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SPECIAL NOTE — JOURNAL DISCONTINUED

For budgetary reasons, this is the last issue of *Industry and Development*, at least for the foreseeable future. We therefore request our readers not to send any further articles for possible publication, and thank them for their past interest in the journal.

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

The term "billion" signifies a thousand million.

In tables:

Totals may not add precisely because of rounding.

A hyphen indicates that the item is not applicable.

An em dash (--) indicates that the amount is nil or negligible.

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

The following abbreviations are used in this publication:

CMEA	Council for Mutual Economic Assistance
GDP	gross domestic product
GNP	gross national product
HBC	hard budget constraint
NIC	newly industrializing country
NSIC	Nepal Standard Industrial Classification
OECD	Organisation for Economic Co-operation and Development
(R)CVA	(Real) cost of value added
R&D	research and development
REs	Rural enterprises
(R)WB	(Revised) wage bill
SBC	soft budget constraint
SOEs	State-owned enterprises
TVEs	Township and village enterprises

Technological development, technology impacts and industrial strategy: a review of the issues

*Sanjaya Lall**

The significance of technology to economic development, and particularly to industrial growth, is universally accepted. With the acceleration in the pace of technical change, its significance is even greater for countries that seek to industrialize efficiently and compete in world markets. Nevertheless, the workings of technological forces in the development process are not well understood. Even in the context of advanced industrial countries, where a large literature exists on technology, the phenomenon remains, at the micro-economic level, something of a "black box" that economists are reluctant to open [1]. In developing countries, ostensibly well behind the frontiers of international technology in most productive activities, it is not merely technological development that tends to be little investigated at the micro-economic level: even its general nature is often not appreciated.

It is common among economists to identify technological progress with major innovations (shifts in the production possibility curve) that are the results of investment in research and development (R&D). Developing countries are not innovators in this sense. Their technological progress is usually initiated by the transfer of existing technology from developed countries in the form of equipment, know-how and skills. The choice of particular techniques from the international "technology shelf" is taken to depend, in the absence of distortions, on relative factor prices, and the absorption of the technology is assumed to be costless, rapid and efficient (thus, technology, once imported, performs at its "best-practice" level). International technology markets are taken to function rather like competitive markets for products. Technology is often assumed to be a widely available and identifiable commodity that can be bought "off the shelf" and used in production like an imported physical input. All that is needed for technological growth in developing countries is undistorted prices and free access to international markets.

Such a simple portrayal of technology is not very realistic, particularly in the context of developing countries. Historically, major innovation has only been one source of productivity increase in manufacturing, even in the developed world. "Minor" innovation (defined as efforts to gain full mastery of existing technologies, adapting them and making small incremental improvements) has been just as important, or more so ([2], [3]). From the perspective of the firm, the distinction

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between innovation (movements of the production function) and adaptation to factor price changes (movements along the function) is artificial. Firms tend to have knowledge of the particular technology they have adopted (for a variety of economic or other reasons), some familiarity with similar technologies and little knowledge of technologies that are dissimilar. The localization of technological change [4] implies that all technological change, be it adaptation or improvement, major or minor, involves search, effort and a degree of risk. Innovation in this sense can be defined broadly to cover efforts to master a given technology as well as those to achieve important breakthroughs. The degree of risk, cost, skills and time involved differ over this spectrum of technological effort, but the process of technological development remains essentially similar ([7], [8]).

In industrially underdeveloped countries, the degree of localization is likely to be greater, because new entrants in a largely unindustrialized setting are apt to have little knowledge of the array of possible technologies or of the skills for purchasing them. They are also likely to be less efficient in utilizing whatever technologies they do select. Firm-level differences in technical efficiency persist everywhere, but firms in developing countries generally display both wider dispersions and lower average levels of efficiency in given activities than firms in developed countries [9]. This phenomenon was extensively analysed in the classic study by Hirschman [10], but its proper understanding had to wait until recent work on the micro-economic phenomena of technical change in developing countries (further discussed below). The work is now being extended to the broader issue of why some developing countries are industrially more successful than others - why, in other words, they have a higher proportion of good enterprises with high degrees of technical efficiency and dynamism than others.

The fact that technology is not costlessly or automatically absorbed by enterprises means that international technology transfer cannot be treated like trade in physical inputs. There are large elements in technology that are "tacit" rather than explicit.* The absorption of these tacit elements requires recipients to devote resources to developing new skills, knowledge and institutional structures [10]. The process of technological assimilation generally also leads to adaptations and improvements in the technology, and, if the firm devotes sufficient resources to the effort, can also lead to more advanced innovations.

Since technological development is necessarily a firm-level process, it is important to the analysis of the role of technology in industrialization to focus on that level. In section A of the present paper, the nature of technological development at the firm level and the capabilities needed to be technologically proficient are described. In section B the determinants

*See Nelson ([5], [6]) and Rosenberg ([1], [2]).

of technological effort by enterprises are discussed. Section C focuses on the set of determinants arising from the international economy - trade strategies and technology transfer from abroad. In section D the main conclusions are drawn.

A. Technological development at the firm level

The micro-economic analysis of technological development in developing countries has been guided by the "evolutionary theory" developed by Nelson and Winter [8]. This theory explores how firms can display persistent differences in productivity, traceable, among other things, to "different degrees of technological accumulation and different efficiencies in the innovative search process" ([11], p. 1156). The evolutionary theory, set in the context of advanced industrial countries, takes a minimum level of mastery of existing, diffused technologies for granted, and concentrates on improvements and advances. However, it can be adapted easily to developing countries, where initial mastery itself is a major focus of technological activity.

When a new technology (that is, a new product or process, or even a different method of organization or much larger scale of operations) is introduced into a developing country, gaining mastery of that technology generally requires the enterprise concerned to acquire new skills and knowledge, technological as well as managerial. Some skills can be hired "ready-made" from the market; a few scarce skills can be imported, but expatriates are expensive, and must transmit their skills to locals if the activity is to be fully competitive. However, skills that are needed for the efficient utilization of new technologies are unlikely to be found in most instances in developing countries. In many cases, even the formal base of skills required (for example, engineers in the relevant field) may not be present. Given such a formal base, a great deal of on-the-job experience as well as training, searching, experimentation, design, standardization of components etc. would be needed before the technology is used near its best practice norms.

The nature of the activity will determine how much and what kind of effort is required for mastery. Some technologies are much easier than others: a technology that is largely embodied in equipment (rather than operator or design skills), requires low levels of formal training, involves the interaction of a small number of different specializations, and does not have stringent requirements of quality, process control, equipment maintenance or organizational control, will allow mastery to be gained far more quickly, cheaply and predictably than other activities. Where a technology is difficult, on the other hand, considerable time and effort may be involved before efficiency is reached, even in a static sense. In a dynamic setting, with changing market conditions and technologies, effort to reach efficiency may be perpetual. The nature of the

technological mastery process will differ, not just by activity, but also within given activities, by the stage of production and level of mastery aimed at (thus, automobile assembly from a knocked-down kit is easier than manufacture of automobile engines and gears, which is easier, in turn, than the design and development of new automobiles).

The degree to which infant industries reach maturity thus depends in part on the amount and effectiveness of their efforts in developing the necessary capabilities for the kind of technologies and level of mastery aimed at [12]. It also depends on factors beyond the control of individual firms (see below), but in-firm capability-building is clearly one essential ingredient. This is true even of simple activities and modest technological ambitions. It is far more significant for complex activities in both process- and product-centred technologies, and for achieving dynamic rather than static efficiency. Static and dynamic efficiency are difficult to distinguish in practice, because one set of capabilities shades into the other, and a competent enterprise is constantly expanding its core of capabilities, while sloughing off those where it lacks a competitive advantage. As the technology concerned grows more complex, a competitive enterprise usually launches formal R&D activity, not necessarily to undertake major innovation, but even to absorb technology purchased or imitated from others, or to keep track of what others are doing ([13], [14], [15]).

Some idea of the range of technological capabilities involved in manufacturing can be gained from table 1, which sets out an illustrative matrix of the main technical functions grouped by degree of complexity. The table is not exhaustive. Nor is it intended to suggest that all the functions have to be performed by a single firm, whatever its level of development, since some specialized tasks are always best left to others (some investment-related functions, in particular are left to specialized engineering firms, and high-level innovative functions may be shared by buying in and selling technologies). However, any efficient enterprise must possess a core of capabilities which are necessary to its functioning. This core defines its institutional identity and competitive advantage: the capabilities concerned cannot be contracted out. At low levels of technological development, these core capabilities comprise equipment selection, quality control, process and product technology, basic industrial engineering and efficient procurement of inputs. At higher levels, they may include technology negotiation, process engineering, process and product improvement and technology interchange with linked enterprises. At the most advanced levels, core capabilities may include control of (proprietary) technology which constitutes the firm's most valuable competitive asset.

Technological development can be defined as the acquisition and deepening of technological capabilities. Such capabilities can be grouped under three broad headings: investment, production and linkages. Of these, attention conventionally focuses on production-related capabilities,

Table 1. Illustrative matrix of technological capabilities

	Investment		*Production*			
Degree of complexity	*Pre-investment*	*Project execution*	*Process engineering*	*Product engineering*	*Industrial engineering*	*Linkages within economy*
Basic Simple, routine (experience-based)	Prefeasibility and feasibility studies, site selection, scheduling of investment	Civil construction, ancillary services, equipment erection, commissioning	Debugging, balancing, quality control, preventive maintenance, assimilation of process technology	Assimilation of product design, minor adaptation to market needs	Work flow, scheduling, time-motion studies, inventory control	Local procurement of goods and services, information exchange with suppliers
Intermediate Adaptive, duplicative (search-based)	Search for technology source, negotiation of contracts, bargaining suitable terms, information systems	Equipment procurement, detailed engineering, training and recruitment of skilled personnel	Equipment stretching, process adaptation and cost saving, licensing new technology	Product and quality improvement, licensing and assimilating new imported product technology	Monitoring productivity, improved coordination	Technology transfer to local suppliers, coordinated design, science and technology links
Advanced Innovative, risky (research-based)		Basic process design, equipment design and supply	In-house process innovation, basic research	In-house product innovation, basic research		Turnkey capability, cooperative R&D, licensing own technology to others

Source: S. Lall, "Technological capabilities and industrialization", *World Development*, vol. 20, No. 2 (1992), pp. 165-186.

but the other two are also of importance to productive efficiency. Investment capabilities are the skills needed to set up a new facility or expand an existing facility. These cover a wide range, from feasibility studies, process design and technology purchase to project implementation and commissioning of plant. Each of these skills is complex, and takes time, special training, experience and sometimes formal research and development (R&D), to develop. The possession of investment capabilities by a developing country (in a manufacturing enterprise or by a set of manufacturers and engineering consultants) can offer significant benefits. Even a modicum of technology selection, negotiation, design and implementation skills can enable an enterprise to specify better the kind of technology and the elements of the technology it needs to buy. It can lower the cost of the technology package. It can also lower the capital costs of projects, not just because local engineering skills are usually far cheaper, but also because project execution is quicker (one of the reasons for high project costs in Africa, even in agriculture and infrastructure, is its poor base of investment capabilities). Local investment capabilities can enable better adaptation of process designs, greater use of local equipment and greater diffusion of technology within the country. More significantly, local participation in project engineering can give deeper understanding of the technology being implemented, allowing greater efficiency in its subsequent operation and improvement.

Production capabilities comprise what is normally understood by technology. They range from basic skills like quality control, layout, maintenance, inventory control and implementation of designs to equipment "stretching", improvement and innovation. Some capabilities may be developed, especially in simple technologies, with a minimal base of formal skills; however, even these are not possessed by many developing countries,* and need considerable time and effort to acquire. Others may require fairly high levels of schooling or training, considerable search for information within the firm (by experimentation) or outside (from journals, competitors, suppliers, buyers, research institutes or academia), institutional effort, and coordination and further investments in equipment, consultants or the purchase of technology.

Linkage capabilities are the specific skills needed by an enterprise to interact with its external environment. In technological terms, these skills involve the ability to locate efficient suppliers and strike up the coordination and information-exchange linkages that characterize interindustry transactions. In certain areas, especially complex engineering products, these linkages are quite demanding - in developing countries they can require a firm to devote considerable resources to "bringing up" subcontractors and suppliers by adapting their technology

*On sub-Saharan Africa, see [16].

and by providing technical and managerial assistance. Modern management techniques like just-in-time inventory systems, fast becoming the *sine qua non* of efficiency in engineering industries, call for high levels of linkage capabilities. Linkage capabilities can also include the skills needed to "plug into" and tap the science and technology infrastructure, and transmit one's own technology to others. Japanese firms have developed an edge in product innovation in several activities, such as automobiles, by building close linkages with suppliers from the earliest stages of design to final stages of production [15]. In general, linkage capabilities are essential supplements to anonymous market relations to promote coordination, specialization, and technological diffusion.

Viewing technological development as the growth of an expanding core of capabilities, which determines static efficiency and dynamic competitiveness, gives a clear picture of what constitutes industrial success. A successful industrializing economy is one where a large proportion of enterprises have invested in developing healthy capabilities, with appropriate specialization among themselves and with respect to the rest of the world. The capability-building process entails time, investment and risk, but these vary, within each technology, by the level of mastery and scale of operations aimed at, and, across technologies, by the inherent complexity of the activities. Higher levels of capability development and entry into more complex activities carry higher risk and cost, but they constitute areas of future growth as easy opportunities are used up (the normal path of structural transformation as analysed by Chenery, Robinson and Syrquin [17]). There is no predictable or automatic learning curve down which enterprises or countries travel, since it is the level and effectiveness of investments in capability acquisition that determine the outcome. These investments are, in turn, determined by a number of factors (considered below). Each country provides a unique outcome depending on the interplay of these factors, with government policy playing an important role, positive as well as negative.

B. Determinants of capability acquisition

Capability acquisition at the enterprise level is partly a stochastic process, and is partly influenced by common elements in the external environment. The stochastic part depends on historic circumstance, entrepreneurial skills and luck: it leads different firms to different levels of efficiency and dynamism where, given transaction costs and product differentiation, they can persist for long periods even in competitive markets ([5], [11]). For the policy maker what is more interesting is the set of common elements that affect all firms. The extent to which a country can produce a substantial proportion of "good" firms that have invested in building up capabilities and are able to compete

internationally depends on several things: the competitive and macroeconomic environment facing firms; the level of development and flexibility of factor markets and industrial support systems; the adequacy of physical infrastructure; the sophistication of the science and technology infrastructure; and the functioning of various legal, financial, marketing and other institutions on which the market system depends.

These factors can be grouped into three: incentive, capabilities and institutions ([18], [19]). This grouping is not watertight - similar factors can appear under different headings - but it is very useful in distinguishing between the demand for capability acquisition (as given by the incentive framework) and the ability to supply those capabilities (as given by the available skill, institutional, infrastructural and industrial structures). It is the interaction of these various factors that determines the final outcome. Several of the factors are fairly self-evident, but the interaction between them is not well understood. The recent literature on industrialization in developing countries has tended to focus on incentive factors, in particular on trade regimes. This has certainly highlighted one major determinant of export success (considered in the next section), but has ignored the role of capabilities and institutions, which have a critical function in explaining differing industrial performance ([19], [20]). It has consequently given the impression that "getting prices right" is the most important policy consideration, apparently assuming that factor and information markets (and the institutions supporting them) are fully efficient and can respond as needed to appropriate incentives.

The literature on the developed industrial countries has taken a different tack. There is a vast amount of writing on the causes of differing productivity and competitiveness performance in the countries of the Organisation for Economic Co-operation and Development (OECD). Much of the recent focus has been on differences in capabilities and institutions rather than incentives. The most important variables identified have been education and training, technological effort, managerial and organizational skills, interindustry linkages and the quality of the science, technology and information infrastructure and institutions.*

Incentive structures tend to be relatively similar across OECD countries (though differences do exist), and they tend to be liberal: relatively open to trade, foreign investment, domestic entry and exit, and technology flows. Developing countries display far greater differences in their strategies on trade, industry and technology. This explains, to some extent, the difference in the focus of the two sets of literature. But it does not justify it entirely, for capability and institutional factors tend to differ even more between developing countries. Thus, the inducement to

*For a representative sample, see [14], [19], [21], [22] and [23].

get prices right will only be weakened if the expected supply response is held back by inadequate technological and other capabilities.

Returning to the three sets of determinants of technological capability, it may be useful to note what they comprise, as dealt with in the following sections.

1. Incentives

The most fundamental incentive to undertake capability-building arises initially from the need to get into production. Any enterprise that wants to succeed commercially, and has the autonomy to do so, will launch the technological effort needed to master the new technology. This will happen regardless of the trade or industrial regime, the intensity of the effort entailed depending upon the nature, complexity, scale and novelty of the technology being utilized. However, the extent to which full mastery is achieved (the efficiency of operations *vis-à-vis* best practice elsewhere) and to which further capability investments (in raising efficiency, making adaptations and improvements, extending the scope of mastery, diversifying, expanding and innovating) are made will be strongly influenced by incentives arising in external markets and policies.

Of the external market conditions, two are given for a country: the size and location of its internal market, and the pace of technological progress in the relevant activities internationally. Others are partly given and partly determined by past and present government policies: the macroeconomic environment and growth prospects; competition in product markets, within domestic markets and from foreign producers (via imports and in export markets); factor prices and availability; and regulations on entry, exit, expansion or prices.

These market signals affect the profitability of investing in capability acquisition just as that of investing in new production capacity. A more predictable, high-growth environment is, *ceteris paribus*, conducive to larger investments in capability development, as is a faster rate of technological progress. Competition, domestic and foreign, is probably the most potent stimulus to capability acquisition, and competitive market signals can guide firms in their decisions on how much and what kinds of capabilities to invest in, along with the production capacities they choose to set up.

Artificial restraints on competition can restrict investments in capability-building, and can divert capability-building into channels that are not socially desirable. For example, highly inward-oriented regimes, with strong pressures to substitute local for imported raw materials, but little pressure to lower costs or raise quality of output, tend to induce firms to develop capabilities to make do with local inputs and not to upgrade technology or improve productive efficiency. Where growth is constrained, firms tend to operate equipment for much longer, and equipment stretching becomes a focus for technological effort. Where

market discipline requiring profitability is relaxed, as in some public enterprises, there is less incentive to develop difficult capabilities of process optimization or product development. Where factor markets are constrained or undeveloped, capability development can be stulified, with severe effects on productive efficiency.

For markets to provide correct incentives for optimal investments in capability-building, however, a number of conditions have to be met. These are the normal conditions for the working of efficient competitive markets in economic theory, and need not be spelt out here. What should be noted is that certain forms of market failure can constitute a valid case for government intervention. Interventions may be functional (designed to restore market efficiency without targeting any particular activity as beneficiary) or selective (designed to promote particular activities). Selective interventions (often, but loosely, referred to as "picking winners") can be aimed at domestic or international transactions, and the two can substitute for each other. A consideration of the correct role for interventions is thus clearly a vital part of the formulation of policy related to industrial and technological development, and is taken up below.

2. *Capabilities*

The capability of enterprises to respond to incentives depends on the availability of adequate infrastructure, financial resources (for physical and capability-building investments), capital goods of the right type at the right price, a network of industrial suppliers, consultants and service firms to permit efficient specialization and provide necessary inputs, a supply of requisite skills on the labour market, flows of information from domestic and foreign sources, and a technological infrastructure that provides standards and essential support for technological activity. These permit the individual firm to complement its physical investment with two things: first, the in-house creation of additional skills among its employees; and second, the undertaking of technological efforts to collect, assimilate and deploy new information.

Of the various factors mentioned, there is little need to discuss the provision of financial resources, infrastructure, or access to capital goods, as these are well covered in the literature. The central role of an education and training system that provides for adequate skills for industrial development is also well known, but a few points need to be noted in this context. First, while primary and secondary education provides a broad base of skills which can be developed, by experience and training, into shopfloor labour skills, these need to be boosted by further formal technical education as the technologies employed grow more complex. Even "simple" industries, such as textiles, leather or food processing, have requirements for certain high-level technical skills to achieve and maintain competitiveness. These requirements rise with more

complex process industries, such as cement, paper, chemicals or basic metals. They reach even higher levels with advanced engineering sectors such as electronics or heavy machinery, where product design as well as process optimization are extremely demanding. Thus, every industrializing economy has a certain level of demand for formal engineering and technical skills; with structural transformation this demand grows rapidly.

Secondly, the demand for high-level skills is specific to the activities being set up. There is some transferability of skills, but this has limits (industrial engineers can work in almost every industry, but a textile engineer cannot work on electronics design). The specificity of skills is likely to rise with the sophistication of the industrial structure, as more specialized disciplines are required. The current trend of technological progress also seems to imply that an increased input of science-based (rather than only engineering-based) skills is needed over time to retain competitiveness.

Thirdly, formal education and training need to be strongly backed by in-firm programmes for further training. These can take several forms - on-the-job, formal instruction, courses outside the firm, attachment to equipment suppliers, "twinning" arrangements with foreign experts - most of which require costly investments by the firms concerned. Again, the need for such investments is low in simple activities, and rises with the complexity and pace of technical progress of activities.

Finally, there is a strong risk of market failure in the provision of skills at each stage. Primary and secondary schooling are generally accepted as a major responsibility of the State in developing countries because of the likelihood of underinvestment by individuals (and equity considerations). The quality and content of education need monitoring at all levels. The specificity of high-level skills may involve intervention when the education system does not possess the information or resources to provide for the future needs of industry. Firms may underinvest in employee training because of the risk of not being able to appropriate the rewards of their investment. The fact that such problems are felt acutely even in highly industrialized countries like the United States of America or the United Kingdom of Great Britain and Northern Ireland ([15], [21]) indicates the greater risk of inadequate skill creation in developing countries.

The industrial success of the East-Asian newly industrializing countries* (NICs) is clearly linked to their capability development based

*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.

on large investments in education and training [18]. Not only did the "gang of four" (Hong Kong, Republic of Korea, Singapore and Taiwan Province) start their modern industrial drive (around the mid-1960s) with a higher stock of educated workers than most developing countries (with the exception of Argentina); they also expanded their education systems faster than most (see table 2). By the mid-1980s, secondary school enrolments in the Republic of Korea and Taiwan Province were practically at developed country levels, and enrolments in tertiary-level science and engineering fields and in vocational training, as a proportion of the population, were significantly ahead of other industrializing countries. Moreover, drop-out rates were relatively low in East Asia, and the quality of instruction (at least at the school level, as gauged by international comparisons of mathematics and science scores) was relatively high. Employee training was strongly promoted in the Republic of Korea, Singapore and Taiwan Province, and the technical bias of education was further directed towards areas of specialization felt by the Government to be in the dynamic comparative advantage of the country or area.

The gang of four differed among themselves in their skill-creation strategies. Those that guided their industrial structures towards complex and demanding activities (see below) had to invest correspondingly more in high-level technical training. Thus, the Republic of Korea had the highest ratio of the population in secondary and tertiary education, and in science and engineering within tertiary education. Singapore and Taiwan Province lagged in overall secondary and tertiary enrolments, but matched (or exceeded) the Republic of Korea in science, mathematics, computing and engineering enrolments. Hong Kong followed the least interventionist strategy in terms of deepening its industrial structure, and faced correspondingly smaller demands on its technical education and vocational or employee training systems.

In contrast to the technical skill-creation strategy of East Asia, countries like Brazil and India, with large industrial sectors, invested relatively little in technical education and training at all levels. In conjunction with inward-looking industrial strategies and various forms of intervention within the economy,* this seems to have led to lags in capability development in large areas of industry. These gaps were particularly evident in small- and medium-scale enterprises - large-sized firms were able to attract sufficient technical talent, even if they did not always use it effectively.

The other aspect of capability determination that deserves note is that of the technological infrastructure and technology policies. The technological development of individual enterprises does not take place

*On Brazil, see [24]; on India, see [25].

