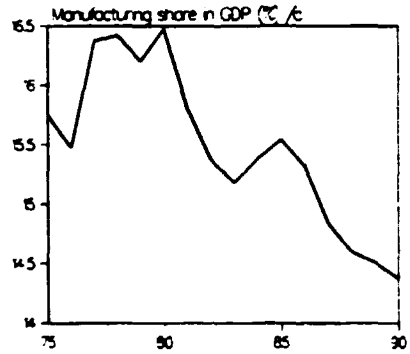
	1980	1985	1987
GDP: /na.c (millions of dollars)	3844	4302	4496
Per capita /na.c (dollars)	1221	1164	1146
Manufacturing share /na.c (%)	16.5	15.5	14.8 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	633	669	667 /e
Value added (millions of dollars)	575	606 /e	574 /e
Industrial production index	100	112	111
Gross output (millions of dollars)	1706 /e	1756 /e	1649 /e
Employment (thousands)	75 /e	94 /e	104 /e
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	66 /e	66 /e	65 /e
Wages and salaries (%)			
Operating surplus (%)	..		
-PRODUCTIVITY:(dollars)			
Gross output / worker	22832 /e	18771 /e	15851 /e
Value added / worker	7698 /e	6474 /e	5522 /e
Average wage	..		
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	6.47	6.52	5.93
as a percentage of average θ in 1970-1975	258	260	237
MVA growth rate / θ	2.00	1.00	0.23
Degree of specialization	29.4	26.5	27.7
-VALUE ADDED:(millions of dollars)			
311 Food products	170	189 /e	186 /e
313 Beverages	43	50 /e	46 /e
314 Tobacco products	6	8 /e	9 /e
321 Textiles	44	40 /e	31 /e
322 Wearing apparel	2	2 /e	2 /e
323 Leather and fur products	7	20 /e	21 /e
324 Footwear	18	24 /e	24 /e
331 Wood and wood products	95	81 /e	79 /e
332 Furniture and fixtures	6	10 /e	11 /e
341 Paper and paper products	-	2 /e	2 /e
342 Printing and publishing	24	26 /e	22 /e
351 Industrial chemicals	4	13 /e	11 /e
352 Other chemical products	10	8 /e	7 /e
353 Petroleum refineries	94	69 /e	63 /e
354 Miscellaneous petroleum and coal products	- /e	- /e	- /e
355 Rubber products	-	- /e	- /e
356 Plastic products	6	11 /e	11 /e
361 Pottery, china and earthenware	-	- /e	- /e
362 Glass and glass products	1	3 /e	3 /e
369 Other non-metal mineral products	26	22 /e	23 /e
371 Iron and steel	-	- /e	- /e
372 Non-ferrous metals	1	2 /e	2 /e
381 Metal products	9	12 /e	10 /e
382 Non-electrical machinery	1	1 /e	1 /e
383 Electrical machinery	-	- /e	- /e
384 Transport equipment	5	7 /e	7 /e
385 Professional and scientific equipment	1	1 /a	1 /e
390 Other manufacturing industries	2	3 /e	2 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

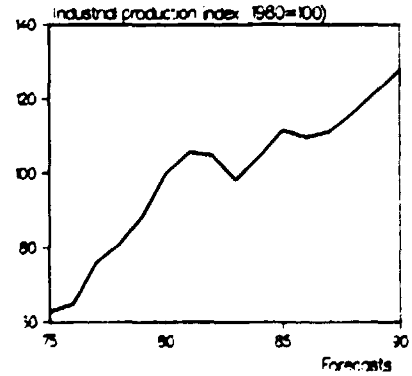
GDP per capita (1000$)/c



Manufacturing share in GDP (%)/c



Industrial production index (1980=100)



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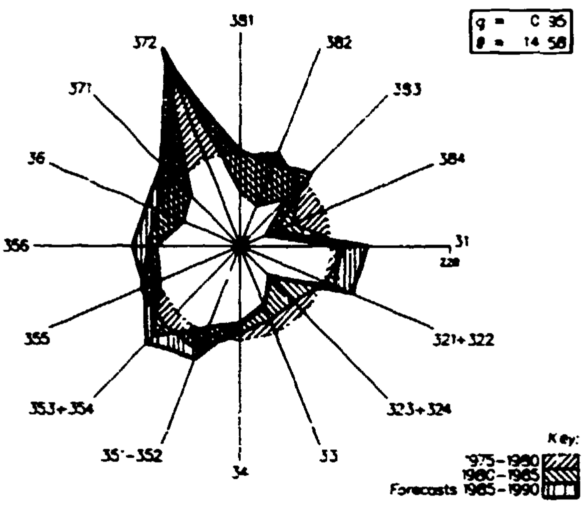
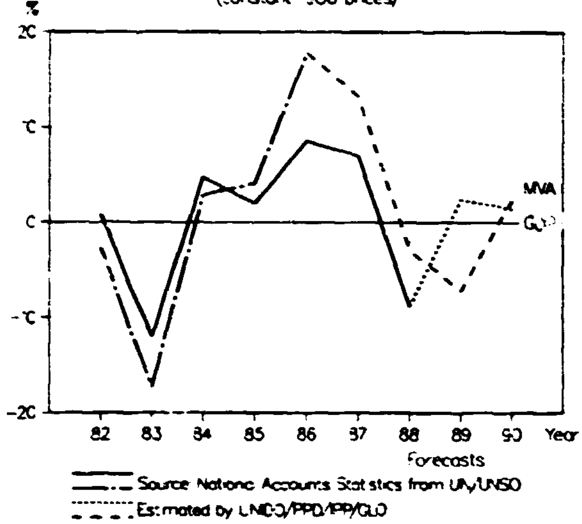
Industrial structural change
(index of value added: 1975=100)



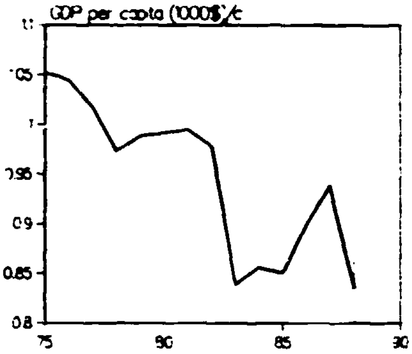
Annual growth rates of GDP and MVA
(constant 1980 prices)



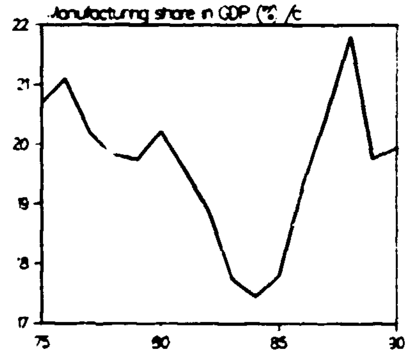
	1980	1985	1987
GDP: /na,c (millions of dollars)	17145	15754	19458
Per capita /na,c (dollars)	991	851	939
Manufacturing share /na,c (%)	20.2	17.8	20.5 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	3466	2984	3981 /e
Value added (millions of dollars)	4984	3257 /e	7867 /e
Industrial production index	100	86	116 /e
Gross output (millions of dollars)	12977	8800 /e	21313 /e
Employment (thousands)	273	263 /e	268 /e
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	62	63 /e	63 /e
Wages and salaries (%)	6	9 /e	9 /e
Operating surplus (%)	32	28 /e	28 /e
-PRODUCTIVITY:(dollars)			
Gross output / worker	47484	33501 /e	79429 /e
Value added / worker	18238	12400 /e	29317 /e
Average wage	2824	3121 /e	6910 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	6.35	3.64 /e	5.32 /e
as a percentage of average θ in 1970-1975	92	53 /e	77 /e
MVA growth rate / θ	1.44	1.55 /e	2.52 /e
Degree of specialization	14.5	17.6 /e	15.7 /e
-VALUE ADDED:(millions of dollars)			
311 Food products	767	393 /e	873 /e
313 Beverages	379	245 /e	595 /e
314 Tobacco products	84	62 /e	147 /e
321 Textiles	466	290 /e	724 /e
322 Wearing apparel	66	60 /e	149 /e
323 Leather and fur products	56	17 /e	37 /e
324 Footwear	41	23 /e	57 /e
331 Wood and wood products	81	35 /e	88 /e
332 Furniture and fixtures	40	23 /e	58 /e
341 Paper and paper products	156	72 /e	181 /e
342 Printing and publishing	100	76 /e	184 /e
351 Industrial chemicals	215	212 /e	530 /e
352 Other chemical products	289	205 /e	514 /e
353 Petroleum refineries	192	546 /e	1372 /e
354 Miscellaneous petroleum and coal products	6	1 /e	1 /e
355 Rubber products	62	56 /e	139 /e
356 Plastic products	89	93 /e	234 /e
361 Pottery, china and earthenware	15	5 /e	14 /e
362 Glass and glass products	47	25 /e	63 /e
369 Other non-metal mineral products	129	117 /e	277 /e
371 Iron and steel	192	120 /e	299 /e
372 Non-ferrous metals	604	171 /e	314 /e
381 Metal products	188	100 /e	251 /e
382 Non-electrical machinery	156	68 /e	162 /e
383 Electrical machinery	211	99 /e	250 /e
384 Transport equipment	278	103 /e	259 /e
385 Professional and scientific equipment	14	10 /e	26 /e
390 Other manufacturing industries	68	31 /e	67 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

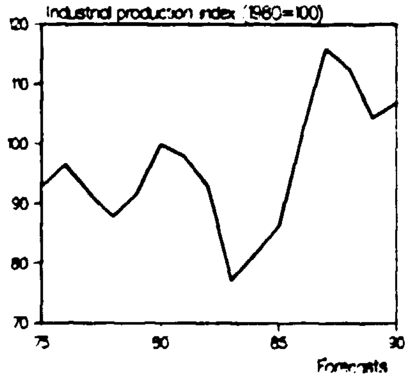
GDP per capita (1000$)/c

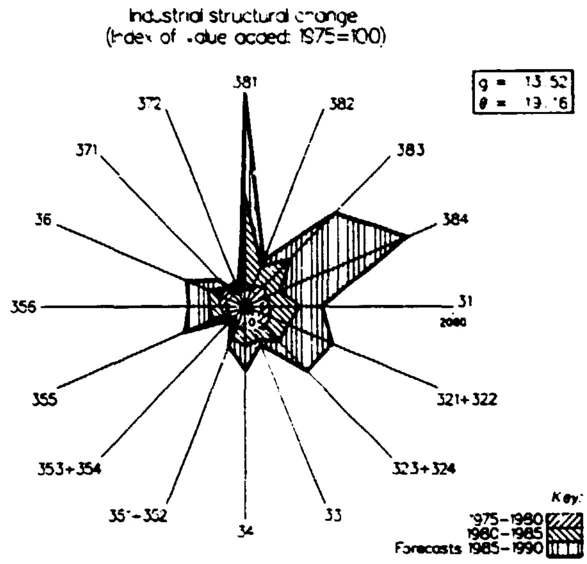


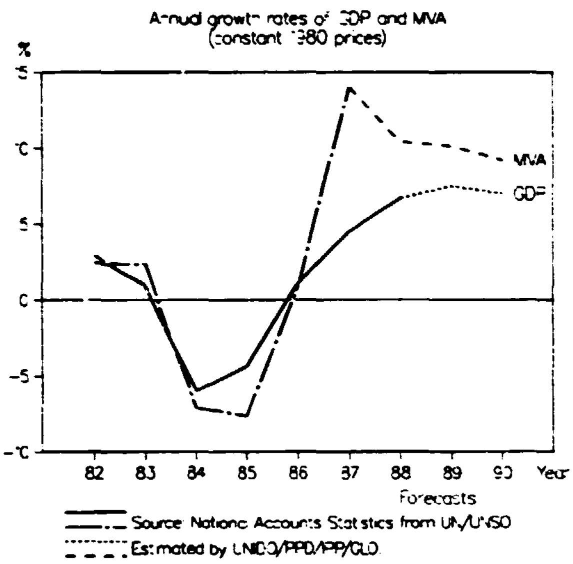
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

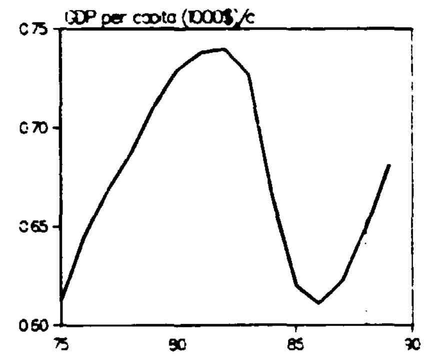


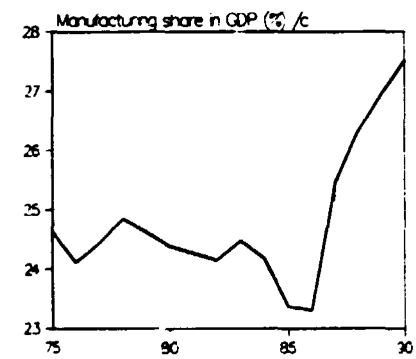


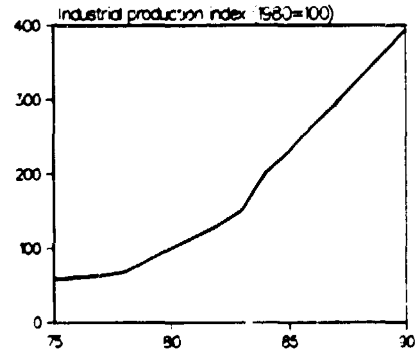


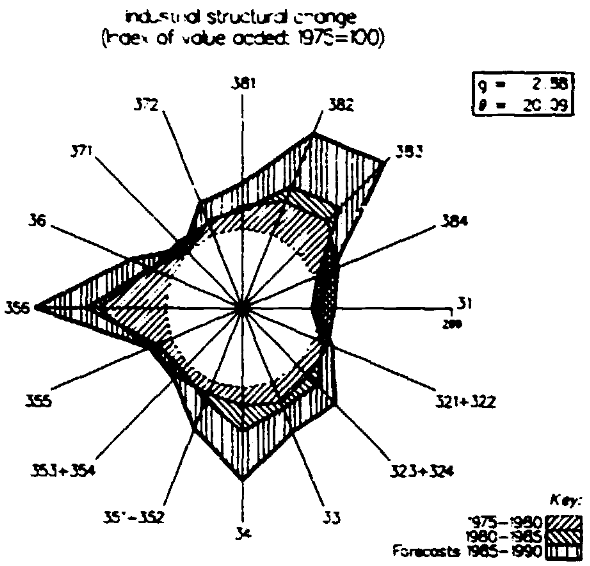
	1980	1985	1987
GDP: /na.c (millions of dollars)	35235	34183	36118
Per capita /na.c (dollars)	729	620	623
Manufacturing share /na.c (%)	24.4	23.4	25.4
MANUFACTURING:			
Value added /na.c (millions of dollars)	8595	7989	9185
Value added (millions of dollars)	4861	3449	4184 /e
Industrial production index	100	230	295
Gross output (millions of dollars)	17369	11905	14110
Employment (thousands)	949	612	655 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	72	71	70 /e
Wages and salaries (%)	6	6	6 /e
Operating surplus (%)	22	23	24 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	18308	19459	21535 /e
Value added / worker	5124	5638	6386 /e
Average wage	1127	1254	1318 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.92 /e	5.71 /e	3.79 /e
as a percentage of average θ in 1970-1975	30 /e	88 /e	58 /e
MVA growth rate / θ	10.49 /e	2.47 /e	2.98 /e
Degree of specialization	22.2 /e	27.5 /e	25.4 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	969	658	1088 /e
313 Beverages	195	423	389 /e
314 Tobacco products	309	209	221 /e
321 Textiles	395	109	159 /e
322 Wearing apparel	205	128	148 /e
323 Leather and fur products	8	3	3 /e
324 Footwear	13	9	11 /e
331 Wood and wood products	229	86	93 /e
332 Furniture and fixtures	75	22	28 /e
341 Paper and paper products	128	97	151 /e
342 Printing and publishing	89	46	56 /e
351 Industrial chemicals	296	101	161 /e
352 Other chemical products	389	204	267 /e
353 Petroleum refineries	328	715	746 /e
354 Miscellaneous petroleum and coal products	2	3	2 /e
355 Rubber products	103	61	56 /e
356 Plastic products	85	32	36 /e
361 Pottery, china and earthenware	33	9	7 /e
362 Glass and glass products	42	28	42 /e
369 Other non-metal mineral products	63	12	16 /e
371 Iron and steel	98	164	130 /e
372 Non-ferrous metals	35	28	29 /e
381 Metal products	127	48	54 /e
382 Non-electrical machinery	98	31	35 /e
383 Electrical machinery	260	166	182 /e
384 Transport equipment	234	35	38 /e
385 Professional and scientific equipment	5	5	8 /e
390 Other manufacturing industries	49	28	28 /e

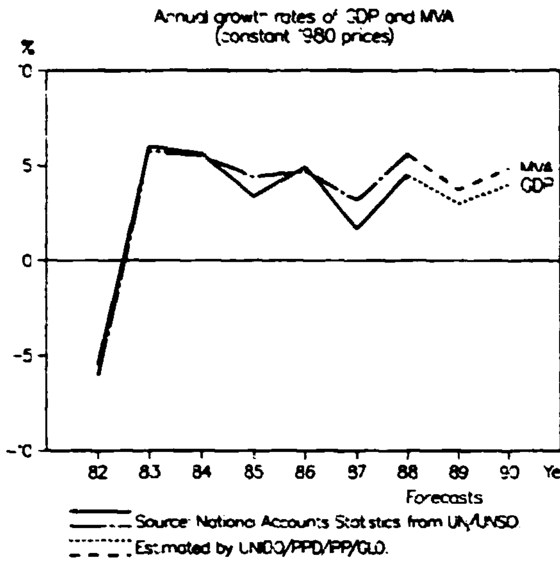
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





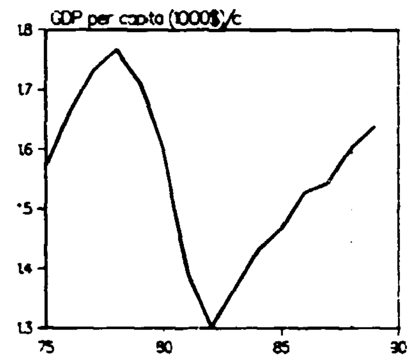


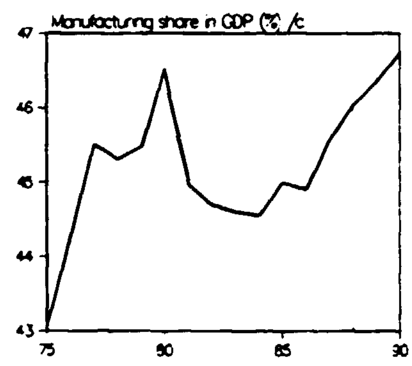


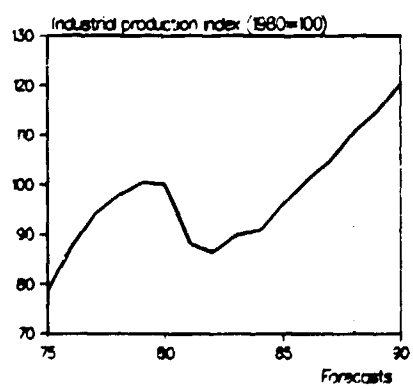


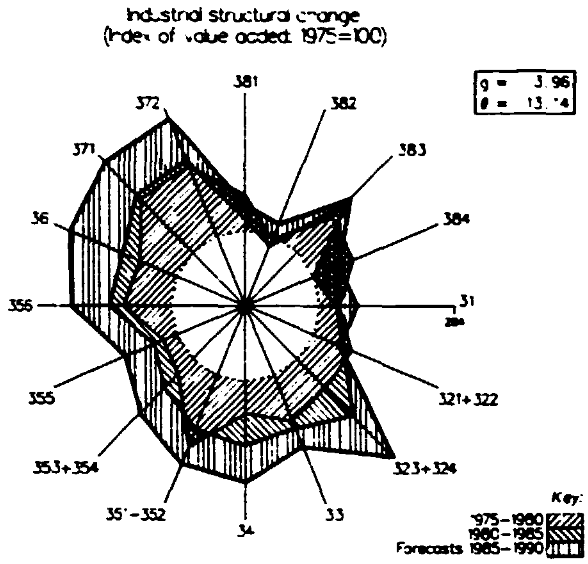
	1980	1985	1987
GDP: /na,c (millions of dollars)	56712	54576	58237
Per capita /na,c (dollars)	1594	1467	1543
Manufacturing share /na,c (%)	46.5	45.0	45.5
MANUFACTURING:			
Value added /na,c (millions of dollars)	26384	24558	26525
Value added (millions of dollars)	22833	23807	19719
Industrial production index	100	96	105
Gross output (millions of dollars)	...	...	...
Employment (thousands)	4126	3578	3571 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	...	...	...
Wages and salaries (%)	...	...	...
Operating surplus (%)	...	...	...
-PRODUCTIVITY: (dollars)			
Gross output / worker	...	...	...
Value added / worker	5534	6654	5522 /e
Average wage	1551	1586	1239 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.11	1.36	1.99
as a percentage of average θ in 1970-1975	49	60	88
MVA growth rate / θ	-0.41	4.17	1.91
Degree of specialization	13.4	12.0	12.3
-VALUE ADDED: (millions of dollars)			
311 Food products	-889	140	32 /e
313 Beverages	3062	3491	2894 /e
314 Tobacco products	636	72	57 /e
321 Textiles	2795	2381	1850 /e
322 Wearing apparel	572	780	645 /e
323 Leather and fur products	122	21[illegible]	178 /e
324 Footwear	403	419	351 /e
331 Wood and wood products	423	423	355 /e
332 Furniture and fixtures	491	487	401 /e
341 Paper and paper products	224	262	257 /e
342 Printing and publishing	154	203	184 /e
351 Industrial chemicals	837	715	575 /e
352 Other chemical products	961	628	550 /e
353 Petroleum refineries	1068	1207	1062 /e
354 Miscellaneous petroleum and coal products	54	58	46 /e
355 Rubber products	317	332	249 /e
356 Plastic products	360	289	245 /e
361 Pottery, china and earthenware	97	142	115 /e
362 Glass and glass products	269	275	208 /e
369 Other non-metal mineral products	335	618	494 /e
371 Iron and steel	868	1131	873 /e
372 Non-ferrous metals	602	328	317 /e
381 Metal products	1343	1313	1106 /e
382 Non-electrical machinery	3263	3274	2842 /e
383 Electrical machinery	1668	1766	1487 /e
384 Transport equipment	2436	2197	1740 /e
385 Professional and scientific equipment	244	244	228 /e
390 Other manufacturing industries	237	426	379 /e

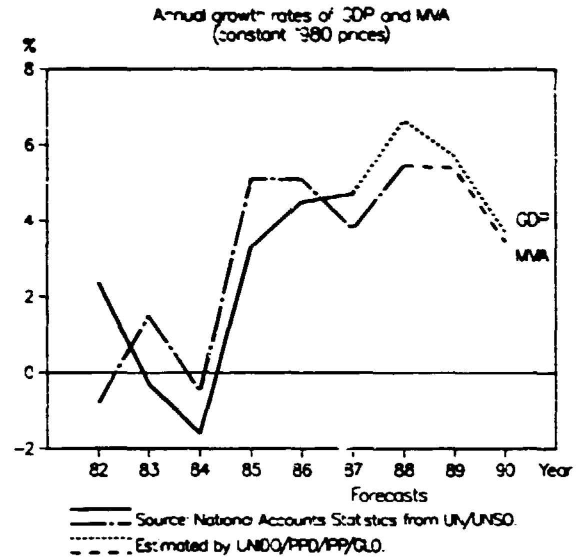
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





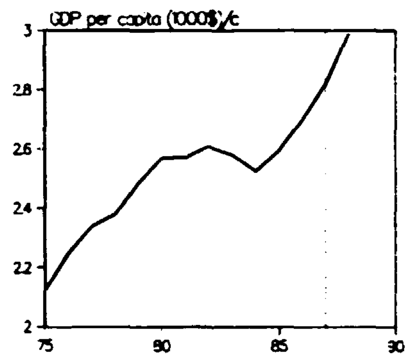


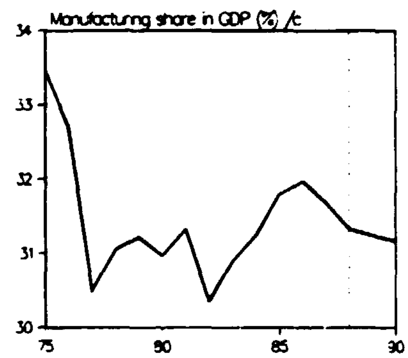


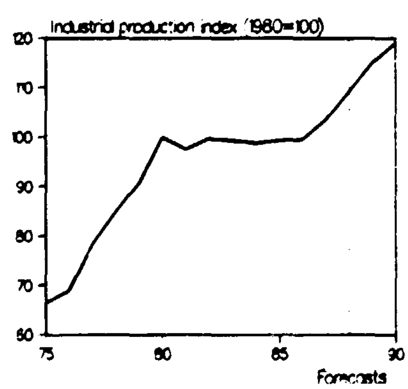


	1980	1985	1987
GDP: /na,c (millions of dollars)	25090	26358	28841
Per capita /na,c (dollars)	2569	2595	2820
Manufacturing share /na,c (%)	31.0	31.8	31.7
MANUFACTURING:			
Value added /na,c (millions of dollars)	7770	8379	9138
Value added (millions of dollars)	5602	4191	6673
Industrial production index	100	99	104
Gross output (millions of dollars)	17932	15793	27150
Employment (thousands)	680	623	641 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	69	73	75 /e
Wages and salaries (%)	13	10	9 /e
Operating surplus (%)	18	16	15 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	26355	25362	42371 /e
Value added / worker	8233	6731	10414 /e
Average wage	3554	2635	3927 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.26 /e	3.31 /e	2.85 /e
as a percentage of average θ in 1970-1975	45 /e	45 /e	39 /e
MVA growth rate / θ	3.12 /e	0.15 /e	1.38 /e
Degree of specialization	15.1 /e	13.8 /e	12.4 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	544	490	514 /e
313 Beverages	135	133	213 /e
314 Tobacco products	64	93	141 /e
321 Textiles	906	679	1099 /e
322 Wearing apparel	186	182	303 /e
323 Leather and fur products	41	41	70 /e
324 Footwear	86	86	145 /e
331 Wood and wood products	325	160	237 /e
332 Furniture and fixtures	106	30	60 /e
341 Paper and paper products	274	276	409 /e
342 Printing and publishing	180	140	218 /e
351 Industrial chemicals	147	215	250 /e
352 Other chemical products	224	190	339 /e
353 Petroleum refineries	219	33	56 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	58	62	80 /e
356 Plastic products	128	82	133 /e
361 Pottery, china and earthenware	80	67	101 /e
362 Glass and glass products	87	63	76 /e
369 Other non-metal mineral products	295	200	360 /e
371 Iron and steel	207	98	150 /e
372 Non-ferrous metals	33	26	37 /e
381 Metal products	323	219	413 /e
382 Non-electrical machinery	170	143	232 /e
383 Electrical machinery	319	263	341 /e
384 Transport equipment	428	222	355 /e
385 Professional and scientific equipment	16	16	28 /e
390 Other manufacturing industries	20	11	19 /e