Table 2. Indicators of human capital investments

Indicator	Hong Kong	Republic of Korea	Singapore	Taiwan Province	Brazil	India	Indonesia	Kenya	Mexico	Thailand
Percentage age group enrolled										
Primary education										
1965	103	101	105	97	100	74	72	54	92	78
1985	105	96	115	109	104	92	118	94	115	97
Secondary education										
1965	20	35	45	36	16	27	12	4	17	14
1985	69	94	71	91	35	35	39	20	55	30
Tertiary education										
1965	5	6	10	7	2	5	1	0	4	2
1985	13	32	12	13	11	9	7	1	16	20
Number of tertiary students per 100,000 population (latest year)	1 410	3 606	1 486	2 888	1 140	776 a/	600	114	1 508	1 998
In GSE b/ (thousands)	36	585	22	207	535	1 443	235	12	563	360
Year 1984	1987	1985	1984	1985	1980	1985	1985	1986	1985	
As percentage of population										
Total	0.67	1.39	0.89	1.06	0.40	0.21	0.14	0.07	0.70	0.66
Urban	0.72	2.02	0.89	1.36	0.57	0.97	0.53	0.30	1.02	3.90
Number of students in SMSE c/ (thousands)	27.5	330.6	16.2	151.7	325.3	1 289	137.3	4.8	336.9	n.a
As percentage of population										
Total	0.51	0.76	0.73	0.78	0.24	0.19	0.09	0.02	0.42	
Urban	0.55	1.10	0.73	1.09	0.34	0.86	0.33	0.12	0.59	
Number of students in engineering only (thousands)	31.1	227.6	15.4	128.7	164.6	397	109.5	3.3	281.8	n.a.
As percentage of population										
Total	0.41	0.54	0.61	0.68	0.13	0.06	0.07	0.02	0.35	
Urban	0.42	0.78	0.61	0.85	0.17	0.27	0.27	0.08	0.50	
Number of students enrolled in vocational training (thousands)	31.7	814.5	9.4	404.6	1 481	397.7	1 061.3	7.8	853.6	388
Year	1984	1986	1984	1984	1985	1981	1986	1985	1985	1984
As percentage of population of working age	0.86	3.06	0.54	3.34	1.03	0.07	1.16	0.08	2.0	0.96

Source: World Bank, *World Development Report 1988* (Washington, D.C. 1988); United Nations Educational, Scientific and Cultural Organization, *Statistical Yearbook 1988* (Paris, 1988); Government of Taiwan Province, *Statistical Yearbook of Republic of China 1988* (Taipei, 1988) and *Educational Statistics of Republic of China 1984* (Taipei, 1984).

a/ 1980

b/ General science and engineering fields: natural sciences, mathematics and computer science, medicine; engineering; architecture; trades, crafts, transport and communications; and agriculture, forestry and fishery.

c/ Natural sciences, mathematics and computer science, engineering.

in isolation, but in a dense network of information flows between them and other enterprises (competing or vertically linked), consultants, equipment suppliers and a variety of institutions that provide standards, quality assurance, testing, research or other forms of information [13]. Many of these relations are market-driven, though, as noted above, firms themselves have to establish interlinkages designed to strengthen information flows that the textbook competitive market does not provide (however, the strength of these linkages depends, to some extent, on government policies to promote subcontracting, technology diffusion and small enterprises).

The role of interventions in the science and technology infrastructure is widely accepted. There are several activities in the "technostructure" (the term is taken from a very useful paper by Tassey [26]) that have public goods characteristics. Their benefits are, in other words, difficult or impossible to appropriate privately, and a competitive market will not provide them adequately (or they may be partially internalized by the largest firms and denied to smaller ones). Such activities relate to the provision of technical standards and metrology, "lumpy" testing and quality assurance facilities, collection of information on sources of technology, performance of basic (precommercial) research or even the performance of R&D that is too large or risky for enterprises in a given context. These functions have to be launched or performed by official institutions, and the historic experience of the industrialized countries illustrate how large a role the State played, in varying forms, in meeting these needs ([14], [15], [27]). Once they become fully institutionalized, the provision of technostructural services may no longer be seen as interventions, and may be taken for granted as a part of efficient markets. However, in countries where the technostructure is weak or non-existent, the need for intervention is very evident: in the absence of interventions, the development of enterprise capabilities can be badly hampered.

Technology policies refer to the internal needs for diffusion and technostructure as well as to the transfer of technology from abroad. In most developing countries, it is the latter that traditionally attracts most attention. Technology transfer can take many forms, from wholly internalized ones (wholly owned subsidiary in foreign direct investment) to fully-arm's-length ones (licensing or consultancy), and from formal (contractual) to informal (migration, imitation). The market for technology differs in several respects from commodity markets. Part of the difference resides in the inherent difficulty of valuing the product, and in the unequal distribution of knowledge between buyer and seller. In developing countries, this is exacerbated by the inadequacy of buyer skills and knowledge in both buying and implementing technologies. Moreover, different modes of technology import have different requirements of buyer capabilities and differing impacts on the future growth of those capabilities. When starting from a position of imperfect or missing markets, high transaction costs, undeveloped capabilities and

dynamic learning potential, developing countries often perceive a case for intervention in the transfer process.

Given the external environment, technostructure provision and technology transfer arrangements, the development of technological capabilities by the individual firm will depend on the nature and effectiveness of its own technological efforts. These efforts can be stimulated by incentives related to technological activity (for example, tax incentives for R&D), but in essence they depend on the firm's perceptions of the rewards of technological effort, its access to resources to finance that effort (internally or from financial markets), its attitude to risk, and its possession of, or access to, the specialized skills needed.

These depend, in turn, on firm size, market structure, the levels of capital and skill, market development, the pace of technical change, the appropriability of returns, past experience of technological effort and the macroeconomic environment. In a seminal paper, Arrow [28] noted the risk of private underinvestment in technological activity where loss of appropriability was a threat. That risk may be increased by deficiencies in financing or support mechanisms for technological effort, the presence of competitors who have already undergone technological learning, lack of information on the requirements or availability of skills, or a lack of appreciation of the nature of technological effort (the learning process may itself have to be learned [29]. Some of the causes of market failure are external (capital market deficiencies, poor technostructure, poor information or skill provision), and have to be tackled at source. Others are internal to the firm (risk perception, lack of appropriability, "learning to learn", inadequate size) and can only be tackled by measures to promote or subsidize technological investments at the firm level.

The East-Asian NICs have undertaken different sets of policy measures to promote their internal technological efforts. Table 3 sets out data on formal R&D by the Republic of Korea, Singapore and Taiwan Province (Hong Kong does not collect such information), and compares it to other developing countries and areas and Japan. R&D does not capture the whole range of technological effort, but it is the only activity on which comparable data are published. Total R&D includes spending on defence, agriculture, infrastructure etc.; thus, data on R&D in the productive sector, and, more particularly, financed by productive enterprises, are more relevant to manufacturing industry. The Republic of Korea emerges with a very large lead. R&D financed by productive enterprise as a proportion of gross national product (GNP) is three times larger than that of Taiwan Province, and 19 times larger than that of India or Brazil. This reflects the "heaviness" of the industrial structure promoted by the Government and the high level of reliance on national ownership (discussed below). It also reflects the effort needed to achieve export competitiveness in high-technology activities (in comparison to the high-technology but more protected industries of the large Latin American countries and India). The Government of the Republic of

Korea provided various incentives to firm-level R&D, and supported it with a large public science and technology infrastructure and the creation of technical skills. However, the main impact of government intervention in the Republic of Korea was probably less direct: it was the heavy-industry push, spearheaded by its giant conglomerates (the *chaebol*), with indigenous technology playing the lead role, that caused the unprecedented growth of R&D in the private sector. The setting of export orientation and domestic competition, but with a protected domestic market to cushion the initial costs of technological development, provided the incentives for such a strategy to work.

Table 3. Formal technological effort in selected developing countries and Japan

Country or area	Year	Total R&D	R&D in productive sector	R&D financed by productive enterprises	Scientists and engineers in R&D per million population
		(Percentage of GNP)			
Japan	1985	3.5	2.4	2.7	4 569
Republic of Korea	1987	2.3	1.5	1.9	1 283
Singapore	1984	0.5	0.2	0.2	960
Taiwan Province	1986	1.1	0.7	0.6	1 426
Brazil	1982	0.7	0.2	0.1	256
India	1984	0.9	0.2	0.1	132
Indonesia	1984	0.3	..	..	152
Kenya	1975	..	..	..	20
Mexico	1984	0.6	0.2	0.005	217
Thailand	1985	0.3	..	0.04	150

Sources: United Nations Educational, Scientific and Cultural Organization, *Statistical Yearbook 1988* (Paris, 1989); Government of Taiwan Province, *Science and Technology Data Book* (Taipei, 1987); Ministry of Science and Technology, *Indicators of Science and Technology* (Tokyo, 1986); Ministry of Science and Technology, *Introduction to Science and Technology* (Seoul, 1988).

In sum, the widespread risk of market failure means that the creation of skills, provision of technostructure, transfer of technology and the undertaking of technological effort can all suffer if left entirely to market forces in developing countries. The interventions called for may be functional, applied unselectively to all activities, for example, primary and secondary education, some forms of general training, basic technostructure and some broad-based support for technology import and

generation. Or they may be selective, directed to the development of specific technologies. Functional intervention is unlikely to be sufficient because different activities differ at any point of time, in their needs for support, and intervention resources are limited. Some are mature or relatively undemanding; others are new, complex and relatively risky (in relation to existing activities and capabilities). These differences then call for selectivity, for example, gearing educational structures to creating specific new skills, providing specific forms of worker training, setting up support systems or institutions for particular technologies, or promoting enterprise-level skill and technological effort in particular activities.

It should be noted that selectivity encompasses measures aimed at factor as well as at product markets. There are many possible levels of selectivity, and many possible instruments for selective intervention. A Government may decide to promote the electronics industry in general, or one branch (consumer electronics), one set of products (television sets), one specific technology (high-definition television) or one selected producer for that product. It may use a range of instruments: from the most general, such as the training of electronics engineers, setting up an R&D structure for electronics, or imposing a flat *ad valorem* tariff on electronics imports, to the highly specific, such as subsidizing, protecting or providing technical support to a particular product or producer.

The correct choice of the form, level and instrument of intervention depends on the nature of market failures. It also depends on the information available to the Government, its capability to act on that information and its flexibility in correcting mistakes. Clearly, political as well as economic factors affect government capabilities to intervene in particular ways, functionally as well as selectively. The fact that some Governments of developing countries have intervened selectively with success is not in question ([18], [30], [31], [32]). What seems to arouse debate is the ability of other Governments to undertake similar interventions. Current knowledge of political economy does not allow to predict that this will not work on a priori grounds. Certainly different countries will have different constraints, but the need for interventions to support capability is so strong that to dismiss it (in a blanket sense) may be highly counterproductive [31]. Issues of government failure have to be addressed directly and on an empirical basis. All governments cannot be assumed to fail all the time.

3. Institutions

Institutions are defined narrowly for present purposes. They include (apart form legal rules of the game within which economic units function) the entities set up to remedy the deficiencies of competitive markets in promoting development. Some institutions emerge naturally in response to market failures, either as profit-seeking private enterprises or as

cooperative efforts by the parties affected by the failures. Thus, deficiencies in information flows may lead to the development of private consultants or intermediaries. In other areas, they may be compensated by information-gathering and -disseminating facilities set up by industry associations. Or some enterprises may grow in size to internalize the relevant market (transnational enterprises are now regarded as this sort of response to failures in international technology and skill markets).

There will nevertheless be many cases in developing countries where such a market-driven solution will either not appear (because the benefits may be inappropriable by private agents), or may take too long to occur. Institutions may then have to be created by the State, though they may function autonomously thereafter. Institutions to provide, for instance, development finance or venture-capital marketing (export) information, technical extension, standards, testing facilities etc. are generally launched by Governments, the most successful ones acquiring an independent status with primary emphasis on technical excellence. The East-Asian NICs have intervened extensively to provide institutional support for various aspects of industrial development, and those interventions have been partly selective because particular sectors or technologies were often selected for promotion.*

4. Interaction of incentives, capabilities and institutions

It has been argued here that technological development is the result of the interaction of three broad sets of factors; one set by itself cannot produce the sustained growth which leads to industrial success. Providing correct incentives may lead to static benefits but not, as the "new growth theory" argues, to dynamic growth, unless there is continuous accumulation of capabilities. Lucas, one of the leading exponents of this theory, argues that neoclassical theory does not (despite the central argument of what is now regarded as the neoclassical approach to development) lead to the conclusion that "the removal of inefficient trade barriers [will] induce sustained increases in growth rates. Removal of trade barriers is, on this theory, analogous to the one-time shifting upwards in production possibilities, and not a growth effect. The empirical connections between trade policies and economic growth that Krueger and Harberger document are of evident importance, but they seem to me to pose a real paradox to the neoclassical theory we have, not a confirmation of it" ([35], pp. 12-13, emphasis added).

Lucas' own explanation of development is technology, which he defines as "human capital", or the "knowledge of particular people" (rather than the potentially usable stock of knowledge in existence which, under

*On the Republic of Korea and Taiwan Province, see [32], [33] and [34].

neoclassical assumptions, is perfectly transferable across countries). Lucas' simple theoretical model, elaborated to make human capital accumulation "specific to the production of particular goods, and acquired on-the-job or through learning-by-doing", is easily amenable to the interpretation given here. Incentives provide conditions in which learning takes place, and "healthy" incentives conduce to the accumulation of competitive capabilities. In this sense, export orientation may turn out to have dynamic as well as static benefits. However, the realization of these benefits needs continuous human-capital creation (by addition to skills and technological effort); otherwise the learning process grinds to a halt. At the same time, the creation of human capital without appropriate incentive or market-supporting institutions can lead to slow-down or to "low-quality" growth, with resulting capabilities unable to produce dynamic industrial performance.

Lucas' theory needs further qualification to take account of market failures. Keeping to the precepts of neoclassical theory, free markets may fail to provide correct incentives in the presence of dynamic and unpredictable learning (or "learning-to-learn" effects), technological and other externalities, or capital market failures. They may not induce adequate capability-building because of failures in skill and technology markets. And they may not produce adequate institutional remedies to many of these failures. There are thus arguments for policy intervention, selective and functional, in each of the three determinants of technological and industrial development.

The experience of the East-Asian NICs (and, earlier, of the OECD countries) illustrates the multiplicity of successful outcomes that can result from different forms of intervention in incentives, capabilities and institutions. At one extreme is Hong Kong. With *laissez faire* trade policies and a stable (colonial) administration, a strong education system, excellent infrastructure and a unique historical background (long trading experience, influx of textile entrepreneurs and technicians from China, a large presence of the United Kingdom of Great Britain and Northern Ireland in trading companies and banking), the Government of Hong Kong provides extremely efficient support for its exporters in the form of information collection and facilitating contacts with buyers, and some selective support for its textile firms in the form of training and design institutes. At the other extreme is the Republic of Korea, with a legacy of highly interventionist policies in trade, domestic resource allocation, conglomerate support, skill and technology creation and institutional development. In between are Taiwan Province and Singapore.

All four are highly successful export-oriented economies, and in this sense "got prices right". But they addressed different market failures in different ways, with differing results. Hong Kong remains specialized in a relatively narrow range of light consumer goods, with relatively low domestic content in terms of components, equipment or technology (except for final product design). Its strength lies in excellent production

management, quality control and product adaptation (all relatively "easy" functions) in relatively simple industries. The Republic of Korea has moved into a wide spectrum of industries, from light to heavy, and simple to high-skill and technology-intensive. In most of these, it shows an impressive degree of local content of physical and skill inputs, technology and equipment. The differences in the degree of industrial deepening, capability development and institutional support can be traced largely to the nature and extent of government interventions in the three determinants of technological development ([30], [32], [33], [34]).

There is, in sum, the potential for multiple solutions depending not just on initial conditions and physical factors, but also on strategies adopted with respect to correcting market-based incentives, capabilities and institutions. The same set of international prices, technologies and skills can be tapped in different ways, with different consequences for industrial and technological development. Received theory does not provide the tools to judge, a priori, which strategy is superior or which combination of market failures has the most constricting effects on development.

It may provide even less guidance in a setting of rapid and widespread technical change, as at present, which calls for a "paradigm change" in the productive system, with new organizational forms, new technologies, different skills, shifting location patterns, and advanced support needs from physical and technological infrastructures [36].

C. International dimensions of technological development

1. Trade strategies

It is now generally accepted that export-oriented trade strategies are superior to inward-oriented strategies in terms of their growth and industrialization effects. Traditional economic theory provides a strong basis for the static (allocative) benefits of specialization according to comparative advantage. Recent analysis has added other benefits: healthier capability-building effort, reduced rent-seeking (or directly unproductive) activities, greater exposure to international technological trends and free inflow of knowledge via export activity, more sustained capacity to import equipment and technology, socially desirable forms of foreign direct investment inflow etc. Empirical evidence, by and large, supports the case for outward orientation ([17], [37]).

The earlier analysis suggested that the effect of export orientation on the nature and depth of technological development is more complex than much of the literature has portrayed. There are different kinds of export orientation, each offering neutral (or somewhat pro-export) incentives across manufacturing activities. Some are "liberal" (like those of Hong Kong), with very little intervention in import and export transactions, and

with current market-determined prices providing incentives for resource allocation (for investment in capabilities as well as physical assets). Others are more "neutral" (like those of the Republic of Korea), with considerable intervention in trade and domestic resource allocation, but with export incentives and other measures designed to offset the inward pull exerted by the intervention. There has been an unfortunate tendency to confuse the two, and to identify export orientation in general with liberal regimes, not just in trade, but with respect to capital and technology flows, domestic industrial policy and interventions more generally. Similarly, and also mistakenly, there has been a tendency to confuse all forms of selective intervention (to overcome market failures) with the haphazard and uneconomic forms of intervention practised under "classic" import substitution by most developing countries. The failure of the latter does not necessarily affect the case for the former.

In the strict definition of export orientation (neutrality of incentives between domestic and foreign markets), there is no necessary logical connection between neutrality and liberalization. As argued above, there is also little empirical connection. The Republic of Korea has been one of the most highly interventionist economies in the developing world, and the content of its export orientation has been strongly influenced by the nature of its interventions ([10], [33], [38]). What implications does its success (and that of a number of competitive industries that have emerged in various countries from protected, interventionist backgrounds) have for the received theory of trade strategy?

As far as the underlying theory of comparative advantage goes, the implications are perhaps not very many. The neoclassical principles of the determinants and benefits of trade are rigorously established, once the premises are accepted. Free markets offer the ideal set of incentives for the maximization of national welfare (ignoring monopoly power in trade), if all markets function efficiently. Once market failures are admitted, however, valid arguments can be advanced for intervention. The argument for one form of intervention, infant industry protection of new activities, has a long and venerable history, and also a tradition of critical appraisal (Bhagwati [39] has a lucid and brief review). Despite a barrage of counter-arguments, the infant industry case retains theoretical and empirical justification, not under "classic" import substitution, but in the context of outward-oriented trade regimes. It may be useful to reiterate the major points at issue within this context.

First, the essence of the infant industry case is that current market prices do not provide the correct incentives for long-term resource allocation when there are unpredictable learning (or "learning-to-learn") sequences, capital market failures and externalities. Market forces may also not provide for adequate responses to incentives when there are failures in factor and technology markets. All these provide a case for intervention, but not all call for intervention in trade. The practice of import substitution seems to have relied on protection as the appropriate

policy instrument for all sorts of market failures that held back competitive production. However, a number of market failures call for selective or functional interventions that do not interfere with trade flows. As Bhagwati [39] suggests, the case for free trade does not entail lack of intervention in other markets: the case against protection is thus not a case against selective intervention in all forms. If the sources of high cost lie in the lack of adequate skills, deficient information flows or technological support, or other factor market failures, the granting of protection will do nothing to remedy this: correct interventions have to aim elsewhere, at the source of the market failure. Free trade can coexist happily with non-trade interventions.

Thus, the case for trade interventions has to be very carefully defined. To the extent that high costs are internal to the firm or activity and arise from inadequate investments in capability acquisition by firms, because they do not realize the benefits of such investments ("learning-to-learn" phenomena), because they are too small to finance the learning costs or cannot raise the finance elsewhere (capital market failure), because they exaggerate the risks (or apply a very high discount rate), because they cannot fully appropriate the returns of their investments or cannot correctly anticipate cost reductions in vertically linked agents (pecuniary and technological externalities [10]), there arises a case for intervention at the firm or activity level. One form of such intervention is protection against imports.

Secondly, even where a case exists for selective intervention at the firm or activity level to encourage, finance or coordinate investments in capability acquisition, it does not follow that protection is the best form of intervention. The trade theory literature argues that subsidies are preferable to tariffs or quotas because they do not carry the consumption costs of the latter. The case for subsidies is strengthened where the activity being promoted is a key input into other productive sectors; its protection can then have knock-on effects on downstream competitiveness (rather than only final consumption). This is particularly true of capital goods, where protection may lead not just to higher product costs, but also to technological obsolescence (capital goods are "embodied" technology to a greater extent than other products).

Thirdly, against the case for subsidies is the obvious argument that protection is much easier for the Government to finance (as John Stuart Mill put it a century and a half ago, a tariff is the "least" inconvenient mode which a nation can tax itself for the support of such an experiment"). Historical evidence shows that import protection was indeed very important in the early industrialization of all developed countries [29]. Consumption losses do not generally loom large in the policy making of most Governments, especially when (as in NICs) the dynamic benefits of learning and entry into new markets appear very large. The costs of protecting local capital goods producers, in particular, may well be offset in dynamic economies by the technological benefits

yielded by the close interaction between them and users, one of the most potent sources of innovation and diffusion [2]. High upstream costs of intermediates may be offset for competitive downstream industries by allowing exporters access to world-priced inputs, the strategy pursued by the Republic of Korea and Taiwan Province.

Fourthly, the evidence also suggests that the widespread doubts in the literature about the ability of Governments to intervene efficiently are perhaps overdone. The most egregious examples of misguided intervention and rent-seeking activity come from countries which did not practice economically selective intervention, rather than from those that used interventions coherently as a strategy to achieve competitiveness. The "classic" strategy of import-substituting industrialization did not intervene selectively or economically; that is, it did not gear interventions to providing protection to learning periods, and did not attempt to offset its costs by providing export incentives and tackling other market failures at source. Protection levels were haphazard, unrelated to the technology of the industry, and protracted indefinitely. Little competitive inducement was given to invest in capability-building, and accompanying interventions to provide skills, information and technical or marketing support were generally inadequate. These experiences, while illustrating the dangers of a certain style of intervention, are not valid criticisms of the ability of Governments to intervene effectively.

The information requirements of selective intervention should also not be overstressed. At early stages of industrial development, it is not difficult to assess what the next step should be because of the experience of the many countries that have gone before. Of the wide range of possible paths, the availability of capabilities and the cost of creating new capabilities can dictate a small set of feasible choices. It is at higher levels of development, when technological frontiers are being reached, that the problem of picking winners becomes narrower and more difficult. It is the highly developed countries, in other words, that face the greatest problems in practising selective intervention: they cannot "follow the leader". The Republic of Korea, by contrast, did very well by closely studying and emulating the model of Japan.

The main problems that remain are those of government competence and corruptibility. If administrative capabilities are very deficient, interventions of all kinds run the risk of waste. This applies to functional as well as selective interventions. But if the Government cannot provide effective additions to the skill or information base, or the minimum institutional basis for industrialization, free market policies are not likely to lead to successful industrial development (though it is plausible that they will be preferable to widespread intervention in these circumstances). The strengthening of administrative capability is thus necessary for industrialization regardless of the trade and industrial regime.

Corruptibility also affects the viability of all kinds of industrialization strategies, and clearly selective interventions run higher risks than

functional interventions. However, if selectivity is a necessary condition for entry into activities with costly and prolonged learning periods, the real choice lies in the degree of selectivity. Certain kinds of selectivity run fewer risks of "hijacking" by vested interests than others, and these are to be preferred even if they yield lower economic returns. It is possible to build in safeguards against hijacking, for example by strong incentives for exporting, by having clear schedules for reducing protection, and by closely monitoring the effects of policies (Westphal [38] has an illuminating analysis of the approach chosen in the Republic of Korea). Also, it is not clear that the absence of specific interventions *per se* will keep a corruptible State from indulging in other kinds of antisocial behaviour. The theory of the State is too undeveloped at the present stage for such large, important questions to be answered satisfactorily.*

2. *Technology import strategies*

Apart from trade in products, the most important aspect of a country's interaction with the rest of the world is its trade in information, skills and technical knowledge, broadly labelled "technology". In developing countries this trade is mostly in one direction, thus the focus of the present section on imports of technology.

Technology flows across national boundaries in many different forms. Some of these are, as noted earlier, informal: migration of skilled personnel, publications, students, seminars, trade fairs, visits etc. Until the late nineteenth century, most technology transfer was of this kind. Over time, a series of more formal methods of technology transfer evolved. These ranged from the highly "packaged", where the seller provided not just the technology but also finance, control, management and marketing on a perpetual basis, to the "unpackaged", where only one discrete element of the package was provided in a one-off transaction, often by specialized service firms that sold only information.

The United Nations Centre on Transnational Corporations [40] has classified the main formal modes of technology transfer in eight categories: foreign direct investment in the "classic" forms (with foreign control); joint ventures or "new forms" of foreign direct investment, where there is minority equity holding by the technology seller; licensing; franchising; management contracts; marketing and technical service contracts; turnkey contracts; and international subcontracting. The different modes of transfer have different costs and benefits, the precise configuration depending on the nature of the technology concerned, the strategy of the seller, the strategy and capabilities of the buyer and the policies of the country in question [41].

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*See Lall [16].

The nature of the technology affects both the composition of the sellers' market and the most efficient mode of transfer. The more advanced and recent the technology, the more monopolistic is its supply likely to be, and the more valuable its proprietary ownership to the holder (the innovator). Under these circumstances, the transfer of technology is likely to be internalized by the innovator in the absence of strong interventions by the Government of the buying country; in some cases, the technology may only be available in the form of classic foreign direct investment.

The nature of the technology also affects the efficient mode of transfer. All else being equal, the more complex and novel the technology, the more likely it is to require new skills to operate it. Such skills are best transferred by a lengthy interaction between the technical personnel of the parties involved, rather than one-off sales of blueprints or instructions or short-term formal courses ("show-how" is, in other words, the most effective means for transferring high-level skills when the necessary receptive base exists). Most of the modes of technology transfer mentioned can accommodate the extended training and "show-how" requirements of advanced technologies. However, where the receptive technological base is weak, where the technology is subject to continuous improvement, and where a mix of other skills (for example, management, marketing, finance) is required for operational efficiency, the most effective method of transfer may be classic or new forms of foreign direct investment. An ownership stake by the transferor provides a vital element of commitment that other modes lack.

The strategy of the seller affects the mode of transfer, given the nature of the technology market. Larger, more dominant firms can be more choosy and can insist on internalized (classic foreign direct investment) modes for their more valuable technologies. Smaller firms, with less of a transnational spread, may prefer less risky, externalized modes. Firms with narrower product concentration would prefer to internalize, while firms with a diversified range may be more willing to sell particular technologies at arm's length. Past experience of technology transfer can affect strategies. Firms that have built up transfer capabilities can spread themselves over different modes more easily, like the discriminating monopolist of textbook economics, while less experienced firms may stick to highly internalized modes (to retain control) or externalized ones (to minimize risk), rather than spread their operations rationally over the spectrum [42].

The buyer's strategies and capabilities have mixed implications for the choice of mode. The more capable the buyer, the fewer the elements of the technology package it needs, the stronger its bargaining position, the lower the transfer costs for the seller, and the greater the assurance of maintaining quality and reputation: all these make for lower costs, higher "quality" of purchase and more efficient absorption. However, the competitive threat to the seller rises with the capability of the buyer, and

may cause the seller to restrict access to more valuable elements of the package (unless the buyer could provide its own technology as a quid pro quo). An inward-oriented buyer would find it easier to buy technology than one which posed a credible threat in world markets. Highly capable, export-oriented buyers may find it as easy to buy mature technologies as others, but as they approach the frontier, they would find arm's-length purchase more difficult. They would then increasingly have to resort to joint ventures with technological leaders and to in-house R&D to catch up on their own. In the last resort, they may have to become junior partners in foreign direct investment by technological leaders. This is avoidable only if sufficient in-house technological skills and investments are created (the *chaebol* of the Republic of Korea are pursuing a combination of these strategies, but with a major stress on building their own technological base).

One of the major factors on the buyer side affecting the cost and content of technology transfer is the buyer's stock of technology-market information and bargaining capabilities. The fragmented, often oligopolistic, nature of the international technology market makes buyer information and bargaining skills a tremendous asset. The same technology can be sold at very different prices and on different conditions by the same seller, depending on the demands placed by the buyer. The ability to assess clearly what is needed, where the potential sources are, what is needed to accompany the contract, or how long the association needs to be, is a valuable asset for a technology buyer, and is acquired only with effort. The ability to buy technology economically is itself a hallmark of technological maturity, and world technology leaders trade technology extensively with each other (as explored for "technology alliances" by Mody [43].

The host Government can play an important role in the technology transfer process. Apart from its impact on the economic environment and the rules of the game within which the buyers operate, which obviously affects the incentive to buy technology and the effectiveness with which it is used, most developing-country Governments intervene directly in the process to improve the terms of transfer and control its content and direction. The fact that technology markets are fragmented and oligopolistic provides a good prima facie case for intervention, but different Governments interpret their roles very differently [41]. Some have minimal review and registration procedures, confining their interventions to promoting inflows of foreign direct investment and providing some information support to buyers (Thailand is a good example, see [44]). Others have very stringent controls: Brazil [24] and India ([25], [45]), for instance, intervene extensively in the technology transfer process, scrutinizing the duration and terms of agreements, stipulating foreign partners, domestic absorption efforts, subsidiary clauses and so on (Enos [46] has a comprehensive survey of the technology transfer literature on South-East Asia).

The more interventionist regimes in the developing world, the leading inward-oriented economies, have gone well beyond the selective and carefully deployed tools employed by such countries as Japan and the Republic of Korea. The latter policies* supported the technology purchasing capabilities of national firms and strengthened their bargaining position, enabling them to demand better conditions (deeper and broader knowledge transfer) from suppliers. They were conducive to domestic absorption and subsequent improvement of imported technologies, because in essence they placed national firms in a highly competitive (export-oriented) framework while providing sheltered domestic markets to cushion the risks and costs of learning. In such a setting, the interventions in Japan and the Republic of Korea did not constrict the inflow of technology or affect its "quality", but provided better information, secured improved terms, provided for greater "local content" (for example, enhanced use of domestic engineers and also local capital goods) and gradually lessened its scope as firms developed their own capabilities.

By contrast, the more interventionist countries overregulated the transfer process. While they may have succeeded in reducing explicit payments for technology imports, they probably reduced the quality of technology transfer by minimizing the involvement of the supplier, so curtailing the scope and depth of knowledge and training provided. As Contractor [41] has shown, technology suppliers have at their disposal several instruments for ensuring their revenues and cutting transfer costs. It is difficult for a purchaser to simultaneously increase the import of high-quality technology and cut its price: one or the other has to give.

Just as important is the fact that such regimes for technology imports were also highly interventionist in other ways. They were mostly "classic" import substituters, with a marked preference for bypassing market forces rather than strengthening them. Thus, national technology importers often faced highly protected domestic markets, limited domestic competition, meagre export incentives, strong pressures to increase local content and little inducement to upgrade quality, productivity or innovativeness. They were, as a result, often content to make do with the constricted technology transfer permitted by the regulations. The evidence suggests, for instance, that the relatively low-cost import of technology, with inadequate provision for upgrading, training or long-term capability-building, was preferable to Indian enterprises, though it fed into the vicious circle of forces that held back the growth of industrial competitiveness [49].

Ideal technology import policies should enable national enterprises to have full access to technological knowledge available abroad, help them to locate appropriate sources and bargains for the best terms, and ensure

*On Japan, see Nagoka [47], and on the Republic of Korea, see Enos and Park [48].

that the imported technology becomes an input into a continuous capability-building process (rather than a substitute for it). Only a part of these objectives are attainable by technology import policies *per se*. The rest can be achieved only by trade and industrial policies that are conducive to indigenous technological effort and the emergence of enterprises with the size and resources needed to absorb and build on imported technologies. These policies are not necessarily free market policies, but may incorporate carefully selected interventions to foster learning in export-oriented activities, to create an adequate skill base, to provide institutional support, and to promote large firms where the minimum economic size of technological effort is large, or where economies of scope are significant. As technology import becomes institutionalized, with private agents intermediating the provision of knowledge and firms themselves being more adept at purchase, the need for intervention declines. In the more advanced NICs, there is now little effective direct intervention with technology imports.

The above considerations apply mainly to technology imports in the form of contractual agreements by local firms, that is, where the transfer is "externalized" by the technology seller. Somewhat different considerations apply to the choice between such modes and "internalized" modes (direct investment with control by the technology supplier): the choice between licensing or turnkey contracts and foreign direct investment. Some of the relevant factors - nature of technology, sellers and buyers - have been noted above, but there is a larger issue at stake. Is there any strategic economic reason for promoting national ownership (thus relying on externalized modes of technology import), given that internalized modes (foreign direct investment) are often quicker means of gaining access to modern technologies, and that they can provide the whole package of skills and capabilities needed for achieving production with new technologies?

Many of the traditional arguments against foreign direct investment are often overdone. The decade of the 1980s witnessed a marked change in the attitude of developing countries in foreign direct investment inflows. Widespread debt problems, their own growing industrial maturity and confidence and the experience of some newly industrialized countries have induced a far more welcoming posture. Earlier fears of economic or political dominance, "excessive" profits, inappropriate technology or skill transfer, inadequate export performance and generally predatory and rent-seeking behaviour have been greatly muted. This is not due merely to the exigencies of the debt crisis and the evident failures of earlier industrial strategies in many developing countries, but also, and largely, to mounting evidence that foreign investors bring several advantages and respond efficiently to market signals.

In the technological area, foreign investors, especially the giant transnational corporations that dominate their respective activities in innovation, trade and production, can be highly efficient means of

transferring new productive knowledge. Given the right incentive framework, they can contribute to the training of local labour, dynamic growth and export diversification, competition in local markets and the stimulation of local suppliers. Nevertheless, the strategic reason for questioning their benefits arises from the possibility that they may contribute less than comparable local firms to technological development in the national economy. Several plausible grounds exist for this presumption, especially in countries with underdeveloped supplier, institutional, educational and technological structures: foreign investors may prefer to maintain established linkages with overseas suppliers and service firms rather than invest in creating strong local linkages; they may pre-empt activities in which local enterprises could, with some protection, establish a competitive presence; and they may transfer the results of technological activity undertaken abroad, but not the innovative process itself.

In the nature of the phenomenon, it is difficult to establish empirically what may have happened had foreign investors not been present and had the local government undertaken the necessary interventions efficiently. It is clear, on a priori grounds, that where learning costs are substantial and risks high (as with establishing local suppliers, building up advanced technological capabilities, or supporting local science and technology institutions), there can be a conflict of interests between the foreign investor and the host country. Cost minimization by the foreign enterprise calls for retaining established linkages and centralizing R&D, design and other advanced functions overseas, in countries with strong science and technology skills and infrastructures. The fostering of local capabilities in host developing countries can be costly, requiring greater commitment than market incentives may provide. In such circumstances, the free flow of foreign capital and the unregulated operation of foreign affiliates may lead to an inadequate development of local innovative capabilities. Transnational corporations may be very efficient transmitters of technological know-how (the results of innovation), but not of technological "know-why" (the innovative process itself), even when the potential for "know-why" development exists. Moreover, the possession of advanced technological capabilities by indigenous firms may have greater dynamic and spillover benefits over the long term than similar capabilities possessed by local affiliates of foreign firms, because it is more "internalized" by the economy than by the firm. These differences may matter less for more advanced host economies, but they may be significant for less developed ones.

The experience of the larger NICs suggests that the development of a strong local technological capability requires the explicit promotion of domestic enterprises at certain stages of development. Where simple production know-how is sufficient to sustain industrial growth and export success, foreign direct investment can play a very positive role; this

applies to early stages of industrialization. Once industrial development reaches the stage where deepening and diversification need continuously expanding "know-why", local innovative capabilities have to be promoted by various means, including restraints on foreign direct investment to promote local firms. The Japanese model, emulated by the Republic of Korea and Taiwan Province, illustrates how the deliberate promotion of domestic ownership can lead to strong and diversified technological capabilities, with widespread benefits for the entire industrial sector (see table 4). The Republic of Korea, in particular, restricted the entry of foreign investments, especially where foreign control was involved, in order to promote the capabilities of its national firms, led by the giant *chaebol*. Its relative independence evidently did not hamper the growth of its industrial capabilities. An overdependence on foreign enterprises for technological inputs, by contrast, may enable a host country to be an efficient producer, but the dynamism and linkages associated with this pattern may well be limited.

Table 4. Foreign direct investment stocks

Country or area	*Year*	*Stock (billion dollars)*	*Percentage of GDP*
Hong Kong	1985 a/	6.0-8.0	20-26
Republic of Korea	1987	2.8	2.3
Singapore	1986	9.4	53.8
Taiwan Province	1988	8.5	8.1
Brazil	1987	28.8	9.6
India	1984 a/	1.0-1.5	0.6-0.7
Indonesia	1987	7.9	11.3
Kenya	1984	0.6	12.0
Mexico	1987	19.3	13.6
Thailand	1986 a/	4.0-5.0	10.5-13.1

Sources: World Bank, *The Role of Foreign Direct Investment in Financing Developing Countries* (Washington, D.C., 1989) and *World Development Report 1989* (Washington, D.C., 1989); S. Lall, *Building Industrial Competitiveness in Developing Countries* (Paris, Organisation for Economic Co-operation and Development, 1990); and Ministry of Economic Affairs, *Statistics on Overseas Chinese and Foreign Investment* (Taipei, 1989).

a/ Estimated.

All modes of technology import are therefore not identical, and market failures in the creation of technological capabilities create a presumption, at certain stages of development, in favour of externalized

rather than internalized modes of transfer. The internalization of technology transfer can "truncate" the creation of local capabilities; its externalization, with adequate support, permits greater deepening of local capabilities. Such deepening does not occur efficiently merely by restricting foreign direct investment - it requires interventions to provide skills, institutional support, incentives for innovation and sufficient firm size and inter-firm coordination to reach the minimum economic size and critical mass. Nevertheless, there cannot be a uniform prescription for all countries, because the ability to utilize externalized modes of transfer differs greatly. Countries that lack the wherewithal to handle licensed technology efficiently would do better to opt for foreign direct investment. At the same time, the development of that wherewithal may require selective interventions to constrict foreign direct investment to build up local capabilities. The correct balance is difficult to define a priori, and in practice only a few countries have managed it.

D. Conclusions

The fact that a handful of developing countries have pulled away from the rest of the developing world in technological and industrial dynamism has formed the basis of much theorizing in the recent development literature. Much of this theorizing has been oversimplified, and has tended to underplay the incidence and impact of market failures in developing countries. This paper has suggested that reality is more complex, its complexity deriving from the variety of such failures, the range of possible remedies, and the differing abilities of Governments to implement those solutions. The variety of views on industrialization strategy that exists can be traced to differing assumptions and interpretations on each of these elements. One extreme position is that markets are highly efficient and that Governments are highly inefficient; the feasible strategies then boil down to minimal interventions. At the other extreme are views that markets are so prone to fail that massive interventions are needed, that Governments are capable of devising and implementing such interventions. Somewhere in between lies reality.

The experience of the four most successful NICs suggests that there is no single ideal strategy for technological or industrial development. Each strategy involves some measure of intervention. At the minimum, as in Hong Kong, these interventions are a mixture of functional (infrastructure, general human capital, information and technical support) and a few selective ones (creating specific skills in textile design, for instance). The degree of intervention and selectivity can rise greatly from this minimal model without becoming inefficient. Thus, the spread, dynamism and high indigenous technological content of industrialization in the Republic of Korea and Taiwan Province can be traced to the mixture of functional and selective interventions practised by their

Governments. There is no doubt that, in the technological sense, their achievements far surpass those of less interventionist NICs. At the same time, the selectivity of their policies also explains why their achievements also surpass those of more highly interventionist, but less economically selective, regimes in Latin America or South Asia, which have a longer history of industrialization.

Selective interventions are delicate tools, and much damage can ensue if they are used haphazardly and uneconomically. A great deal of administrative capability is needed to deploy them, and development thinking should address the problem of building such capabilities rather than emphasizing the universal desirability of non-interventionist markets.

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Technical change in Chinese industry: incentive systems

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The extent to which Chinese industrial enterprises pursue dynamic paths of technical change, and hence among other things exploit technology transfer projects to enhance their change-generating technological capabilities, depends on several aspects of their environment, in particular: government legislation focused specifically on technology transfer and technical change; the set of institutional structures in which they operate; and the structure of incentives they face. The present article examines the last-mentioned aspect of creating an environment conducive to technical change in China.

A. Incentives: concept and key issues

The concept of incentives involves two different issues. The first is concerned with incentives for the allocation of resources between different production activities and between different "technologies" (capital and labour) used in those lines of production. In market economies, the price mechanism plays the main role in inducing individual firms to make allocation decisions in ways that achieve short-term allocative efficiency objectives, while in centrally planned economies, allocative decisions are determined centrally in the light of a combination of "shadow" prices and various social and economic objectives.

The present article is concerned with the second issue, that of stimulating innovation and technical change through improvements in the efficiency with which inputs are transformed into outputs or through the introduction of new and improved products. The incentives to achieve such longer-term dynamic efficiency take two broad forms. The first involves elements of reward for increased efficiency and innovation. The second involves penalties for failure to generate change and innovation. These two types of incentive can be described as "pull" and "push" incentives (or carrots and sticks). In market economies, the pressure for competition constitutes the main push incentive (sticks), while profits, dependent on prices and reinforced by patent law and other intellectual

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property systems, constitute the main pull incentive. However, various forms of central intervention are commonly used to direct the course of objectives) or to increase the rate of investment in innovation to complement what would be achieved solely by the market system. In centrally planned economies, other kinds of incentive are needed to induce innovation and technical change.

B. Technical progress in centrally planned economies

Traditional socialist economic theory argues that the State represents the common interests of the whole society and thus sets common goals for all units of the society. Such reasoning is based on three assumptions. First, the State can ensure that resources are allocated properly to achieve the objectives of society. Secondly, the resources are used optimally. Thirdly, the national economy develops properly. The aim of the enterprise within the planned economy is thus to achieve the portion of the society's common goals assigned to it. Other objectives the enterprise might have are subordinate to the goals assigned to the enterprise ([1], p. 45). The ultimate goal of the planned economy is to achieve the highest possible standard of living for everyone in the society.

Derived from the search for ways of achieving the highest standard of living, the Marxist theory of economic development and social change indicates a strong emphasis on economic efficiency and productivity levels as key factors that decide the outcome of competition between different forms of organization of economic activity ([2], [3], p. 42). It is therefore reasonable to expect that high economic efficiency and productivity levels would be achieved in countries with centrally planned economies. Such levels would indicate a highly efficient utilization of resources and a dynamic process of technical change within those economies.

It has been widely accepted that the centrally planned economies sustained a reasonably high rate of economic growth over the three decades from 1950 to 1980. In terms of the growth rate of real gross domestic product (GDP), centrally planned countries fall into the mainstream of 72 countries surveyed between 1950 and 1980, with China ranking just behind the former German Democratic Republic [4]. Countries with centrally planned economies have also experienced rapid technical change over a long period of time. They compare not unfavourably with the leading industrial economies of the nineteenth (United Kingdom of Great Britain and Northern Ireland) and twentieth (United States of America) centuries in terms of growth rate of labour productivity [5]. Ellman's study ([1989], pp. 306-8) indicates that although they feature enormous wastage of resources and low efficiency (slow transfer, adoption etc.), countries with centrally planned economies (those of Eastern Europe, the former Union of Soviet Socialist Republics (USSR)

and China) fell into the international mainstream in terms of average growth rate of labour productivity between 1958 and 1968 [5]. It is interesting to note that above the international mainstream were, in Ellman's terms, the most dynamically efficient countries, such as Japan, the Republic of Korea, Sweden and France, and below it the least dynamically efficient, such as Chile, South Africa and the United Kingdom. Both the most and the least dynamically efficient countries were market economies. Another point deserving more attention is that China ranked at the bottom of the international mainstream, which means that its performance was rather poor. Thus, Ellman argues that the decision of the Government of China to embark on economic reform is entirely understandable, given the past performance of the country with respect to industrial labour productivity, which was below that of countries of Eastern Europe and the former USSR.

The implications of the above are twofold. The first is that central planning could possibly ensure a reasonably high rate of technical change, above that of the least dynamically efficient market economies. The second is that the rate of technical change in centrally planned economies seems to have an upper limit which is unfortunately below that of the most dynamically efficient market economies.

Although the centrally planned economies of Eastern Europe in general experienced rapid technical progress from the 1950s through the 1970s, the technological gap between them and the leading market economies seems to have remained undiminished. From the mid-1950s to the mid-1970s, the technological gap between the former USSR (perhaps the most technologically advanced of the centrally planned economies) and the leading market economies did not diminish, despite the significant efforts made by the former USSR in planning technical progress [6]. Centrally planned economies performed poorly in technological catch-up compared with technologically dynamic countries like Japan and the newly industrializing countries.* Worse still, the rate of technical change started to slow down in those economies in the late 1970s. The technological gap between them and the world leaders in technology seems to have remained as wide as ever [5], and the gap in the core civilian technologies - mechanical, chemical, electrical and electronic engineering - has not been reduced [7]. The experience (especially during the 1980s) of the countries of Eastern Europe and the former USSR has lent support to the argument that centrally planned economies are inefficient, hamper innovation, generate shortages and produce frequent market disequilibriums [8]. The decline of technological dynamism

*The term "newly industrializing countries" 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.

(innovative vitality, total factor productivity growth etc.) was obvious in those countries during the 1980s. Their slow diffusion of technological progress has also been noticed [9].

There have been various arguments about why the centrally planned economies performed poorly in research and development (R&D) and innovation. There is a major difference between the way industrial enterprises operate in centrally planned economies and in market economies. The difference ranges from macroeconomic factors such as rationalization of resource allocation, organizational structures and incentive systems, to micro-economic factors such as economic constraints on enterprises. It is this difference that has affected R&D and innovative activities in centrally planned economies.

Gomulka ([3], pp. 45-48) has pointed out several major characteristics in R&D and innovative activities in centrally planned economies. According to him, the financial incentives for innovation are weak. Although industrial R&D personnel have considerable freedom in their work, decision-making freedom and the resources available for enterprises to devote to inventions are severely limited. The time-lags involved in domestic invention and innovation are high, and the subsequent spread of innovations tends to be slow.

With regard to the micro-economic factors, it has been pointed out that enterprises in centrally planned economies and market economies operate under different constraints. Kornai [10] has made a distinction between enterprises in centrally planned economies and in market economies in terms of their budget constraints. Enterprises are termed hard-budget-constraint (HBC) enterprises if they are responsible for their own profit and loss. Enterprises are termed soft-budget-constraint (SBC) enterprises if they are able to obtain financial help from a superior or patron institution for survival. It is obvious that enterprises in centrally planned economies are generally characterized by SBC and those in market economies by HBC, although there are exceptions such as privately owned enterprises, in centrally planned economies and publicly owned ones in market economies. The difference in economic behaviour between SBC and HBC enterprises has a strong implication for technical change. More precisely, according to Hanson and Pavitt [11]:

> "The HBC enterprise has powerful and continuously operating incentives to increase sales revenue and economize on total input costs ....
>
> "The SBC enterprise, on the other hand, has much weaker incentives to increase revenue and economize on inputs. Both product and process innovation will therefore, other things equal, be treated as a much less compelling pursuit by the SBC enterprise."