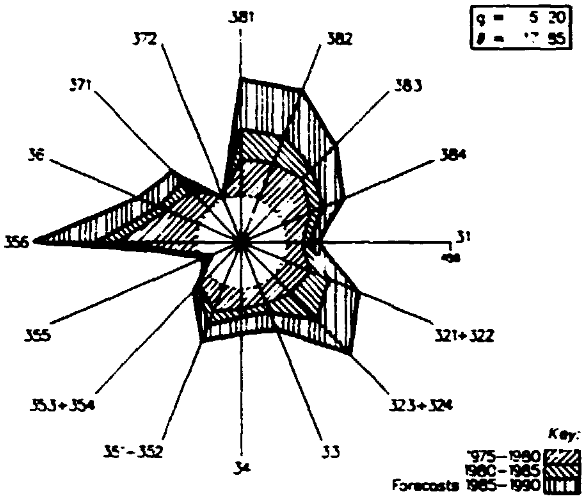
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



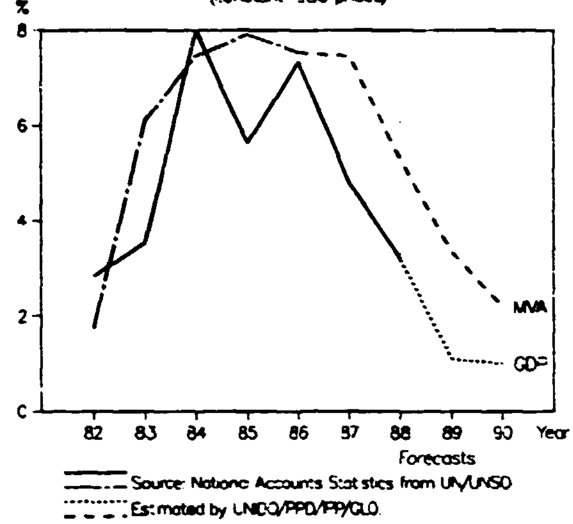




Industrial structural change
(Index of value added: 1975=100)



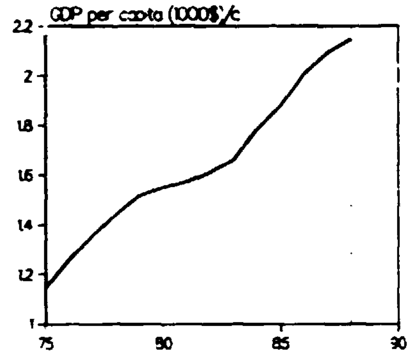
Annual growth rates of GDP and MVA
(constant 1980 prices)



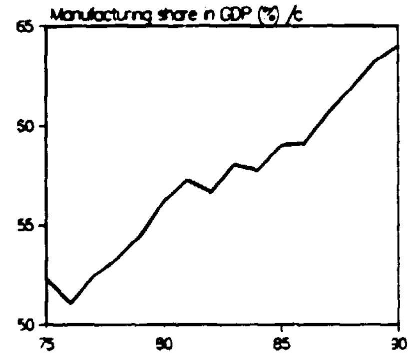
	1980	1985	1987
GDP: /na,c (millions of dollars)	34439	42693	48023
Per capita /na,c (dollars)	1551	1879	2094
Manufacturing share /na,c (%)	56.2	59.0	60.6 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	19358	25192	29113 /e
Value added (millions of dollars)/c	...	...	...
Industrial production index	100	121	140 /e
Gross output (millions of dollars)	...	...	...
Employment (thousands)	3221	3437	3587 /e
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	...	...	...
Wages and salaries (%)	...	...	...
Operating surplus (%)	...	...	...
-PRODUCTIVITY:(dollars)			
Gross output / worker	...	...	...
Value added / worker /c	...	...	...
Average wage	135 /e	210 /e	...
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.07 /e	1.72 /e	0.62 /e
as a percentage of average θ in 1970-1975	69 /e	57 /e	21 /e
MVA growth rate / θ	2.94 /e	2.75 /e	12.81 /e
Degree of specialization	20.5 /e	21.1 /e	21.1 /e
-VALUE ADDED:(millions of dollars)/c			
311 Food products	...	...	...
313 Beverages	...	...	...
314 Tobacco products	...	...	...
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.

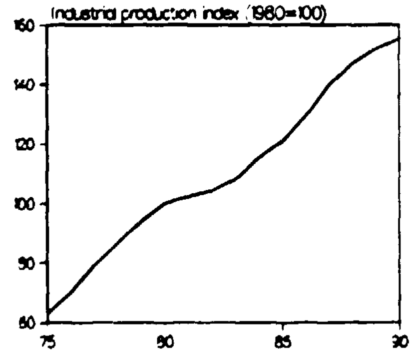
GDP per capita (1000$)/c

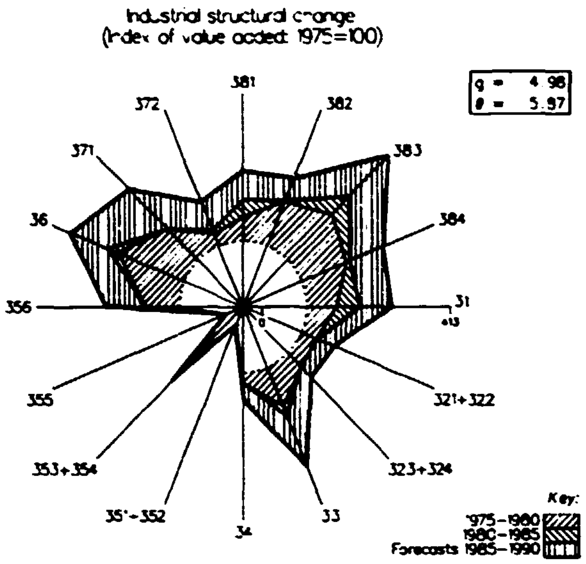


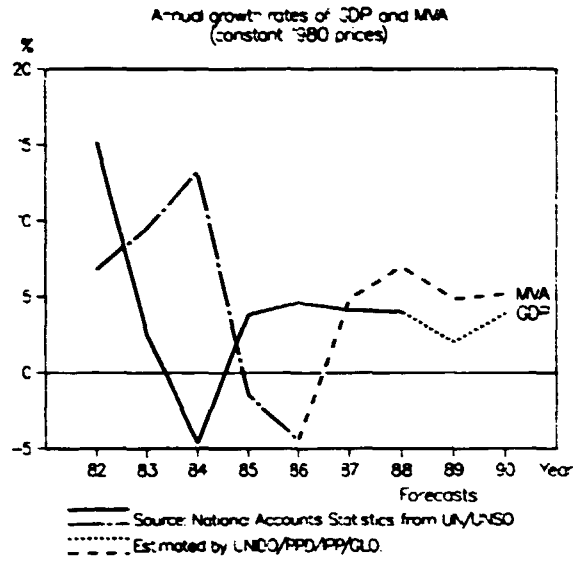
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

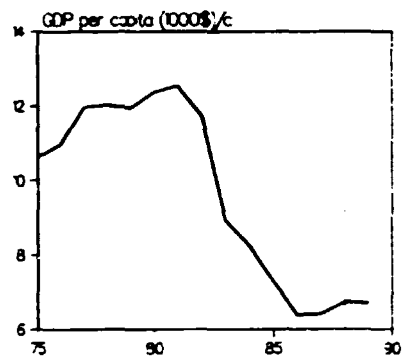


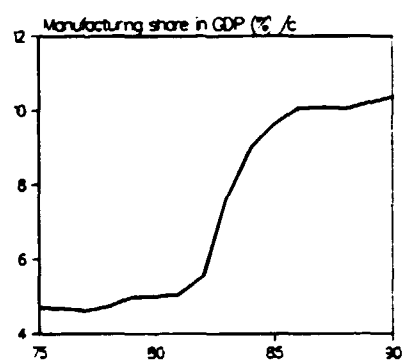


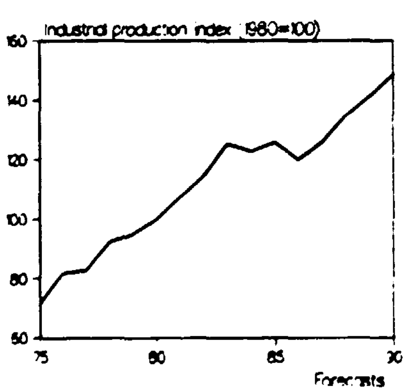


	1980	1985	1987
GDP: /na,c (millions of dollars)	115962	84342	80698
Per capita /na,c (dollars)	12372	7273	6415
Manufacturing share /na,c (%)	5.0	9.6	10.1 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	5800	8113	8129 /e
Value added (millions of dollars)/c	5819	7316	7330 /e
Industrial production index	100	126	126 /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 (in degrees)	0.86 /e	0.93 /e	0.72 /e
as a percentage of average θ in 1970-1975	106 /e	116 /e	90 /e
MVA growth rate / θ	6.21 /e	2.56 /e	6.75 /e
Degree of specialization	47.0 /e	51.4 /e	49.4 /e
-VALUE ADDED:(millions of dollars)/c			
311 Food products	385 /e	529 /e	558 /e
313 Beverages	59 /e	63 /e	71 /e
314 Tobacco products	98 /e	123 /e	128 /e
321 Textiles	86	85 /e	87 /e
322 Wearing apparel	102 /e	108 /e	110 /e
323 Leather and fur products	26	26 /e	27 /e
324 Footwear	41 /e	40 /e	41 /e
331 Wood and wood products	61 /e	67 /e	75 /e
332 Furniture and fixtures	38 /e	43 /e	50 /e
341 Paper and paper products	58	59 /e	63 /e
342 Printing and publishing	58	58 /e	59 /e
351 Industrial chemicals	...	...	...
352 Other chemical products	...	...	...
353 Petroleum refineries	3579	4796	4659 /e
354 Miscellaneous petroleum and coal products	-	-	- /e
355 Rubber products	...	...	...
356 Plastic products	396	402 /e	447 /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	-	-	- /e
369 Other non-metal mineral products	506	552	570 /e
371 Iron and steel	13 /e	13 /e	15 /e
372 Non-ferrous metals	5 /e	5 /e	5 /e
381 Metal products	78 /e	96 /e	101 /e
382 Non-electrical machinery	60 /e	60 /e	60 /e
383 Electrical machinery	66 /e	80 /e	86 /e
384 Transport equipment	77 /e	80 /e	83 /e
385 Professional and scientific equipment	...	...	...
390 Other manufacturing industries	29	30 /e	36 /e

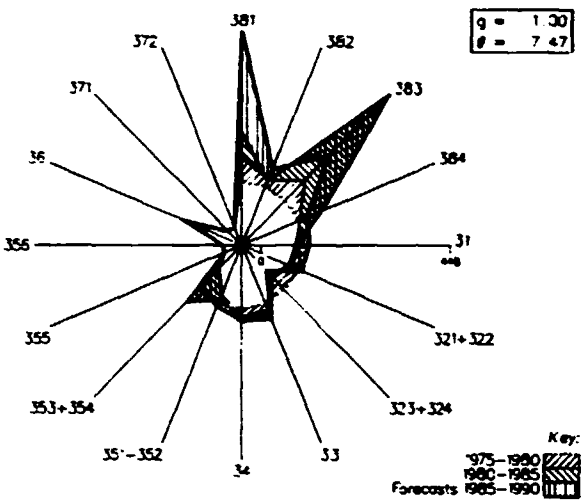
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



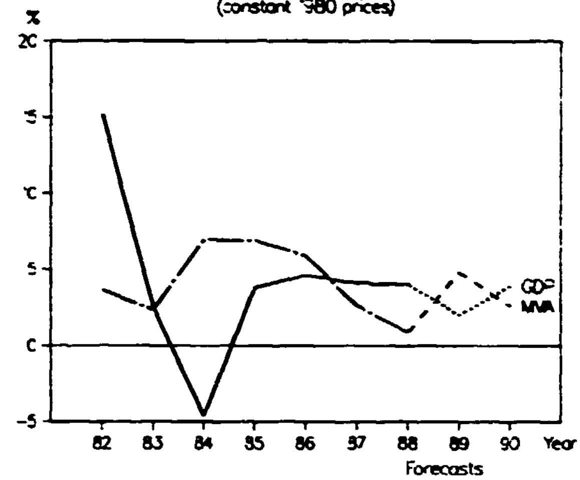




Industrial structural change
(Index of value added: 1975=100)



Annual growth rates of GDP and MVA
(constant 1980 prices)

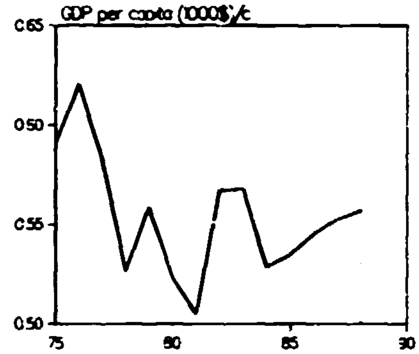


Source: National Accounts Statistics from UN/UNSO
Estimated by UNIDO/PPD/IPP/GLO.

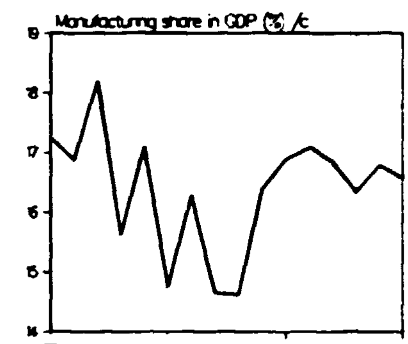
	1980	1985	1987
GDP: /na.c (millions of dollars)	2970	3447	3754
Per capita /na.c (dollars)	524	535	553
Manufacturing share /na.c (%)	14.7	16.9	16.8
MANUFACTURING:			
Value added /na.c (millions of dollars)	438	582	632
Value added (millions of dollars)	258	231	386
Industrial production index	100	98	121
Gross output (millions of dollars)	1070	1022	1402 /e
Employment (thousands)	32	35 /e	38 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	76	77 /e	72 /e
Wages and salaries (%)	10	9 /e	11 /e
Operating surplus (%)	14	13 /e	17 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	33812	28825 /e	37087 /e
Value added / worker	8164	6520 /e	10217 /e
Average wage	3508	2636 /e	3922 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	8.19 /e	3.64 /e	5.09 /e
as a percentage of average θ in 1970-1975	142 /e	63 /e	88 /e
MVA growth rate / θ	-2.87 /e	-1.58 /e	3.37 /e
Degree of specialization	25.8 /e	28.7 /e	32.0 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	106	92 /e	160 /e
313 Beverages	11	9 /e	16 /e
314 Tobacco products	7	9 /e	15 /e
321 Textiles	33	24 /e	34 /e
322 Wearing apparel	10	7 /e	12 /e
323 Leather and fur products	5	4 /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	3 /e
342 Printing and publishing	6	5 /e	9 /e
351 Industrial chemicals	16	12 /e	18 /e
352 Other chemical products	5	4 /e	6 /e
353 Petroleum refineries	18	13 /e	20 /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	31 /e
371 Iron and steel	-	- /e	- /e
372 Non-ferrous metals	-	- /e	- /e
381 Metal products	10	16 /e	28 /e
382 Non-electrical machinery	3	5 /e	9 /e
383 Electrical machinery	1	2 /e	3 /e
384 Transport equipment	6	8 /e	13 /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.

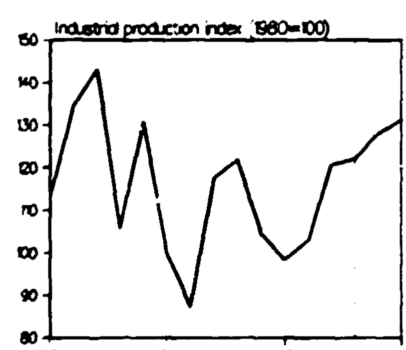
GDP per capita (1000$) /c



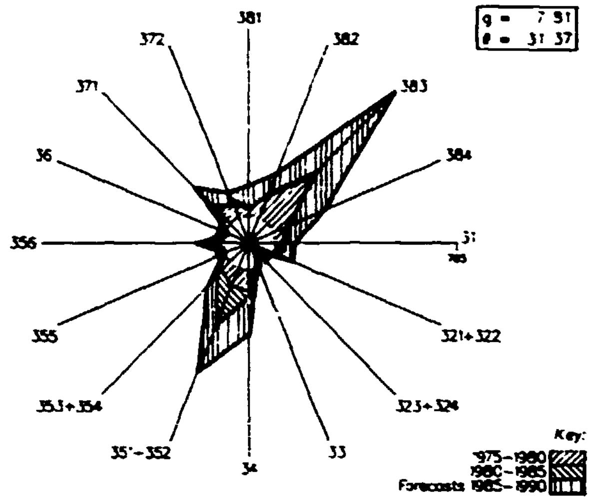
Manufacturing share in GDP (%) /c



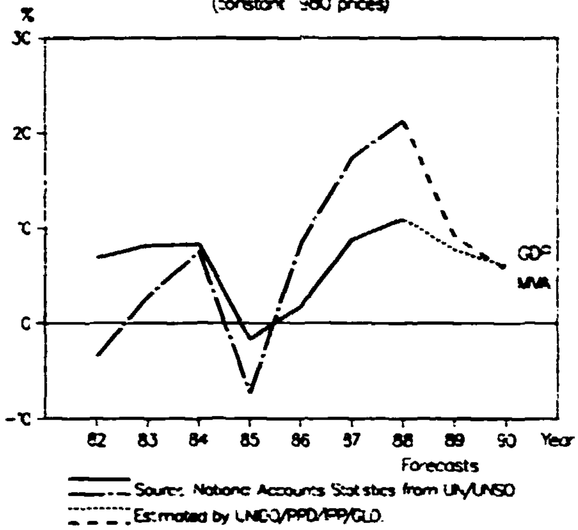
Industrial production index (1980=100)



Industrial structural change
(Index of value added: 1975=100)



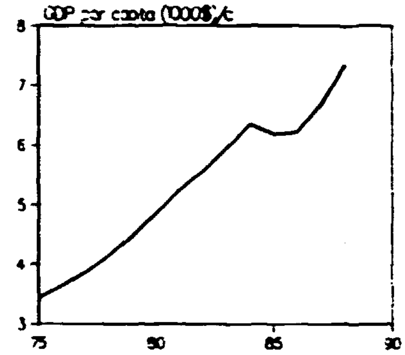
Annual growth rates of GDP and MVA
(constant 1980 prices)



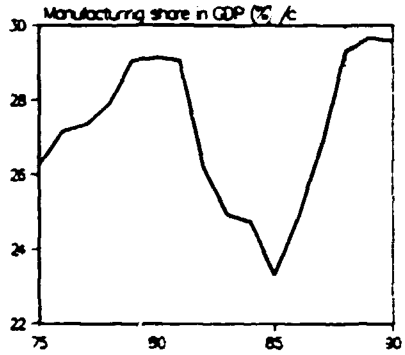
	1980	1985	1987
GDP: /na.c (millions of dollars)	11719	15821	17516
Per capita /na.c (dollars)	4851	6180	6693
Manufacturing share /na.c (%)	29.1	23.3	26.8
MANUFACTURING:			
Value added /na.c (millions of dollars)	3415	3689	4695
Value added (millions of dollars)	4074	4970	6798
Industrial production index	100	103	129
Gross output (millions of dollars)	15482	17844	21295
Employment (thousands)	294	263	264 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	74 /e	72 /e	68 /e
Wages and salaries (%)	8 /e	11 /e	9 /e
Operating surplus (%)	19 /e	17 /e	23 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	52930 /e	68511 /e	81336 /e
Value added / worker	13926 /e	19082 /e	25964 /e
Average wage	4131 /e	7216 /e	7387 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	6.29 /e	3.28 /e	7.08 /e
as a percentage of average θ in 1970-1975	86 /e	45 /e	97 /e
MVA growth rate / θ	1.81 /e	-3.00 /e	2.55 /e
Degree of specialization	22.2 /e	25.0 /e	27.3 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	129	190	241 /e
313 Beverages	51	76	106 /e
314 Tobacco products	25	36	41 /e
321 Textiles	75	29	45 /e
322 Wearing apparel	132	170	219 /e
323 Leather and fur products	7	6	8 /e
324 Footwear	11	7	9 /e
331 Wood and wood products	87	45	46 /e
332 Furniture and fixtures	44	69	83 /e
341 Paper and paper products	45	83	108 /e
342 Printing and publishing	136	246	314 /e
351 Industrial chemicals	51	138	283 /e
352 Other chemical products	143	270	432 /e
353 Petroleum refineries	687 /e	397 /e	437 /e
354 Miscellaneous petroleum and coal products	- /e	- /e	- /e
355 Rubber products	44	21	27 /e
356 Plastic products	84	106	132 /e
361 Pottery, china and earthenware	1	-	- /e
362 Glass and glass products	11	5	3 /e
369 Other non-metal mineral products	82	141	134 /e
371 Iron and steel	32	48	67 /e
372 Non-ferrous metals	11	18	24 /e
381 Metal products	202	310	406 /e
382 Non-electrical machinery	360	386	439 /e
383 Electrical machinery	949	1645	2401 /e
384 Transport equipment	601	478	674 /e
385 Professional and scientific equipment	81	90	126 /e
390 Other manufacturing industries	86	61	94 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

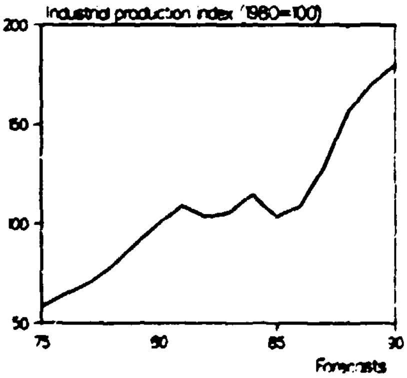
GDP per capita (1000$)/e

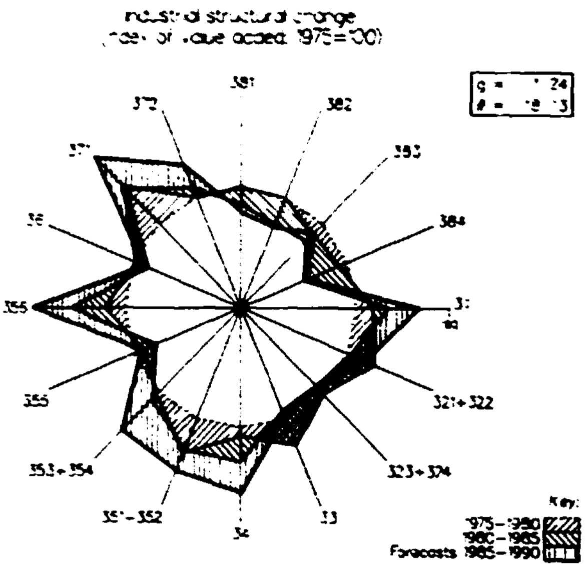


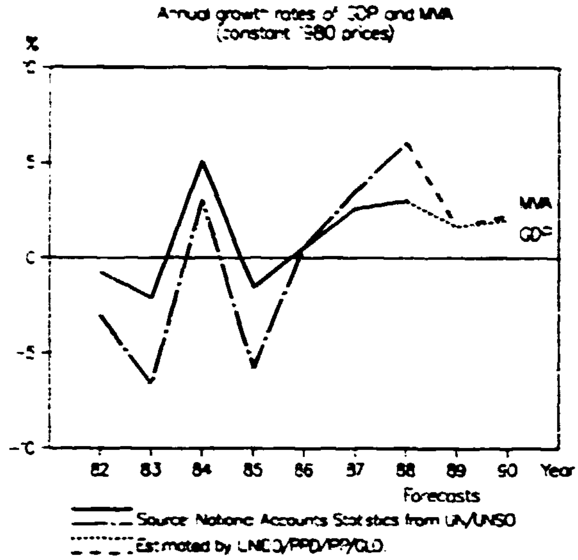
Manufacturing share in GDP (%) /e



Industrial production index (1980=100)