It is clear that there is no life-or-death problem for SBC enterprises. There is no strong desire to innovate, or to gain a monopoly position in order to make supernormal profits. On the contrary, HBC enterprises have to innovate in product and production technology in order to sustain or create (temporary) monopoly profits, a process termed destructive disequilibrium by Schumpeter. Otherwise, the enterprise would cease to exist or lose its independence. Considerable attention has been drawn to the fact that lack of competition in centrally planned economies does not encourage entrepreneurial initiative to generate technical change. Technological stagnation in centrally planned economies looks inevitable. Whitesell's model indicates that although the economies like that of the former USSR can maintain a fairly static allocative efficiency, the high allocative efficiency is a direct consequence of the dynamic stagnation of such economies [12]. In contrast, the success of Japan since the Second World War exemplifies the opposite case [13].

C. Ideological and political foundations of central planning in China

As in other countries with centrally planned economies, planning has played a major role in the economic development of China since 1949. However, there are differences between China and Eastern European countries with respect to the economic basis for socialist construction. One of the major differences was the critical state of the national economy and human resources in the early stages of socialist construction in China. The other was that the Chinese revolution started in rural areas rather than in cities. Apart from those two differences, there are major differences between China and the countries of Eastern Europe and the former USSR in the way the national industry operates.

The way in which industrial enterprises operate in China differs in several respects from that of the countries of Eastern Europe and the former USSR. Granick points out four differences in the way the planned economy in China works for industry [14]. First, the Chinese system is distinctive in the extent to which trade between enterprises is conducted in markets equilibrated by price. From this Granick argues that the market in China is stronger than in any country of the former Council of Mutual Economic Assistance (CMEA), including Hungary. Secondly, the labour market is weak in China in both theory and reality. Thirdly, enterprises in China attribute much less significance to plans regulating their current operations than those in countries of the former CMEA (except Hungary). In China, overfulfilment is easier, but rewards are less closely linked, and supply allocations and labour recruitment quotas are not closely linked, to fulfilment of the assigned output targets. Fourthly, regional authorities in China possess more power than their counterparts in countries of the former CMEA. Moreover, China

allocated fewer goods centrally than the former USSR [15]. Byrd and Tidrick thus argue that enterprises in China enjoy a considerable amount of autonomy [16].

Another important difference is that the significance of technical change in economic development was realized at a much later date in China. Policy makers in the former USSR and the countries of Eastern Europe concluded, in about 1960, that economic growth could only be sustained by shifting emphasis from extensive growth (growth by increase of factor inputs) to intensive growth (growth by upgrading technology and improving total factor productivity) ([16], p. 60). The Government of China failed to perceive the full significance of the issue of technical change in economic development until the late 1970s.

In 1949 the Government of the newly established People's Republic of China inherited an underdeveloped country and a bankrupt economy in which modern industry accounted for just 10 per cent of gross national product (GNP) and the illiteracy rate was estimated at 90 per cent of the population ([17], [18], p. 104). That was the situation in which the socialist economy of China started. In other words, socialism in China did not evolve from an advanced capitalism as hypothesized by Marx. However, Mao Zedong, like Lenin, believed that the peasantry of an underdeveloped country could enter socialism without necessarily passing through the capitalist stage of development. But the resources (financial, technological and human) were scarce.

The economic thought of Mao Zedong was reflected in his attempt to educate the Chinese people to become selfless parts of a socialist society and to exert all their energy and skills in the development of that society, in accordance with the ideology that selflessness is the supreme state of mind, and that work is an essential part of life rather than just a way of making a living. In fact, it could be argued that Mao Zedong stressed the importance of the sense of fulfilment as the highest human aspiration. Once motivated and dedicated to the course of socialist construction, people were thus viewed as the determinants of economic development. The slogan was: "Of all the things in the world, people are the most valuable. As long as there are people, every kind of miracle can be created by the people under the leadership of the Communist Party."

Over the past 40 years, seven major forms of emulation campaign have been widely used to motivate employees to work hard for the well-being of the State ([19], pp. 140-141). Those campaigns were focused on the following: advanced workers; model workers; emulating, learning from, catching up with, helping and overtaking advanced units; small targets; workers in the same industrial branch; inter-factory emulation; and model industrial projects. Empirical studies show that non-material motivation does play an important role in Chinese industry. Among 20 factors influencing motivation, the "four-modernizations" programme is the fourth most important for workers, and the second for administrative and technical personnel. Increases in basic wages is the

first for workers, while responsibility and challenge of work is the first for administrative and technical personnel ([19], p. 145).

Another feature of the economic thought of Mao Zedong was the egalitarian distribution of income (ideally among all people). The ultimate purpose was to create and maintain a society in which people are equally rewarded and become better off at the same time. It could be argued that this egalitarian thought actually provided strong incentives to the general public, especially in the early 1950s, in their struggle to overcome the legacy of high unemployment, inflation, taxation etc., and helped to win the support of the majority of people. Researchers such as Cheng have argued that a reasonably egalitarian distribution was almost as important to Mao Zedong as economic growth [20]. The egalitarian idea was strengthened by the unified salary system introduced for the whole industrial workforce in 1956. Workers were classified into eight grades based on tenure and skills, with slight variations between branches. A similar salary system was also used for administrative and technical personnel. The salary spectrum was fairly narrow between the lowest and the highest in both systems. At the same time, the experience of economic development in the former USSR and the bitter memory of the contemporary history of China led the Chinese leaders to believe that a socialist planned economy and public ownership could lead to faster development and give a better life to all people than was possible under capitalism.

Such economic conditions, ideological factors and political aspirations provided the basis for the main stages of economic and political development that shaped the industries, management and productive activities of the country. A centrally planned economic system was established, covering financing and banking, organization of the workforce, the salary structure, price controls and distribution of supplies. This highly centralized system played an important role in economic development, especially in the early days, because it ensured that the limited resources were distributed as reasonably as possible, and that almost everyone was supplied with basic necessities.

The Government of China was determined to develop and coordinate the national economy by central planning. They believed that central planning could facilitate the effective use of the material, human and financial resources of the nation and eliminate resource waste caused by market fluctuations, and that a high rate of economic development could only be achieved through central planning [21]. Although it could be argued that the leaders of China essentially followed the example of the former USSR, the confiscation of private enterprises took much longer to complete and was much less violent. The Government pursued a strategy of gradual rather than sudden confiscation, jointly administering the enterprise with the private owner for a certain period of time as it was being taken over, with the owner receiving some compensation for several years afterwards. The institutional framework for a centrally planned

economy was completed with the incorporation of private enterprises into the State-run sector and the collectivization of handicrafts under individual ownership in collectively owned enterprises and of agriculture in communes. Thus, when the period of socialist transformation ended in 1956, a relatively complete central planning system had been established.

In terms of enterprise management, the central planning system of China has two features [22]. The first relates to State-owned enterprises, which operate under an administrative mechanism with no positive incentives to enhance performance, while facing enormous constraints from authorities at various levels rather than from within. It is claimed that under this mechanism, the long-term interest of the enterprise and of the whole economy can be easily maintained.

The second feature relates to collectively owned enterprises, which also operate without positive incentives, but the constraints are largely internal. Herein lies a major difference between this mechanism and the one for State-owned enterprises: the internal constraints mean that losses cannot be made up by the Government, and must be borne by the enterprise, that is, its employees. The collectively owned enterprises are also subject to planning, and provide roughly the same kinds of social welfare to their employees.

Defects in the system have been noticed since the mid-1950s. In 1956 Mao Zedong, in a famous speech on the "ten major relationships", highlighted the need to study and properly handle the relationships between the State, the producing unit (enterprises) and the producer (employee). He stated, in particular:

> "We must not follow the example of the Soviet Union in concentrating everything in the hands of the central authorities, shackling the local authorities and denying them the right to independent action."
>
> "It is not right, I am afraid, to place everything in the hands of the central or the provincial and municipal authorities without leaving the factories any power of their own, any room for independent action, and benefits [23]."

Mao Zedong's idea of reform seemed to contain decentralization of authority at two levels, that of central and local government and that of local enterprise. Although such an idea of reform is, to a large extent, in line with reforms of the 1980s, Mao Zedong seemed to focus on administrative reform.

Other Chinese leaders also had some ideas about how the economy should be run. For instance, in the mid-1950s Chen Yun, Vice-Chairman of the Central Committee of the Communist Party of China, commented thus on the Chinese economy:

> "In the production and management of industry and commerce, the mainstay will either be state or collective management, to be supplemented by a certain minor proportion of individual management. As regards planning, the bulk of the industrial and agricultural output of the country will be produced according to plan; but, at the same time, a certain amount of production will be carried out freely, with the changing conditions of the market as its guide and within the scope prescribed by the state plan. In industrial and agricultural production, planned production will be the mainstay, to be supplemented by free production carried on within the scope prescribed by the state plan and in accordance with market fluctuations. This kind of market under a socialist economy is in no way a capitalist free market, but a unified socialist market. In this unified socialist market, the state market is the mainstay, and attached to it is a free market of certain proportions under the guidance of the state. The free market is under the guidance of the state and supplements the state market. Consequently, it is a component part of the unified socialist market ([24], p. 59)."

The main defects (overcentralization and excessive egalitarianism) of the conventional system were widely perceived in the early stages of economic reform in the late 1950s and early 1960s, and structural reform was seen as essential for China's economic development ([24], pp. 60-62).

The economy was transformed to a planned commodity economy by the economic reforms of the late 1970s. The basic principles of the system are outlined in a decision of the Central Committee on reform of the economic structure, as follows [25]:

> "First, generally speaking the planned economy that we have implemented is a planned commodity economy, not a market economy that is completely regulated by the market. Second, in production and exchange, which are totally regulated by the market, the major labour tasks involve certain agricultural products, articles of daily use, and service and repair industries. These all play a supplementary yet essential role in the national economy. Third, implementing a planned economy is not equivalent to giving priority to mandatory plans. Mandatory plans and guidance plans are both essential to a planned economy. Fourth, guidance plans are primarily to be used as economic levers while command plans are compulsory, but they must also follow the law of value."

The economic and ideological foundations of Chinese industry having been considered, government policies and regulations on the

provision of incentives (rewards and pressures) to generate technical change in industrial enterprises are dealt with in the following sections.

D. Incentive systems for technical change

The issue of incentives for the generation of technical change must be examined in two distinct phases: the planned economy period up to the late 1970s; and the mixed economy period of the 1980s. During the planned economy period the Government focused on developing a system of pressures on enterprises to improve their performance. As discussed below, the pressures were not consistently applied over the years, and the specific criteria used in the performance assessments varied widely. Very few incentives based on reward were provided. In contrast, the mixed economy has been characterized by incentives based on rewards to both enterprises and individuals. Attempts were made to break down the reliance of enterprises on the State and of individuals on the enterprise, that is, to change SBC enterprises to HBC ones. A fairly complete system of incentives has been gradually established. However, limited pressures are exerted on enterprises for the generation of technical change.

1. Incentives in the planned economy: inconsistent pressures on enterprises

The concept of technical change was first discussed by the Government in the early 1980s, before which time there had been no clearly defined policy of the subject. However, this does not mean that there had been a lack of direct or indirect incentives to promote the generation of technical change.

The central planning system established soon after the founding of a new China in 1949 was intended to guide productive and business activities for the highest possible growth rate. To fulfil that purpose, the Government used mandatory technological and economic measures to assess the performance of industrial enterprises. For instance, between 1953 and 1957, the period of the first five-year plan, twelve measures were used to set up targets for enterprises. They were total production value, output of major products, new product experimentation, major technological and economic indicators, decreasing production costs, amount of decrease in production costs, total number of employees, number of employees at the end of the year, total payroll, average salary, productivity and profit ([26], p. 329).

It can be seen that at least three of the twelve mandatory targets measured by the Government, namely new product experimentation, decreasing production costs and the amount of decrease in production costs, were directly related to technical change. The first target would require technical change in product technology. The other two would

force enterprises to make changes in production technology, and perhaps in the management of production. Together with these three, the productivity target (production value per employee) and the profit target might also have put pressure on enterprises. The award for good performance served to acknowledge the efforts of the workforce in working for a better tomorrow. On the other hand, no explicit sanctions were provided for.

The incentive system described above was largely dismantled during the period of decentralization between 1957 and 1960. The number of mandatory measures was reduced to four: output of major products, total number of employees, total payroll and profit. The other measures became non-mandatory, and could be changed by enterprises according to their specific conditions ([26], p. 329). None of the other measures was linked directly to technical change. The linkage between profit and technical change, if there was any, would be rather weak, because the product mix was decided, the output predetermined, and input and product prices were fixed. The desire for profit maximization was virtually non-existent under those conditions. Although enterprises were given greater autonomy in their managerial and administrative decisions relating to personnel and property [27], there was virtually no pressure for technical change in enterprises.

It was not until the readjustment of 1960 that six mandatory measures were used: output, variety and specification of major products; production value and completion of contracts; product quality; major technological and economic indicators (consumption of major raw materials, equipment utilization rate, working hours); productivity; and the decreasing production costs ([26], pp. 329-330). Four of them, namely product quality, major technological and economic indicators, productivity and decreasing production costs, could lead to technical change. The targets especially concerned with major technological and economic indicators and decreasing production costs, if strictly implemented and constantly updated, would in principle force enterprises to devote considerable effort to technical change in production technology. Several types of monetary award were also tried between 1961 and 1965, and piece-work payment and bonus systems were established in many enterprises. An environment was thus created in which both pressures and rewards were part of a system of incentives for enterprises and employees.

The period of the Cultural Revolution (mid-1960s to mid-1970s) plunged the nation into chaos and brought the economy to the brink of collapse. The system of mandatory measures was virtually ignored, and the reward system completely broke down. Some western scholars such as Laaksonen ([18], p. 113) have described the Cultural Revolution as a fight between two ideologies about economic development when China was beginning to make headway toward a free-market economy. During that period, the Government somehow made limited efforts to maintain the growth of industry. In 1972, it put forward seven mandatory

measures relating to output, product variety, product quality, consumption of inputs, productivity, production costs and profit. Another mandatory measure (possession of floating capital) was added three years later ([26], p. 330). This set of mandatory measures remained in force until replaced in the programme of economic reform. It could be seen that only two of the eight measures could lead to the generation of technical change.

In reality, pressures ("push incentives") were applied through the Party administration during the planned economy phase. Employees were supposed to work as hard as possible. In many enterprises, a pattern of output was gradually established. The output rate and productivity level were fairly good at the beginning of the fiscal year, fell to low levels in the middle of the year, and then increased dramatically as the end of the year approached. But enterprises would survive anyway. No employee would be fired unless he or she committed a serious crime, because enterprises viewed as small societies should not transfer their "burdens" to the whole society. Hence, it can be seen that there was no HBC environment. However, incentives were provided to individuals for innovative activities before the mid-1960s. An official circular on rewarding invention, technical improvements and suggestions for rationalizing production was issued in 1950. Between 1950 and 1957, nearly 6 million suggestions were handed in by employees nationwide [28].

The above analysis of the incentives offered by the Government between 1953 and 1978 seems to indicate that they were push (stick) incentives and that the number and kind of mandatory measures that could lead to technical change were fairly inconsistent over time. Moreover, the Government failed to combine mandatory measures with monetary rewards, and incentives for technical change in general remained weak. The main reason for its failure seems to be that it underestimated the importance of technical change during the whole period.

2. Incentives in a mixed economy: an increasing variety of rewards for enterprises

The programme of economic reform, it could be argued, has gradually built up a system of incentives for technical change in enterprises. The process of reform in industry and the building-up of the incentives system have involved several steps. The first was to expand the autonomy to enterprises, the second to introduce the economic responsibility system, followed by the replacement of profit retention by taxation. The last was to implement the second step of the replacement of profit retention by taxation.

(a) Autonomy to enterprises: the enterprise fund

This step in the economic reform process began when the decree on certain regulations concerning enlargement of autonomy of business and management of State-owned enterprises was issued in 1979. It gave enterprises autonomy to manage some of their productive activities, personnel affairs, sales, the export and import of machinery and their own earnings ([26], pp. 330-331). In particular, enterprises could produce not only according to government mandatory plans and guidelines, but also in the light of market demands, and they were entitled to retain and use a certain percentage of profits as the so-called enterprise fund. This seems to imply the introduction of certain incentives for enterprises. However, the range of incentives was limited, because the Government required that the total amount of retained profit should be 6 to 11 per cent of the total payroll, which is fixed by the unified wage system.

The decree on the experimental method concerning profit retention in State-owned enterprises, issued in 1980, states that the enterprise fund is based on predetermined profit levels, and increases proportionally as the actual profit exceeds those levels. The Government put pressure on enterprises, and failure to implement any of the measures would lead to a 10 per cent reduction of the fund [29]. It could be argued, however, that although profit-seeking would provide some incentives for better performance, it would not necessarily stimulate technical change in the Chinese socio-economic context.

To supplement its effort to provide incentives, the Government promulgated its regulation on excellent quality products [30], which was clearly intended to encourage enterprises in their efforts to improve product quality. Although the only direct reward is the National Quality Award, a certificate of honour, the enterprise is given priority in the allocation of raw materials. More importantly, it can charge a higher price for its products, according to the circular of the State Council certifying and conveying the report of the State Price Bureau and State Economic Commission concerning further implementation of the policy of deciding the price of industrial products according to quality. A study by the China Economic Structural Reform Research Institute indicates that the difference could be as high as 5 to 15 per cent. This would provide a strong incentive for enterprises ([31], p.47).

It is clear that the main performance incentive offered was the "carrot" of the enterprise fund, and the only pressure for technical change as mandated by the Government was concerned with product quality. But even this limited incentive system was later weakened by the Government's own regulations. The temporary regulation on conducting and protecting socialist competition states that socialist competition is different in nature from capitalist competition, and is aimed at the well-being of society as a whole rather than profit maximization of individual enterprises [32]. However, this regulation was the first to officially

acknowledge the value of technology. It states that the transfer of major technological results should be accompanied by rewards.

(b) Economic responsibility system: preliminary incentives for technological development

Under the economic responsibility system introduced in 1981, the Government gave greater attention to the issue of technical change. Apart from stressing output, product quality, product variety, production costs, and profit, the Government required that enterprises should set up a production development fund from the profit retained, and that the growth rate of employee bonuses should be linked to production performance. This has been clearly stated by the State Economic Commission and System Reform Office, under the State Council, in comments on certain problems in carrying out the responsibility system of industrial production [33]. The incentives offered for this purpose are described below.

The purpose of the economic responsibility system is to clarify the relationship between enterprises and the Government by deciding the major issue of the way in which profit is distributed between them. Three methods of distribution are used. The first is profit retention, which basically means that the enterprise retains a certain percentage of total profit, or profit above a predetermined level. The second method is that enterprises are responsible for their own profit and loss, and must pay a predetermined amount of profit to the Government. The profit above that level is retained, and any loss will have to be made up by the enterprise. The third method is that the enterprise pays various taxes to the Government rather than profits, and is responsible for its own loss and profit. By each method, the more profit an enterprise makes, the more it can retain, with one restriction: the Government makes it clear that the State should acquire at least 60 per cent of the profit above the predetermined level.

It soon became clear that it would be very difficult for enterprises to sell freely and make profits under fairly severe constraints on output, selling price etc. To overcome this problem, the State System Reform Commission, the State Economic Commission and the Finance Ministry issued a report on certain problems in improving the current economic responsibility system, which stated that enterprises must be given the right to sell a certain percentage of their output (to be determined individually) [34]. The report suggested that enterprises that perform best in trade, are well managed and make substantial contributions to the State would be allowed a higher percentage, while poorly managed enterprises would have a lower percentage. Moreover, it emphasized that the production development fund and technological transformation fund should be used for the generation of technical change and new product

experimentation. This was the first time that a government regulation explicitly stressed incentives for the generation of technical change.

(c) Replacement of profit retention by taxation

The Government paid more attention to the issue of technical change in the phase of replacement of profit retention by taxation. It not only required the establishment of new product experiment funds and production development funds, but also regulated the percentage of the profit retained to be devoted to those funds. On one hand, this would ensure that sufficient financial resources were dedicated to technical change in varying amounts over the years. On the other hand, it provided clear incentives to enterprises. Moreover, the Government sought to reward individuals for better performance (better work, inventions etc.). The third stage of economic reform began with the introduction, in May 1983, of the experimental method of replacing profit retention by taxation of State-owned enterprises [35]. As the name suggests, its purpose is to change the method of profit retention by the State to a method of taxation. It requires that large- and medium-scale State-owned enterprises should pay an income tax of 55 per cent on their profit. Small-scale enterprises (with fixed assets of no more than 1.5 million yuan renminbi (Y) and an annual income of below Y200,000 as of the end of 1982) pay income tax according to eight progressive rate levels. The importance of the regulation is that it guarantees that enterprises retain more if they earn more, and requires that profits retained should be used to set up a new product experiment fund, a production development fund, a reserve fund, an employee welfare fund and an employee bonus fund. The regulation also states that the first three funds should account for at least 60 per cent of the total profit retained. It is now clear that the regulation provides a strong incentive to improve performance, with the emphasis on the long-term technological development of enterprises.

In addition, the Government has offered incentives to individuals, making it clear that reform of the salary system is moving in the direction of the so-called floating salary [36]. This is the first formal attempt to break up the unified salary system established decades ago. However, such attempts seemed to be restricted by other concerns. A simple preventive method was used by taxing the bonuses of individuals. A circular on relevant problems regarding bonuses in State-owned enterprises and a temporary regulation of bonus taxes on State-owned enterprises were promulgated in 1984 ([37], [38]). According to the temporary regulation, a rate of 30 per cent will be imposed on bonuses equal to salaries of 2.5 to 4 months, 100 per cent on bonuses equal to salaries of 4 to 6 months, and 300 per cent on bonus salaries of above six months (article 4). In principle, the monetary incentives to individuals are unlimited, but the high tax rates would act as a disincentive.

Nevertheless, the circular and the regulation state that bonuses and rewards for inventions, for reducing material consumption and for rationalization suggestions are exempt from the taxes. This clearly reflects the Government desire to foster technical change in enterprises.

(d) Second step in the replacement of profit retention by taxation

During this phase the Government focused on breaking down the reliance of individuals on the enterprise and that of enterprises on the State. It sought to make enterprises truly independent entities responsible for their own profit and loss, while the Government would be responsible for adjustment measures and supervision.

The process started in September 1984 when the decree on the experimental method relating to the second step in the replacement of profit retention by taxation of State-owned enterprises was issued [39]. An important feature of this method is that the profit-making enterprises will have to pay a profit adjustment tax at various rates, apart from the 55 per cent tax rate imposed previously. Profit above the predetermined level is exempt from 70 per cent of the adjustment tax. However, this method more finely regulates the percentages applied to the new product development fund, the production development fund and the reserve fund. It generally provides for 50 per cent of the retained profit above the predetermined level to be used on production development, 20 per cent on employee welfare, and 30 per cent on employee bonuses. Another important feature of the method is that it requires the enterprise to possess 10 to 30 per cent of the total finance needed for technology-related projects in order to borrow the rest. This would create some difficulties for enterprises that intend to conduct risky and innovative projects, which are generally costly.

Another important regulation issued during this phase was the Implementing Act of the Patent Law of China, the country's first patent law, promulgated in January 1985 [40]. Apart from general concerns, the law provides that the institution (enterprise, research centre etc.) holding a patent should award a certain amount of money (at least Y200 or Y50 in case of the exterior design) to the inventor or designer (article 71). It also provides that the patent-holding institution should allocate 0.5 to 2 per cent of the profits earned from the patent to the inventor or designer, or 0.05 to 0.2 per cent if the patent is of exterior-design-type, or should allocate a lump sum based on those percentages (article 72). It further provides that the inventor or designer should receive 5 to 10 per cent of the earnings made by other institutions using the patent (article 73). According to the law, all of the rewards are tax-exempt. They would certainly provide strong incentives to anyone who has the intention, the capability and the chance to invent something.

In line with its intention to provide strong incentives to individuals, the Government began taking steps to break down the system of dependence and restrictions. First it tried to remove the limitations on the salary system. In 1985 it issued a temporary regulation for adjustment tax on salaries at State-owned enterprises [41]. This regulation states that an increase of the total payroll above 7 per cent of the previous annual figure shall be taxed. The limit on total payroll imposed by the Government is therefore revoked, and enterprises can pay their employees for good performance as much as they can afford.