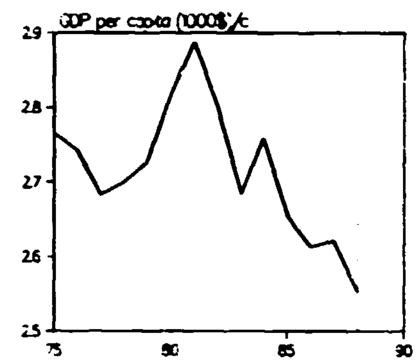


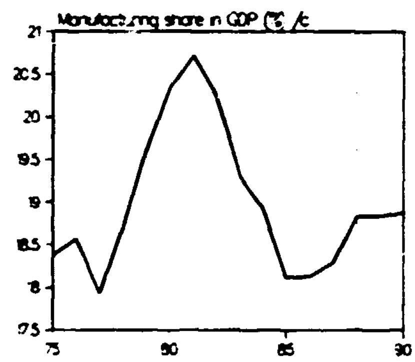


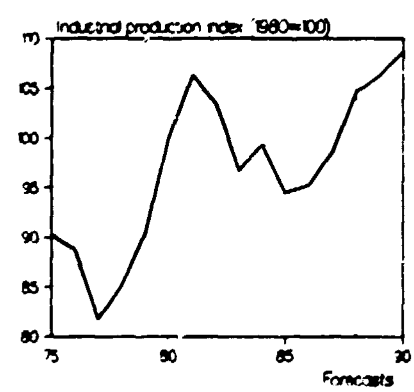


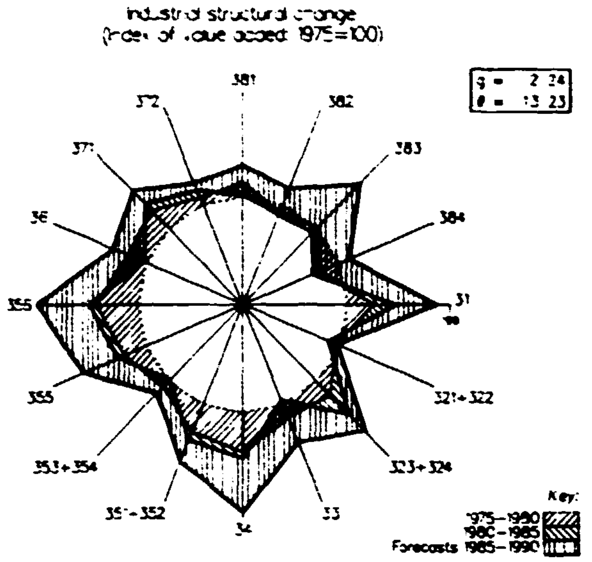
	1980	1985	1987
GDP: /na.c (millions of dollars)	79701	83927	86557
Per capita /na.c (dollars)	2818	2656	2622
Manufacturing share /na.c (%)	20.3	18.1	18.3
MANUFACTURING:			
Value added /na.c (millions of dollars)	16203	15202	15828
Value added (millions of dollars)	17866	11857	18287
Industrial production index	100	95	99
Gross output (millions of dollars)	57396 /e	39208	60471
Employment (thousands)	1392	1328	1333 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	69 /e	70 /e	70 /e
Wages and salaries (%)	15 /e	15 /e	14 /e
Operating surplus (%)	16 /e	15 /e	16 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	41233 /e	29524 /e	45350 /e
Value added / worker	12835	8929	13715 /e
Average wage	6118	4420	6274 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.27	5.96	3.20 /e
as a percentage of average θ in 1970-1975	91	167	89 /e
MVA growth rate / θ	3.24	-0.81	1.09 /e
Degree of specialization	10.5	10.2	9.9 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	1626	1260	1917 /e
313 Beverages	458	461	641 /e
314 Tobacco products	111	125	158 /e
321 Textiles	886	447	696 /e
322 Wearing apparel	477	284	402 /e
323 Leather and fur products	40	38	66 /e
324 Footwear	152	103	140 /e
331 Wood and wood products	213	145	208 /e
332 Furniture and fixtures	219	108	160 /e
341 Paper and paper products	591	334	466 /e
342 Printing and publishing	549	363	477 /e
351 Industrial chemicals	1006	587	876 /e
352 Other chemical products	639	825	1369 /e
353 Petroleum refineries	634	817	1312 /e
354 Miscellaneous petroleum and coal products	111	143	240 /e
355 Rubber products	297	170	254 /e
356 Plastic products	366	236	381 /e
361 Pottery, china and earthenware	28	13	17 /e
362 Glass and glass products	154	134	224 /e
369 Other non-metal mineral products	754	513	860 /e
371 Iron and steel	2136	1111	1860 /e
372 Non-ferrous metals	555	530	910 /e
381 Metal products	1576	893	1279 /e
382 Non-electrical machinery	1361	606	798 /e
383 Electrical machinery	1229	667	1016 /e
384 Transport equipment	1268	612	1019 /e
385 Professional and scientific equipment	49	30	41 /e
390 Other manufacturing industries	416	304	523 /e

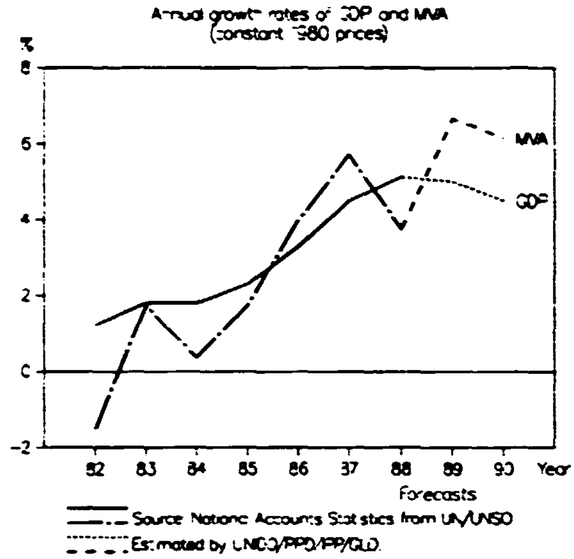
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





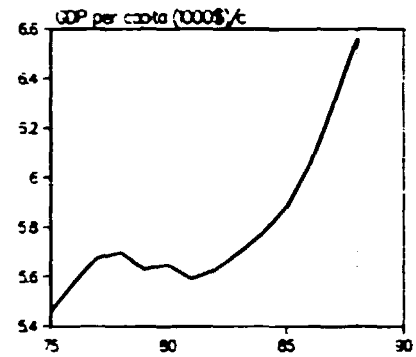


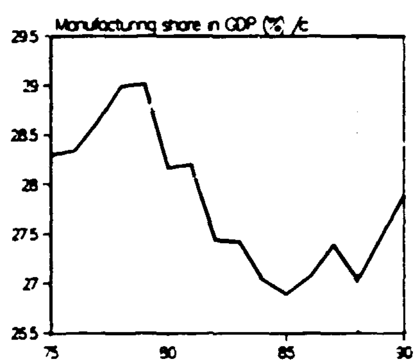


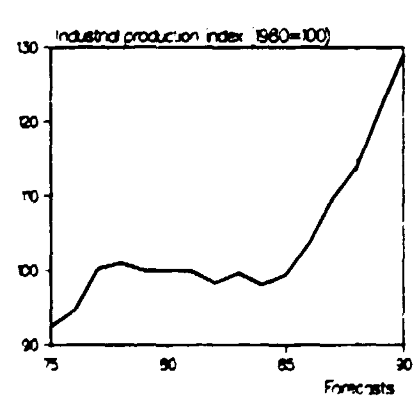


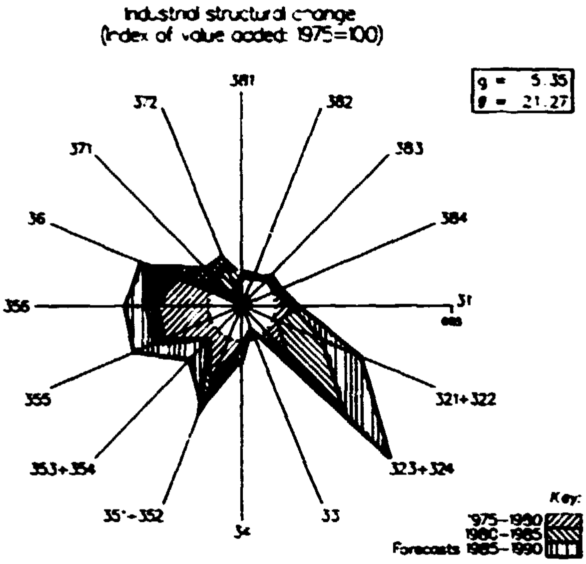
	1980	1985	1987
GDP: /na.c (millions of dollars)	212115	227068	245109
Per capita /na.c (dollars)	5650	5882	6299
Manufacturing share /na.c (%)	28.2	26.9	27.4
MANUFACTURING:			
Value added /na.c (millions of dollars)	59751	61074	67142
Value added (millions of dollars)	51576	34675	58403
Industrial production index	100	99	110
Gross output (millions of dollars)	148168	105303	173658 /e
Employment (thousands)	2368	1889 /e	1908 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	65	67	66 /e
Wages and salaries (%)	16	13 /e	13 /e
Operating surplus (%)	19	20 /e	20 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	62571	55736 /e	90997 /e
Value added / worker	21780	18353 /e	30603 /e
Average wage	9805	7345 /e	12198 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.00	1.72	3.02 /e
as a percentage of average θ in 1970-1975	69	40	70 /e
MVA growth rate / θ	0.00	0.78	1.89 /e
Degree of specialization	8.4	8.1	8.8 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	5665	4261	7207 /e
313 Beverages	1932	1525	2449 /e
314 Tobacco products	649	499	613 /e
321 Textiles	3265	1752	3003 /e
322 Wearing apparel	1508	790	1302 /e
323 Leather and fur products	374	262	460 /e
324 Footwear	810	453	724 /e
331 Wood and wood products	1294	640	1247 /e
332 Furniture and fixtures	1261	609	962 /e
341 Paper and paper products	1278	943	1773 /e
342 Printing and publishing	1506	1060	1782 /e
351 Industrial chemicals	2105	1529	2632 /e
352 Other chemical products	2296	1844	2988 /e
353 Petroleum refineries	1407	2479	4100
354 Miscellaneous petroleum and coal products	116	203	184 /e
355 Rubber products	955	664	1043 /e
356 Plastic products	1098	814	1367 /e
361 Pottery, china and earthenware	340	182	316 /e
362 Glass and glass products	640	433	733 /e
369 Other non-metal mineral products	2640	1560	2737 /e
371 Iron and steel	3162	1910	3036 /e
372 Non-ferrous metals	1049	818	1100 /e
381 Metal products	4219	2192	3663 /e
382 Non-electrical machinery	2913	2431	4348 /e
383 Electrical machinery	3669	2241	4649 /e
384 Transport equipment	4743	2113	3239 /e
385 Professional and scientific equipment	205	126	197 /e
390 Other manufacturing industries	478	353	669 /e

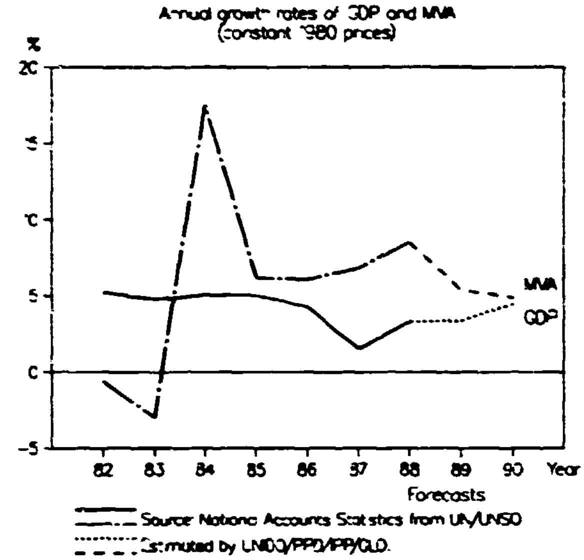
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





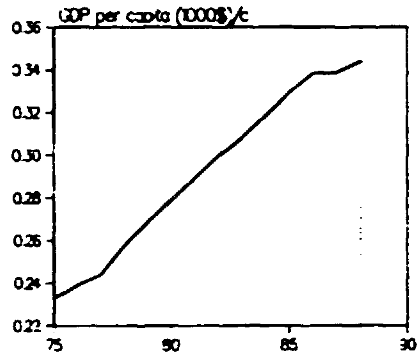


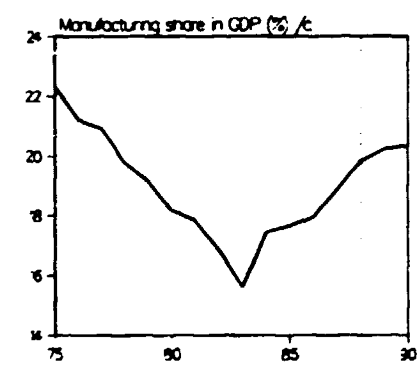


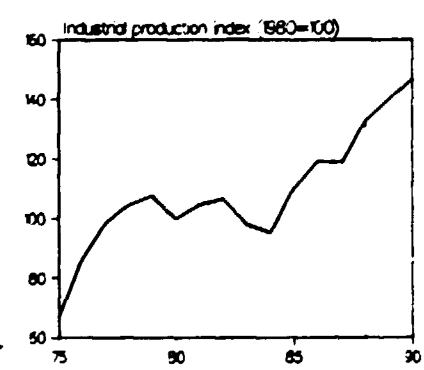


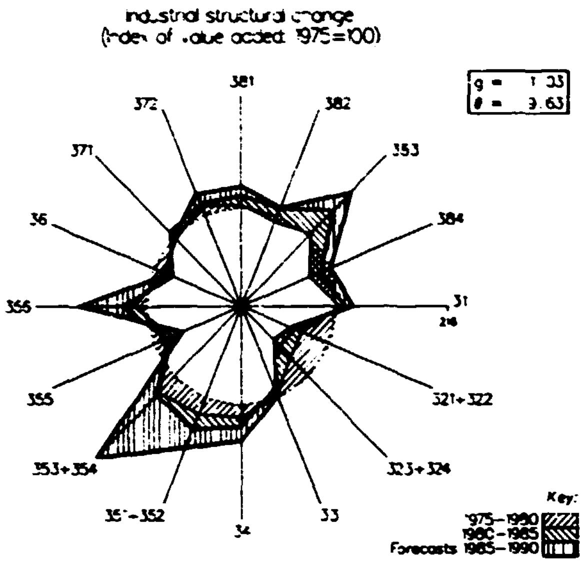
	1980	1985	1987
GDP: /na,c (millions of dollars)	4133	5303	5612
Per capita /na,c (dollars)	279	329	339
Manufacturing share /na,c (%)	18.2	17.7	18.9
MANUFACTURING:			
Value added /na,c (millions of dollars)	751	936	1060
Value added (millions of dollars)	307	653 /e	791 /e
Industrial production index	100	110	119
Gross output (millions of dollars)	1129	1815	2167 /e
Employment (thousands)	163	211	220 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	73	64 /e	63 /e
Wages and salaries (%)	7	6	5 /e
Operating surplus (%)	20	30 /e	31 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	6934	8583	9861 /e
Value added / worker	1887	3089 /e	3600 /e
Average wage	486	526	535 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	25.22	8.34 /e	4.05 /e
as a percentage of average θ in 1970-1975	159	53 /e	26 /e
MVA growth rate / θ	-0.28	1.90 /e	-0.07 /e
Degree of specialization	25.1	25.1 /e	25.7 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	28	86 /e	96 /e
313 Beverages	8	12 /e	13 /e
314 Tobacco products	63	168 /e	199 /e
321 Textiles	27	51 /e	64 /e
322 Wearing apparel	12	37 /e	38 /e
323 Leather and fur products	1	2 /e	2 /e
324 Footwear	2	2 /e	2 /e
331 Wood and wood products	5	18 /e	23 /e
332 Furniture and fixtures	1	4 /e	5 /e
341 Paper and paper products	8	7 /e	9 /e
342 Printing and publishing	4	9 /e	11 /e
351 Industrial chemicals	6	28 /e	36 /e
352 Other chemical products	12	24 /e	25 /e
353 Petroleum refineries	55	61 /e	76 /e
354 Miscellaneous petroleum and coal products	-	- /e	- /e
355 Rubber products	14	46 /e	59 /e
356 Plastic products	4	4 /e	5 /e
361 Pottery, china and earthenware	4	11 /e	14 /e
362 Glass and glass products	2	3 /e	4 /e
369 Other non-metal mineral products	21	53 /e	66 /e
371 Iron and steel	3	5 /e	6 /e
372 Non-ferrous metals	2	2 /e	3 /e
381 Metal products	7	9 /e	12 /e
382 Non-electrical machinery	4	7 /e	8 /e
383 Electrical machinery	10	7 /e	9 /e
384 Transport equipment	4	3 /e	3 /e
385 Professional and scientific equipment	1	- /e	- /e
390 Other manufacturing industries	1	3 /e	4 /e

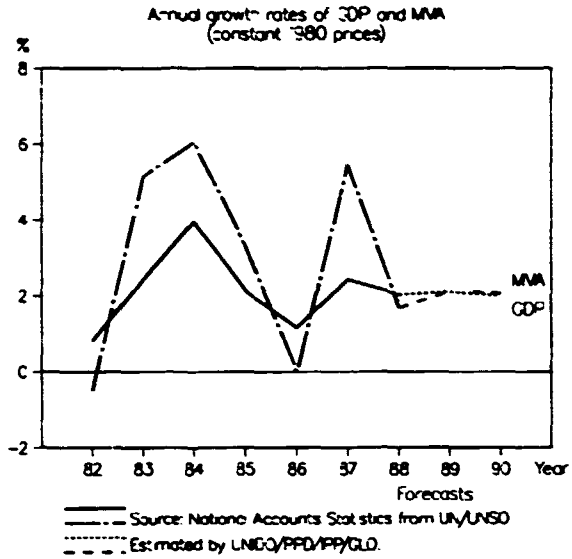
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.











	1980	1985	1987
GDP: /na,c (millions of dollars)	124137	135673	140578
Per capita /na,c (dollars)	14935	16246	16836
Manufacturing share /na,c (%)	21.1	21.4	21.8
MANUFACTURING:			
Value added /na,c (millions of dollars)	26245	29096	30683
Value added (millions of dollars)	30905	24486	39100
Industrial production index	100	109	112
Gross output (millions of dollars)	73194	59391	90549
Employment (thousands)	853	769	772 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	58	59	57 /e
Wages and salaries (%)	18	15	15 /e
Operating surplus (%)	24	26	28 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	85808	77252	117304 /e
Value added / worker	36231	31850	50652 /e
Average wage	15835	11676	17961 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.30	2.02	1.70
as a percentage of average θ in 1970-1975	115	70	59
MVA growth rate / θ	0.10	1.36	2.18
Degree of specialization	16.7	17.9	17.9
-VALUE ADDED: (millions of dollars)			
311 Food products	2719	2107	3094 /e
313 Beverages	338	250	481 /e
314 Tobacco products	104	108	177 /e
321 Textiles	534	379	603 /e
322 Wearing apparel	274	157	224 /e
323 Leather and fur products	54	40	57 /e
324 Footwear	61	24	37 /e
331 Wood and wood products	2102	1154	1811 /e
332 Furniture and fixtures	452	285	465 /e
341 Paper and paper products	2596	2230	3595 /e
342 Printing and publishing	1842	1517	2471 /e
351 Industrial chemicals	986	841	1463 /e
352 Other chemical products	1246	1090	1688 /e
353 Petroleum refineries	359	396	677 /e
354 Miscellaneous petroleum and coal products	137	122	210 /e
355 Rubber products	314	225	314 /e
356 Plastic products	402	334	574 /e
361 Pottery, china and earthenware	87	71	108 /e
362 Glass and glass products	175	124	217 /e
369 Other non-metal mineral products	801	510	807 /e
371 Iron and steel	1660	1186	1704 /e
372 Non-ferrous metals	390	331	543 /e
381 Metal products	2598	2048	3237 /e
382 Non-electrical machinery	3936	3186	4619 /e
383 Electrical machinery	2570	2132	3320 /e
384 Transport equipment	3662	3153	5825 /e
385 Professional and scientific equipment	371	400	632 /e
390 Other manufacturing industries	154	87	146 /e

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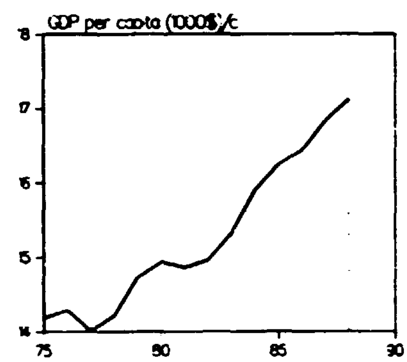
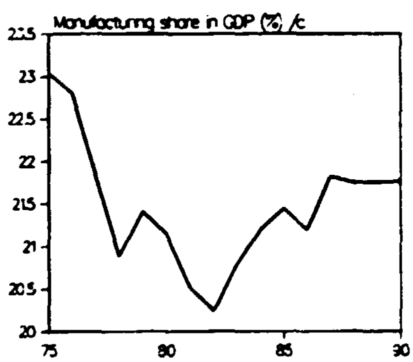
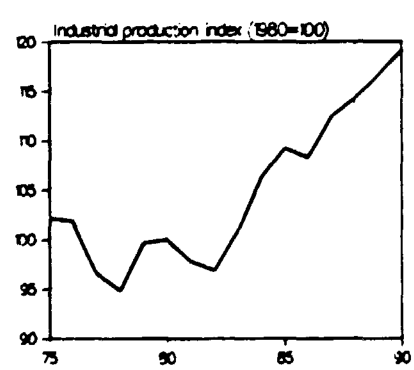
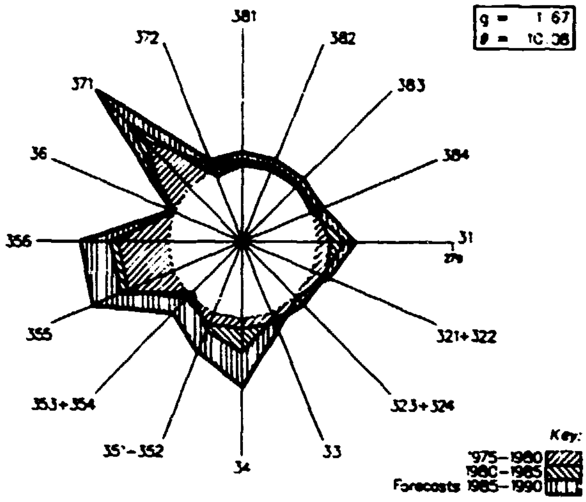


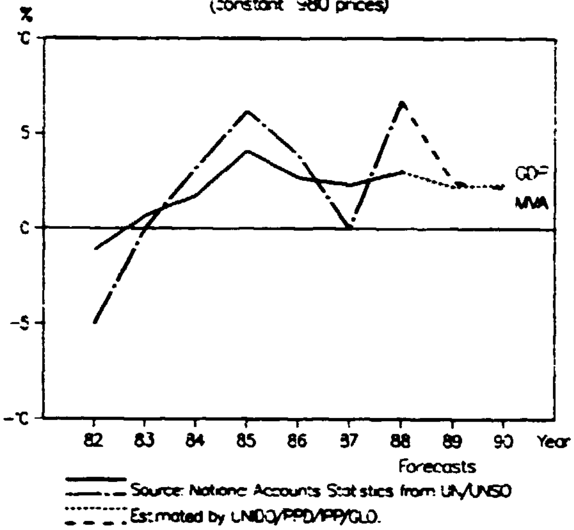




Industrial structural change
(Index of value added: 1975=100)



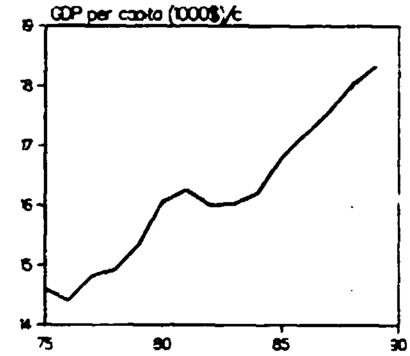
Annual growth rates of GDP and MVA
(constant 1980 prices)



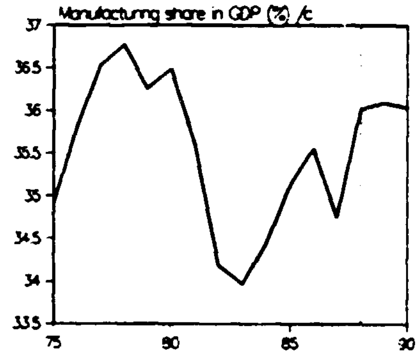
	1980	1985	1987
GDP: /na,c (millions of dollars)	101629	108700	114162
Per capita /na,c (dollars)	16060	16798	17555
Manufacturing share /na,c (%)	36.5	35.1	34.8
MANUFACTURING:			
Value added /na,c (millions of dollars)	37081	38194	39677
Value added (millions of dollars)	27466	23571	41289
Industrial production index	100	100	104
Gross output (millions of dollars)	...	...	...
Employment (thousands)	686	656	664 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	...	...	...
Wages and salaries (%)	...	...	...
Operating surplus (%)	...	...	...
-PRODUCTIVITY: (dollars)			
Gross output / worker	...	...	...
Value added / worker	40050	35910 /e	62190 /e
Average wage	...	...	...
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	2.13	2.45	1.62 /e
as a percentage of average θ in 1970-1975	84	97	64 /e
MVA growth rate / θ	2.06	2.23	0.54 /e
Degree of specialization	11.6	12.0	12.0 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	2907	2544 /e	4207 /e
313 Beverages	499	444 /e	829 /e
314 Tobacco products	293	153 /e	238 /e
321 Textiles	973	867	1456 /e
322 Wearing apparel	864	625	1145 /e
323 Leather and fur products	124	73 /e	103 /e
324 Footwear	324	251	416 /e
331 Wood and wood products	1079	862 /e	1422 /e
332 Furniture and fixtures	707	565 /e	932 /e
341 Paper and paper products	624	662	1213 /e
342 Printing and publishing	1472	1683	3061 /e
351 Industrial chemicals	1531	1547 /e	2425 /e
352 Other chemical products	1333	1642 /e	2827 /e
353 Petroleum refineries	585	554 /e	890 /e
354 Miscellaneous petroleum and coal products	96	112 /e	174 /e
355 Rubber products	226	216 /e	365 /e
356 Plastic products	626	621 /e	1041 /e
361 Pottery, china and earthenware	137	146 /e	202 /e
362 Glass and glass products	187	200 /e	278 /e
369 Other non-metal mineral products	661	426 /e	631 /e
371 Iron and steel	456	461 /e	756 /e
372 Non-ferrous metals	584	421 /e	692 /e
381 Metal products	1923	1519 /e	2896 /e
382 Non-electrical machinery	3779	2986 /e	5692 /e
383 Electrical machinery	2862	2261 /e	4310 /e
384 Transport equipment	509	402 /e	766 /e
385 Professional and scientific equipment	1978	1197 /e	2121 /e
390 Other manufacturing industries	139	130 /e	204 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

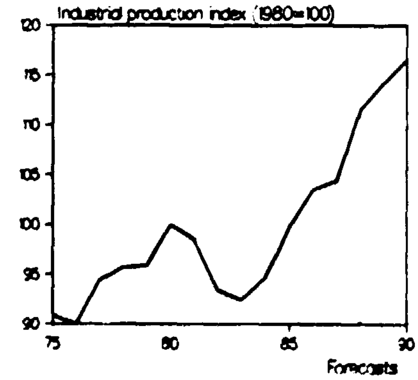
GDP per capita (1000$)/c

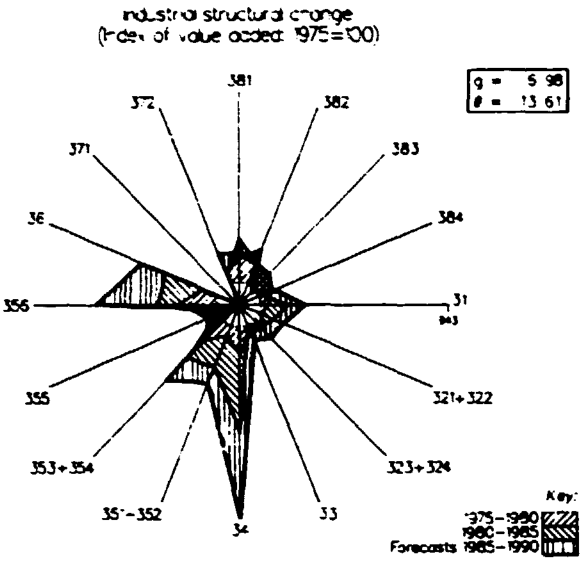


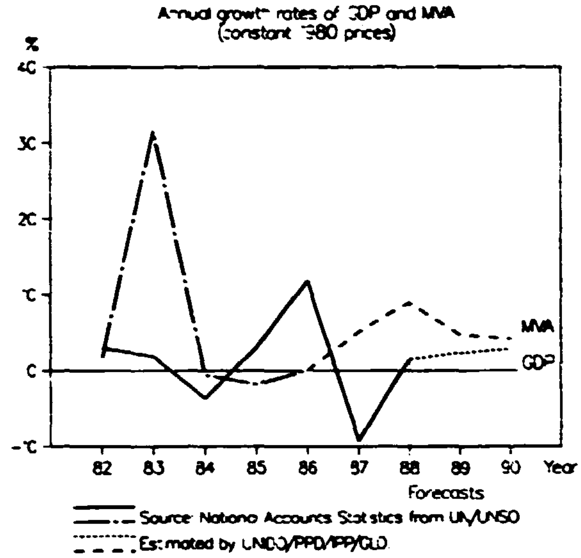
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

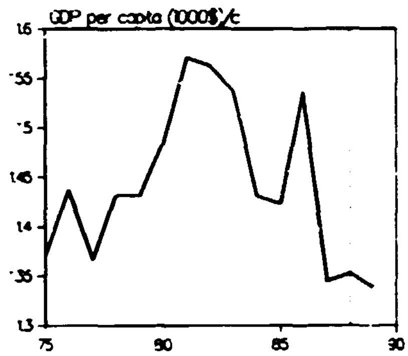


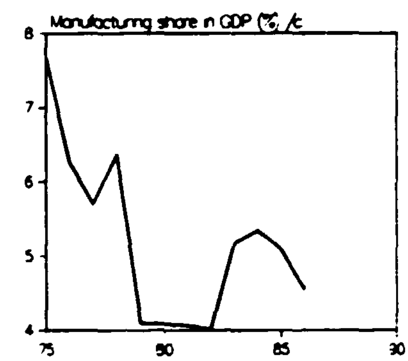


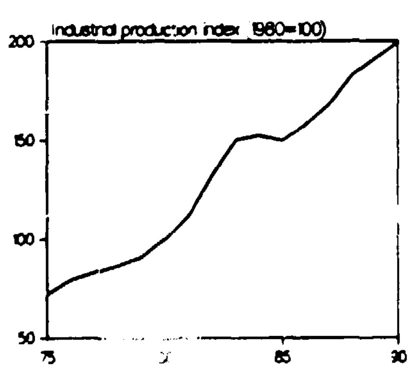


	1980	1985	1987
GDP: /na.c (millions of dollars)	13062	14885	15101
Per capita /na.c (dollars)	1484	1423	1345
Manufacturing share /na.c (%)	...	5.1	...
MANUFACTURING:			
Value added /na.c (millions of dollars)	...	758	...
Value added (millions of dollars)	1548	2001	5340
Industrial production index	100	150	168 /e
Gross output (millions of dollars)	4146	7955	19116 /e
Employment (thousands)	195	221 /e	231 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	63	75	72 /e
Wages and salaries (%)	10	8	7 /e
Operating surplus (%)	27	17	21 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	21306	36062 /e	82778 /e
Value added / worker	7956	9070 /e	23123 /e
Average wage	2206	3023 /e	5747 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	5.44	10.41 /e	2.43 /e
as a percentage of average θ in 1970-1975	142	271 /e	63 /e
MVA growth rate / θ	1.85	-0.17 /e	2.63 /e
Degree of specialization	22.7	25.5 /e	26.0 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	263	353	971 /e
313 Beverages	46	63	175 /e
314 Tobacco products	180	245	677 /e
321 Textiles	336	207	498 /e
322 Wearing apparel	18	12	29 /e
323 Leather and fur products	32	25	62 /e
324 Footwear	53	38	90 /e
331 Wood and wood products	36	37	101 /e
332 Furniture and fixtures	91	93	235 /e
341 Paper and paper products	8	11	30 /e
342 Printing and publishing	17	21	59 /e
351 Industrial chemicals	4	9	22 /e
352 Other chemical products	38	99	273 /e
353 Petroleum refineries	123	152	419 /e
354 Miscellaneous petroleum and coal products	4	6	15 /e
355 Rubber products	18	22	59 /e
356 Plastic products	15	19	52 /e
361 Pottery, china and earthenware	8	18	48 /e
362 Glass and glass products	15	32	87 /e
369 Other non-metal mineral products	89	181	503 /e
371 Iron and steel	-	-	- /e
372 Non-ferrous metals	16	37	103 /e
381 Metal products	66	136	362 /e
382 Non-electrical machinery	22	56	142 /e
383 Electrical machinery	20	84	201 /e
384 Transport equipment	4	15	43 /e
385 Professional and scientific equipment	-	-	- /e
390 Other manufacturing industries	24	30	84 /e

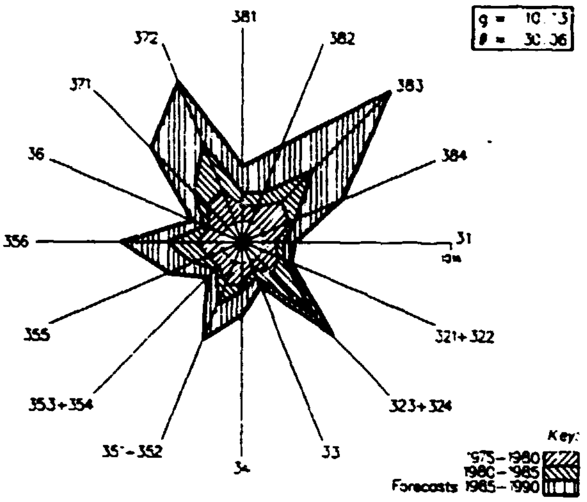
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



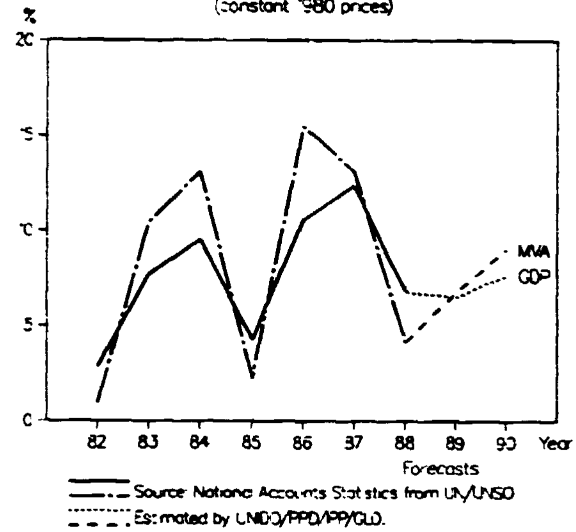




Industrial structural change
(Index of value added: 1975=100)



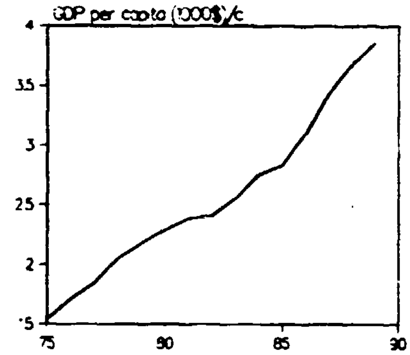
Annual growth rates of GDP and MVA
(constant 1980 prices)



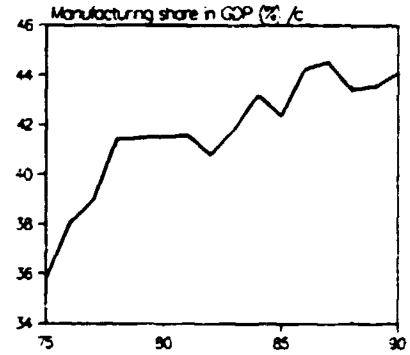
	1980	1985	1987
GDP: /na,c (millions of dollars)	40805	54760	68039
Per capita /na,c (dollars)	2292	2832	3436
Manufacturing share /na,c (%)	41.5	42.4	44.5
MANUFACTURING:			
Value added /na,c (millions of dollars)	16947	23200	30300
Value added (millions of dollars)	16947	24439	36967
Industrial production index	100	138	180
Gross output (millions of dollars)	55343	69508	94039
Employment (thousands)	1997	2242	2381 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	69	65	61 /e
Wages and salaries (%)	10	12	12 /e
Operating surplus (%)	21	23	27 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	27719	31007	3950[illegible] /e
Value added / worker	8488	10902	1552[illegible] /e
Average wage	2678	3833	4885 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.85 /e	3.55 /e	4.55 /e
as a percentage of average θ in 1970-1975	123 /e	113 /e	145 /e
MVA growth rate / θ	1.47 /e	0.32 /e	2.70 /e
Degree of specialization	12.6 /e	12.9 /e	14.3 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	1787	2533	3087
313 Beverages	200	245	326
314 Tobacco products	143	143	147
321 Textiles	2068	3117	4190
322 Wearing apparel	370	787	1073
323 Leather and fur products	193	291	380
324 Footwear	51	81	106
331 Wood and wood products	347	350	431 /e
332 Furniture and fixtures	131	160	275 /e
341 Paper and paper products	453	609	867
342 Printing and publishing	281	381	538
351 Industrial chemicals	709	895	1324
352 Other chemical products	573	874	1411
353 Petroleum refineries	820	1364	2326
354 Miscellaneous petroleum and coal products	179	154	164
355 Rubber products	254	368	569
356 Plastic products	1045	1673	2686
361 Pottery, china and earthenware	191	215	260
362 Glass and glass products	103	113	139
369 Other non-metal mineral products	528	502	669
371 Iron and steel	950	1321	1827 /e
372 Non-ferrous metals	160	155	315 /e
381 Metal products	750	1154	1852
382 Non-electrical machinery	559	765	1366
383 Electrical machinery	1973	2939	5691
384 Transport equipment	902	1313	2396
385 Professional and scientific equipment	152	204	370
390 Other manufacturing industries	1076	1734	2184

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

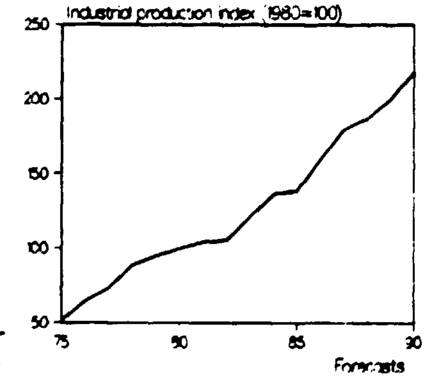
GDP per capita (1000$) /c



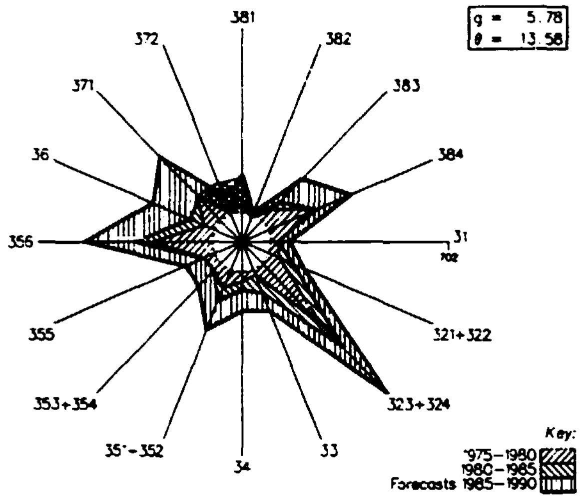
Manufacturing share in GDP (%) /c



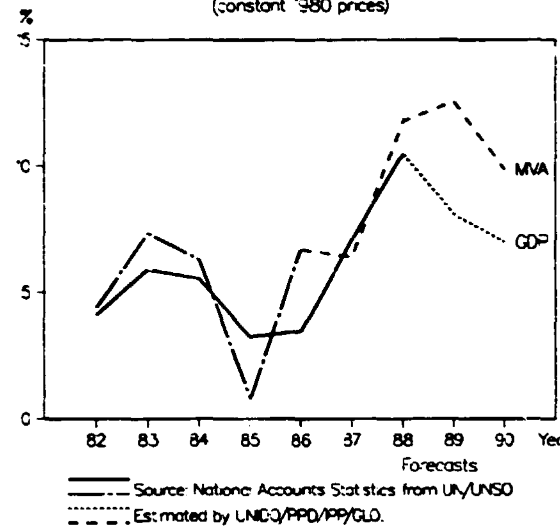
Industrial production index (1980=100)



Industrial structural change
(Index of value added: 1975=100)



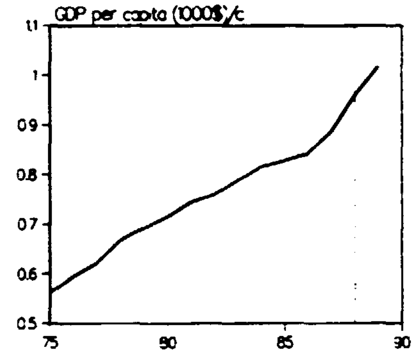
Annual growth rates of GDP and MVA
(constant 1980 prices)



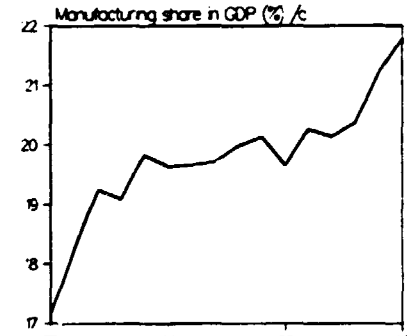
	1980	1985	1987
GDP: /na,c (millions of dollars)	33460	42704	47316
Per capita /na,c (dollars)	716	828	887
Manufacturing share /na,c (%)	19.6	19.7	20.1 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	6569	8394	9528 /e
Value added (millions of dollars)	9341	10752	11727 /e
Industrial production index	100	117	118 /e
Gross output (millions of dollars)	29255	33165	37216 /e
Employment (thousands)	1549	1329 /e	1355 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	68	68	68 /e
Wages and salaries (%)	7	8	8 /e
Operating surplus (%)	25	25	24 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	18890	24951 /e	27457 /e
Value added / worker	6032	8089 /e	8652 /e
Average wage	1401	1911 /e	2088 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	4.99 /e	7.44 /e	3.58 /e
as a percentage of average θ in 1970-1975	51 /e	76 /e	37 /e
MVA growth rate / θ	1.33 /e	-0.94 /e	1.68 /e
Degree of specialization	14.5 /e	15.7 /e	15.4 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	1763	2022	2031 /e
313 Beverages	698	824	877 /e
314 Tobacco products	361	436	518 /e
321 Textiles	1021	1143	1078 /e
322 Wearing apparel	489	703	847 /e
323 Leather and fur products	24	33	40 /e
324 Footwear	53	69	79 /e
331 Wood and wood products	267	215	240 /e
332 Furniture and fixtures	113	128	163 /e
341 Paper and paper products	357	334	314 /e
342 Printing and publishing	80	86	90 /e
351 Industrial chemicals	171	211	269 /e
352 Other chemical products	347	475	583 /e
353 Petroleum refineries	561	569	579 /e
354 Miscellaneous petroleum and coal products	35	35	36 /e
355 Rubber products	301	272	265 /e
356 Plastic products	108	116	140 /e
361 Pottery, china and earthenware	33	42	49 /e
362 Glass and glass products	97	122	143 /e
369 Other non-metal mineral products	212	268	312 /e
371 Iron and steel	312	230	280 /e
372 Non-ferrous metals	138	102	124 /e
381 Metal products	230	217	239 /e
382 Non-electrical machinery	158	217	272 /e
383 Electrical machinery	319	315	388 /e
384 Transport equipment	661	820	816 /e
385 Professional and scientific equipment	20	34	41 /e
390 Other manufacturing industries	412	716	914 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

GDP per capita (1000$)/c

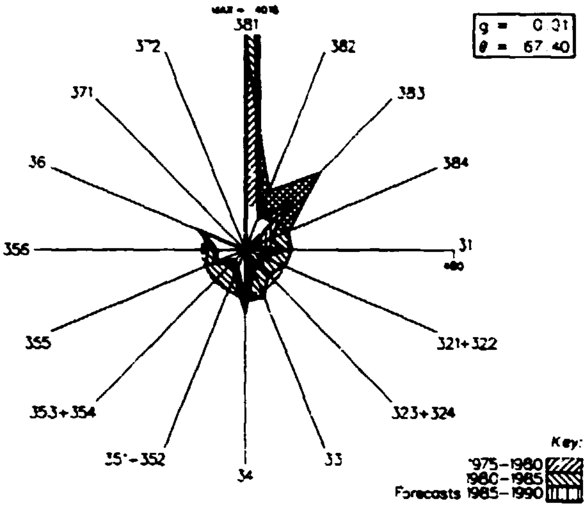


Manufacturing share in GDP (%) /c

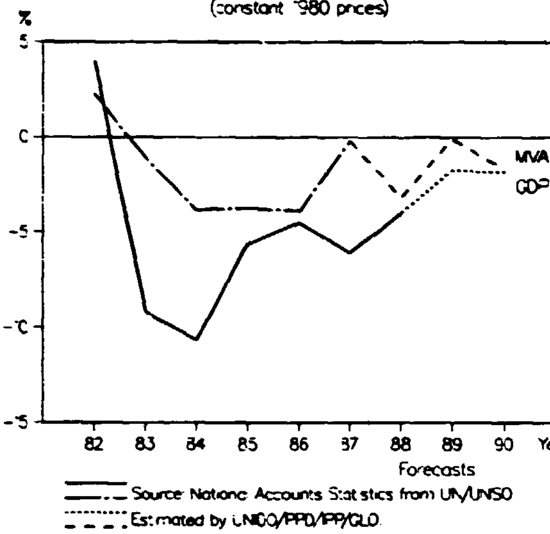


Industrial production index (1980=100)

Industrial structural change
(Index of value added: 1975=100)



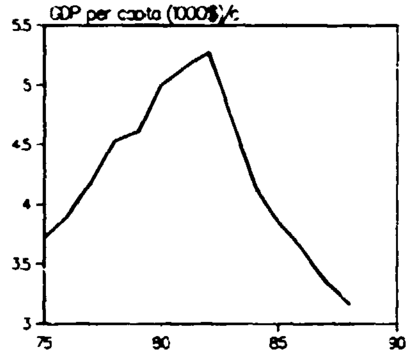
Annual growth rates of GDP and MVA
(constant 1980 prices)



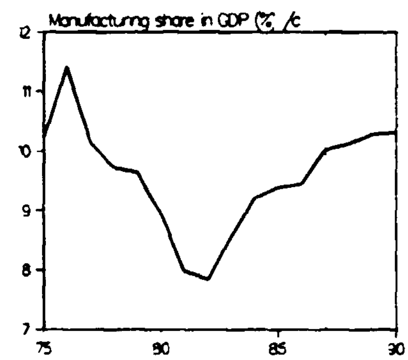
	1980	1985	1987
GDP: /na,c (millions of dollars)	5486	4572	4100
Per capita /na,c (dollars)	5005	3855	3349
Manufacturing share /na,c (%)	8.9	9.4	10.0
MANUFACTURING:			
Value added /na,c (millions of dollars)	490	429	412
Value added (millions of dollars)	492	413	447 /e
Industrial production index	100	80	98
Gross output (millions of dollars)	1568 /e	1804	1515 /e
Employment (thousands)	44	33	33 /e
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	69 /e	77	71 /e
Wages and salaries (%)	17 /e	18 /e	22 /e
Operating surplus (%)	14 /e	5 /e	7 /e
-PRODUCTIVITY:(dollars)			
Gross output / worker	35392 /e	54673	45694 /e
Value added / worker	11099	12512	13477 /e
Average wage	6093 /e	9853 /e	10268 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.80	6.07	5.12 /e
as a percentage of average θ in 1970-1975	112	178	150 /e
MVA growth rate / θ	0.23	-1.80	0.49 /e
Degree of specialization	25.7	25.4	35.3 /e
-VALUE ADDED:(millions of dollars)			
311 Food products	67	93	110 /e
313 Beverages	27	43	41 /e
314 Tobacco products	14	35	40 /e
321 Textiles	1	2	2 /e
322 Wearing apparel	16	13	15 /e
323 Leather and fur products	-	-	- /e
324 Footwear	4	5	5 /e
331 Wood and wood products	6	5	6 /e
332 Furniture and fixtures	9	9	10 /e
341 Paper and paper products	9	14	14 /e
342 Printing and publishing	13	19	19 /e
351 Industrial chemicals	5	8	8 /e
352 Other chemical products	12	19	19 /e
353 Petroleum refineries	191	17	11 /e
354 Miscellaneous petroleum and coal products	1	1	1 /e
355 Rubber products	9	10	13 /e
356 Plastic products	2	9	9 /e
361 Pottery, china and earthenware	-	-	- /e
362 Glass and glass products	3	4	4 /e
369 Other non-metal mineral products	23	31	35 /e
371 Iron and steel	-	-	- /e
372 Non-ferrous metals	-	-	- /e
381 Metal products	26	9	12 /e
382 Non-electrical machinery	13	11	14 /e
383 Electrical machinery	3	2	3 /e
384 Transport equipment	28	60	48 /e
385 Professional and scientific equipment	-	-	- /e
390 Other manufacturing industries	8	5	6 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