Then the Government moved to break down the reliance of employees on enterprises and that of enterprises on the State. In 1986 it promulgated a regulation and a law that were widely considered to be ground-breaking. The temporary regulation of work contracts in State-owned enterprises, states that the contract system shall apply to all workers recruited, unless covered by special government regulations [42]. It sets up standards for contractual workers, who may be dismissed if found not up to the standards. This regulation was supplemented by three other temporary regulations on recruitment, dismissal and employment insurance [43].

The Law of Bankruptcy of Enterprises applies to all State-owned enterprises [43]. Under its provisions, any loss-making enterprise that is unable to pay off loans because of poor management and business dealings will be declared bankrupt (article 3). The State offers protection (financial support) only to enterprises in the social services or of national importance. Thus, there seems to be an HBC environment for most enterprises. However, as will be discussed later, this environment has proved to be rather "flexible".

It seems that the Government thought that more regulations were needed in order to force enterprises to properly use the retained profit. The temporary regulation of financial problems of large- and medium-scaled State-owned enterprises in carrying out the contract responsibility system, issued in 1987, provides that in the case of profit retained in enterprises where the total payroll is linked to enterprise performance, 90 per cent of such profit should be spent on production and technological transformation, and that in enterprises where the total payroll is not linked to performance, at least 75 per cent of the retained profit should be used on production and technological transformation [44].

After issuing all the above-mentioned regulations concerned mainly with large- and medium-scale enterprises, the Government turned its attention to small-scale State-owned enterprises, and in 1988 the State Council issued a temporary regulation of lease of small-scale State-owned enterprises [45]. This regulation provides that such enterprises can be leased to individuals, a group of individuals, all employees in the enterprise, another enterprise etc. (article 7). It dramatically revitalizes the enterprises by cutting off almost all administrative linkages between them and the central authorities.

The only major regulation concerning collectively owned enterprises is the regulation of urban collectively owned enterprises promulgated in 1991 [46]. It specifies nine responsibilities that collectively owned enterprises are supposed to undertake (article 12), some of which have a direct impact on the generation of technical change in those enterprises. For instance, the fourth responsibility is "to improve business and management, to promote technical change and to improve economic efficiency". The fifth is to maintain product quality and service quality. The last is to improve the quality of the workforce by education and training, particularly in science and technology. These responsibilities seem to suggest that the Government is putting pressure on collectively owned enterprises to generate technical change in both its technological and its human aspects.

Most importantly, during the whole period of economic reform, the only source of pressure on State-owned enterprises seems to have been the Law of State-owned Industrial Enterprises, issued in the late 1980s [47]. This law vaguely states that enterprises should "promote technical change", "save energy and raw materials", "employ new technology and improve and update machinery", and "strengthen employee technical training". However, it does not provide for any concrete measures for achieving those ends.

The Government has clearly built up a relatively complete system of incentives which, despite potential weaknesses in the socio-economic structure of China, could be expected to generate some technical change in industry. In fact, this expectation is justified as far as concerns the Chinese automotive industry, which experienced substantial technical change during the 1980s. However, the HBC environment was quite flexible, for several reasons. First, bankruptcies have not been common, and have always drawn considerable attention. The first enterprise declared bankrupt was a small plant producing fire-extinguishing equipment at Shenyang, an event that caused much debate and concern in China. Six years later, the *People's Daily* still carried an article about how its former employees felt after the collapse of the enterprise [48]. Secondly, laid-off employees of bankrupt enterprises are usually paid 60 per cent of their basic salary after the shutdown. Thirdly, in many cases the enterprises are transferred to another administrative authority, and make other products. Finally, the Government subsidizes many loss-making enterprises, which is the case of about one third of all State-owned enterprises, according to estimates by western economists. For all those reasons, the number of enterprises that have been closed down and transferred amounts to only 1,729, of which 600 are State-owned [49].

During the period of economic reform the Government seems to have focused its attention mainly on incentives in the form of rewards rather than attempting to put pressure on enterprises. Although it could be argued that incentives alone would generate substantial technological dynamism in industry, government pressure could possibly play an equally

important role, for the following reasons. First, the national economy is a mixture of a planned and a market economy. In 1988, mandatory production quotas accounted for 28 per cent of total production on average. The Government allocated 30 per cent of all raw materials, while the enterprises were responsible for selling only 74 per cent of their output [50]. This implies that the enterprises are subject to certain constraints, and cannot operate completely on the basis of market demand. Secondly, State-allocated raw materials and semi-finished items are usually much cheaper than those available on the market, and the prices of some products are controlled by the Government. This would benefit enterprises with a higher percentage of inputs allocated by the State, leading to competition on unequal terms, with a weakening of the emphasis on technical change. If an enterprise earns a large profit with lower cost inputs, it would not feel a strong need to generate technical change. Thirdly, many enterprises are protected from international competition. In the case of passenger cars, for instance, the Government has virtually prohibited the import of foreign passenger cars, which are subject to a customs tax as high as 270 per cent. Finally, up to 1992, through the active intervention of various administrative authorities, enterprises could not operate freely, according to the Government of China [51].

E. Summary and conclusions

Government policies during the planned economy period were inconsistent in the exertion of pressure on enterprises to improve their performance and to meet specific quotas. Such pressure might have led to a slow process of technical change in enterprises, but there were limited incentives to foster such a process. The economic reform period enabled the Government to gradually introduce a relatively complete incentive system for the generation of technical change in industrial enterprises during the 1980s. The incentive system was mainly focused on rewards, on pull-type incentives, with only a limited effort being made to put pressure (push-type incentives) to generate technical change, mainly by diminishing their reliance on the State. Bankruptcies have been uncommon, however, and in practice the HBC environment has proved to be fairly flexible. It therefore seems essential for the Government of China to take steps to establish a complete incentive system which both offers rewards and exerts pressure for the generation of technical change in Chinese industrial enterprises. In other words, a harder-budget-constraint environment should be brought to bear on enterprises.

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Classification and dualism of the industries of China in the 1980s

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In development literature, dualism is defined as the dichotomy between a modern sector, in which workers are hired at an institutional wage in numbers that rise with the growth of the industrial capital stock, and a traditional sector, in which workers subsist at an income level that is somewhat below the industrial wage and that is linked to their average rather than marginal productivity ([1] and [2]). In such a dual economy, factor rewards will not equal either marginal productivity or opportunity cost, and factor reward divergences exist for the same factor used in different sectors.

According to this theory, the dualism between a capital intensive industrial sector and a labour intensive agricultural sector implies a misallocation of resources since more could have been produced through additional investment in agriculture and the use of less capital intensive technologies in the industrial sector. However, when the modern sector absorbs surplus labour from the traditional sector until the value of marginal product is equal in the two sectors, the dualism ends and the entire economy allocates labour and other resources according to the rule of equal marginal productivity of each factor of production across sectors.

The dualism of the Chinese economy has been identified in the English-language literature in a number of recently published papers (e.g. [3], [4] and [5]). Putterman [4] argued that China was a standard dual economy prior to the reforms and that this dualism was ended by creating a non-state, non-staple third sector. Zhang [5] examined the likely impact of the dualism on the country's production and international trade pattern. From these studies emerged some new insights into the research. For example, is the development of the third sector (basically rural enterprises) sufficient to end the dualism? What is its likely impact on the national industrial structure? More importantly, how did the emergence of the third sector generate economic efficiency and improve national welfare? Is there any potential for further improvement? Since no comprehensive study has provided clear-cut answers to these questions, this article is designed to fill the gap.

Applying an independent classification of 40 of the manufacturing industries of China, this article argues that the emergence of rural

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enterprises (the third sector) has improved the country's industrial structure but has not been strong enough to eliminate the dualism between a capital intensive urban sector and a labour intensive rural sector (the latter is involved in both agricultural and manufacturing activities). Therefore, further economic gains may be achievable should this "new dualism" be removed by encouraging factor mobility and abolishing price distortions.

In order to clarify the dualism of the industrial structure of China, section A explains the classification criteria and reports the main results of classifying 40 of the country's industrial branches by factor intensity. Section B adjusts the distorted data and reports the results of final classification. Section C uses the classification to examine the country's urban and rural industrial structure. Section D contains a summary of the article and concluding remarks.

A. Classification criteria and primary results

The classification of industries or commodity groups by factor intensity is straightforward if one can use competitive prices to measure free-trade factor intensities ([6], [7] and [8]). An industry census in China in 1985 provided sufficient information for this purpose. In that census, all industrial branches above the level of village enterprises were included; it was therefore quite representative of the industrial structure of the country.*

Various indicators can be used to measure factor intensities. Hufbauer [9], followed by Hirsch [10], estimated capital intensities by two indices, fixed capital per worker and a skill ratio. A high fixed capital per worker indicates a capital intensive industry and a low one, a labour intensive industry. Since capital stock rather than capital flow is concerned, this measure is useful for comparing not only the capital consumed but also the capital stock required in the process of production. The skill ratio is used as a surrogate for the innovative content of the goods manufactured. It can be estimated by the share of professional, technical and scientific personnel in the total labour force. The higher the ratio, the more intensive the human capital used in the industry.

A popular measure for classifying different commodity groups in terms of factor intensity is the value added per worker. Krause [11] first identified labour intensive goods as those with low levels of value

*Village and rural private enterprises were excluded from this census. This would, though not significantly, lead to an overestimation of China's capital intensity in industries. However, since village and rural private enterprises accounted for a relatively low proportion (less than 10 per cent) of national production in 1985, the bias would not be serious enough to reverse the classification result.

added per worker. This classification is the same as that used by Garnaut and Anderson [12].

In addition, the labour requirement per unit of value added (represented by labour share in value added) was used by Findlay and Li [13] as an index of the capital intensity of China's textile and clothing industries. The wage bill, if not distorted, can be used as an approximate indicator of the labour requirement. But a high wage bill/value added ratio might be due to the use of either a large number of low-wage unskilled workers or fewer skilled workers with a high wage rate. In the first case the activity is labour intensive and in the second case it is human capital intensive. To distinguish between these two possibilities, it is necessary to use both ratios, value added per worker and wage bill/value added.

The distinctions between these measures should be noted. Fixed capital per worker indicates capital stocks rather than capital flows in operating the production process. Value added per worker represents the productivity of a worker, given the nature of the commodity and the fixed capital equipment. They coincide with one another to the extent that for a given product, a high value added per worker is more likely when labour is working with a relatively large stock of capital.

Another distinction can be made. Fixed capital per worker and the skill ratio are usually the result of long-term investment in an industry. For this reason, the classification based on them can be called the "industry method". The classification based on value added per worker and wage bill/value added is called the "commodity method", since both ratios involve the result of current value-adding activity. Tables 1 and 2 compare the two methods.*

Table 1. Identifying industries by factor intensity (industry method)

	Fixed capital per worker	
Skill ratio	*Low*	*High*
Low	Labour intensive	Physical capital intensive
High	Human capital intensive	Human and physical capital intensive

*The significance of the distinction between the two measures should not be ignored. The classification based on the industry method is instructive for new investment projects, implying that the establishment of industries that use relatively scarce factors of the country would lead to inefficiencies in the long run, given the factor endowment of the country. The commodity method, in contrast, is instructive concerning the activities of established industries, by way of attaining the maximum economic efficiency and rational allocation of the factor endowments of the country.

Table 2. Identifying commodities by factor intensity (commodity method)

Wage bill/ value added	*Value added per worker*	
	Low	*High*
Low	Labour or capital intensive	Human capital intensive
High	Physical capital intensive	Human and physical capital intensive

The two methods can also be combined and the industries or commodity groups classified under a combination of variables. Table 3 summarizes the expected relationship between the indicators and the factor intensities.

Table 3. Relationship between indicators and factor intensities

As this indicator increases	*The industry becomes more*
Fixed capital per worker	Physical capital intensive
Skill ratio	Human capital intensive
Value added per worker	Physical and human capital intensive
Wage bill/value added	Labour intensive

The data used for classification are taken from official statistics based on an industrial census made in 1985. The data on the country's manufacturing sector can be divided into a number of groups, including (a) ownership type, for example state-owned or collectively owned, (b) industrial division, such as heavy and light industries, (c) scale division, for example, large, medium and small, and (d) sub-industrial level, i.e. industrial branch.

1. The industry method

The first attempt at ranking the industries of China by using fixed capital per worker and skill ratio (industry method) indicates that the state-owned, large enterprises and the heavy industries were more capital

intensive than the collective, small and light industries. For example, state-owned industries as a whole were nearly five times more capital intensive than collective industries (including township enterprises) in terms of fixed capital per worker and more than nine times more human capital intensive in terms of the skill ratio. The capital intensity of heavy industry was more than double that of light industry in terms of both fixed capital per worker and the skill ratio. The large enterprises, classified by both fixed capital per worker and the skill ratio, were about 1.5 times more capital intensive than the medium-sized enterprises and 6 times more so than the small ones.

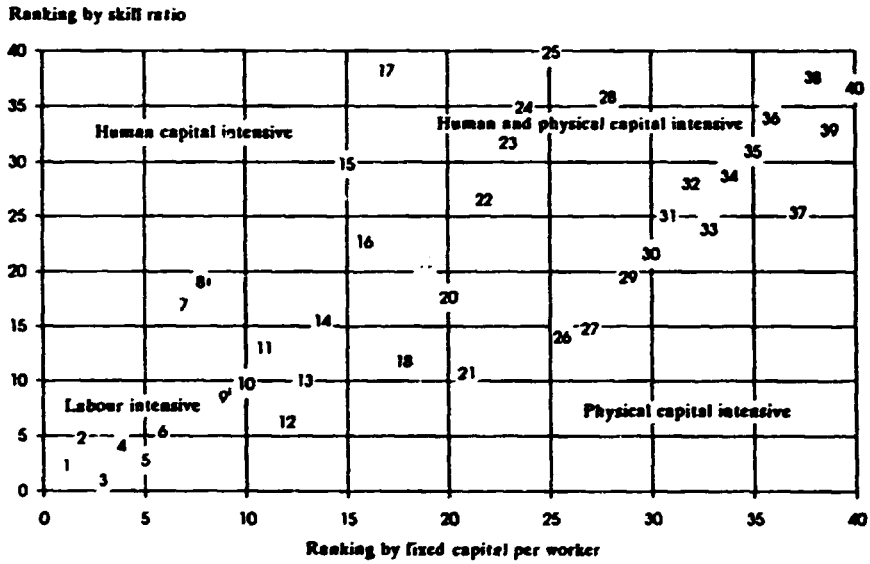
The ranking and classification for 40 sub-industries are shown in figure I. Power generation appears to be the most capital intensive industry in terms of both human and physical resources since it is ranked in place 40 by the fixed capital per worker ratio and in place 37 by the skill ratio, while the electronic and telecommunications equipment industry appears to be the most human capital intensive, given its top ranking by the skill ratio and its place 25 ranking by fixed capital per worker. The clothing industry, however, is the most labour intensive, given its first-place ranking by the fixed capital worker ratio and its second-place ranking by the skill ratio.

2. *The commodity method*

The first attempt to rank the country's industries using the commodity method led to obviously erroneous results. For example, tobacco manufacture ranks as the most capital intensive in terms of value added per worker, and coal mining and preparation is the second most labour intensive (the most labour intensive is the mining of other minerals). The ranking by wage bill/value added is similar to that by value added per worker, with chemical fibres being the most capital intensive and coal mining and preparation the most labour intensive. These suspicious results are due to price distortions in China. For example, the extremely high capital intensity of the tobacco industry is due to the high price of tobacco products, a large share of whose value added is accounted for by government taxation. Coal mining and preparation, on the other hand, is considered as a labour intensive industry by the above calculation but would be a capital intensive one if coal had not been undervalued.* National statistics reveal that in the tobacco industry, the rate of profit and taxes on total investment of

*This situation has been discussed by Thompson [14]. His procedure lowered the labour share to value added in the coal industry from 79 per cent to 42 per cent. The estimates of price distortions he provided could not be matched exactly with the industries available here and so have not been used.

Figure 1. Ranking of the industries in China by fixed capital per worker and the skill ratio, 1985



Key:
1 Clothing
2 Arts and crafts
3 Mining of other minerals
4 Furniture manufacture
5 Others
6 Leather, furs and manufactured goods
7 Cultural, educational and sports materials
8 Metal products
9 Timber processing, bamboo, cane, palm fibre
10 Mining and preparation of building materials
11 Plastic manufactured goods
12 Printing
13 Building materials and other non-metal goods
14 Textile manufacture
15 Electric equipment and machinery
16 Rubber manufactured goods
17 Instruments, meters and other measuring equipment
18 Food manufacture
19 Beverage manufacture
20 Paper making and manufactured goods
21 Animal feed manufacture
22 Logging and transport of timber and bamboo
23 Machine building
24 Medical and pharmaceutical goods
25 Electronic and telecommunication equipment
26 Tobacco manufacture
27 Salt mining
28 Transportation equipment
29 Coal mining and preparation
30 Ferrous metals mining and preparation
31 Non-ferrous mining and preparation
32 Chemical industry
33 Coking, gas and coal-related products
34 Smelting and pressing of ferrous metals
35 Smelting and pressing of non-ferrous metals
36 Chemical fibres
37 Production and supply of running water
38 Petroleum processing
39 Petroleum and natural gas extraction
40 Power generation, steam and hot water supply

state-owned enterprises reached 218.18 per cent in 1985, while in the coal mining and preparation industry it was only 0.16 per cent in the same year ([15], 1986, p. 67).

In the presence of price distortions, information from the ranking, especially that derived by the commodity method, will have little value for policy-making. However, some action can be taken to adjust the data.

B. Adjusting the data and the final classification

One indicator of the extent of distortion is the different profit levels in different industries. In an economy with mobile capital and flexible prices, all industries should have the same (or zero) economic profit in the long run. A divergence in profit level at any point in time, given the same competitive conditions, could be due to better or poorer management. But under conditions of free entry, it cannot be imagined that one industry as a whole can consistently make losses while another can earn large profits. However, the data suggest that this was the situation in China in 1985, when profit and tax levels on total investment differed more than 100-fold between different industrial branches.

The commodity price distortion can be adjusted by first dividing the plan price into four parts:

Plan price = Raw materials and supplement (RM) +
Depreciation of fixed assets and interest on loans, rents etc. (DI) +
Labour costs (wages, allowances etc.) (LC) +
Profit and taxes (PT)

For simplicity, write this as

$$P = RM + DI + LC + PT$$

in which

$$DI + LC + PT = \text{Value added (VA)}$$

Now assume that the price distortions are reflected in the divergence of profit and taxes among industries. To eliminate these distortions, profit and taxes can be subtracted from value added and the remainder defined as the cost of value added (CVA):

$$CVA = VA - PT = DI + LC$$

In the absence of data on other allowances, the wage bill was used as the estimate of labour cost. Further adjustments can be made to the CVA to allow for factor market distortions.

In the urban industrial sector of China, the most commonly observed distortion in labour markets is that payments to skilled workers, unskilled workers and technicians are usually the same, even reversed [16]. This distortion will lead to an underestimate of the human capital intensity of an industry or commodity group that uses technical staff, i.e. an industry with a low ratio of wages to value added could be underestimated in terms of human capital intensity.

An adjustment is needed to solve this problem. The method is to find a proper rate of return to human capital and use it as an adjustment coefficient. If it is assumed that technicians are underpaid by 10 per cent, a 10 per cent multiplier, weighted by the skill ratio, can be added to the original wage bill of the industry under consideration.

Another common distortion is that urban capital is underpriced. In order to allow for an appropriate return on capital invested, and assuming that the rate of return to the country's capital is underestimated by 10 per cent, this kind of distortion is also simply adjusted for by adding 10 per cent to the return on total capital (fixed plus circulating).*

Now the real cost of value added can be compared across industries. The real cost of value added (RCVA) is defined as the revised capital consumption (RKC) plus the revised wage bill (RWB). Thus the new criteria used in the classification become:

$$RCVA_i/worker_i = (RKC_i + RWB_i)/worker_i$$
$$RWB_i/RCVA_i = \text{share of real wage bill in real cost of value added}$$

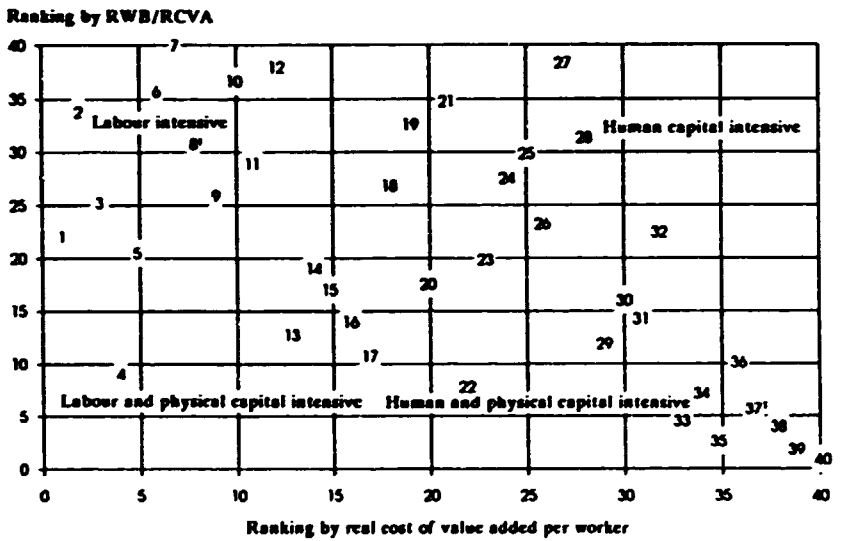
where i denotes the industry under consideration.

The ranking and classification of the industries by the commodity method are presented in figure II.

The industry method, which uses fixed capital per worker and the skill ratio, is expected to be more reliable than the commodity method, which uses RCVA per worker and RWB/RCVA. This is partly because adjusting the current data cannot accurately account for distortions in commodity and factor markets. However, it turns out that the results of the commodity method are not very sensitive to a change in coefficients. To test the sensitivity of the ranking to the adjustments, alternative coefficients of the return to human capital and physical capital (total investment) were used. Reducing the coefficients from 10 per cent to 5 per cent in both cases would not change the final classifications. In

*There have been several adjustments to China's interest rates since 1989. By 1986, the interest rate on medium- and long-term loans in China was only 6-12 per cent [17].

Figure II. Ranking of the industries in China by RCVA per worker and RWB/RCVA, 1985



Key:
1 Mining of other minerals
2 Timber processing, bamboo, cane, palm fibre
3 Clothing
4 Others
5 Arts and crafts
6 Furniture manufacture
7 Mining and preparation of building materials
8 Building materials and other non-metal goods
9 Leather, furs and manufactured goods
10 Metal products
11 Printing
12 Cultural, educational and sports materials
13 Plastic manufactured goods
14 Textile manufacture
15 Paper making and manufactured goods
16 Food manufacture
17 Animal feed manufacture
18 Ferrous metals mining and preparation
19 Coal mining and preparation
20 Rubber manufactured goods
21 Logging and transport of timber and bamboo
22 Beverage manufacture
23 Coking, gas and coal-related products
24 Electric equipment and machinery
25 Machine building
26 Non-ferrous mining and preparation
27 Instruments, meters and other measuring equipment
28 Transportation equipment
29 Chemical industry
30 Medical and pharmaceutical goods
31 Smelting and pressing of ferrous metals
32 Electronic and telecommunication equipment
33 Tobacco manufacture
34 Production and supply of running water
35 Salt mining
36 Smelting and pressing of non-ferrous metals
37 Chemical fibres
38 Petroleum processing
39 Power generation, steam and hot water supply
40 Petroleum and natural gas extraction

fact, in the absence of any adjustments to the factor market distortions, the ranking by the commodity method is not changed significantly.

After the adjustments for price distortions, the 40 industries are classified into three groups: labour intensive, human capital intensive and physical capital intensive. To these is added a fourth group, natural resource intensive industries. The fourth group is composed of those industries, mainly involving mining, in which the production process is directly based on or related to the country's natural endowments. One of their characteristics is that they are also usually physical capital intensive.