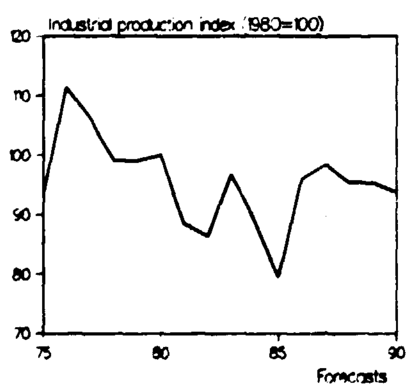
GDP per capita (1000$)/c

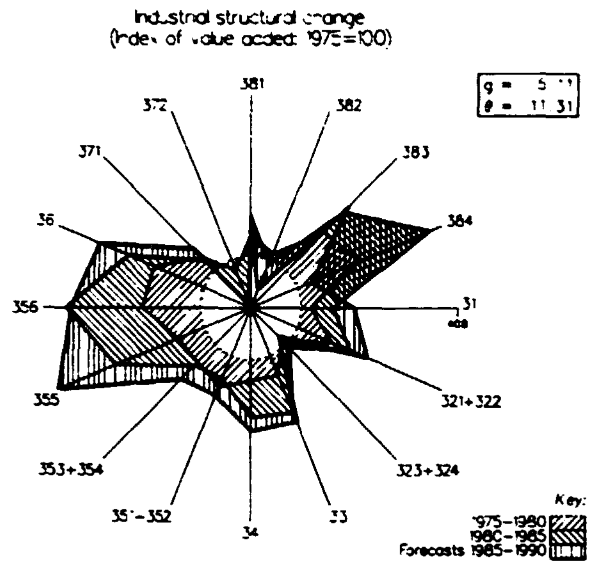


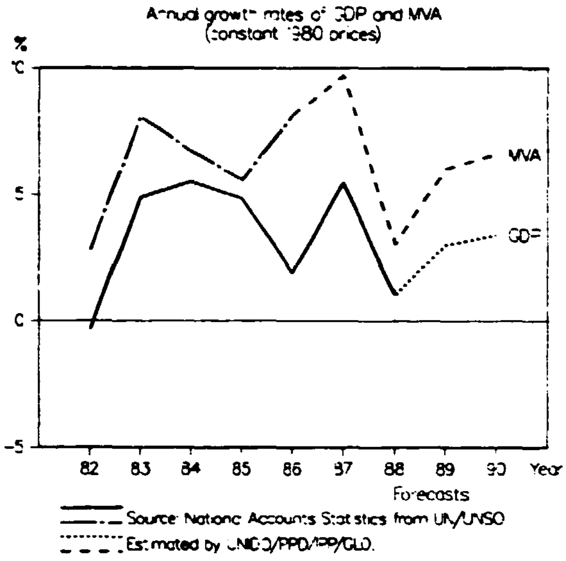
Manufacturing share in GDP (%) /c



Industrial production index (1980=100)

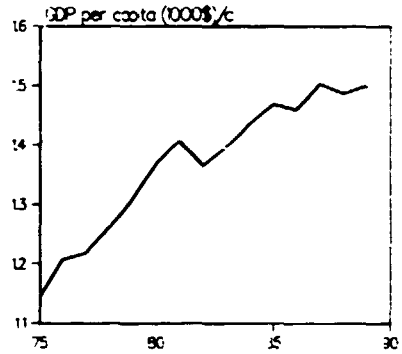


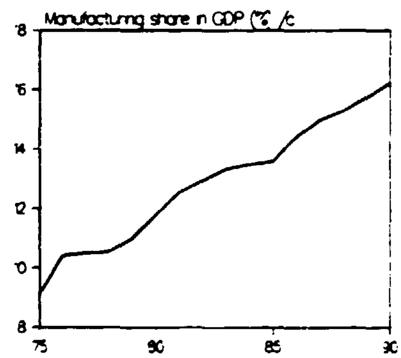


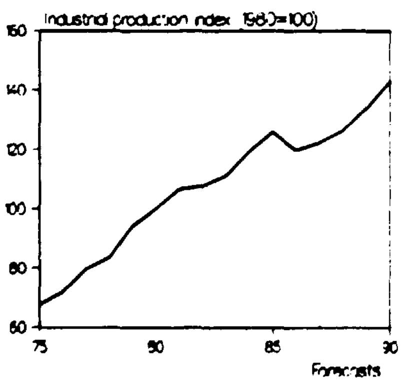


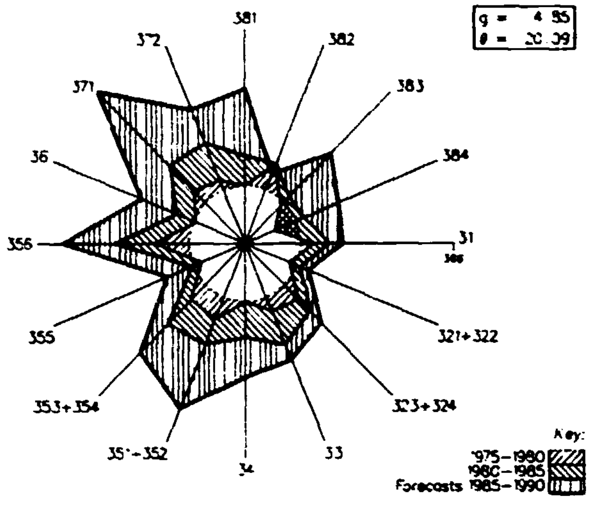
	1980	1985	1987
GDP: /na.c (millions of dollars)	8742	10667	11464
Per capita /na.c (dollars)	1369	1469	1503
Manufacturing share /na.c (%)	11.8	13.6	15.0 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	1030	1449	1719 /e
Value added (millions of dollars)	939	943 /e	1230 /e
Industrial production index	100	126	122
Gross output (millions of dollars)	3579	3782 /e	4959 /e
Employment (thousands)	125	159 /e	174 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	74 /e	75 /e	75 /e
Wages and salaries (%)	12	13 /e	13 /e
Operating surplus (%)	14 /e	12 /e	12 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	28737	23767 /e	28440 /e
Value added / worker	7542 /e	5924 /e	7055 /e
Average wage	3499	2988 /e	3575 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	4.73 /e	3.60 /e	3.16 /e
as a percentage of average θ in 1970-1975	98 /e	74 /e	65 /e
MVA growth rate / θ	1.33 /e	1.55 /e	0.69 /e
Degree of specialization	14.1 /e	14.6 /e	16.3 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	96	74 /e	88 /e
313 Beverages	49	56 /e	74 /e
314 Tobacco products	22	24 /e	31 /e
321 Textiles	56	59 /e	75 /e
322 Wearing apparel	92	101 /e	137 /e
323 Leather and fur products	6	6 /e	7 /e
324 Footwear	21	20 /e	27 /e
331 Wood and wood products	12	12 /e	15 /e
332 Furniture and fixtures	13	14 /e	19 /e
341 Paper and paper products	24	19 /e	26 /e
342 Printing and publishing	17	17 /e	19 /e
351 Industrial chemicals	42 /e	20 /e	24 /e
352 Other chemical products	96 /e	77 /e	103 /e
353 Petroleum refineries	13	10 /e	12 /e
354 Miscellaneous petroleum and coal products	-	- /e	- /e
355 Rubber products	8	8 /e	10 /e
356 Plastic products	18	21 /e	27 /e
361 Pottery, china and earthenware	11	8 /e	10 /e
362 Glass and glass products	7	5 /e	7 /e
369 Other non-metal mineral products	156	175 /e	234 /e
371 Iron and steel	45	72 /e	96 /e
372 Non-ferrous metals	8	5 /e	5 /e
381 Metal products	53	73 /e	99 /e
382 Non-electrical machinery	2	2 /e	2 /e
383 Electrical machinery	35	34 /e	46 /e
384 Transport equipment	30	27 /e	31 /e
385 Professional and scientific equipment	1	1 /e	2 /e
390 Other manufacturing industries	5	3 /e	4 /e

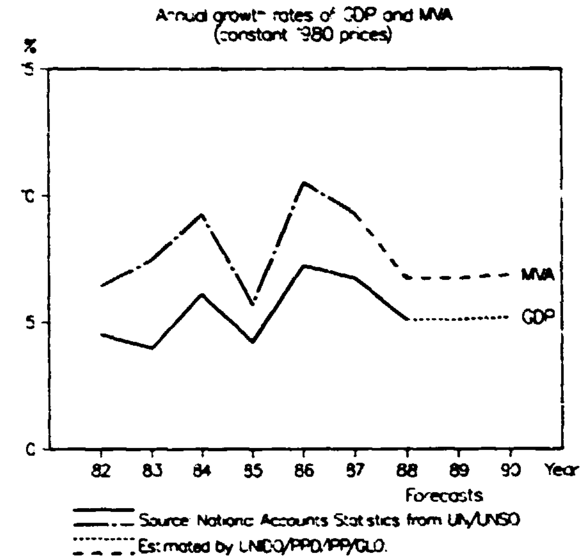
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





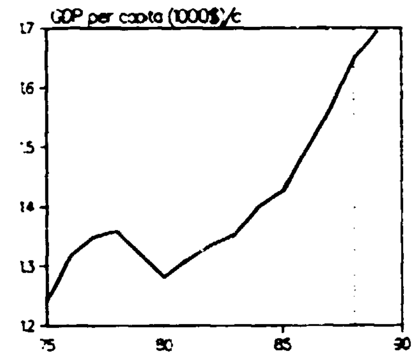


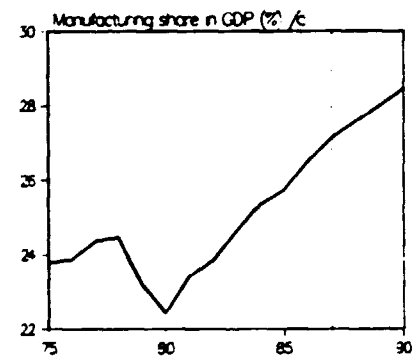


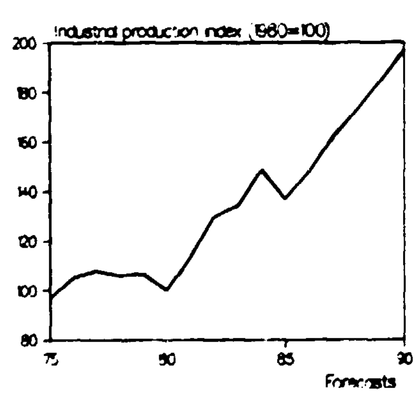


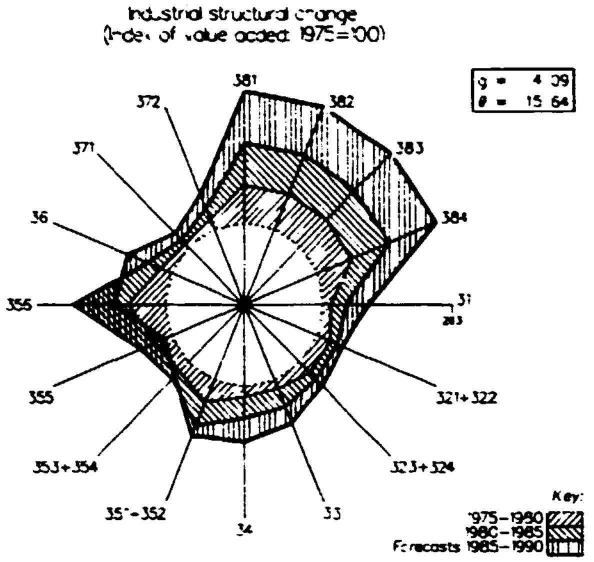
	1980	1985	1987
GDP: /na,c (millions of dollars)	56919	. 745	82116
Per capita /na.c (dollars)	1281	1425	1564
Manufacturing share /na,c (%)	22.4	25.7	27.1
MANUFACTURING:			
Value added /na,c (millions of dollars)	12770	18457	22292
Value added (millions of dollars)	10837	10449	13532 /e
Industrial production index	100	137	162
Gross output (millions of dollars)	29413	32471	43239 /e
Employment (thousands)	787	844	919 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	63	68	69 /e
Wages and salaries (%)	11	7	6 /e
Operating surplus (%)	26	25	25 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	37374	38478	47046 /e
Value added / worker	13770	12382	14724 /e
Average wage	4231	2618	3048 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	6.27 /e	9.19 /e	8.37 /e
as a percentage of average θ in 1970-1975	96 /e	141 /e	129 /e
MVA growth rate / θ	-0.98 /e	-0.87 /e	1.11 /e
Degree of specialization	14.4 /e	14.7 /e	16.0 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	1185	973	1186 /e
313 Beverages	335	331	397 /e
314 Tobacco products	467	877	1082 /e
321 Textiles	1535	1289	1708 /e
322 Wearing apparel	60	146	208 /e
323 Leather and fur products	25	37	43 /e
324 Footwear	33	22	30 /e
331 Wood and wood products	118	64	86 /e
332 Furniture and fixtures	16	55	52 /e
341 Paper and paper products	205	241	312 /e
342 Printing and publishing	97	133	176 /e
351 Industrial chemicals	719	457	604 /e
352 Other chemical products	387	394	507 /e
353 Petroleum refineries	1352	1514	1877 /e
354 Miscellaneous petroleum and coal products	222	152	214 /e
355 Rubber products	201	151	186 /e
356 Plastic products	125	76	91 /e
361 Pottery, china and earthenware	93	102	133 /e
362 Glass and glass products	110	167	230 /e
369 Other non-metal mineral products	535	428	541 /e
371 Iron and steel	783	734	1035 /e
372 Non-ferrous metals	292	181	241 /e
381 Metal products	395	344	419 /e
382 Non-electrical machinery	506	466	635 /e
383 Electrical machinery	463	531	737 /e
384 Transport equipment	541	534	724 /e
385 Professional and scientific equipment	8	9	13 /e
390 Other manufacturing industries	28	49	65 /e

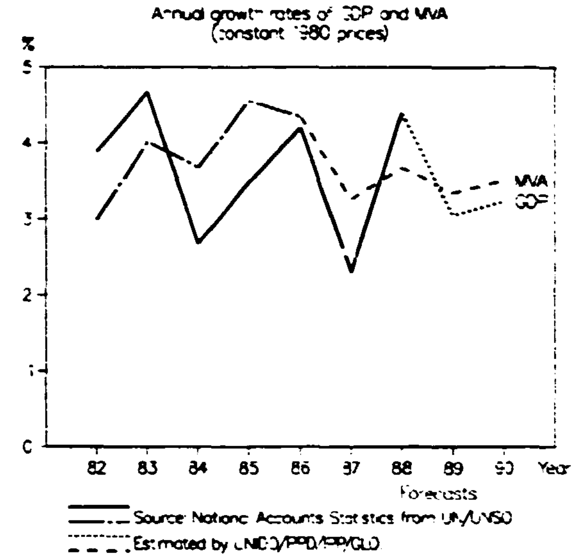
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.





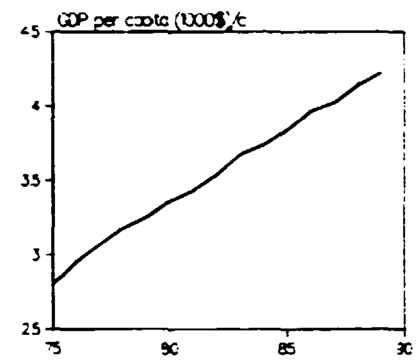


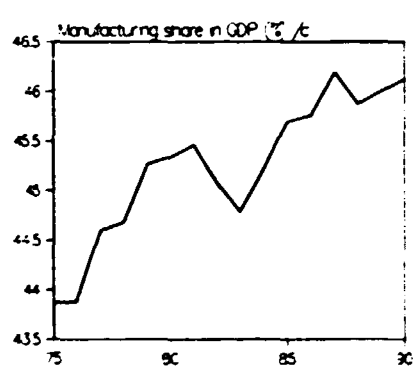


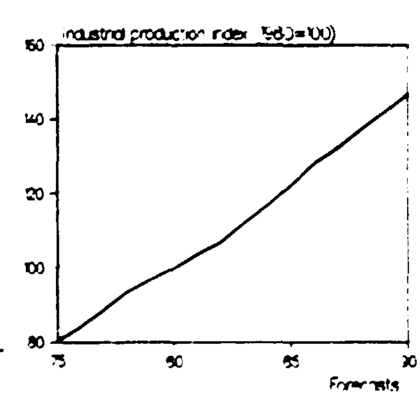


	1980	1985	1987
GDP: /na.c (millions of dollars)	892879	1062526	1132635
Per capita /na.c (dollars)	3362	3837	4024
Manufacturing share /na.c (%)	45.3	45.7	46.2 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	404805	485530	523181 /e
Value added (millions of dollars)/c	362425	442428	479938 /e
Industrial production index	100	122	132 /e
Gross output (millions of dollars)	834090	913245	1266855 /e
Employment (thousands)	31464	32400	32627 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)			
Wages and salaries (%)	...	...	...
Operating surplus (%)	...	...	
-PRODUCTIVITY: (dollars)			
Gross output / worker	27398 /e	29136 /e	40143 /e
Value added / worker /c	11190	13287	14322 /e
Average wage	3249	3168	4251 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.66	1.40	1.49 /e
as a percentage of average θ in 1970-1975	96	81	86 /e
MVA growth rate / θ	1.99	3.16	2.19 /e
Degree of specialization	18.1	19.2	20.8 /e
-VALUE ADDED: (millions of dollars)/c			
311 Food products	66053	80584	93134
313 Beverages	10336	9303	7442
314 Tobacco products	2032	2866	3049
321 Textiles	32553	34506	35808
322 Wearing apparel	19633	21792	22184
323 Leather and fur products	2443	2345	2443
324 Footwear	3892	4593	4593
331 Wood and wood products	4932	5771	6214
332 Furniture and fixtures	3457	4459	4805
341 Paper and paper products	2784	3424	3703
342 Printing and publishing	2613	3214	3475
351 Industrial chemicals	14704	19115	20291
352 Other chemical products	7584	8419	7499 /e
353 Petroleum refineries	5490	6093	5459 /e
354 Miscellaneous petroleum and coal products	11003	12213	10739 /e
355 Rubber products	4154	4861	4239 /e
356 Plastic products	1546	2273	2084 /e
361 Pottery, china and earthenware	2014	2457	2538
362 Glass and glass products	1204	1517	1709
369 Other non-metal mineral products	13769	15696	17072
371 Iron and steel	14418	15283	16292
372 Non-ferrous metals	7716	8719	9182
381 Metal products	7130	9625	10908
382 Non-electrical machinery	79367	107145	121431
383 Electrical machinery	9105	12291	13930
384 Transport equipment	11574	16626	17708
385 Professional and scientific equipment	9711	13110	14858
390 Other manufacturing industries	11210	15133	17151

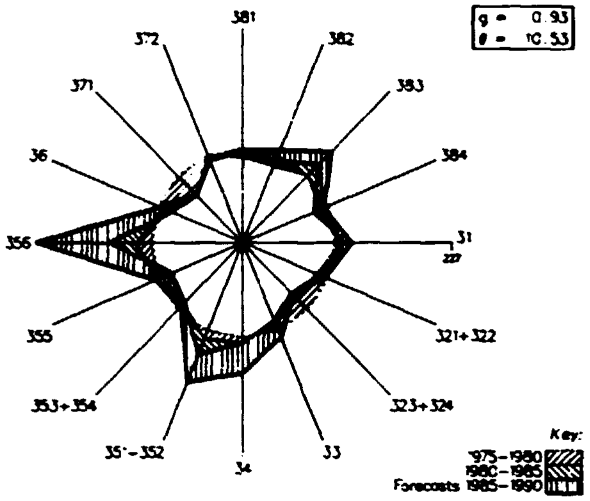
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex



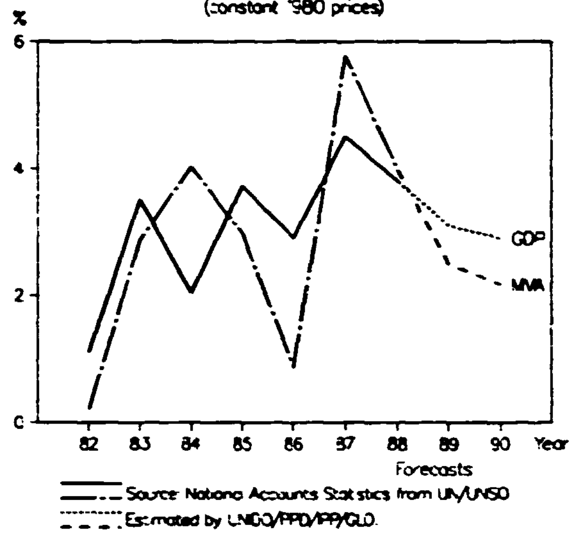




Industrial structural change
(Index of value added: 1975=100)



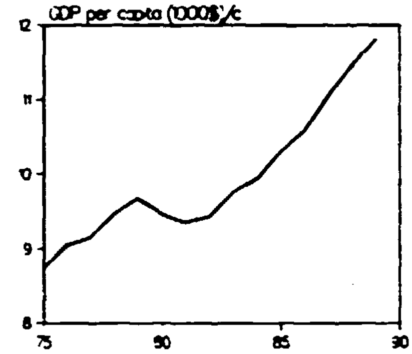
Annual growth rates of GDP and MVA
(constant 1980 prices)



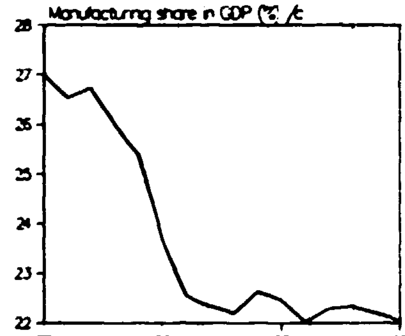
	1980	1985	1987
GDP: /na.c (millions of dollars)	535095	586674	629807
Per capita /na.c (dollars)	9467	10308	11061
Manufacturing share /na.c (%)	23.7	22.5	22.3
MANUFACTURING:			
Value added /na.c (millions of dollars)	126779	131597	140396
Value added (millions of dollars)	163790	124409	179984 /e
Industrial production index	100	104	110
Gross output (millions of dollars)	400929	306225	445538
Employment (thousands)	6462	4932	4766 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	59	59	60 /e
Wages and salaries (%)	20	18	17 /e
Operating surplus (%)	21	23	23 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	62044	62089	93479 /e
Value added / worker	25347	25225	37763 /e
Average wage	12371	10916	15881 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.19	2.26	1.71
as a percentage of average θ in 1970-1975	135	95	72
MVA growth rate / θ	-2.53	1.37	2.97
Degree of specialization	11.4	12.1	11.9
-VALUE ADDED: (millions of dollars)			
311 Food products	14744	12179	17503 /e
313 Beverages	5419	3554	5378 /e
314 Tobacco products	1814	1479	1919 /e
321 Textiles	5419	3917	5860 /e
322 Wearing apparel	3395	2633	3615 /e
323 Leather and fur products	658	363	557 /e
324 Footwear	1093	762	1135 /e
331 Wood and wood products	2349	1556	2621 /e
332 Furniture and fixtures	2558	2101	2845 /e
341 Paper and paper products	4860	3800	5677 /e
342 Printing and publishing	9814	8807	13534 /e
351 Industrial chemicals	8233	7328	10744 /e
352 Other chemical products	7512	6641	9512 /e
353 Petroleum refineries	4512	1712	2562 /e
354 Miscellaneous petroleum and coal products	721	428	603 /e
355 Rubber products	2349	1506	2389 /e
356 Plastic products	3698	3087	4841 /e
361 Pottery, china and earthenware	977	766	1061 /e
362 Glass and glass products	1442	960	1493 /e
369 Other non-metal mineral products	5698	4215	6366 /e
371 Iron and steel	6860	4345	5991 /e
372 Non-ferrous metals	2581	1506	2204 /e
381 Metal products	10140	7211	9982 /e
382 Non-electrical machinery	21326	15110	21563 /e
383 Electrical machinery	15209	12399	17211 /e
384 Transport equipment	17512	12944	18323 /e
385 Professional and scientific equipment	2209	1803	2621 /e
390 Other manufacturing industries	1791	1310	1994 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

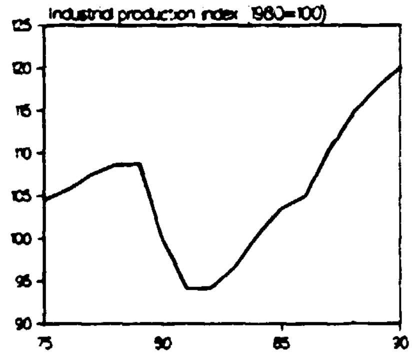
GDP per capita (1000$)/c



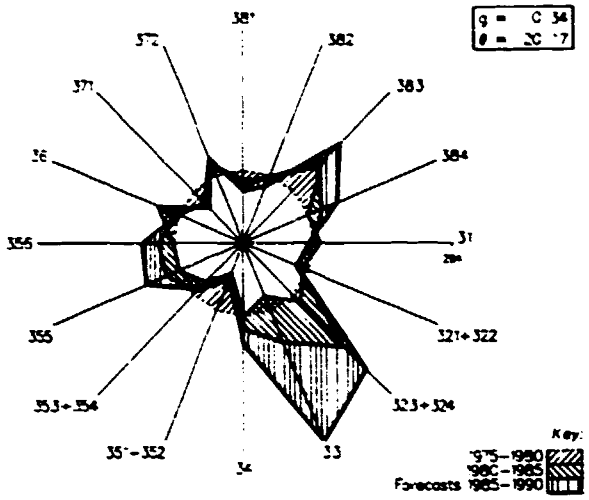
Manufacturing share in GDP (%)/c



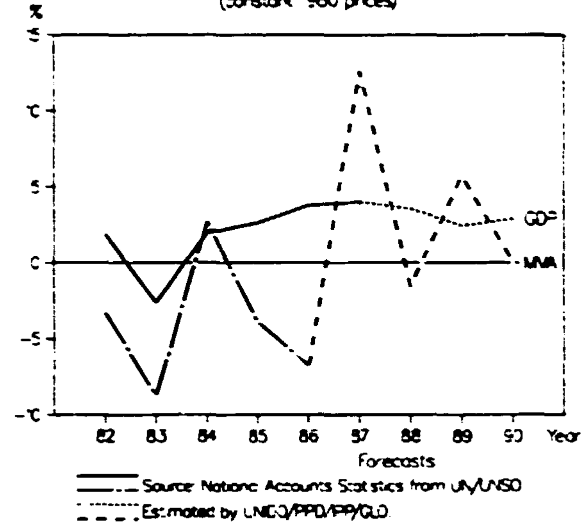
Industrial production index (1980=100)



Industrial structural change
(Index of value added 1975=100)

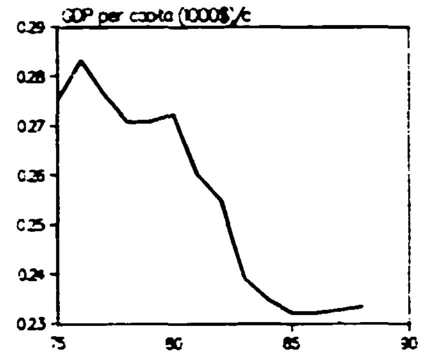


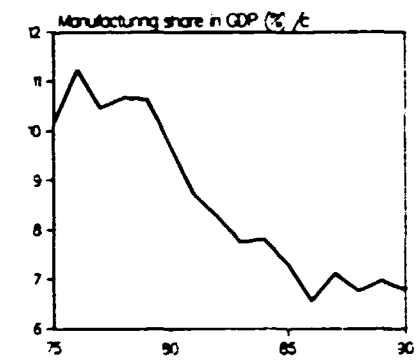
Annual growth rates of GDP and MVA
(constant 1980 prices)

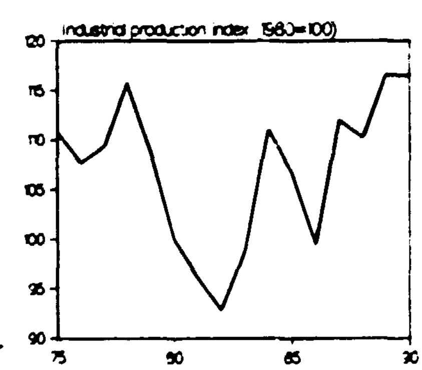


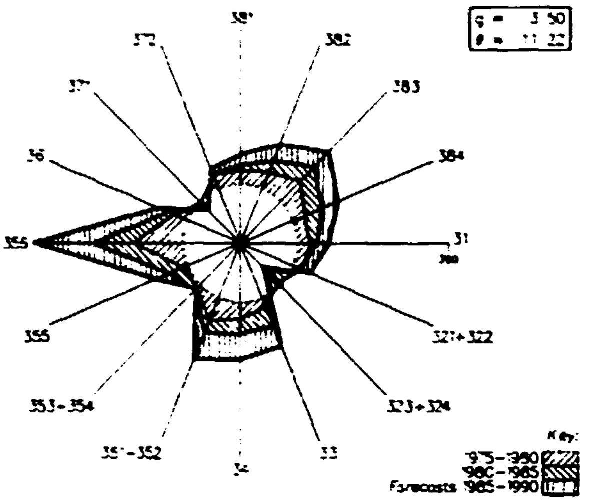
	1980	1985	1987
GDP: /na,c (millions of dollars)	5138	5283	5701
Per capita /na,c (dollars)	272	232	233
Manufacturing share /na,c (%)	9.7	7.3	7.1 /e
MANUFACTURING:			
Value added /na,c (millions of dollars)	500	387	406 /e
Value added (millions of dollars)	361	278	125 /e
Industrial production index	100	107	112 /e
Gross output (millions of dollars)	1266	1145	527 /e
Employment (thousands)	101	94	98 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	71 /e	76 /e	76 /e
Wages and salaries (%)	9 /e	9 /e	8 /e
Operating surplus (%)	19 /e	16 /e	16 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	12537 /e	12217 /e	5393 /e
Value added / worker	3577 /e	2970 /e	1276 /e
Average wage	1174 /e	1041 /e	426 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	5.20 /e	7.16 /e	4.76 /e
as a percentage of average θ in 1970-1975	63 /e	86 /e	57 /e
MVA growth rate / θ	-1.54 /e	-0.54 /e	2.65 /e
Degree of specialization	15.7 /e	11.6 /e	10.6 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	58	58	27 /e
313 Beverages	14	21	10 /e
314 Tobacco products	12	16	7 /e
321 Textiles	95	43	19 /e
322 Wearing apparel	10	4	2 /e
323 Leather and fur products	7	4	2 /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	6 /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	5 /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	5 /e	2 /e
372 Non-ferrous metals	4 /e	6 /e	3 /e
381 Metal products	20	15	7 /e
382 Non-electrical machinery	3	4	2 /e
383 Electrical machinery	6	6	3 /e
384 Transport equipment	19	19	7 /e
385 Professional and scientific equipment	-	-	- /e
390 Other manufacturing industries	2	2	1 /e

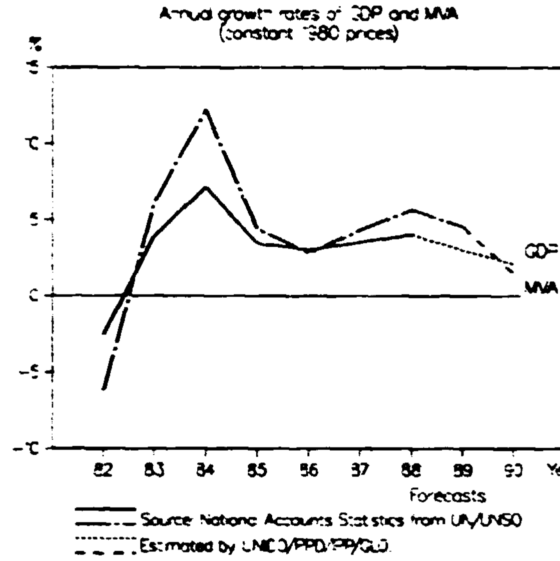
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex





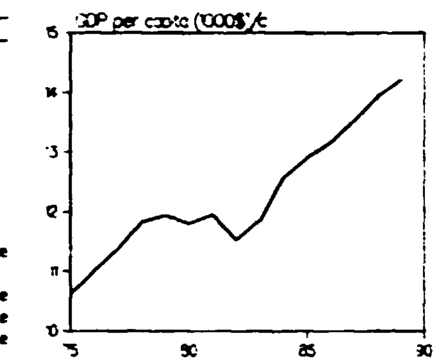


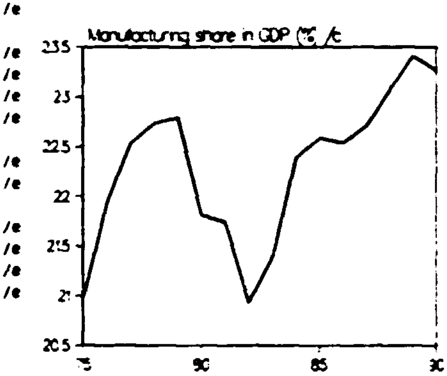


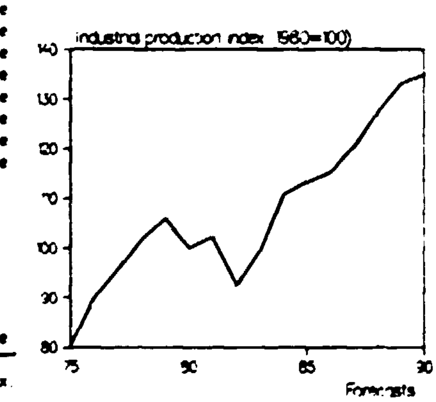


	1980	1985	1987
GDP: /na.c (millions of dollars)	2688470	3086280	3292724
Per capita /na.c (dollars)	11804	12898	13526
Manufacturing share /na.c (%)	21.8	22.6	22.7
MANUFACTURING:			
Value added /na.c (millions of dollars)	586438	697020	747767
Value added (millions of dollars)	769900	996379	1123417
Industrial production index	100	113	120
Gross output (millions of dollars)	1857100	2266993	2428294
Employment (thousands)	19210	17422	16941 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	59	56	54 /e
Wages and salaries (%)	17	17	17 /e
Operating surplus (%)	24	27	29 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	96674	130122	143340 /e
Value added / worker	40078	57191	66314 /e
Average wage	16406	22683	24803 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.88	1.93	1.26 /e
as a percentage of average θ in 1970-1975	147	73	48 /e
MVA growth rate / θ	-1.45	1.16	3.57 /e
Degree of specialization	11.6	12.6	12.5 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	63460	87950	102228 /e
313 Beverages	11810	16160	18860 /e
314 Tobacco products	6160	11890	14064
321 Textiles	23030	26910	32237 /e
322 Wearing apparel	19730	22150	25650 /e
323 Leather and fur products	1860	1570	1554 /e
324 Footwear	2950	2470	2440 /e
331 Wood and wood products	12970	15390	19078
332 Furniture and fixtures	9840	13250	15750
341 Paper and paper products	29790	40390	48180
342 Printing and publishing	44390	73050	86685
351 Industrial chemicals	38920	43360	55581 /e
352 Other chemical products	35530	54280	57513 /e
353 Petroleum refineries	23010	13890	15845 /e
354 Miscellaneous petroleum and coal products	2670	3450	4242 /e
355 Rubber products	8030	10970	12250 /e
356 Plastic products	14640	24740	29460 /e
361 Pottery, china and earthenware	1210	1300	1503 /e
362 Glass and glass products	6470	7660	9229 /e
369 Other non-metal mineral products	16300	19880	21330 /e
371 Iron and steel	30780	24070	27147
372 Non-ferrous metals	14340	11440	13077
381 Metal products	53180	61810	66856
382 Non-electrical machinery	102760	116560	124588
383 Electrical machinery	74860	111220	121886
384 Transport equipment	81280	128230	139199
385 Professional and scientific equipment	27940	40280	42676
390 Other manufacturing industries	12060	13060	16322 /e

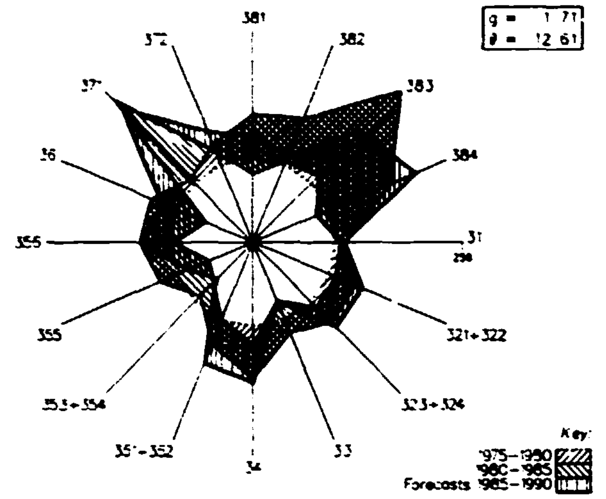
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



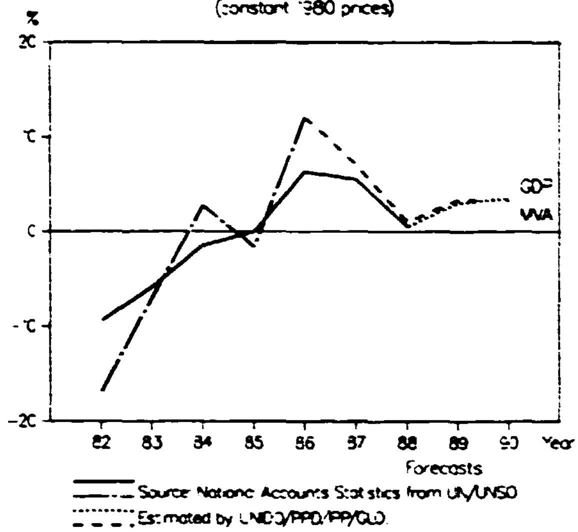




Industrial structural change
(Index of value added: 1975=100)



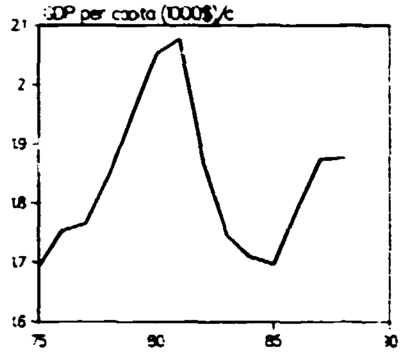
Annual growth rates of GDP and MVA
(constant 1980 prices)



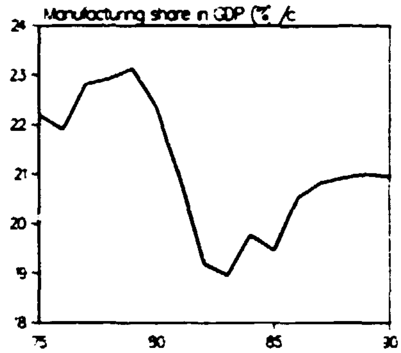
	1980	1985	1987
GDP: /na.c (millions of dollars)	5970	5113	5734
Per capita /na.c (dollars)	2062	1697	1874
Manufacturing share /na.c (%)	22.3	19.5	20.8 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	1334	995	1194 /e
Value added (millions of dollars)	1286	1344	1871 /e
Industrial production index	100	74	91
Gross output (millions of dollars)	3302	3189	4114 /e
Employment (thousands)	160	123	127 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	61 /e	58	55 /e
Wages and salaries (%)	13 /e	9	11 /e
Operating surplus (%)	26 /e	33	35 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	20615 /e	26012	32304 /e
Value added / worker	8028 /e	10966	14692 /e
Average wage	2635 /e	2448	3517 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	4.55 /e	4.30 /e	7.14 /e
as a percentage of average θ in 1970-1975	100 /e	95 /e	158 /e
MVA growth rate / θ	0.29 /e	-0.11 /e	1.37 /e
Degree of specialization	11.7 /e	15.1 /e	13.1 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	165	266	298 /e
313 Beverages	104	92	138 /e
314 Tobacco products	90	68	88 /e
321 Textiles	109	137	195 /e
322 Wearing apparel	59	43	62 /e
323 Leather and fur products	31	76	64 /e
324 Footwear	18	8	15 /e
331 Wood and wood products	14 /e	8	11 /e
332 Furniture and fixtures	7 /e	2	4 /e
341 Paper and paper products	30	47	71 /e
342 Printing and publishing	37	27	38 /e
351 Industrial chemicals	20	26	37 /e
352 Other chemical products	5	112	150 /e
353 Petroleum refineries	32	194	296 /e
354 Miscellaneous petroleum and coal products	2	4	5 /e
355 Rubber products	40	34	59 /e
356 Plastic products	24	25	39 /e
361 Pottery, china and earthenware	13	7	16 /e
362 Glass and glass products	14	7	20 /e
369 Other non-metal mineral products	41	24	28 /e
371 Iron and steel	10	14	16 /e
372 Non-ferrous metals	3	3	4 /e
381 Metal products	53 /e	32	53 /e
382 Non-electrical machinery	16 /e	12	13 /e
383 Electrical machinery	33	31	48 /e
384 Transport equipment	78	38	94 /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.

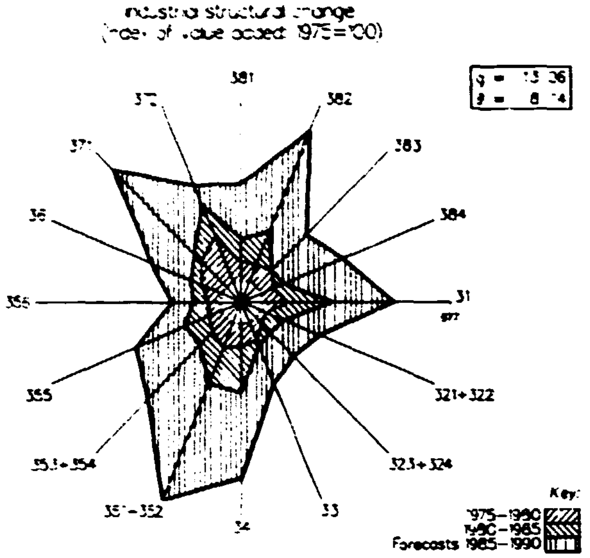
GDP per capita (1000$)/c

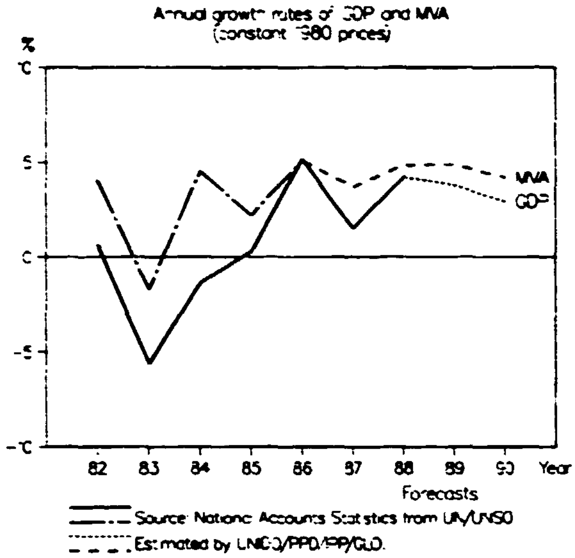


Manufacturing share in GDP (%)/c



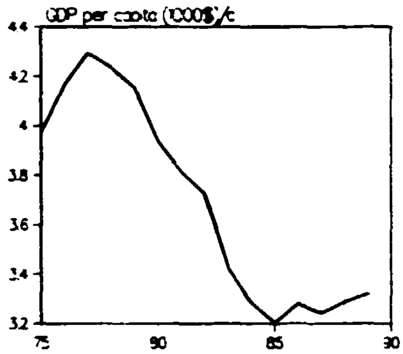
Industrial production index (1980=100)

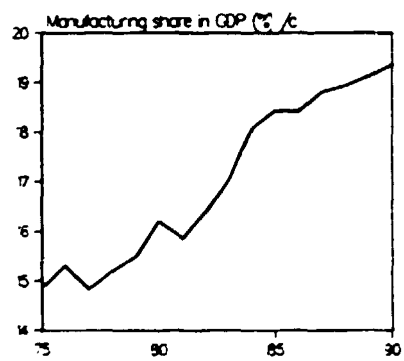


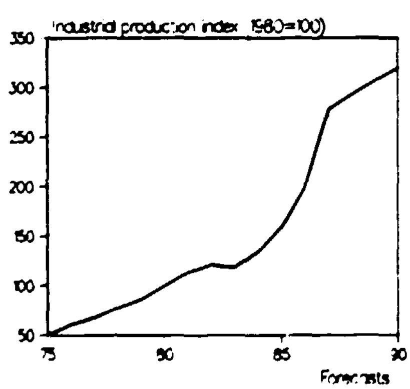


	1980	1985	1987
GDP: /na.c (millions of dollars)	59213	55491	59229
Per capita /na.c (dollars)	3941	3204	3242
Manufacturing share /na.c (%)	16 2	18.4	18.8 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	9596	10229	11144 /e
Value added (millions of dollars)	14172	14071	10112 /e
Industrial production index	100	159	278
Gross output (millions of dollars)	29407	30305	23452 /e
Employment (thousands)	477	426	449 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	52	54	57 /e
Wages and salaries (%)	13	12	12 /e
Operating surplus (%)	35	35	31 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	61640	71155	52181 /e
Value added / worker	29705	33038	22499 /e
Average wage	7532	8436	6081 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.02 /e	3.73 /e	3.80 /e
as a percentage of average θ in 1970-1975	66 /e	82 /e	84 /e
MVA growth rate / θ	5.28 /e	5.04 /e	10.65 /e
Degree of specialization	21.9 /e	23 1 /e	24.5 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	1410	1597	1216 /e
313 Beverages	992	836	683 /e
314 Tobacco products	331	597	464 /e
321 Textiles	483	505	382 /e
322 Wearing apparel	330	359	307 /e
323 Leather and fur products	55	58	50 /e
324 Footwear	147	158	127 /e
331 Wood and wood products	88	80	54 /e
332 Furniture and fixtures	167	142	108 /e
341 Paper and paper products	355	357	248 /e
342 Printing and publishing	364	299	231 /e
351 Industrial chemicals	275	498	389 /e
352 Other chemical products	881	890	723 /e
353 Petroleum refineries	4417	3634	1520 /e
354 Miscellaneous petroleum and coal products	24	30	24 /e
355 Rubber products	141	188	141 /e
356 Plastic products	379	348	295 /e
361 Pottery, china and earthenware	44	39	36 /e
362 Glass and glass products	136	132	116 /e
369 Other non-metal mineral products	441	378	334 /e
371 Iron and steel	632	855	878 /e
372 Non-ferrous metals	198	447	418 /e
381 Metal products	601	503	411 /e
382 Non-electrical machinery	217	241	166 /e
383 Electrical machinery	291	307	279 /e
384 Transport equipment	652	486	431 /e
385 Professional and scientific equipment	34	26	20 /e
390 Other manufacturing industries	88	81	64 /e

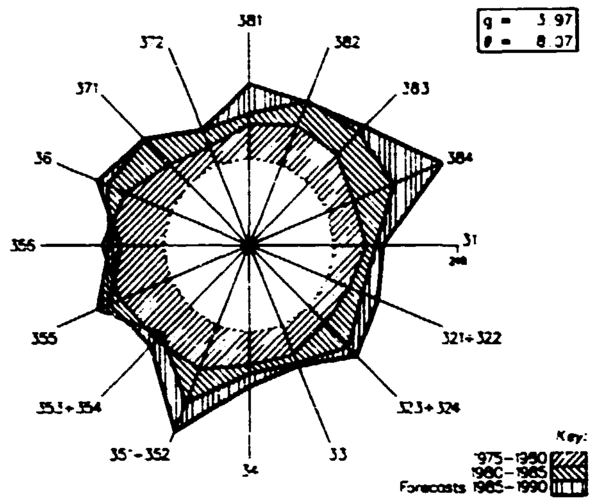
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



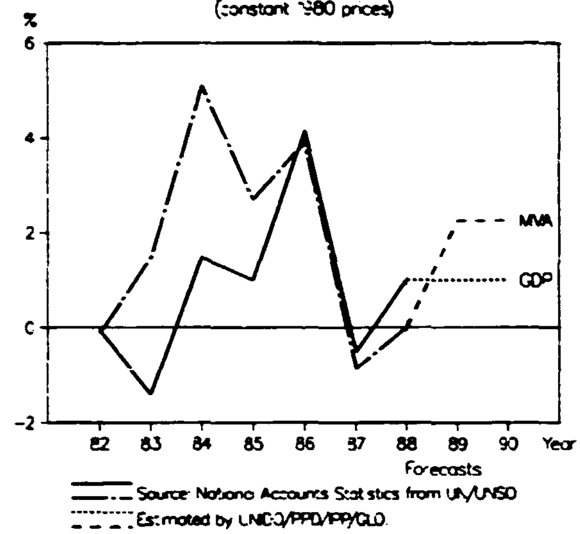




Industrial structural change
(Index of value added 1975=100)

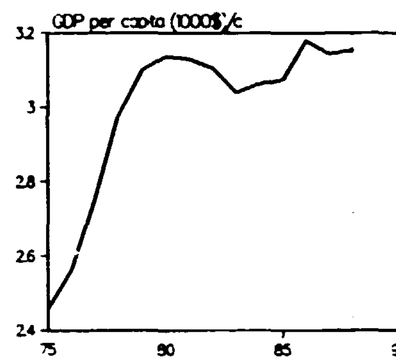


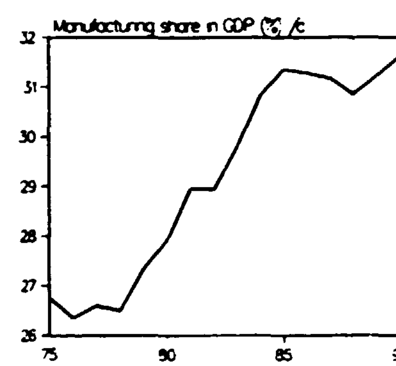
Annual growth rates of GDP and MVA
(constant 1980 prices)

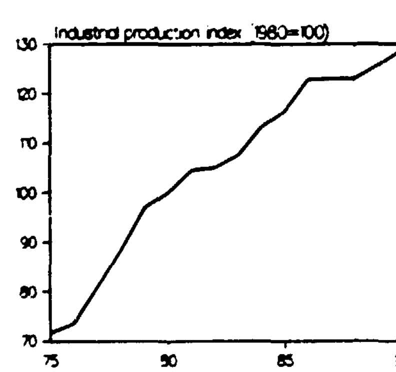


	1980	1985	1987
GDP: /na,c (millions of dollars)	69958	71068	73634
Per capita /na,c (dollars)	3137	3073	3144
Manufacturing share /na,c (%)	27.9	31.4	31.2
MANUFACTURING:			
Value added /na,c (millions of dollars)	19526	22283	22954
Value added (millions of dollars)	21750	17171	25751
Industrial production index	100	116	123
Gross output (millions of dollars)	72629	57021	79713
Employment (thousands)	2106	2467	2634 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	70	70	68 /e
Wages and salaries (%)	10	9	11 /e
Operating surplus (%)	20	21	21 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	34486	23114	30265 /e
Value added / worker	10328	6960	9777 /e
Average wage	3646	2024	3279 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	1.77	1.99	2.14
as a percentage of average θ in 1970-1975	77	86	93
MVA growth rate / θ	1.76	1.38	0.06
Degree of specialization	8.8	8.9	9.0
-VALUE ADDED: (millions of dollars)			
311 Food products	1897	1458	2766 /e
313 Beverages	459	353	660 /e
314 Tobacco products	184	221	328 /e
321 Textiles	1759	1428	1995 /e
322 Wearing apparel	903	718	1232 /e
323 Leather and fur products	226	231	321 /e
324 Footwear	482	503	644 /e
331 Wood and wood products	977	530	750 /e
332 Furniture and fixtures	730	438	751 /e
341 Paper and paper products	529	394	609 /e
342 Printing and publishing	876	462	770 /e
351 Industrial chemicals	694	631	849 /e
352 Other chemical products	681	525	750 /e
353 Petroleum refineries	454	415	311 /e
354 Miscellaneous petroleum and coal products	101	101	136 /e
355 Rubber products	276	269	397 /e
356 Plastic products	413	258	406 /e
361 Pottery, china and earthenware	128	72	145 /e
362 Glass and glass products	163	113	191 /e
369 Other non-metal mineral products	906	513	774 /e
371 Iron and steel	1221	1000	1377 /e
372 Non-ferrous metals	480	509	550 /e
381 Metal products	2106	1577	2267 /e
382 Non-electrical machinery	1828	1463	2368 /e
383 Electrical machinery	1600	1644	2293 /e
384 Transport equipment	1441	1263	1808 /e
385 Professional and scientific equipment	101	93	148 /e
390 Other manufacturing industries	134	88	166 /e

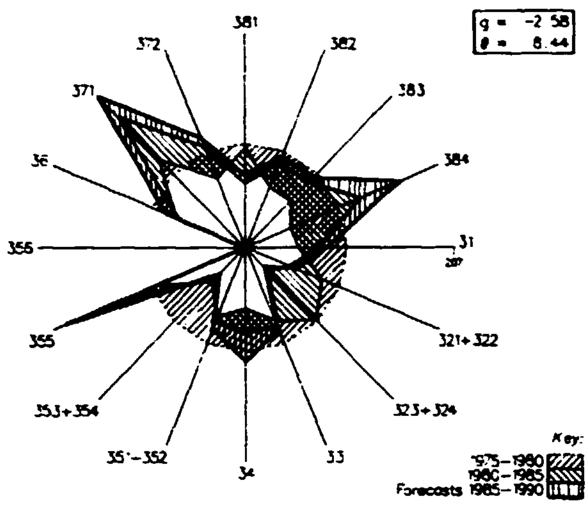
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.