In table 4, which is based on table 3, natural resource intensive industries are listed first because their classification is the most apparent. The remaining industries are divided into three groups. Those ranked in places 1-20 with respect to fixed capital per worker are classified as labour intensive (they have a fixed capital per worker of less than 8,429 yuan renminbi). Those ranked between places 20 and 30 by fixed capital per worker are classified as human capital intensive; to these are added the industries whose ranking by the skill ratio is higher than place 30, even if their ranking by fixed capital per worker is less than place 30. The rest are physical capital intensive industries. Given that the physical capital intensive industries are also usually human capital intensive, the classification is determined by fixed capital per worker; that is, if the fixed capital per worker and the skill ratio are ranked at the same level, the industry is classified as physical capital intensive. Power generation, petroleum processing and chemical fibres are examples.

Table 4. Classification of industries by factor intensity, 1985

	Ranking			
Classification	*Fixed capital per worker*	*Skill ratio*	*RCVA per worker a/*	*RWB/ RCVA b/*
Natural resource intensive				
Mining of other minerals	3	1	1	22
Mining and preparation of building materials	10	10	7	40
Logging and transport of timber and bamboo	22	27	21	35
Salt mining	27	15	35	3
Coal mining and preparation	29	20	19	33
Ferrous metals mining and preparation	30	22	18	27
Non-ferrous mining and preparation	31	25	26	24
Coking, gas and coal-related products	33	24	23	20
Petroleum and natural gas extraction	39	33	40	1

Classification	*Ranking*			
	Fixed capital per worker	*Skill ratio*	*RCVA per worker a/*	*RWB/ RCVA b/*
Labour intensive				
Clothing	1	2	3	25
Arts and crafts	2	5	5	21
Furniture manufacture	4	4	6	36
Others	5	3	4	9
Leather, furs and manufactured goods	6	5	9	26
Cultural, educational and sports materials	7	17	12	38
Metal products	8	19	10	37
Timber processing, bamboo, cane, palm fibre	9	9	2	34
Plastic manufactured goods	11	13	13	13
Printing	12	7	11	29
Building materials and other non-metal goods	13	10	8	31
Textile manufacture	14	16	14	19
Rubber manufactured goods	16	23	20	18
Food manufacture	18	12	16	14
Beverage manufacture	19	21	22	8
Paper making and manufactured goods	20	18	15	17
Human capital intensive				
Electrical equipment and machinery	15	30	24	28
Instruments, meters and other measuring equipment	17	39	27	39
Machine building	23	32	25	30
Medical and pharmaceutical goods	24	35	30	16
Electronic and telecommunication equipment	25	40	32	23
Transportation equipment	28	36	28	32
Physical capital intensive				
Animal feed manufacture	21	11	17	11
Tobacco manufacture	26	14	33	5
Chemical industry	32	28	29	12
Smelting and pressing of ferrous metals	34	29	31	15
Smelting and pressing of non-ferrous metals	35	31	36	10
Chemical fibres	36	34	37	6
Production and supply of running water	37	26	34	7
Petroleum processing	38	38	38	4
Power generation steam and hot water supply	40	37	39	2

a/ RCVA: real (adjusted) cost of value added per worker.

b/ RWB/RCVA: share of real wage bill (adjusted wage bill) in value added.

C. Industrial structure and dualism

An impression of China's industrial structure is that it should have been adjusted so as to encourage more labour intensive activities after the reforms, especially after the country changed its foreign trade strategy from import substitution to export promotion. A conventional methodology is to equate heavy industry with capital intensive products and light industry with labour intensive products, but this classification becomes less clear if further disaggregation of the industries is introduced. Table 5 summarizes the production structure of China in 1980-1991 on the basis of the industrial classification established in section B. The results are plotted in figure III.

The pattern shown in table 5 appears to be paradoxical. According to standard international trade theory, when an economy opens to international trade, its production mix will shift to reflect the economy's comparative advantage. Since China is likely to have a comparative advantage in labour intensive manufactured goods, it might be expected that its labour intensive industries would expand as the country becomes more outward-oriented. However, the pattern is consistent neither with this theoretical expectation nor with intuition. On the contrary, the country's labour intensive industries contracted: their share of the gross output of industry and agriculture declined, from 31 per cent in 1980 to 29 per cent in 1991. Surprisingly, capital intensive industries grew, from 34 per cent to 39 per cent over the same period. The share of natural resource intensive industries decreased slightly, while the share of agriculture declined by more than 2 per cent. Thus, the open-door policy appeared to encourage capital intensive production rather than labour intensive production.

However, a structural change might have occurred that was not reflected in government planning and official statistics. The quiet, peaceful and dramatic industrial revolution that had taken place in the countryside was ignored until the second half of the 1980s. By then, rural enterprises accounted for more than half of the output in rural society and about one third of the national industrial gross outputs. The outward orientation of rural enterprises surprised not only government bureaucrats but also foreign observers. One fourth of the country's exports were coming from rural enterprises in the late 1980s. These so-called "peasant entrepreneurs", who had not much knowledge of international markets, lacked productive capital, had no financial support from above and sometimes had to pay extra money to the government bureaucracy in order to sell their products, had beaten the well-equipped and well-organized cadres in the state-owned enterprises (SOEs).

Urban and rural industrial sectors diverge not only in factor marginal productivity and factor rewards but also in factor intensity. Given that the urban sector is more capital abundant and the rural sector more labour abundant, it might be expected that the urban industries would be more

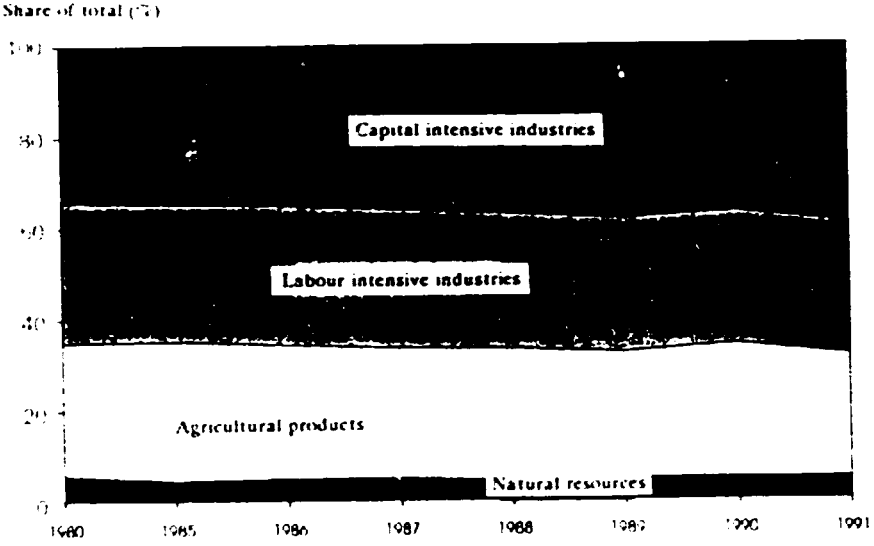
Table 5. Changing production pattern in China, 1980-1991 a/
(Percentage)

Industry group	*1980*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*
Natural resource intensive	5.8	5.2	5.2	5.1	4.7	5.0	5.0	5.1
Labour intensive	30.9	29.0	30.4	30.4	29.6	29.4	29.0	29.2
Capital intensive	34.3	35.7	35.2	36.0	37.0	38.2	36.8	39.3
Human capital intensive	14.8	17.6	16.6	17.2	18.1	17.8	16.1	17.4
Physical capital intensive	19.5	18.1	18.5	18.8	18.9	20.4	20.7	21.9
Agricultural products	29.1	30.1	29.3	28.5	28.8	27.5	29.2	27.1
	100	100	100	100	100	100	100	100

Source: [18], various volumes.

a/ Shares calculated on the basis of current prices.

Figure III. Changes in the industrial structure of China, 1980-1991



capital intensive than their rural counterparts. Table 6 compares the SOEs and the township and village enterprises (TVEs) over the period 1978-1990. The last three columns of the table indicate that the TVEs, although growing more rapidly than the SOEs as measured by three indicators of capital intensity, were largely less capital intensive than the SOEs.*

The branch level of each industry in the rural sector might also be expected to be more labour intensive than that in the urban sector. Here the 6 largest of 37 rural industrial branches are chosen as the sample. According to the 1985 industrial census, these 6 branches accounted for about 60 per cent of the total output value and employment of township enterprises in 1985, so they are representative. Table 7 compares these branches in the urban and rural sectors in 1985.** The results of tables 6 and 7 are consistent in the sense that almost all indicators show that the rural industries are more labour intensive than their urban counterparts.

The divergence in factor intensity creates different industrial structures in the two sectors. Using the industry classification established in section B, the gross outputs of the urban sector and of the TVEs are compared in terms of factor intensity groups for 1985-1991 (table 8 and figures IV and V.

Table 8 indicates that TVEs are more labour intensive than the urban sector. For example, the ratio of labour intensive production to capital intensive production was 63:31 for TVEs in 1991, while the same ratio was roughly reversed (37:56) for the urban sector. Similar results are evident in the data for other years as well.

Another point that needs to be noted in connection with table 8 is that TVEs accounted for only 8 per cent of the number of rural enterprises, 50 per cent of employment and 65 per cent of the gross output of all rural enterprises in 1989 [21]. Because they lacked access to a formal capital allocation regime, private rural enterprises were usually constrained by limited capital stock and production scale. If these enterprises were included, the rural share would be even more labour intensive.

The two sectors are not only distinct in structure but also different with respect to how this structure changes over time. Careful examination of the data reveals that the share of the capital intensive industries (the

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*The data on total employees in the state-owned enterprises include all staff in the state sector. These data obviously disguised the capital intensity of the sector since a large part of the employee total is in government administration, education and scientific research institutions. These activities are very labour intensive but they are also non-productive by Chinese standards.

**Due to the lack of statistics in village-run and private enterprises, only township enterprises are reported. It is obvious that if the village and private enterprises are included, the rural enterprises could be more labour intensive than is evident from the table.

Table 6. Production indicators: SOEs and TVEs in the industrial sector, 1978-1991

Year	Fixed capital (billion Y)	Employees (million Y)	Total wages (million Y)	Value added (million Y) a/	Fixed capital per worker (Y)	Value added per worker (Y)	WB/VA (%)
State-owned enterprises							
1978	449	74.51	46 870	153 345	6 026	2 058	30.6
1979	489	76.93	52 950	159 381	6 356	2 072	33.2
1980	531	80.19	62 790	167 946	6 622	2 094	37.4
1981	577	83.92	66 040	171 119	6 876	2 039	38.6
1982	626	96.30	70 890	177 918	6 501	1 848	39.8
1983	683	87.71	74 810	189 920	7 787	2 165	39.4
1984	737	96.37	87 580	..	7 648	..	..
1985	800	89.90	106 480	..	8 899	..	..
1986	904	93.33	128 850	..	9 686	..	..
1987	1 020	96.54	145.930	..	10 566	..	..
1988	1 179	99.94	180 710	..	11 809	..	..
1989	1 339	101.08	205 020	..	13 247	..	..
1990	1 535	103.46	232 410	..	14 837	..	..
1991	..	106.64	259 490	..	..	..	..
Township and village enterprises							
1978	23	28.26	8 600	19 670	814	696	43.7
1979	28	29.09	10 380	23 090	963	794	45.0
1980	33	30.00	11 940	26 350	1 100	878	45.3
1981	38	29.70	13 060	27 770	1 279	935	47.0
1982	38	31.13	15 330	31 350	1 221	1 007	48.9
1983	43	32.34	17 580	35 250	1 330	1 090	49.9
1984	48	38.48	23 930	44 710	1 247	1 162	53.5
1985	58	41.52	30 140	58 130	1 397	1 400	51.9
1986	75	43.92	35 551	65 428	1 708	1 490	54.3
1987	123	47.02	42 768	78 351	2 616	1 666	54.6
1988	158	48.93	54 120	103 690	3 229	2 119	52.2
1989	192	47.20	58 070	109 330	4 068	2 316	53.1
1990	220	45.92	60 680	111 500	4 791	2 428	54.4
1991	263	47.67	70 650	132 500	5 517	2 780	53.3

Sources: [18], various volumes and years, but mainly 1992, pp. 27, 107, 124, 389 and 391; [19], p. 973.

a/ Value added is defined as the sum of profit, taxes and total wage bill.

Table 7. Factor intensities and indicators for rural vs. urban industrial branches in China, 1985

Industry group a/	*Factor intensity classification b/*	*Fixed capital per worker (Y) c/*	*Skill ratio per 100 workers*	*Total capital per worker (Y)*	*Value added per worker (Y)*	*WB/VA (%)*
Rural total		3 099	0.64	5 010	2 267	34.7
Building materials and others	L	3 106	0.51	4 200	1 914	40.9
Machine building	H	3 787	1.17	6 709	3 109	29.4
Textile manufacture	L	2 724	0.39	5 269	2 331	29.3
Metal products	L	3 204	0.85	5 409	2 436	33.9
Coal mining and preparation	N	2 385	0.65	3 023	2 189	50.8
Clothing	L	1 148	0.45	3 076	1 658	42.2
Urban total		12 352	2.84	14 040	5 321	21.3
Building materials and others	L	8 130	1.15	2 980	3 388	30.2
Machine building	H	9 891	4.80	12 730	4 158	27.4
Textile manufacture	L	6 761	1.48	3 437	4 297	23.7
Metal products	L	4 916	1.56	7 624	3 516	29.7
Coal mining and preparation	N	12 600	1.62	19 099	2 436	56.7
Clothing	L	2 465	0.47	5 947	2 997	29.9
Rural/urban ratio (%)						
All industries		25.1	22.5	35.7	42.6	163.1
Building materials and others	L	38.2	44.3	140.9	56.5	135.5
Machine building	H	38.3	24.4	52.7	74.8	107.2
Textile manufacture	L	40.3	26.3	153.3	54.2	123.2
Metal products	L	65.2	54.5	70.9	69.3	113.9
Coal mining and preparation	N	18.9	40.1	15.8	89.9	89.6
Clothing	L	46.6	95.7	51.7	55.3	141.5

Sources: [18], various volumes and years; [20], vol. 3, pp. 164 and 1132, vol. 7, pp. 118, 174 and 178, vol. 8, pp. 428 and 954; [15], 1986, p. 77, and 1987, pp. 124 and 2265.

a/ Rural: township enterprises; urban: derived from the national total less the township enterprises.

b/ L = labour intensive, H = human capital intensive and N = natural resource intensive.

c/ Original fixed assets per worker.

Figure IV. Urban industrial structure of China, 1985-1991

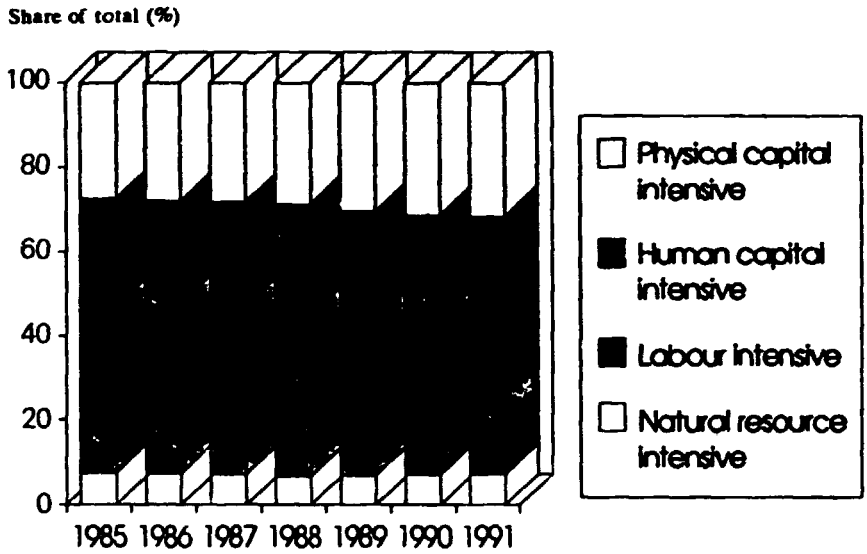

Figure V. Industrial structure of township and village enterprises of China, 1985-1991

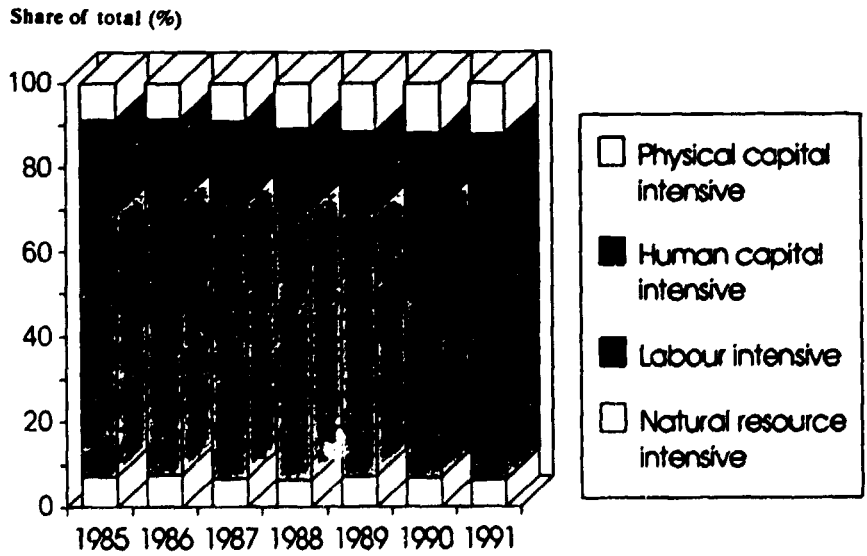

Table 8. Share of gross output for urban and rural industries, 1980-1991 a/
(Percentage)

Industry group	*1980*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*
Urban sector								
Natural resource intensive	8.6	7.5	7.3	7.3	6.7	6.9	7.2	7.2
Labour intensive	42.7	39.7	40.9	40.2	38.5	37.3	37.7	36.5
Capital intensive	49.3	52.8	51.8	52.6	54.8	55.8	55.1	56.3
Human capital intensive	20.8	25.4	23.8	24.4	26.1	25.4	23.4	24.6
Physical capital intensive	28.5	27.5	28.0	28.2	28.7	30.4	31.6	31.7
	100	100	100	100	100	100	100	100
TVEs								
Natural resource intensive	10.9	7.2	7.3	6.6	6.3	7.2	6.9	6.4
Labour intensive	61.3	61.9	65.7	65.3	63.8	62.2	63.7	62.8
Capital intensive	28.7	30.9	27.0	28.1	29.9	30.6	29.5	30.8
Human capital intensive	21.9	22.3	18.8	19.2	19.1	19.0	17.6	18.7
Physical capital intensive	6.8	8.6	8.3	8.9	10.8	11.6	11.9	12.2
	100	100	100	100	100	100	100	100

Sources: [18], 1986-1991; [15]; [22].

a/ Rural industries include TVEs only; 1980 data are for township enterprises only. Data for urban industry are derived by netting out township industries from the national data.

sum of physical capital intensive and human capital intensive industries) was relatively stable in the rural sector (around 30 per cent), while it expanded by 7 per cent in the urban sector over the decade. A clear trend of a declining share for labour intensive industries and an increasing share for capital intensive industries in the urban sector is evident throughout the period 1980-1991. The share of capital intensive industries increased from 49 per cent in 1980 to 56 per cent in 1991, while the share of labour intensive industries declined from 43 per cent to 37 per cent. As revealed by a detailed examination of data from urban industrial branches (table 9), the expansion of capital intensive industries in the urban sector was due to the increasing share of the electrical equipment and machinery, medical and pharmaceutical goods, electronic and telecommunication equipment, transportation equipment, animal feed, chemical fibres and tobacco industries. In labour intensive industries, the decline of the clothing, furniture, textiles, rubber and food manufacturing industries was the most significant factor.

The structure in the rural sector was relatively stable. Table 10 shows the gross output of each industrial branch in the rural sector. While labour intensive industries as a whole remained quite stable, the most labour intensive one, clothing, expanded rapidly. In contrast to the urban sector, the shares of human capital intensive industries in the rural sector declined in the second half of the 1980s. This may reflect the extreme shortage of human capital stocks in this sector. The industry whose share contracted most sharply was machine building. Its share declined from 12.5 per cent in 1985 to only 10 per cent in 1991. However, physical capital intensive industries expanded by more than 3 per cent from 1985 to 1991. In this group, the chemical industry increased from 3.9 to 5.9 per cent between 1985 and 1991.

These events may reflect two simultaneously developed forces: (a) rapid capital accumulation resulting from economic growth may permit each sector to upgrade its capital intensity over time and (b) price distortions became effective and dominant in the late 1980s. Since the chemical industry is protected, this adjustment is probably the result of price distortions. Other expanding capital intensive industrial branches include the chemical fibres, smelting and pressing of metals and animal feed industries, in both sectors.

In table 5, the increase in capital intensive industries in the post-reform era was paradoxical. However, since the data in that table excluded village enterprises, the result may be biased. A proper evaluation of the national industrial structure should include all industries in the country. Table 11 has been created by adding the data on village industries to the data from table 5 to show a more comprehensive picture of the industrial structure for the period 1985-1991. This table reveals that when the data on village enterprises are included, the bias towards capital intensive industries is removed and the industrial structure becomes very stable over time. This indicates that the development of

Table 9. Gross output in the urban industries of China, 1980-1991
(Percentage)

Classification a/	*1980*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*
Natural resource intensive	8.01	7.47	7.34	7.26	6.70	6.93	7.23	7.19
OTHERMINE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MINBUID	0.27	0.24	0.25	0.26	0.24	0.27	0.28	0.26
TIMBER	0.86	0.72	0.83	0.90	0.81	0.68	0.56	0.52
SALT	0.38	0.23	0.25	0.22	0.22	0.25	0.21	0.20
COAL	2.80	2.55	2.37	2.15	2.12	2.31	2.44	2.38
FERMETAL	0.18	0.20	0.19	0.18	0.16	0.15	0.17	0.18
NONFEMET	0.45	0.44	0.47	0.49	0.47	0.52	0.54	0.51
COKING	0.32	0.32	0.35	0.29	0.30	0.33	0.38	0.39
PETROLUME	2.75	2.79	2.63	2.77	2.39	2.42	2.65	2.74
Labour intensive	42.73	39.70	40.87	40.17	38.51	37.31	37.69	36.54
CLOTHING	2.27	1.97	1.86	1.82	1.72	1.75	1.86	1.95
ARTS	0.72	0.88	0.75	0.78	0.81	0.84	0.84	0.81
FURNITURE	0.45	0.50	0.49	0.50	0.46	0.41	0.37	0.34
LEATHER	1.06	0.97	1.00	0.97	0.93	0.91	0.91	0.98
CULTURAL	0.47	0.44	0.47	0.50	0.43	0.40	0.43	0.47
METAL	2.38	2.42	2.57	2.57	2.34	2.39	2.31	2.29
TIMPRO	0.61	0.63	0.71	0.75	0.62	0.54	0.46	0.46
PLASTIC	1.35	1.54	1.57	1.65	2.02	1.66	1.64	1.76
PRINTING	1.02	1.02	1.11	1.10	0.99	0.95	0.97	1.03
BULDMAT	3.53	3.93	4.65	4.49	3.91	3.97	3.70	3.75
TEXTILES	15.15	12.41	11.87	11.40	11.27	11.65	11.55	10.69
RUBBER	1.94	1.72	1.61	1.48	1.48	1.00	1.59	1.15
FOODMA	8.52	7.72	8.58	8.16	7.34	7.16	6.93	6.85

continued

Classification a/	1980	1985	1986	1987	1988	1989	1990	1991
BEVERAGE	1.42	1.75	1.83	2.07	2.11	1.96	2.11	2.17
PAPER	1.85	1.80	1.81	1.94	2.09	2.10	2.01	1.84
Human capital intensive	20.79	25.37	23.83	24.40	26.09	25.37	23.43	24.61
ELETRICMA	3.24	4. 5	4.19	4.07	4.55	4.91	4.19	4.04
INSTRUME	0.87	0.66	0.79	0.74	0.74	0.70	0.63	0.59
MACHINE	9.71	11.00	10.54	10.62	10.67	10.03	8.94	9.06
MEDICAL	1.53	1.61	1.76	1.94	2.19	2.06	2.11	2.25
ELECTRONIC	1.67	3.06	2.62	3.05	3.71	3.48	3.43	3.85
TRANSPORT	3.76	4.70	3.93	3.98	4.24	4.19	4.14	4.84
Physical capital intensive	28.47	27.46	27.95	28.17	28.70	30.40	31.64	31.66
ANIMALFD	0.04	0.30	0.39	0.45	0.63	0.70	0.69	0.73
TOBACCO	1.92	2.62	2.57	2.66	2.90	3.00	3.18	2.91
CHEMICAL	7.73	6.97	6.91	7.41	7.81	8.34	8.32	7.58
SMELTFER	6.99	6.82	7.29	7.08	6.95	7.18	7.59	7.71
SMELTNON	2.75	2.45	2.55	2.47	2.48	2.82	2.84	2.72
CHEMIFIB	0.75	1.00	1.09	1.17	1.28	1.47	1.57	1.59
RUNWATER	0.24	0.25	0.25	0.24	0.24	0.23	0.27	0.33
PETROPRO	3.77	3.30	3.39	3.23	3.06	3.01	3.07	3.76
POWER	4.27	3.75	3.52	3.48	3.34	3.64	4.12	4.33
	100	100	100	100	100	100	100	100

Sources: [23]; [15], 1986, p. 97; [22], 1988, p. 327, 1990, p. 403, 1991, p. 397, and 1992, pp. 435 and 436.

a/ See annex for abbreviations of the industries. The item "other industry" is not included due to incomplete data, and the shares are calculated based on current prices.