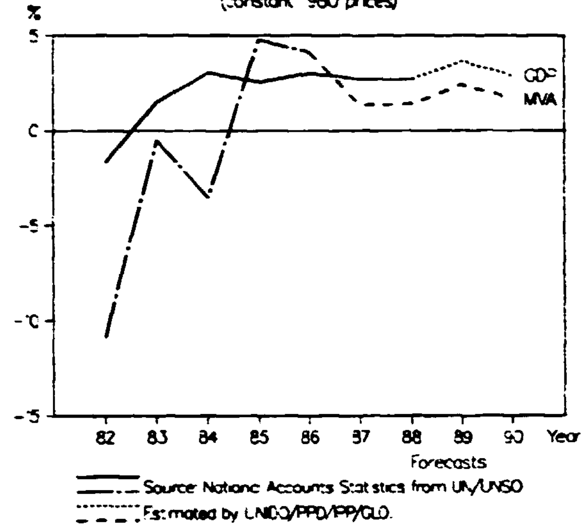




Industrial structural change
(Index of value added: 1975=100)



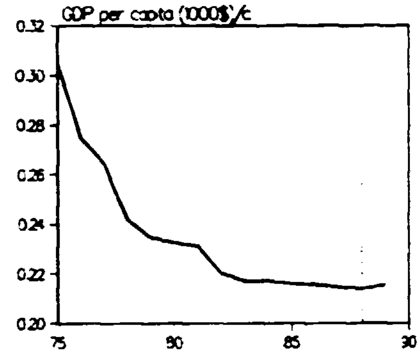
Annual growth rates of GDP and MVA
(constant 1980 prices)



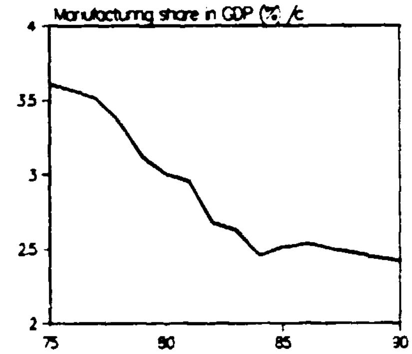
	1980	1985	1987
GDP: /na.c (millions of dollars)	6137	6630	7014
Per capita /na.c (dollars)	233	216	214
Manufacturing share /na.c (%)	3.0	2.5	2.5 /e
MANUFACTURING:			
Value added /na.c (millions of dollars)	184	166	176 /e
Value added (millions of dollars)	170	56	73
Industrial production index	100	120	126 /e
Gross output (millions of dollars)	...	...	...
Employment (thousands)	58 /e	63 /e	64 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	...	...	...
Wages and salaries (%)	...	...	...
Operating surplus (%)	...	...	...
-PRODUCTIVITY: (dollars)			
Gross output / worker	...	...	...
Value added / worker	2925 /e	895 /e	1144 /e
Average wage	6086 /e	2157 /e	2561 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	8.99 /e	4.34 /e	1.07 /e
as a percentage of average θ in 1970-1975	68 /e	33 /e	8 /e
MVA growth rate / θ	-0.39 /e	1.28 /e	1.26 /e
Degree of specialization	16.8 /e	21.2 /e	21.3 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	20	4 /e	6 /e
313 Beverages	35	16 /e	21 /e
314 Tobacco products	9	6 /e	7 /e
321 Textiles	10	3 /e	3 /e
322 Wearing apparel	7	1 /e	1 /e
323 Leather and fur products	-	- /e	1 /e
324 Footwear	8	2 /e	3 /e
331 Wood and wood products	4	1 /e	2 /e
332 Furniture and fixtures	1	- /e	- /e
341 Paper and paper products	- /e	- /e	- /e
342 Printing and publishing	2 /e	1 /e	1 /e
351 Industrial chemicals	12	5 /e	7 /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
369 Other non-metal mineral products	4	1 /e	2 /e
371 Iron and steel	4	...	...
372 Non-ferrous metals	2		..
381 Metal products	5	1 /e	2 /e
382 Non-electrical machinery	6	2 /e	3 /e
383 Electrical machinery	3	1 /e	1 /e
384 Transport equipment	6	2 /e	3 /e
385 Professional and scientific equipment	-	- /e	- /e
390 Other manufacturing industries	16	7 /e	8 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

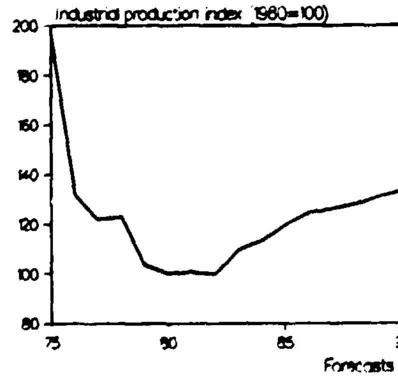
GDP per capita (1000$)/c



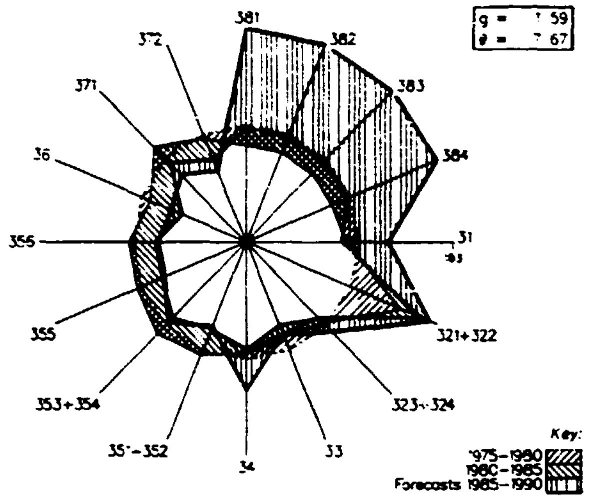
Manufacturing share in GDP (%) /c



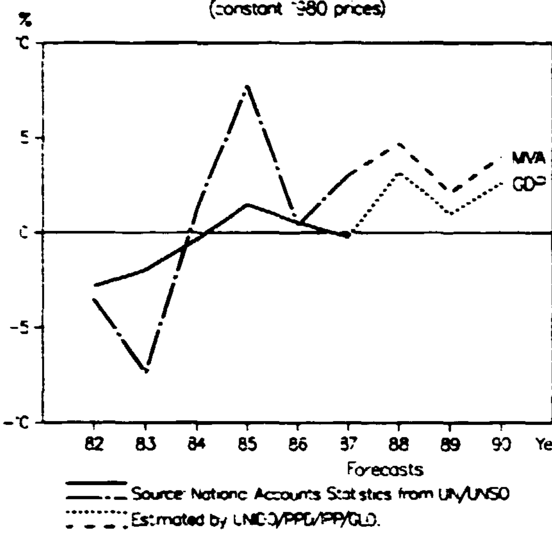
Industrial production index (1980=100)



Industrial structural change (Index of value added 1975=100)

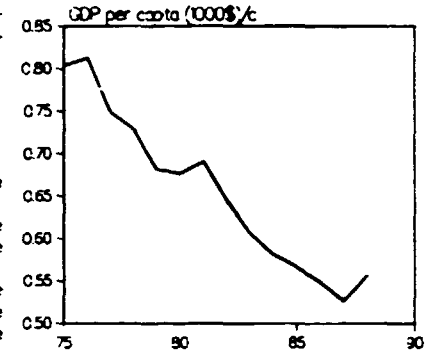


Annual growth rates of GDP and MVA (constant 1980 prices)

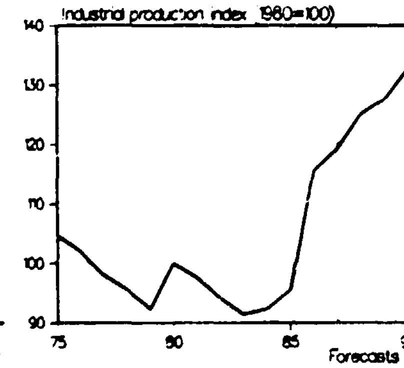


	1980	1985	1987
GDP: /na.c (millions of dollars)	3883	3972	3984
Per capita /na.c (dollars)	677	567	527
Manufacturing share /na.c (%)	..	...	..
MANUFACTURING:			
Value added /na.c (millions of dollars)	...	...	...
Value added (millions of dollars)	780	528	437 /e
Industrial production index	100	95	119
Gross output (millions of dollars)	1672	1340	946 /e
Employment (thousands)	59	65 /e	67 /e
-PROFITABILITY:(in percent of gross output)			
Intermediate input (%)	53	61 /e	54 /e
Wages and salaries (%)	11	10 /e	10 /e
Operating surplus (%)	35	29 /e	36 /e
-PRODUCTIVITY:(dollars)			
Gross output / worker	28291	20620 /e	14069 /e
Value added / worker	13198	8126 /e	6494 /e
Average wage	3245	2148 /e	1456 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	4.06 /e	4.44 /e	0.89 /e
as a percentage of average θ in 1970-1975	148 /e	161 /e	33 /e
MVA growth rate / θ	2.04 /e	0.77 /e	3.66 /e
Degree of specialization	16.6 /e	17.1 /e	19.9 /e
-VALUE ADDED:(millions of dollars)			
311 Food products	92	66 /e	53 /e
313 Beverages	193	125 /e	104 /e
314 Tobacco products	58	38 /e	31 /e
321 Textiles	51	42 /e	36 /e
322 Wearing apparel	34	21 /e	17 /e
323 Leather and fur products	4	3 /e	3 /e
324 Footwear	15	10 /e	9 /e
331 Wood and wood products	8	5 /e	4 /e
332 Furniture and fixtures	12	9 /e	8 /e
341 Paper and paper products	15	11 /e	9 /e
342 Printing and publishing	17	11 /e	9 /e
351 Industrial chemicals	22	15 /e	13 /e
352 Other chemical products	47	34 /e	29 /e
353 Petroleum refineries	9	4 /e	3 /e
354 Miscellaneous petroleum and coal products	3	2 /e	2 /e
355 Rubber products	20	13 /e	11 /e
356 Plastic products	7	5 /e	4 /e
361 Pottery, china and earthenware	1	1 /e	- /e
362 Glass and glass products	3	2 /e	2 /e
369 Other non-metal mineral products	33	20 /e	16 /e
371 Iron and steel	10	6 /e	5 /e
372 Non-ferrous metals	2	1 /e	1 /e
381 Metal products	50	31 /e	25 /e
382 Non-electrical machinery	18	12 /e	10 /e
383 Electrical machinery	26	17 /e	14 /e
384 Transport equipment	28	22 /e	18 /e
385 Professional and scientific equipment	-	-	- /e
390 Other manufacturing industries	2	2 /e	1 /e

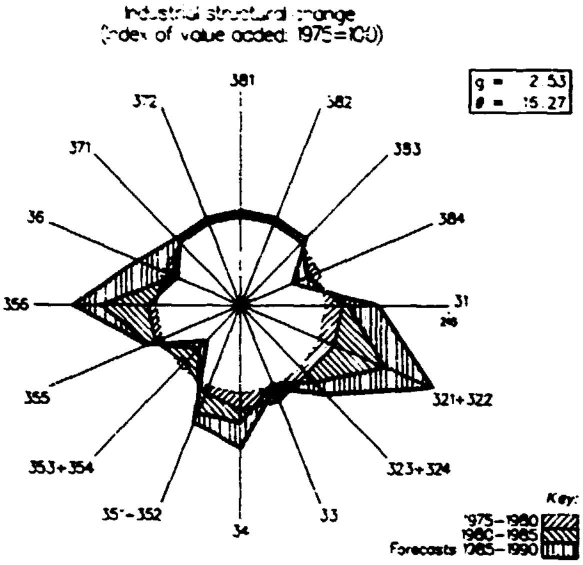
GDP per capita (1000$)/c

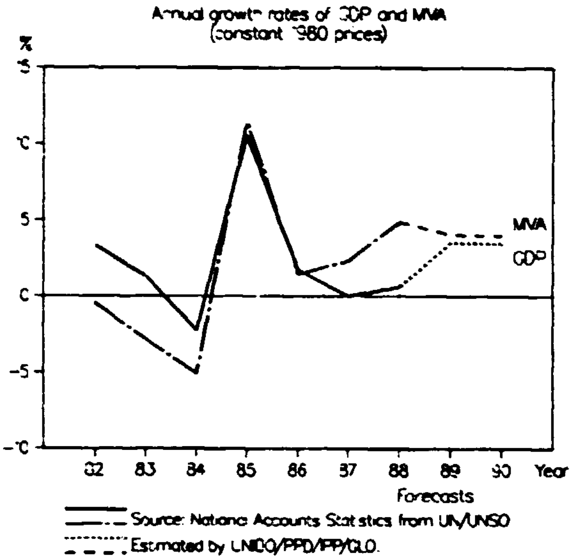


Industrial production index (1980=100)



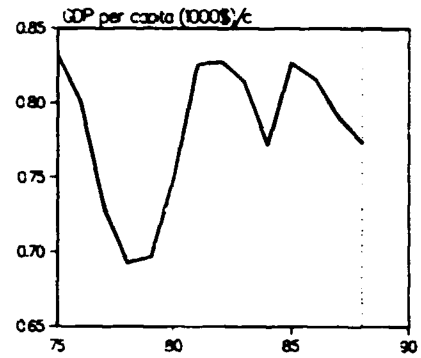
For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

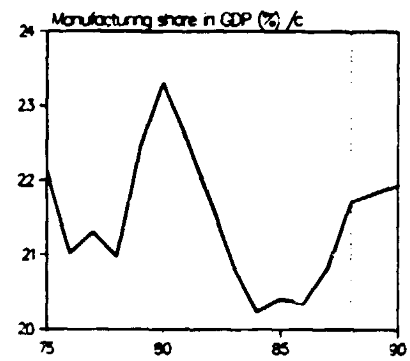


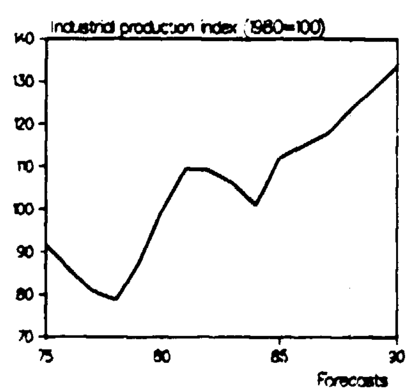


	1980	1985	1987
GDP: /na,c (millions of dollars)	5351	6872	6992
Per capita /na,c (dollars)	750	827	791
Manufacturing share /na,c (%)	23.3	20.4	20.8
MANUFACTURING:			
Value added /na,c (millions of dollars)	1247	1403	1456
Value added (millions of dollars)	1480	1420	1676 /e
Industrial production index	100	112	118
Gross output (millions of dollars)	3579	3067 /e	3779 /e
Employment (thousands)	161	168 /e	175 /e
-PROFITABILITY: (in percent of gross output)			
Intermediate input (%)	59	54 /e	56 /e
Wages and salaries (%)	17	17 /e	18 /e
Operating surplus (%)	24	30 /e	26 /e
-PRODUCTIVITY: (dollars)			
Gross output / worker	22265	18293 /e	21638 /e
Value added / worker	9205	8473 /e	9598 /e
Average wage	3848	3038 /e	3889 /e
-STRUCTURAL INDICES:			
Structural change θ (in degrees)	3.50 /e	8.30 /e	2.57 /e
as a percentage of average θ in 1970-1975	157 /e	372 /e	115 /e
MVA growth rate / θ	4.13 /e	1.32 /e	0.91 /e
Degree of specialization	13.8 /e	15.7 /e	16.3 /e
-VALUE ADDED: (millions of dollars)			
311 Food products	193	177	256
313 Beverages	92	198 /e	282 /e
314 Tobacco products	55	92 /e	130 /e
321 Textiles	147	192	214 /e
322 Wearing apparel	70	55 /e	48 /e
323 Leather and fur products	4	5 /e	5 /e
324 Footwear	34	39 /e	35 /e
331 Wood and wood products	38	17 /e	15 /e
332 Furniture and fixtures	26	19 /e	14 /e
341 Paper and paper products	30	34 /e	42 /e
342 Printing and publishing	59	50 /e	59 /e
351 Industrial chemicals	58	46 /e	49 /e
352 Other chemical products	80	69 /e	75 /e
353 Petroleum refineries	-	- /e	- /e
354 Miscellaneous petroleum and coal products	7	7 /e	8 /e
355 Rubber products	30	21 /e	23 /e
356 Plastic products	25	44 /e	48 /e
361 Pottery, china and earthenware	3	2 /e	3 /e
362 Glass and glass products	9	5 /e	7 /e
369 Other non-metal mineral products	44	38 /e	54 /e
371 Iron and steel	194	81 /e	89 /e
372 Non-ferrous metals	10	8 /e	7 /e
381 Metal products	132	86 /e	93 /e
382 Non-electrical machinery	39	24 /e	22 /e
383 Electrical machinery	44	60 /e	64 /e
384 Transport equipment	38	60	31 /e
385 Professional and scientific equipment	2	2 /e	1 /e
390 Other manufacturing industries	17	11 /e	9 /e

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.







AFGHANISTAN	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	2946	3195	3329 /e	3473 /f	3503 /f
Growth rate /na.c (%)	-2.75	-0.30	0.08 /e	1.73 /f	0.85 /f
Per capita /na.c (in dollars)	183.4	220.1	226.3 /e	224.3 /f	...
MVA: /na.c (in million dollars)	...	...	...	...	...
Growth rate /na.c (%)	...	...	...	...	...
Manufacturing share /na.c (%)	...	...	...	...	...

ALBANIA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	2373	2711	2990 /e	3342 /f	3533 /f
Growth rate /na.c (%)	6.29	1.48	4.40 /e	6.20 /f	5.70 /f
Per capita /na.c (in dollars)	888.1	914.9	971.5 /e	1044.2 /f	...
MVA: /na.c (in million dollars)	912	1111	1246 /e	1407 /f	1503 /f
Growth rate /na.c (%)	6.08	1.57	6.04 /e	6.64 /f	6.84 /f
Manufacturing share /na.c (%)	38.4	41.0	41.7 /e	42.1 /f	42.6 /f

BAHAMAS	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1475	1983	2125	2221	2323
Growth rate /na.c (%)	-3.56	0.69	3.00	1.50	4.60
Per capita /na.c (in dollars)	6556.0	8160.6	8464.9	8885.0 /f	...
MVA: /na.c (in million dollars)	...	...	...	...	...
Growth rate /na.c (%)	...	...	...	...	...
Manufacturing share /na.c (%)	...	...	...	...	...

BARBADOS	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	761	843	885	934	949
Growth rate /na.c (%)	4.64	1.00	0.00	3.10	1.60
Per capita /na.c (in dollars)	3442.1	3319.0	3444.3	...	...
MVA: /na.c (in million dollars)	91	79	80	87 /f	89 /f
Growth rate /na.c (%)	2.16	-9.51	-6.45	3.58 /f	2.20 /f
Manufacturing share /na.c (%)	10.6	9.3	9.0	9.4 /f	9.4 /f

BELIZE	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	171	183	199	210 /f	217 /f
Growth rate /na.c (%)	4.39	2.25	5.00	2.97 /f	3.41 /f
Per capita /na.c (in dollars)	1172.6	1113.2	1161.0	1140.2 /f	...
MVA: /na.c (in million dollars)	22	21	22 /e	23 /f	23 /f
Growth rate /na.c (%)	14.91	-1.09	3.16 /e	2.01 /f	2.31 /f
Manufacturing share /na.c (%)	13.1	11.2	10.9 /e	10.8 /f	10.7 /f

BENIN	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	[illegible]33	1206	1199	1236 /f	1260 /f
Growth rate /na.c (%)	10.16	-2.90	-2.53	1.00 /f	2.00 /f
Per capita /na.c (in dollars)	332.6	297.8	278.1	268.5 /f	...
MVA: /na.c (in million dollars)	78	89	86 /e	81 /f	81 /f
Growth rate /na.c (%)	7.43	-3.55	-3.65 /e	-3.37 /f	-0.06 /f
Manufacturing share /na.c (%)	6.7	7.4	7.2 /e	6.6 /f	6.5 /f

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

BERMUDA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	624	606	608	629 /f	635 /f
Growth rate /na.c (%)	4.95	-2.31	2.50	1.00 /f	1.10 /f
Per capita /na.c (in dollars)	11350.9	10630.8	10481.6	10649.5 /f	...
MVA: /na.c (in million dollars)	84	84	92 /e	99 /f	102 /f
Growth rate /na.c (%)	4.09	3.09	4.43 /e	3.38 /f	3.28 /f
Manufacturing share /na.c (%)	13.5	13.8	15.2 /e	15.8 /f	16.1 /f

BHUTAN	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	148	190	215 /e	251 /f	272 /f
Growth rate /na.c (%)	17.63	3.29	7.81 /e	8.23 /f	8.44 /f
Per capita /na.c (in dollars)	119.0	139.5	151.0 /e	169.3 /f	...
MVA: /na.c (in million dollars)	6	8	9 /e	10 /f	10 /f
Growth rate /na.c (%)	6.28	11.72	14.65 /e	10.27 /f	3.50 /f
Manufacturing share /na.c (%)	3.7	4.2	4.0 /e	3.8 /f	3.6 /f

BOTSWANA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1017	1684	2039	2174	2359
Growth rate /na.c (%)	8.72	5.41	14.73	8.00	8.50
Per capita /na.c (in dollars)	1126.2	1560.4	1760.9	1764.4 /f	...
MVA: /na.c (in million dollars)	63	60	...	...	...
Growth rate /na.c (%)	26.71	-1.89	...	...	...
Manufacturing share /na.c (%)	6.2	3.6	...	...	...

BRUNEI DARUSSALAM	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	4848	4115	3434 /e	3579 /f	3687 /f
Growth rate /na.c (%)	-7.00	0.73	-4.88 /e	2.50 /f	3.00 /f
Per capita /na.c (in dollars)	26063.3	18287.7	14189.3 /e	14174.7 /f	...
MVA: /na.c (in million dollars)	573	321	230 /e	226 /f	227 /f
Growth rate /na.c (%)	-8.35	-8.40	-9.60 /e	-0.35 /f	0.26 /f
Manufacturing share /na.c (%)	11.8	7.8	6.7 /e	6.3 /f	6.1 /f

CAPE VERDE	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	104	151	171	203 /f	216 /f
Growth rate /na.c (%)	3.32	8.28	6.00	6.00 /f	6.50 /f
Per capita /na.c (in dollars)	351.0	457.3	490.2	547.4 /f	...
MVA: /na.c (in million dollars)	6	8	...	...	...
Growth rate /na.c (%)	7.16	6.38	...	...	...
Manufacturing share /na.c (%)	5.6	5.3	...	...	...

CHAD	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1005	804	850	824 /f	792 /f
Growth rate /na.c (%)	-7.40	6.86	0.50	-1.23 /f	-3.93 /f
Per capita /na.c (in dollars)	224.5	160.2	161.3	149.1 /f	...
MVA: /na.c (in million dollars)	92	69	71 /e	67 /f	64 /f
Growth rate /na.c (%)	-12.00	5.39	-1.13 /e	-2.66 /f	-4.63 /f
Manufacturing share /na.c (%)	9.1	8.6	8.3 /e	8.1 /f	8.1 /f

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

CHINA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	286716	466506	554676	647640 /f	686498 /f
Growth rate /na.c (%)	6.55	12.28	10.50	5.00 /f	6.00 /f
Per capita /na.c (in dollars)	293.0	448.4	518.9	579.6 /f	...
MVA: /na.c (in million dollars)	...	...	...	...	...
Growth rate /na.c (%)	...	...	...	...	...
Manufacturing share /na.c (%)	...	...	...	...	...

COMOROS	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	139	170	174 /e	182 /f	190 /f
Growth rate /na.c (%)	7.27	2.71	-0.05 /e	3.50 /f	4.10 /f
Per capita /na.c (in dollars)	363.7	382.5	367.2 /e	366.4 /f	...
MVA: /na.c (in million dollars)	5	6	7 /e	7 /f	7 /f
Growth rate /na.c (%)	5.78	3.52	-3.42 /e	2.57 /f	3.80 /f
Manufacturing share /na.c (%)	3.6	3.8	3.8 /e	3.8 /f	3.7 /f

DJIBOUTI	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	339	362	375	378 /f	385 /f
Growth rate /na.c (%)	4.72	0.60	1.62	0.77 /f	1.64 /f
Per capita /na.c (in dollars)	1127.5	1029.0	1004.5	965.5 /f	...
MVA: /na.c (in million dollars)	33	36	37 /e	38 /f	39 /f
Growth rate /na.c (%)	2.98	0.92	2.02 /e	2.16 /f	2.38 /f
Manufacturing share /na.c (%)	10.1	9.8	9.8 /e	10.2 /f	10.2 /f

EQUATORIAL GUINEA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	55	63	66	74 /f	77 /f
Growth rate /na.c (%)	-9.14	7.31	2.00	4.00 /f	4.10 /f
Per capita /na.c (in dollars)	156.6	159.2	161.7	...	...
MVA: /na.c (in million dollars)	3	3	4 /e	4 /f	4 /f
Growth rate /na.c (%)	-9.24	4.19	6.95 /e	4.91 /f	8.64 /f
Manufacturing share /na.c (%)	5.1	5.0	5.3 /e	5.4 /f	5.7 /f

FRENCH GUIANA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	183	182	166 /e	162 /f	161 /f
Growth rate /na.c (%)	0.00	-3.96	-3.36 /e	-1.40 /f	-0.80 /f
Per capita /na.c (in dollars)	2611.7	2197.4	1907.0 /e	...	...
MVA: /na.c (in million dollars)	[illegible]	11	12 /e	13 /f	13 /f
Growth rate /na.c (%)	4.08	3.10	3.10 /e	3.10 /f	2.72 /f
Manufacturing share /na.c (%)	5.9	5.9	7.1 /e	7.7 /f	8.0 /f

FRENCH POLYNESIA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1265	1576	1814 /e	1959 /f	2029 /f
Growth rate /na.c (%)	0.48	-1.96	7.95 /e	3.88 /f	3.58 /f
Per capita /na.c (in dollars)	8488.8	9610.7	10606.4 /e	...	...
MVA: /na.c (in million dollars)	83	115	131 /e	146 /f	154 /f
Growth rate /na.c (%)	1.78	5.89	7.65 /e	5.78 /f	5.50 /f
Manufacturing share /na.c (%)	6.6	7.3	7.2 /e	7.5 /f	7.6 /f

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

GAMBIA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	239	242	268	289	295
Growth rate /na.c (%)	-54.21	5.66	5.30	2.[illegible]0	2.30
Per capita /na.c (in dollars)	373.0	324.2	339.8	...	...
MVA: /na.c (in million dollars)	16	16	16 /e	15 /f	14 /f
Growth rate /na.c (%)	91.04	3.93	-5.58 /e	-5.67 /f	-5.37 /f
Manufacturing share /na.c (%)	6.8	6.5	6.1 /e	5.2 /f	4.8 /f

GUADELOUPE	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1387	1475	1476 /e	1458 /f	1430 /f
Growth rate /na.c (%)	-4.68	1.36	-1.28 /e	-1.10 /f	-1.90 /f
Per capita /na.c (in dollars)	4227.7	4404.0	4367.2 /e	4337.9 /f	...
MVA: /na.c (in million dollars)	85	84	89 /e	89 /f	88 /f
Growth rate /na.c (%)	4.09	3.09	0.35 /e	-0.33 /f	-1.21 /f
Manufacturing share /na.c (%)	6.1	5.7	6.1 /e	6.1 /f	6.1 /f

GUINEA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1595	1316	1368	1466	1481 /f
Growth rate /na.c (%)	5.60	-10.58	6.00	2.60	1.00 /f
Per capita /na.c (in dollars)	295.0	216.7	214.3	...	...
MVA: /na.c (in million dollars)	51	40	37 /e	37 /f	36 /f
Growth rate /na.c (%)	2.70	-19.43	-0.39 /e	-0.61 /f	-1.27 /f
Manufacturing share /na.c (%)	3.2	3.1	2.7 /e	2.5 /f	2.4 /f

GUINEA-BISSAU	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	154	171	188	196	204
Growth rate /na.c (%)	-4.19	-2.30	5.50	0.50	[illegible].80
Per capita /na.c (in dollars)	190.0	191.8	203.0	...	...
MVA: /na.c (in million dollars)	3	3	[illegible] /e	2 /f	2 /f
Growth rate /na.c (%)	-5.10	-5.96	-0.06 /e	-1.11 /f	0.73 /f
Manufacturing share /na.c (%)	1.8	1.5	1.2 /e	1.2 /f	1.1 /f

GUYANA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	591	494	493	482 /f	485 /f
Growth rate /na.c (%)	1.66	1.02	-0.54	-0.2[illegible] /f	0.49 /f
Per capita /na.c (in dollars)	683.0	517.6	498.1	...	...
MVA: /na.c (in million dollars)	64	45	45 /e	44 /f	45 /f
Growth rate /na.c (%)	0.76	-3.13	1.05 /e	-0.81 /f	1.42 /f
Manufacturing share /na.c (%)	10.7	9.1	9.2 /e	9.2 /f	9.3 /f

HAITI	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1437	1365	1387	1377 /f	1391 /f
Growth rate /na.c (%)	7.34	0.26	1.00	-0.10 /f	1.00 /f
Per capita /na.c (in dollars)	265.3	230.5	225.6	220.2 /f	
MVA: /na.c (in million dollars)	274	228	223 /e	213 /f	215 /f
Growth rate /na.c (%)	14.69	-2.87	0.53 /e	-1.63 /f	0.53 /f
Manufacturing share /na.c (%)	19.1	16.7	16.1 /e	15.5 /f	15.4 /f

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

KOREA, DEMOCRATIC PEOPLE'S REPUBLIC	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	12730	20368	24691 /e	29375 /f	31431 /f
Growth rate /na.c (%)	9.89	9.59	10.21 /e	8.00 /f	7.00 /f
Per capita /na.c (in dollars)	706.2	999.1	1154.3 /e	1308.2 /f	
MVA: /na.c (in million dollars)	...	...	...		...
Growth rate /na.c (%)	...	...	...	...	...
Manufacturing share /na.c (%)	...	...		...	...

LAO PEOPLE'S DEMOCRATIC REPUBLIC	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	626	925	1012 /e	1156 /f	1219 /f
Growth rate /na.c (%)	1.70	8.19	4.80 /e	6.54 /f	5.52 /f
Per capita /na.c (in dollars)	195.2	257.2	267.7 /e	...	...
MVA: /na.c (in million dollars)	...	...	...	...	...
Growth rate /na.c (%)	...	...	...	...	...
Manufacturing share /na.c (%)	...	...	...		...

LESOTHO	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	382	400	437	488 /f	519 /f
Growth rate /na.c (%)	8.35	1.83	3.26	3.00 /f	6.20 /f
Per capita /na.c (in dollars)	285.2	259.7	268.3	...	...
MVA: /na.c (in million dollars)	18	31	...	...	...
Growth rate /na.c (%)	16.00	-1.23	...	...	...
Manufacturing share /na.c (%)	4.7	7.8	...		...

LIBERIA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	917	843	813	800	804
Growth rate /na.c (%)	-6.29	-2.02	-2.00	-0.10	0.50
Per capita /na.c (in dollars)	493.6	386.9	349.9	...	...
MVA: /na.c (in million dollars)	77	75	71 /e	72 /f	73 /f
Growth rate /na.c (%)	-21.21	-1.61	-1.76 /e	1.39 /f	1.93 /f
Manufacturing share /na.c (%)	8.4	8.9	8.7 /e	9.0 /f	9.1 /f

MALI	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1670	1708	1978	2158 /f	2244 /f
Growth rate /na.c (%)	4.01	-0.11	4.58	2.00 /f	4.00 /f
Per capita /na.c (in dollars)	237.8	211.3	230.8	...	...
MVA: /na.c (in million dollars)	73	108	118 /e	130 /f	137 /f
Growth rate /na.c (%)	1.58	-0.47	3.23 /e	6.86 /f	5.40 /f
Manufacturing share /na.c (%)	4.4	6.3	5.9 /e	6.0 /f	6.1 /f

MARTINIQUE	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1444	1797	1957 /e	2056 /f	2139 /f
Growth rate /na.c (%)	2.80	4.50	4.24 /e	2.00 /f	4.00 /f
Per capita /na.c (in dollars)	4415.4	5462.2	5931.4 /e		
MVA: /na.c (in million dollars)	72	72	79 /e	85 /f	88 /f
Growth rate /na.c (%)	4.09	3.09	4.30 /e	3.84 /f	3.33 /f
Manufacturing share /na.c (%)	5.0	4.0	4.0 /e	4.1 /f	4.1 /f

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

MAURITANIA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	829	808	874	922	959
Growth rate /na.c (%)	0.70	3.11	4.00	1.50	4.00
Per capita /na.c (in dollars)	534.3	457.3	468.5	...	...
MVA: /na.c (in million dollars)	37	37	43 /e	47 /f	49 /f
Growth rate /na.c (%)	4.84	7.80	5.25 /e	4.34 /f	4.34 /f
Manufacturing share /na.c (%)	4.5	4.6	4.9 /e	5.1 /f	5.2 /f

MONGOLIA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1389	1911	2161 /e	2470 /f	2612 /f
Growth rate /na.c (%)	3.43	5.51	7.43 /e	5.39 /f	5.74 /f
Per capita /na.c (in dollars)	835.0	1001.3	1065.4 /e	...	...
MVA: /na.c (in million dollars)	347	512	555 /e	688 /f	741 /f
Growth rate /na.c (%)	8.03	3.13	8.17 /e	10.43 /f	7.65 /f
Manufacturing share /na.c (%)	25.0	26.8	25.7 /e	27.8 /f	28.4 /f

MONTSERRAT	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	24	27	30 /e	32 /f	34 /f
Growth rate /na.c (%)	10.22	4.73	6.49 /e	2.10 /f	3.93 /f
Per capita /na.c (in dollars)	1863.2	2068.7	2317.3 /e	...	...
MVA: /na.c (in million dollars)	1	1	2 /e	2 /f	2 /f
Growth rate /na.c (%)	10.73	0.00	10.26 /e	5.19 /f	7.30 /f
Manufacturing share /na.c (%)	5.2	5.3	5.7 /e	6.0 /f	6.2 /f

MOZAMBIQUE	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	2414	1566	1521	1662 /f	1687 /f
Growth rate /na.c (%)	2.46	-4.00	5.00	1.20 /f	1.50 /f
Per capita /na.c (in dollars)	199.5	114.1	105.2	...	...
MVA: /na.c (in million dollars)	762	336	369 /e	424 /f	434 /f
Growth rate /na.c (%)	3.25	-11.98	5.73 /e	1.87 /f	2.37 /f
Manufacturing share /na.c (%)	31.6	21.5	24.3 /e	25.5 /f	25.7 /f

MYANMAR, UNION OF	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	5861	7554	8003	7499 /f	7206 /f
Growth rate /na.c (%)	7.94	4.32	2.20	-3.40 /f	-3.91 /f
Per capita /na.c (in dollars)	173.0	201.2	204.5	181.2 /f	...
MVA: /na.c (in million dollars)	558	739	813 /e	773 /f	738 /f
Growth rate /na.c (%)	7.46	4.53	2.88 /e	-4.02 /f	-4.54 /f
Manufacturing share /na.c (%)	9.5	9.8	10.2 /e	10.3 /f	10.2 /f

NAMIBIA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1860	1717	1678 /e	1737 /f	1779 /f
Growth rate /na.c (%)	4.75	-0.96	-0.35 /e	1.50 /f	2.43 /f
Per capita /na.c (in dollars)	1355.6	1073.3	983.5 /e	...	...
MVA: /na.c (in million dollars)	75	76	...	...	...
Growth rate /na.c (%)	2.56	0.00	...	...	...
Manufacturing share /na.c (%)	4.0	4.4	...	...	...

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

NEPAL	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1946	2397	2554	2769 /f	2886 /f
Growth rate /na.c (%)	-2.32	2.96	2.41	1.17 /f	4.22 /f
Per capita /na.c (in dollars)	131.0	141.7	143.6	149.1 /f	...
MVA: /na.c (in million dollars)	78	101	103 /e	104 /f	113 /f
Growth rate /na.c (%)	-4.52	-9.86	2.51 /e	-1.74 /f	8.59 /f
Manufacturing share /na.c (%)	4.0	4.2	4.0 /e	3.7 /f	3.9 /f

NETHERLANDS ANTILLES	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1152	1103	1089	1178 /f	1237 /f
Growth rate /na.c (%)	4.05	-2.10	1.50	3.50 /f	5.00 /f
Per capita /na.c (in dollars)	6660.2	6094.3	5823.1	...	...
MVA: /na.c (in million dollars)	89	89	98 /e	106 /f	110 /f
Growth rate /na.c (%)	4.09	3.09	4.58 /e	3.87 /f	3.94 /f
Manufacturing share /na.c (%)	7.7	8.0	9.0 /e	9.0 /f	8.9 /f

NEW CALEDONIA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1182	1081	1046 /e	1043 /f	1053 /f
Growth rate /na.c (%)	-0.40	-3.66	-2.31 /e	-0.29 /f	1.00 /f
Per capita /na.c (in dollars)	8446.1	7018.8	6581.7 /e	...	..
MVA: /na.c (in million dollars)	68	72	78 /e	82 /f	83 /f
Growth rate /na.c (%)	2.00	4.51	3.21 /e	2.26 /f	1.08 /f
Manufacturing share /na.c (%)	5.8	6.6	7.4 /e	7.8 /f	7.9 /f

NIGER	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	2501	2530	2597	2820	2963
Growth rate /na.c (%)	4.90	9.73	0.40	1.00	4.70
Per capita /na.c (in dollars)	470.9	413.6	400.2	...	...
MVA: /na.c (in million dollars)	97	99	103 /e	109 /f	112 /f
Growth rate /na.c (%)	4.68	8.29	1.30 /e	3.25 /f	2.31 /f
Manufacturing share /na.c (%)	3.9	3.9	4.0 /e	3.9 /f	3.8 /f

OMAN	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	5896	11951	13063	13612	14252
Growth rate /na.c (%)	6.05	13.99	7.00	4.20	4.70
Per capita /na.c (in dollars)	5985.5	9614.4	9785.2	9472.4 /f	...
MVA: /na.c (in million dollars)	45	297	...	...	...
Growth rate /na.c (%)	19.06	23.56	...	...	.
Manufacturing share /na.c (%)	0.8	2.5	...	...	...

PAPUA NEW GUINEA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	2549	2807	3043	3294 /f	3409 /f
Growth rate /na.c (%)	-2.29	4.62	4.82	4.00 /f	3.60 /f
Per capita /na.c (in dollars)	825.9	799.2	821.5	862.5 /f	..
MVA: /na.c (in million dollars)	242	269	299 /e	349 /f	375 /f
Growth rate /na.c (%)	-3.26	1.54	7.90 /e	7.82 /f	7.47 /f
Manufacturing share /na.c (%)	9.5	9.6	9.8 /e	10.6 /f	11.0 /f

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

PUERTO RICO	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	15823	17849	19127 /e	21145 /f	21758 /f
Growth rate /na.c (%)	0.60	6.96	-0.02 /e	6.00 /f	2.90 /f
Per capita /na.c (in dollars)	4944.7	5170.7	5380.4 /e	...	...
MVA: /na.c (in million dollars)	5786	7659	8479 /e	9807 /f	10328 /f
Growth rate /na.c (%)	0.14	8.77	5.49 /e	9.47 /f	5.31 /f
Manufacturing share /na.c (%)	36.6	42.9	44.3 /e	46.4 /f	47.5 /f

QATAR	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	7829	7109	5695	5844	6048
Growth rate /na.c (%)	7.10	-7.00	2.00	1.10	3.50
Per capita /na.c (in dollars)	34039.5	23697.0	17415.1	15751.3 /f	...
MVA: /na.c (in million dollars)	258	389	419 /e	492 /f	536 /f
Growth rate /na.c (%)	11.77	3.64	8.58 /e	8.35 /f	8.97 /f
Manufacturing share /na.c (%)	3.3	5.5	7.4 /e	8.4 /f	8.9 /f

REUNION	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1999	2455	2752 /e	3006 /f	3113 /f
Growth rate /na.c (%)	[illegible].20	3.49	6.93 /e	3.00 /f	3.60 /f
Per capita /na.c (in dollars)	3927.7	4488.9	4861.6 /e	...	...
MVA: /na.c (in million dollars)	190	217	231 /e	246 /f	254 /f
Growth rate /na.c (%)	0.86	3.36	2.72 /e	3.44 /f	3.28 /f
Manufacturing share /na.c (%)	9.5	8.8	8.4 /e	8.2 /f	8.2 /f

RWANDA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1163	1335	1433	1502 /f	1562 /f
Growth rate /na.c (%)	6.01	4.89	4.56	2.90 /f	4.00 /f
Per capita /na.c (in dollars)	225.2	218.7	219.5	...	...
MVA: /na.c (in million dollars)	178	228	...	...	...
Growth rate /na.c (%)	12.30	3.48	...	...	...
Manufacturing share /na.c (%)	15.3	17.1	...	...	...

SAMOA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	112	106	111 /e	114 /f	118 /f
Growth rate /na.c (%)	3.00	2.63	2.50 /e	1.31 /f	4.00 /f
Per capita /na.c (in dollars)	718.4	648.2	662.5 /e	...	...
MVA: /na.c (in million dollars)	...	...	...	...	...
Growth rate /na.c (%)	...	...	...	...	...
Manufacturing share /na.c (%)	...	...	...	...	...

SAO TOME AND PRINCIPE	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	47	33	37	38 /f	39 /f
Growth rate /na.c (%)	2.59	-5.01	-0.50	0.80 /f	1.25 /f
Per capita /na.c (in dollars)	543.4	339.5	364.9	...	...
MVA: /na.c (in million dollars)	4	3	4 /e	4 /f	4 /f
Growth rate /na.c (%)	0.00	-8.74	-0.10 /e	0.85 /f	1.17 /f
Manufacturing share /na.c (%)	9.1	10.2	9.5 /e	9.5 /f	9.5 /f

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex

SEYCHELLES	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	147	151	154	166 /f	169 /f
Growth rate /na.c (%)	-2.55	9.50	0.51	2.00 /f	1.88 /f
Per capita /na.c (in dollars)	2302.4	2282.2	2258.7	...	...
MVA: /na.c (in million dollars)	11	11	12 /e	14 /f	15 /f
Growth rate /na.c (%)	27.33	5.68	7.64 /e	8.41 /f	8.35 /f
Manufacturing share /na.c (%)	7.4	7.1	7.7 /e	8.6 /f	9.1 /f

SIERRA LEONE	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1052	880	796	832 /f	842 /f
Growth rate /na.c (%)	6.17	-15.33	-2.01	-1.00 /f	1.20 /f
Per capita /na.c (in dollars)	322.2	240.0	206.9	...	...
MVA: /na.c (in million dollars)	76	69	56 /e	59 /f	60 /f
Growth rate /na.c (%)	7.44	-15.06	2.27 /e	-0.13 /f	1.79 /f
Manufacturing share /na.c (%)	7.3	7.8	7.0 /e	7.1 /f	7.1 /f

SOMALIA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1586	1726	1809	1871 /f	1940 /f
Growth rate /na.c (%)	1.79	6.63	4.00	1.12 /f	3.66 /f
Per capita /na.c (in dollars)	296.3	269.7	263.5	361.8 /f	...
MVA: /na.c (in million dollars)	91	76	...	...	...
Growth rate /na.c (%)	9.17	7.55	...	...	...
Manufacturing share /na.c (%)	5.7	4.4	...	...	...

SUDAN	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	10172	10022	10559	10010 /f	10210 /f
Growth rate /na.c (%)	0.21	-1.71	2.50	-0.21 /f	2.00 /f
Per capita /na.c (in dollars)	544.5	459.3	456.5	...	...
MVA: /na.c (in million dollars)	789	839	857 /e	819 /f	813 /f
Growth rate /na.c (%)	12.50	4.03	0.19 /e	-2.57 /f	-0.73 /f
Manufacturing share /na.c (%)	7.8	8.4	8.1 /e	8.2 /f	8.0 /f

SURINAME	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	899	886	880 /e	857 /f	845 /f
Growth rate /na.c (%)	-7.72	1.07	-0.09 /e	-1.85 /f	-1.36 /f
Per capita /na.c (in dollars)	2521.5	2355.6	2273.7 /e	...	...
MVA: /na.c (in million dollars)	140	112	107 /e	97 /f	92 /f
Growth rate /na.c (%)	-10.62	6.45	-3.31 /e	-4.99 /f	-4.74 /f
Manufacturing share /na.c (%)	15.5	12.6	12.1 /e	11.3 /f	10.9 /f

SWAZILAND	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	543	623	654	706 /f	725 /f
Growth rate /na.c (%)	2.88	3.00	2.50	4.00 /f	2.80 /f
Per capita /na.c (in dollars)	960.3	935.4	917.4	...	...
MVA: /na.c (in million dollars)	119	142	152 /e	163 /f	168 /f
Growth rate /na.c (%)	11.17	1.26	3.37 /e	3.62 /f	3.31 /f
Manufacturing share /na.c (%)	22.0	22.7	23.2 /e	23.1 /f	23.2 /f

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

TOGO	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	1131	1047	1051	1120	1136
Growth rate /na.c (%)	-4.53	5.34	2.00	2.60	1.40
Per capita /na.c (in dollars)	442.5	353.5	333.6	...	...
MVA: /na.c (in million dollars)	79	74	71 /e	72 /f	72 /f
Growth rate /na.c (%)	-3.19	4.80	0.27 /e	0.50 /f	0.03 /f
Manufacturing share /na.c (%)	7.0	7.1	6.8 /e	6.5 /f	6.4 /f

TONGA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	60	90	76 /e	87 /f	94 /f
Growth rate /na.c (%)	15.81	5.37	-4.84 /e	7.50 /f	7.00 /f
Per capita /na.c (in dollars)	614.8	819.0	656.8 /e	...	...
MVA: /na.c (in million dollars)	3	3	3 /e	5 /f	6 /f
Growth rate /na.c (%)	21.44	6.26	8.01 /e	17.61 /f	4.33 /f
Manufacturing share /na.c (%)	5.3	3.5	4.6 /e	6.1 /f	5.9 /f

UGANDA	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	2638	2781	2938	3193	3305
Growth rate /na.c (%)	-3.40	-5.50	4.00	3.50	3.50
Per capita /na.c (in dollars)	201.0	179.5	177.0	...	...
MVA: /na.c (in million dollars)	109	110	121 /e	135 /f	141 /f
Growth rate /na.c (%)	6.10	-12.70	5.40 /e	4.38 /f	4.04 /f
Manufacturing share /na.c (%)	4.1	4.0	4.1 /e	4.2 /f	4.3 /f

UNITED ARAB EMIRATES	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	29629	27036	22227	22180	22660 /f
Growth rate /na.c (%)	26.42	-2.39	5.50	1.00	2.16 /f
Per capita /na.c (in dollars)	29162.0	20012.0	15276.3	14496.7 /f	...
MVA: /na.c (in million dollars)	1131	2547	2635 /e	3119 /f	3451 /f
Growth rate /na.c (%)	64.87	-2.20	12.35 /e	11.78 /f	10.66 /f
Manufacturing share /na.c (%)	3.8	9.4	11.9 /e	14.1 /f	15.2 /f

VANUATU	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	113	149	152 /e	170 /f	175 /f
Growth rate /na.c (%)	-11.46	4.01	3.86 /e	4.49 /f	2.76 /f
Per capita /na.c (in dollars)	961.3	1038.5	1002.6 /e	...	...
MVA: /na.c (in million dollars)	3	10	16 /e	25 /f	32 /f
Growth rate /na.c (%)	24.99	9.95	20.65 /e	22.45 /f	26.85 /f
Manufacturing share /na.c (%)	3.0	6.8	10.4 /e	14.7 /f	18.1 /f

VIET NAM	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	5380	7446	7823	8448 /f	8736 /f
Growth rate /na.c (%)	-4.81	6.20	2.10	4.27 /f	3.42 /f
Per capita /na.c (in dollars)	100.2	124.0	124.6	128.6 /f	...
MVA: /na.c (in million dollars)	...	...	...	...	...
Growth rate /na.c (%)	...	...	...	...	...
Manufacturing share /na.c (%)	...	...	...	...	...

For sources, footnotes and comments see "Technical notes" at the beginning of this Annex.

YEMEN (ARAB REPUBLIC)	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	2768	4194	4659	5040	5241
Growth rate /na.c (%)	3.75	20.37	4.80	4.00	4.00
Per capita /na.c (in dollars)	461.6	608.9	637.4	662.3 /f	...
MVA: /na.c (in million dollars)	160	499	657 /e	772 /f	836 /f
Growth rate /na.c (%)	7.69	76.12	11.56 /e	8.32 /f	8.28 /f
Manufacturing share /na.c (%)	5.8	11.9	14.1 /e	15.3 /f	16.0 /f

YEMEN, DEMOCRATIC	1980	1985	1987	1989	1990
GDP: /na.c (in million dollars)	668	892	772 /e	828 /f	861 /f
Growth rate /na.c (%)	14.78	-2.97	-4.81 /e	2.00 /f	4.00 /f
Per capita /na.c (in dollars)	359.0	417.0	340.2 /e	320.3 /f	...
MVA: /na.c (in million dollars)	34	62	64 /e	70 /f	73 /f
Growth rate /na.c (%)	-41.12	22.41	4.69 /e	4.57 /f	4.53 /f
Manufacturing share /na.c (%)	5.0	6.9	8.3 /e	8.4 /f	8.5 /f

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