Table 10. Gross output in the township and village enterprises of China, 1980-1991
(Percentage)

Classification a/	*1980*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*
Natural resource intensive	9.95	7.16	7.30	6.59	6.26	7.18	6.86	6.39
OTHERMINE	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.03
MINBUID	3.55	2.21	3.05	2.85	2.60	2.71	2.63	2.44
TIMBER	0.08	0.10	0.00	0.16	0.17	0.14	0.13	0.13
SALT	0.42	0.15	0.14	0.09	0.12	0.14	0.12	0.13
COAL	4.78	3.76	3.17	2.46	2.25	2.85	2.60	2.34
FERMETAL	0.34	0.30	0.34	0.35	0.34	0.32	0.37	0.42
NONFEMET	0.57	0.47	0.40	0.44	0.50	0.58	0.53	0.48
COKING	0.20	0.16	0.19	0.23	0.28	0.41	0.47	0.43
PETROLUME	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Labour intensive	61.35	61.90	65.68	65.29	63.81	62.17	63.68	62.76
CLOTHING	2.52	2.91	3.48	3.58	3.47	3.91	4.33	4.59
ARTS	1.85	1.65	1.98	2.14	2.02	2.08	2.19	2.19
FURNITURE	1.36	1.32	1.22	1.25	1.18	1.11	1.04	1.01
LEATHER	1.18	1.34	1.76	1.83	1.81	1.81	1.99	2.13
CULTURAL	0.39	0.48	0.67	0.79	0.70	0.72	0.78	0.87
METAL	8.60	6.87	6.98	7.27	6.83	7.03	6.77	6.75
TIMPRO	1.56	1.13	1.46	1.37	1.35	1.37	1.34	1.31
PLASTIC	2.70	3.21	3.76	3.88	4.10	3.88	3.79	3.86
PRINTING	0.71	0.72	1.00	0.99	0.93	0.93	0.95	1.02
BULDMAT	20.11	17.40	17.28	16.00	15.75	15.92	13.97	13.02
TEXTILES	9.83	14.36	14.08	14.03	13.35	10.56	13.88	13.52
RUBBER	0.74	0.81	0.89	0.92	1.00	1.07	1.05	1.07
FOODMA	5.70	5.33	6.70	6.67	6.77	6.92	7.12	7.03

continued

Classification a/	1980	1985	1986	1987	1988	1989	1990	1991
BEVERAGE	1.80	2.16	1.82	1.85	1.84	1.97	1.57	1.52
PAPER	2.30	2.22	2.61	2.72	2.72	2.90	2.90	2.85
Human capital intensive	21.90	22.31	18.77	19.22	19.10	19.03	17.56	18.68
ELETRICMA	3.33	5.10	4.01	4.04	4.10	4.50	4.05	4.26
INSTRUME	0.47	0.50	0.41	0.42	0.39	0.39	0.35	0.60
MACHINE	15.16	12.50	11.69	11.53	11.23	10.79	9.89	10.01
MEDICAL	0.50	0.47	0.18	0.41	0.49	0.49	0.51	0.73
ELECTRONIC	0.51	1.17	1.07	1.29	1.26	1.20	1.18	1.22
TRANSPORT	1.94	2.57	1.41	1.54	1.63	1.66	1.58	1.85
Physical capital intensive	6.80	8.63	8.25	8.90	10.82	11.62	11.91	12.18
ANIMALFD	0.07	0.20	0.46	0.38	0.51	0.49	0.53	0.57
TOBACCO	0.05	0.02	0.02	0.02	0.01	0.01	0.01	0.01
CHEMICAL	4.17	3.89	3.92	4.31	5.19	5.51	5.70	5.92
SMELTFER	1.07	2.35	1.88	1.92	2.48	2.72	2.67	2.65
SMELTNON	0.52	1.12	1.29	1.37	1.73	1.88	1.83	1.80
CHEMIFIB	0.10	0.36	0.37	0.37	0.36	0.39	0.48	0.57
RUNWATER	0.01	0.04	0.01	0.04	0.05	0.05	0.06	0.07
PETROPRO	0.14	0.14	0.06	0.22	0.21	0.24	0.22	0.26
POWER	0.66	0.51	0.24	0.27	0.28	0.33	0.36	0.32
	100	100	100	100	100	100	100	100

Sources: [23]; [15], 1986, p. 97; [22], 1988, p. 327, 1990, p. 403, 1991, p. 397 and pp. 435 and 436.

a/ See annex for abbreviations of the industries. The item "other industry" is not included due to incomplete data, and the shares are calculated based on current prices.

Table 11. National industrial structure in China, 1985-1991
(Percentage)

Industry group	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*
Natural resource intensive	7.41	7.29	7.03	6.49	6.90	7.03	6.82
Labour intensive	44.38	46.40	46.25	45.81	44.67	45.61	44.92
Capital intensive	48.21	46.31	46.72	47.70	48.43	47.36	48.25
Human capital intensive	24.72	22.80	23.27	24.15	23.51	21.70	22.79
Physical capital intensive	23.49	23.51	23.45	23.55	24.92	25.66	25.46
	100	100	100	100	100	100	100

Sources: [23]; [15], 1986, p. 97; [22], 1988, p. 327, 1990, p. 403, 1991, p. 397 and 1992, pp. 435 and 436.

rural enterprises alleviated the bias and improved the national industrial structure in terms of allocative efficiency.

Thanks to low labour costs, rural enterprises can compete internationally with SOEs. It is reported that the foreign exchange earning for each yuan renminbi of expenditure in rural enterprises was $0.81, much higher than that in SOEs ($0.50-0.60). The cost of earning foreign exchange in rural enterprises was 5-30 per cent lower than in SOEs. For rural exporting enterprises, the recycling period for investment was 6-12 months shorter than that for SOEs in 1988 [24]. These figures indicate that rural enterprises are more competitive than SOEs.

During the period 1986-1990 (the Seventh Five-Year Plan), the rural industries of China accounted for 31.5 per cent of the increase in social output value, 37.7 per cent of the increase in industrial output, 67 per cent of the increase in rural social output value, 57 per cent of the increase in employment and 28 per cent of the increase in foreign exchange earnings [25]. The industrial output of rural enterprises accounts for about one third of the country's total industrial output. During the 1980s, the annual growth rate of the output of rural enterprises was at least 25 per cent in constant prices. Table 12 shows the growth of rural industries (REs) in terms of gross output, employment and the ratios of REs to SOEs in the industry sector.* The figures indicate that the growth of the REs was remarkable. For example, the ratio of REs to SOEs in gross output was only 0.12 in 1978 but 0.58 in 1991. As early as 1985, employment in rural enterprises of the industry sector surpassed that in SOEs, and the rural to urban ratio had increased to 1.3 by 1991.

Note that the statistics for rural industry before 1984 are incomplete owing to the lack of data on private firms, of which there were in any case few before that year. After 1984, private firms were included in the rural industry category, causing the numbers to rise dramatically, especially the number of enterprises. Nevertheless, the increases after 1984 can still be said to be remarkable. For example, the ratio between rural industry and state-owned industry for gross output and employment increased considerably, from 0.24 and 1.00 in 1984 to 0.58 and 1.30 in 1991.

*Since rural enterprises and SOEs use different accounting regimes, the direct comparison of gross and net output or even number of enterprises in the two sectors is impossible. Therefore only the data for the industry sector, not including the construction, transport, commerce and service sectors, are displayed in table 12.

Table 12. Growth of SOEs and REs in the industry sector, 1978-1991 a/

	Gross output (million Y)			*Employees (thousands)*		
Year	*SOEs*	*REs*	*REs/SOEs*	*SOEs*	*REs*	*REs/SOEs*
1978	328 918	38 526	0.12	31 390	17 345	0.55
1979	367 360	42 352	0.12	32 080	18 144	0.57
1980	391 560	50 941	0.13	33 340	19 423	0.58
1981	403 710	57 934	0.14	34 880	19 801	0.57
1982	432 600	64 602	0.15	35 820	20 728	0.58
1983	473 940	75 709	0.16	36 320	21 681	0.60
1984	526 270	124 535	0.24	36 690	36 561	1.00
1985	630 212	182 719	0.29	38 150	41 367	1.08
1986	697 172	241 340	0.35	39 550	47 620	1.20
1987	825 009	324 388	0.39	40 860	52 667	1.29
1988	1 035 128	452 938	0.44	42 290	57 034	1.35
1989	1 234 291	524 411	0.42	42 730	56 241	1.32
1990	1 306 375	605 025	0.46	43 640	55 717	1.28
1991	1 495 458	870 861	0.58	44 720	58 136	1.30

Sources: [18], various volumes, but mainly 1992, pp. 107, 389, 390 and 403-406.

a/ SOEs: state-owned enterprises; REs: rural enterprises (both township- and village-run before 1984).

Annex

INDUSTRIAL BRANCHES ABBREVIATIONS

Abbreviation	*Industrial branch*
Natural resource intensive	
OTHERMINE	Mining of other minerals
MINBUID	Mining and preparation of building materials
TIMBER	Logging and transport of timber and bamboo
SALT	Salt mining
COAL	Coal mining and preparation
FERMETAL	Ferrous metals mining and preparation
NONFEMET	Non-ferrous mining and preparation
COKING	Coking, gas and coal-related products
PETROLUME	Petroleum and natural gas extraction
Labour intensive	
CLOTHING	Clothing
ARTS	Arts and crafts
FURNITURE	Furniture manufacture
OTHERS	Others
LEATHER	Leather, furs and manufactured goods
CULTURAL	Cultural, educational and sport materials
METAL	Metal products
TIMPRO	Timber processing, bamboo, cane, palm fibre
PLASTIC	Plastic manufactured goods
PRINTING	Printing
BULDMAT	Building materials and other non-metal goods
TEXTILES	Textile manufacture
RUBBER	Rubber manufactured goods
FOODMA	Food manufacture
BEVERAGE	Beverage manufacture
PAPER	Paper making and manufactured goods
Human capital intensive	
ELETRICMA	Electric equipment and machinery
INSTRUME	Instruments, meters and other measuring equipment
MACHINE	Machine building
MEDICAL	Medical and pharmaceutical goods
ELECTRONIC	Electronic and telecommunication equipment
TRANSPORT	Transportation equipments
Physical capital intensive	
ANIMALFD	Animal feed manufacture
TOBACCO	Tobacco manufacture
CHEMICAL	Chemical industry
SMELTFER	Smelting and pressing of ferrous metals
SMELTNON	Smelting and pressing of non-ferrous metals
CHEMIFIB	Chemical fibres
RUNWATER	Production and supply of running water
PETROPRO	Petroleum processing
POWER	Power generation steam and hot water supply
AGRCUL	Agriculture

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Industrializing the subsistence agricultural economy of Nepal

*Narayan Khadka**

The role of industry as the engine of development has long been emphasized. Many developing countries have been making serious efforts to industrialize their economies as it has been generally believed that economic growth (increase in per capita incomes) and development (structural transformation) are invariably associated with industrialization. It is also the commonly held view that industrial progress undeniably contributes to technological progress, modern social structures, better economic opportunities for absorbing underemployed and unemployed labour and a higher standard of living. Indeed, the difference in the structure and level of industrial development between developed and developing countries is the major factor responsible for the growing inequalities between them. In developed market economies, industrial development issues are dominated by questions of how fast to increase competitiveness, safeguard environmental interests and save resources from massive depletion. It is said that there has been a third industrial revolution, having its nucleus in the electronics complex, which will create a technological-economic paradigm [1]. But many developing countries are confronted with the problem of rapidly achieving structural transformation at the same time as they are constrained by internal economic conditions. Population growth, with its consequences of growing unemployment, uncongenial urban conditions and increasing poverty and inequality, has remained at the forefront of their economic challenges. These constraints are coupled on the one hand with falling prices for primary commodities and declining external resources and on the other hand with the growing debt burden, bulging current account deficit and a shrinkage in import capacities. All these factors have forced the developing countries to adopt a more aggressive industrialization policy.

One of the main aspects of industrialization is the optimal size of industries. There has been intensive debate about the relative merits of small vs. large industries. Large industries have the advantage of economies of scale, whereas small and cottage industries have the advantage of adaptability in terms of both technology and culture. Another advantage of the small and cottage industry sector is the possibility of gearing it to agricultural and other key sectors of the economy. These small industries do not need large amounts of capital, technology or management skills.

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Nepal is one of the less developed countries that has been attempting to bring about a structural transformation of its economy. The need for rapid structural transformation has been urgent in recent times because of two intertwined problems, the growing population and the worsening performance of the agricultural sector, which has been the predominant source of livelihood for the majority of the population. Nepal has been making a deliberate attempt to gradually reduce its overwhelming dependence on the agricultural sector since having launched its first five-year plan in 1956. But the planned attempts to industrialize the economy have not been successful owing to a number of interrelated factors. The main objectives of this paper are (a) to briefly examine the industrial policies and strategies followed by Nepal over the last three decades, (b) to examine the characteristics of industrial development by type of economic activity, (c) to measure the relative efficiency of industries by type of economic activity and (d) to suggest measures to plan industrialization and maximize its ability to improve the stagnating subsistence agricultural economy.

The present article focuses on manufacturing establishments which produce goods by utilizing raw materials, semi-processed materials, or by-products or waste products.* It must be mentioned that there are serious data constraints in Nepal. This article relies primarily on data published in 1988 by the Central Bureau of Statistics of Nepal in its *Census of Manufacturing Establishments 1986/87*. The Bureau defines an establishment as "an economic unit which engages under a single ownership or control, in one or predominantly one kind of economic activity at a single physical locale". The data pertain to 1986/87. Although some data are for 1987/88, they are grouped according to the Nepal Standard Industrial Classification (NISC). The data available are not grouped by size as measured by the number of persons engaged. The Bureau has been surveying manufacturing establishments every 5 years and cottage industries every 10 years; however, data coverage is extremely limited. Wherever possible, data have also been obtained from the economic surveys of the Government.

This article focuses on the industrial policies and performance of the manufacturing sector in the period 1960-1989, during which a partyless system of government, called the *panchayat*, was being tried out, with the king continuing to maintain overall control. That system was overthrown in April 1990. Nepal now has a constitutional monarchy with a multi-party system of government. The country held its first general election in May 1991, and the Nepalese Congress Party is in power. This article

* The Government of Nepal has classified industries into six types: manufacturing, energy-based, agro-based, mineral, tourism and service (Ministry of Industry, *Industrial Policy and Industrial Enterprises Act*, Kathmandu, 1987, pp. 7-8).

will provide some insights for those who are formulating industrial policies and programmes for Nepal.

A. Background

Sandwiched between China to the north and India to the south, east and west, Nepal is a country with a population estimated to have been about 20 million in 1990. It is a predominantly agricultural country with a subsistence level of production. It is also one of the poorest countries in the world (its per capita income in 1990 was estimated to be $170). It is landlocked, and the nearest seaport is some 1,100 km from its border with India on the south. Transit costs are formidable, and although Nepal also has a road link with China, the movement of goods and services is extremely limited. Nepal also has a long and open border with India, across which people and goods move freely despite some restrictions on the flow of goods through customs checkpoints. Land, forest and water have been the main natural resources. However, owing to the rapid growth of population over the last three decades, population pressures on land and forest have increased considerably. The country is well endowed with water resources. It is generally believed to have a power potential of some 83,000 megawatts, but constrained by both technology and capital, only 280 megawatts of power were harnessed up to 1990. Nepal's efforts to harness water resources are also dogged by a lack of progress in striking a deal with India for the purchase of surplus power. Compared with the situation in the 1950s, the country has made some progress in creating socio-economic infrastructures such as roads, power and telecommunications, education and health, but most of this socio-economic infrastructure has been underutilized.

The low level of industrial development is apparent from the fact that only a small percentage of production and employment is accounted for by the industrial sector. The economy is dominated by a stagnating agricultural sector. As can be seen from table 1, the share of agriculture and allied activities in total gross domestic product (GDP) was 72 per cent in 1975 and 60 per cent in 1990. Over the years, the share of the trade, construction and financial sectors, which are highly capital-intensive and are concentrated in a few urban areas, has increased. The contribution of the industrial sector (the modern manufacturing sector) to GDP increased only modestly, from 2.8 per cent to 4.4 per cent from 1975 to 1990. Although the manufacturing sector turns out to be the most dynamic sector, as its average growth rate has been much higher than that of the other sectors its overall value added is still very low. Table 1 also indicates that the growth rates of the trade, restaurant and hotel, construction, finance and transport and communication sectors have been quite impressive, leading to a high average growth rate for GDP in current prices. However, prices also rose rather sharply during this

period, so the real growth rate has been low. The real growth rate in GDP (in 1975 prices) during 1975-1990 was 3.9 per cent, and the population growth rate was 2.6 per cent.* Growth in GDP fluctuated sharply owing to the variability in agricultural production. Overpopulation, the use of marginal lands, soil erosion and rudimentary cultivation methods are some of the major factors responsible for low agricultural productivity.

Table 1. Gross domestic product by industrial sector, 1975-1990
(Millions of Nepalese rupees)

Sector	1975 GDP	1975 Per cent of total	1990 GDP	1990 Per cent of total	Average annual growth rate (%)
Agriculture and ancillaries	11 435	71.8	49 704	60.2	22.3
Mining and quarrying	22	0.1	97	0.1	22.7
Modern manufacturing	440	2.8	3 589	4.4	47.7
Cottage manufacturing	224	1.4	731	0.9	15.1
Electricity, gas and water	34	0.2	655	0.8	121.7
Trade, restaurants and hotels	540	3.4	3 759	4.6	39.7
Construction	583	3.7	6 392	7.7	66.4
Transport and communications	690	4.3	3 848	4.7	30.5
Finance and real estate	1 095	6.8	6 776	8.2	34.6
Community and social services	873	5.5	6 915	8.4	46.1
GDP at factor cost	15 936	100.0	82 466	100.0	27.8
Indirect tax less subsidy	635		6 245		
GDP at market price	16 571		88 711		29.02

Source: Calculated from tables 1.2 and 1.3 (National Accounts Summary) in Ministry of Finance, *Economic Survey 1991/92* (Kathmandu).

Note: The exchange rate was $1 = NRs 10.5 in 1975 and $1 = NRs 26.5 in 1990.

*Calculated from data contained in Ministry of Finance, *Economic Survey 1990/91*, Kathmandu.

The country's economy is also constrained by the low level of savings. While investment has been increasing owing to large inflows of foreign grants and loans, the savings rate is still one of the lowest in the world. The ratio of savings to GDP at factor cost was about 8 per cent in 1989. This is due to low income and gross inequalities in the distribution of income. As much as 43 per cent of the population is estimated to be below the official poverty level. The low level of savings is also due to the absence of efficient financial intermediaries to channel resources into productive sectors.

The Nepalese economy has been facing serious difficulties with respect to international trade and development. The share of exports in GDP was 5 per cent in 1975, increasing marginally in 1990, to 5.9 per cent. By comparison, the share of imports rose from 10 to 14 per cent in the same period. The country's landlocked position and open borders have imposed a heavy cost on its economy. Over the years Nepal has succeeded to some extent in reducing its almost total trade dependence on India, from 82 per cent in 1975 to 22 per cent in 1990, but India has a monopoly over the trade routes. India's protectionist policy also led not only to trade disputes but also to political problems between the two countries. Nepal's exports are primary commodities and its imports are basically capital, intermediate and manufactured consumer goods. As a result of the imbalance in international trade, the country has been facing ever-increasing trade deficit problems. This has led to a large current account deficit, which has more than offset the increasing inflow of aid.

B. Industrial policies and strategies

Before the 1950s Nepalese economic problems were not as serious as they are now. The economy was self-reliant in many ways. The per capita availability of land was fairly adequate and most of the basic needs were met locally. The large number of cottage and village industries scattered throughout the country met almost every need of the society.

It was only after the formulation of the country's first five-year plan, in 1956, that the Government made a committed effort to gradually industrialize the country. One of the objectives of the plan was to revive cottage and small industries. It provided for opening training centres and extending loans as well as technical assistance for this purpose. In June 1958, towards the last phase of the plan, the Government announced its first industrial policy, although in reality "a comprehensive industrial policy was not even evolved until the Nepali Congress took office in 1959" [2]. The Government set up the Industrial Enquiry Commission in September 1959. A development bank, initially known as the Industrial Development Centre, had been created in 1958 to provide institutional finance and make technical and managerial services available to

entrepreneurs. Around the same time the Government also established a timber corporation.

The foreign aid commitment from some donor countries and India's willingness to support Nepal in its efforts to industrialize helped the Government to initiate the process of industrial development. The Government of Nepal, like that of India, adopted a mixed economic framework, wherein public and private sectors would coexist, but without a clear sector demarcation policy. Within this mixed economic framework, the Government accorded priority to the private sector and stated that wherever the private sector could play an effective role, the Government would provide entrepreneurial skill, assure profitability and enact suitable laws to encourage it [3]. However, towards the end of the plan, Nepal received aid for certain import-substitution industries and decided to establish them in the public sector.

A survey of the various industrial policies and declarations announced by the Government during the past three decades shows them to have had five main goals: (a) the attainment of self-reliance in basic commodities such as sugar, cement, pharmaceuticals, cotton textiles, plastic and polythene goods, (b) the encouragement of import substitution in other essential commodities, (c) the promotion of exports of tea, jute goods and skin and hides, (d) the use of labour-intensive techniques and (e) the encouragement of cottage and small industries.

In an attempt to liberalize the economy, especially since the 1980s, the Government has been making efforts to encourage private sector development and attract foreign investment. With regard to the role of the private sector, the Government realized that the existing constraints did not permit the viability of large-scale industries. It thought that only small industries, which are labour-intensive, could be developed. The seventh five-year plan (1985-1990) re-emphasized the need for the full-fledged development of the private sector. It maintained that "an atmosphere which is suited to the economic development has to be created. For this purpose government interferences and control in the investment activities of the private sector and in the price fixing process of goods and services and means of production will be kept at the minimum" [3].

In the 1980s, the Government liberalized its foreign exchange and trade policies. A number of incentives and concessions were offered to foreign investors in areas such as income tax, customs duty, excise duty, sales tax, convertibility of foreign currency, electricity and interest rates, depending on the type of investment [4]. Similarly, protection of various kinds was set in place and other facilities were announced to attract foreign investment. Also, the Government announced an export promotion development policy in November 1983 and established the Foreign Investment Promotion Division in the Ministry of Industry in 1984.

By the middle of the decade, the Government realized the need to integrate industrial policy with macro-economic policy. The seventh five-year plan spelled out economic policies aimed at stimulating savings, investment and productive activities and encouraging the supply of goods and services through private initiative. Although emphasis was given to the growth of the private sector, the Government has been attempting to evolve greater coordination between the public and the private sectors. In 1987, it announced a slightly modified version of the industrial policy of 1981, because, it said, the earlier policy had led to the gross misuse of foreign exchange facilities and promoted the wrong kind of industries in the country, i.e. industries largely based on imported materials. The new Industrial Policy and Industrial Enterprises Act (1987) provided an array of concessions and tariffs for industries based on local materials, with the hope that domestic goods would be some 30 per cent cheaper than their imported equivalents. The industrial licensing system was simplified depending on the import content of the industries. As in the past, cottage industries were given high priority. To reduce regional inequality, the new policy offered a 15-30 per cent tax rebate. It also encouraged industrial development by setting up a stock exchange, and public limited companies were encouraged by concessions in the form of a rebate on corporate tax rates [5].

The Government not only made changes to industrial policies and programmes, but it also increased the volume of its investment in the sector. For example, the share of investment allocated to the industrial sector had been 9 per cent in the fifth five-year plan. This rose to 22 per cent (including electricity) in the seventh five-year plan. Of the total development outlay of NRs 9,190 million in the fifth five-year plan, about NRs 6,170 million was allocated to the public sector and the rest to the private and the *panchayat* sector. The total development outlay increased to NRs 54,110 million in the seventh five-year plan, of which the public sector accounted for NRs 30,150 million, about 56 per cent of the total. The share of the private sector in the total development outlay was 33 per cent in the fifth five-year plan, but this increased to 44 per cent in the seventh five-year plan.

C. The role of manufacturing industries in the country's industrial development

The manufacturing sector plays a vital role in the industrial development of a country. Indeed, industrialization is often synonymous with the development of manufacturing industries. Some who believe in unbalanced development, such as Albert Hirschman, have argued for the development of the manufacturing sector. According to Hirschman, "agriculture certainly stands convicted on the count of its lack of direct stimulus to the setting up of new activities through linkage effects: the

superiority of manufacturing in this respect is crushing" [6]. Countries characterized by a large cottage industry sector are termed pre-industrial economies. The diversification and development of import-substitution industrial policy rests on the growth and development of manufacturing industries. Since many basic needs are manufactured and since economic activities of different magnitudes and at different levels are generally promoted by manufacturing industries, it is this sector that has received the most attention from the Governments of developing countries.

The manufacturing sector of Nepal is characterized by a large number of small, privately owned firms. Most of the large manufacturing industries are public enterprises. According to the *Census of Manufacturing Establishments 1986/87*, 62 manufacturing industries were government-owned, 14 were mixed enterprises, and 21 were joint ventures between domestic and foreign entities. Public manufacturing enterprises contributed over 20 per cent of the total manufacturing employment and almost the same per cent to manufacturing GDP. Owing to poor financial performance, the Government privatized some 20 public enterprises, but without any success. It has not, however, closed them down because that would entail high social costs.

The contribution of the Nepalese manufacturing sector to the country's GDP is much lower than that in most other countries. The average share of the manufacturing sector in low-income countries was about 8 per cent in 1965; this increased to 14 per cent in 1989. The contribution of Nepal's manufacturing sector to GDP in 1989 was 4.8 per cent, which shows that the country's industrial development is still at an early stage. Although in terms of current prices the growth rate of both the GDP and the manufacturing sector was high between 1975 and 1990, the relative share of the manufacturing sector in 1991 was 1.06 per cent.* The sector's contribution to employment is also lower than in other developing countries: it employs about 2 per cent of the total labour force. According to the Central Bureau of Statistics, the number of persons engaged in manufacturing industry was 17,892 in 1965, increasing to 144,925 in 1989 [7], [8]. The manufacturing value added by the

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*The relative share of the manufacturing sector is calculated using Kuznets' formula for calculating the relative share of the agricultural sector:

$$1 + \frac{1}{P_a r_a / P_b r_b}$$

where P_a = product of the manufacturing sector, P_b = total GDP, r_a = rate of growth of P_a and r_b = rate of growth of P_b. The average growth rate is calculated for the period 1975-1990 and the relative share for 1991. For the formula, see Simon Kuznets, *Economic Growth and Structure: Selected Essays* (London, Heinemann Educational Books, 1966).

industrial sector of Nepal is very small, even compared with other countries of south Asia, although its rate of growth is quite high.

There has been very little structural change in the manufacturing industries since the 1960s. The number of industrial establishments rose from 1,260 in 1965 to 9,359 in 1987. This growth shows highly unbalanced development: the central region has the highest concentration of industries, although its relative share has fallen over the years, from 55 per cent in 1967 to 47 per cent in 1987. Between 1967 and 1986 the number of establishments grew by 33 per cent. The industries in the central region accounted for 57 per cent of employment, 65 per cent of value added and 60 per cent of fixed assets as compared with the far-western region, which accounted for only 3 per cent of employment, 2.5 per cent of value added and 5 per cent of fixed assets. This clearly demonstrates that there is widespread regional inequality. Development in the central region, with its better educational and other facilities, has benefited mainly the urban élite and vested interest groups. The highest growth rates were seen in the mid-western and western regions (about 52 per cent and 49 per cent, respectively), mainly because there had been so few industries in these two regions in 1967. While these regions also registered a high growth rate in terms of employment generation, their relative share is still very low: only about 4 per cent and 3 per cent, respectively. They have a similar share in terms of gross fixed assets and value added. Poverty there is acute, and the living conditions of average people are far below those of people in the central and eastern development regions. The unequal regional dispersion of industries can be attributed to the poor infrastructure in the western and mid-western regions.

The pattern of industries in Nepal indicates an early stage of development. The country's industrial sector is dominated by a large cottage industry sector, which is defined by the Government as comprising those industries whose foreign exchange requirements for raw materials, machinery, tools and implements do not exceed NRs 200,000, whose total fixed capital does not exceed NRs 700,000, whose use of energy is no more than 10 horsepower and whose total annual output does not exceed NRs 1.5 million. Based on the size of fixed assets, over 80 per cent of all industrial establishments are classified as cottage industries; they employ 56 per cent of the total number of employees (table 2). Very few industries fall into the categories of small, medium and large industries.

Table 2 indicates the importance of the cottage industry sector in the economy of Nepal in terms of both employment and the payment of wages and salaries. Of the 3,633 industries covered, the number of medium and large industries was only 111 and 67, respectively. Not surprisingly, however, the medium and large industries contributed more in terms of value added and gross fixed assets.

Table 2. Industrial establishments by size, 1986/87
(Percentage)

Industry size group	*Number of establishments*	*Employment*	*Wages and salaries*	*Fixed assets*	*Gross value added*
Cottage	83.5	56.0	42.0	12.8	28.0
Small	11.0	14.1	15.2	13.2	12.8
Medium	3.0	9.5	11.0	14.2	9.4
Large	1.8	19.5	31.5	59.8	49.3
Subtotal	99.3	99.1	99.7	100.0	99.5
Fixed assets not stated	0.7	0.9	0.3	-	0.5
Total	100.0	100.0	100.0	100.0	100.0

Source: Calculated from data contained in Central Bureau of Statistics, *Census of Manufacturing Establishments 1986/87* (Kathmandu, 1988).

The classification of Nepal's industrial sector by major economic activity (table 3) reveals that food processing industries dominate in all size groups; this group of industries is based on agricultural products or the processing thereof and includes dairy products, grain milling and vegetable oils and fats. The second largest group in all but medium-size industries is textile manufacturing. This means that Nepal is at an early stage of industrialization, concentrating heavily on industries that produce basic needs such as food and clothing. The early stage of industrialization is also revealed by the relatively small number of industries involved in capital-intensive activities such as the production of iron and steel and electrical machinery.

Most industries in Nepal are labour-intensive and are widely dispersed. Owing to geographical barriers and a lack of adequate infrastructure, most of them, especially those in the cottage industry sector, serve only a small local market. Cottage and small industries do, however, enjoy cost advantages *vis-à-vis* large industries in terms of supply of raw materials and transportation costs: while many large industries are located in areas where adequate infrastructure exists, in a country like Nepal the cost of transporting raw materials is quite high. Another advantage of small industries in the Nepalese context is their vertical specialization and their ability to cater to the basic needs of the population, which has extremelty limited purchasing power, by providing goods at affordable prices.

Table 3. Number of manufacturing establishments by type of economic activity, based on size of gross fixed assets

NSIC	*Cottage industries*	*Small industries*	*Medium-sized industries*	*Large industries*
Food processing	621	150	47	18
Beverage	15	13	2	7
Tobacco	55	7	1	1
Textiles	457	33	8	11
Wearing apparel a/	68	19	4	1
Leather products	1	6	3	1
Wood products	307	20	4	2
Furniture/fixtures	282	6	3	0
Paper and paper products	18	9	0	2
Printing and allied	296	27	3	0
Other chemical products	55	20	14	7
Rubber products	12	8	2	0
Plastic products	40	8	6	0
Glass and glass products	1	0	0	0
Non-metallic products	461	38	1	7
Iron and steel industries	23	3	3	5
Non-machinery fabricated metal	264	23	5	2
Electrical machinery	16	6	2	3
Other manufacturing industries	39	6	3	0
Total industries	3 034	402	111	67
Classified by numbers of persons engaged b/	1 579	1 387	301	360

Source: Central Bureau of Statistics, *Census of Manufacturing Establishments 1986/87* (Kathmandu, 1988).

a/ This group also includes footwear.
b/ 1-19, cottage; 20-49, small; 50-99, medium; and 100+, large.

D. Performance of the industrial sector

Nepal is a country with a saturated and stagnant agricultural economy. The high rate of population growth and low productivity in the agricultural sector reflect the country's low level of development. Non-

agricultural employment is extremely limited. Until now, a number of industries have been set up, but they cater to the needs of the urban population. Many are merely assembly-type industries with limited scope for generating employment and income. The overall performance of the industrial sector has not been satisfactory. Since the country depends heavily on imported raw materials, intermediate and capital goods, the irregularity of supplies and the increasing cost of transport and fuels have made its industries cost-inefficient. The open border with India and the competition that results, especially from a country that is better industrialized and enjoys economies of scale, have threatened the existence of a large number of industries.

1. Industrial structure and production

The industrial structure in Nepal reveals the beginnings of a transition from subsistence agriculture to an early stage of industrial development. Of the industries covered in table 3, about 61 per cent were grain mills, which only provide industrial services.

The large number of industrial units is misleading: when the contribution of the industrial sector to national employment and gross domestic product is considered, it is seen to be insignificant. In fact, the sector comprises a myriad of industries that are small in terms of their assets. About 84 per cent of all industrial units have fixed assets of NRs 700,000 or less, which means they are cottage industries according to the definition of the Government.* Of all the industries, 402, or 11 per cent, had fixed assets between NRs 0.7 million and NRs 3 million and were classified as small or medium-size industries. Only 67 industries, or 1.8 per cent of the total, were large industries having fixed assets of more than NRs 10 million. These large industries were dominated by agro-based industries, such as dairy and grain mill products, and capital-intensive industries, such as soft drinks and beer manufacturing, iron and steel and cement and structural clay industries. Interestingly, the large industry sector did not create the largest percentage of employment opportunities. The market base of the industrial sector has widened over the years owing to the gradual expansion of infrastructural networks. Industries such as those that make soap, furniture, cotton textiles, shoes, cigarettes and *biris* (local type of cigarette) have expanded their market base in most of the townships of Nepal. These are also the industries with a high effective rate of tariff

*According to the Ministry of Industry and Commerce (*Industrial Policy 2037*, Kathmandu, 1981, p. 11), cottage industry "denotes an industrial enterprise in which investment in machinery, equipment and tools does not exceed NRs 200,000 in value and in which fixed assets do not exceed NRs 500,000".

protection. According to one study, the effective rates of protection for furniture and soap in 1982 were 10,989 per cent and 4,633 per cent respectively ([9], table A-10). Other industries that enjoyed high effective rates of protection were iron and milk and milk products.

The increase in the production of goods such as cigarettes and *biris* will have significant effects on industrial value added, employment and income because their share of total industrial production has been so large (for example, 20 per cent in 1987). The production of soap grew some 88 per cent between 1979 and 1990, shoes grew 40 per cent and liquor grew 28 per cent. Some urban-based industries also grew impressively, for example, soft drinks, beer, cement, synthetic textiles and bricks and tiles (see table 4), but there has been a negative growth rate for sugar, which is a basic necessity. The expanding output of some of the industries indicates that the Government is succeeding to a considerable extent in realizing the goals of its import substitution policy. However, owing on the one hand to the constant depreciation of the national currency, which makes it more expensive to import the necessary inputs and increases the cost of transport and on the other hand to the lack of effective competition, the import substitution policy may have been only partially successful. Since one of the policy goals of the *panchayat* system was to reduce the dependence of Nepal on its neighbours, economic efficiency may have been sacrificed for political interests.

Table 4. Production of selected major industries and average annual growth rates, 1979-1990

Type of industry	*Unit of production*	*Production*		*Growth rate (%)*
		1979	*1986-1990 Average*	
Jute goods	Tonnes	15 520	15 260	-0.1
Sugar	Tonnes	27 200	24 790	-0.8
Cigarettes	Million pieces	2 069	5 638	15.7
Matches	Thousand gross	724	1 234	6.4
Liquor	Thousand litres	455	1 843	27.7
Soap	Tonnes	1 121	11 949	87.8
Shoes	Pairs	55 779	297 888	39.5
Leather	Thousand pieces	1 320	2 083	5.3
Agricultural tools	Tonnes	179	332	7.8
Tea	Tonnes	326	1 124	22.2
Stainless steel utensils	Tonnes	294	332	1.2
Bricks and tiles	Thousand pieces	12 403	29 337	12.4

continued

Type of industry	Unit of production	Production 1979	Production 1986-1990 Average	Growth rate (%)
Beer	Thousand litres	1 181	4 797	27.8
Cotton textiles	Thousand metres	2 429	10 839	31.5
Cement	Tonnes	21 019	156 306	58.5
Biscuits	Tonnes	2 037	4 454	10.8
Plywood	Thousand square feet	1 809	1 431	-1.9
Synthetic textiles	Thousand metres	1 775	11 182	48.2

Source: Calculated from the data contained in National Planning Commission, Central Bureau of Statistics, *Statistical Yearbook of Nepal 1991* (Ramshah Path, Kathmandu).

Most of the industries that registered impressive growth rates over the last decade were based on the use of local raw materials. Production data for the period between 1987 and 1989 indicate that some of the industries, such as vegetable ghee, soft drinks, cotton textiles, synthetic fibres and bricks and tiles, were affected by the trade and transit impasse with India. But the effects were industry-specific, as the production of other goods that relied on imports was not much affected. Moreover, although the impasse affected some urban-based industries, average growth rates were quite high. These urban-based industries, which are mainly assembly industries (e.g. garments made of synthetic fibres, television sets and watches) and are based on imported raw materials and intermediate products, have grown considerably over the last decade. However, in terms of their contribution to employment, income and linkages in the national economy, they have not made any significant progress. On the contrary, they have been relying on government support for foreign exchange finance at a concessional rate, enhancing the scope for currency misuse and speculation. Other industry groups that have grown over the years are carpets and garments, hides and skins and handicrafts, which are mainly export-oriented. For example, the number of carpet and rug manufacturing industries increased from 122 in 1987 to 131 in 1989, accounting for about 10 per cent of the total employment in industries that engage 10 or more people. These industries also depend to a large extent on imported raw materials. The foreign exchange earned by them is often used for importing consumer goods from overseas, a large percentage of which are then illegally exported to India, making exchange rate control difficult and draining reserves of foreign exchange.

A study of the comparative performance of the industrial sector by plant size gives some interesting results (table 5). The cottage industry

sector has fewer working hours than the medium-size and large industry sectors. This is mainly because many cottage industries are run by family members as part-time employment. About 20 per cent of all industries employ a maximum of 4 persons, and industries employing 10 persons or fewer constitute 44 per cent of all industries. Another reason is that a considerable number of industries in the cottage industry group are highly seasonal. Workers in large industries work slightly more hours per day than the average, which can be explained by the high capital intensity. The figure for capital intensity in this group is NRs 97,340 per person engaged, which means that industries with a higher level of capital intensity tend to maximize the use of labour.

Table 5. Indicators of efficiency in manufacturing industries by size

Indicator	*Cottage*	*Small*	*Medium*	*Large*	*Average*
Hours worked per day	4.96	6.01	8.37	10.8	7.53
Capital productivity a/	2.01	0.88	0.60	0.75	1.06
Labour productivity b/					
Per worker (thousands of NRs)	13.45	25.20	28.45	73.76	35.29
Per man-hour (NRs)	7.52	11.77	9.43	18.93	11.91
Capital intensity c/					
Per worker (thousands of NRs)	6.68	28.85	46.85	97.34	44.93
Per man-hour (NRs)	3.73	13.32	15.54	24.98	14.39
Wages paid					
Per worker (thousands of NRs)	5.43	7.78	8.37	11.66	8.31
Per man-hour (NRs)	2.79	3.44	2.73	2.98	2.98

Source: Calculated from the data contained in various publications of the Central Bureau of Statistics.

a/ Capital productivity is defined as value added/fixed assets.

b/ Labour productivity is defined as value added/persons engaged and as value added/total man-hours worked.

c/ Capital intensity is defined as fixed assets/number of persons engaged and as fixed assets/total man hours worked.

2. Factor input coefficients (the rate of technical substitution)

The factor input coefficients indicate how efficiently the various industry groups have combined the different factors of production so as to minimize costs. No time series data on output or various inputs are

available either in terms of fixed assets or number of persons engaged. Data for a particular industry group by size are also not available, which makes it impossible to compare the relative technical efficiency of industries according to their size. Factor inputs and other data for industries grouped by amount of fixed assets are available for a single year, 1987. Based on these data, factor input coefficients (capital and labour coefficients) were first calculated by size group and then compared using pairwise combinations (table 6).

Table 6. Technical efficiency ratio of pairs by size

Pair	*Technical efficiency ratio a/*
Cottage-small	-7.18
Cottage-medium	4.62
Cottage-large	-0.45
Small-medium	1.00
Small-large	-0.19
Medium-large	-9.15

Source: Calculated from the data in Central Bureau of Statistics, *Census of Manufacturing Establishments 1986/87* (Kathmandu, 1988).

a/ Technical efficiency ratio = $(k/v_a - k/v_b) - (l/v_a - l/v_b)$, where k = gross fixed assets, l = labour (measured in terms of wage payments), v = value added, and a and b are industry pairs, for example, cottage-small.

The results indicate that medium-size industries, that is, industries with a fixed capital investment between NRs 3 million and NRs 10 million, are technically more efficient than other size industries. Both the capital and labour coefficients are lowest in this size group. According to the coefficients, NRs 1,000 of value added can be produced by a fixed capital investment of NRs 130. Although the labour coefficient, measured in terms of total wage payments, is lower for large industries, the average coefficient (capital and labour) is lower for medium-size industries. Medium-size industries constituted only about 3 per cent of all industries: 22 per cent of all the industries in this group made grain mill products and 10 per cent made chemical products.

When the size groups were paired, cottage industries were more efficient than either small or large industries. However, they were less efficient than medium-size industries. Similarly, small industries were technically less efficient than medium-size industries but more efficient than large industries. One interesting result of this analysis is that

technical efficiency increased with size, but only up to the medium range. Another outcome of this analysis is that large industries were inefficient on all counts. Large industries accounted for 2 per cent of all industries and were concentrated in bakery products, iron and steel, electrical apparatus and glass and glass products.

3. The relative factor price ratios

The average factor input coefficients indicate that the medium-size industries are technically efficient, with an investment of NRs 45,000 generating one job. However, technically efficient firms may or may not be economically efficient since the factor input ratios may or may not be equal to the factor price ratio. For firms to be both technically and economically efficient at a given level of production, the marginal rate of technical substitution between factors of production should be equal to the ratio of input prices.

Because there are no time series data, no breakdown of data by size and market wage rate, and no information on the opportunity cost of capital and labour, it was not possible to compare technically efficient medium-size firms in Nepal with other size firms. The same size firm should have used more labour and less capital to produce a given level of output. However, a rough comparison between the technical rate of substitution (average factor input coefficients) and the factor price ratio (average wage rate and average bank lending rates) by size group indicates that firms did not determine their capital labour combinations on the basis of optimum substitution possibilities. Contrary to the expected isocost curves, where higher capital inputs are combined with lower labour inputs, firms in Nepal used more capital and more labour as they moved from cottage to larger scale industries. The average capital investment for a cottage industry was NRs 174,000. The level of both capital and labour increased as the size of industries increased: for example, the average capital investment for small industries was NRs 1,372,000 and the average number of employees was 48; the corresponding capital investment for medium-size and large industries was NRs 5.3 million and NRs 36.9 million, respectively. There are two possible explanations for this: (a) firms used less capital than would be expected by increasing size or (b) owing to labour market imperfections, firms found it profitable to use extra labour rather than capital and so tended to be labour-intensive.

Capital costs are high in Nepal as are the costs of imported capital and intermediate goods. Labour is cheaper than capital and abundant, especially unskilled labour. The marginal cost of an extra unit of labour is zero because of elastic supply at the minimum wage rate, so firms have a tendency to minimize the use of capital. However, as indicated, capital intensity increased as plant size increased.

E. Relative efficiency by economic activity

In so far as comparative efficiency by sector size is concerned, industry groups differ widely if compared in terms of capital and labour productivity separately. The cottage industry sector, which is highly labour-intensive, turns out to have higher productivity per unit capital. Medium-size and large industries, which are more capital-intensive than cottage and small industries, are less efficient (the medium-size industries are even less efficient than the large industries). In terms of labour productivity, however, the cottage and small industries are less efficient than the medium-size and large industries. This is due to the large number of persons engaged relative to capital. Factor substitution and the use of technology vary across plant sizes, as does labour productivity. Salaries and wages paid by cottage industries are less than for the other groups. Small industries have the highest hourly wage rates.

When the performance of the manufacturing industries by economic activity is compared (table 7), the results are mixed. Judged in terms of capital productivity, industries such as tobacco, wearing apparel, non-metallic products and leather products are the most efficient, i.e value added per unit of capital is highest. In general, the capital-intensive industrial groups are less efficient than the labour-intensive groups, and labour-intensive industries (for example, wearing apparel) are labour-inefficient. But interestingly, some of the capital-efficient groups are less efficient if judged in terms of their labour productivity. For example, non-metallic products have the lowest labour productivity, and wearing apparel is also one of the least efficient industries in terms of labour productivity. There are other groups of industries, such as paper and pulp, that are inefficient in terms of both capital and labour productivity. Still other groups of industries have higher capital and labour productivity. The food processing industries fall in the category of industries that have the same level of capital and labour productivity. To examine the overall efficiency, the average factor input coefficients were calculated. These coefficients indicate the average input ratio per unit of value added.

Table 7. Relative efficiency of manufacturing industries by major activity

NSIC	*Capital productivity a/*	*Labour productivity b/ (1,000 NRs)*	*Average factor input coefficients c/*	*Wages per paid employee (1,000 NRs)*
Food processing	0.75	39.83	0.75	7.42
Beverage	0.62	78.79	0.88	8.80
Tobacco	3.84	73.73	0.18	7.93
Textiles	0.65	23.76	0.74	8.60
Wearing apparel d/	3.54	21.18	0.35	8.70
Leather products	1.69	122.94	0.32	9.32
Wood products	0.75	19.34	0.86	9.04
Paper and paper products	0.26	21.97	2.05	7.66
Printing and allied	0.87	23.14	0.75	11.15
Other chemical products	0.59	37.31	0.96	9.19
Non-metallic products	3.29	12.17	0.32	4.28
Iron and steel industries	0.74	79.66	0.73	7.50
Non-machinery fabricated metal	0.95	28.60	0.70	10.94
Electrical machinery	0.82	77.63	0.68	6.33

Source: Calculated from data available in Central Bureau of Statistics, *Census of Manufacturing Establishments 1986/87* (Kathmandu, 1988).

a/ Value added/fixed assets.

b/ Value added/number of employees.

c/ The average factor input ratio is calculated as fixed assets/value added + wages/value added.

d/ This group also includes footwear.

F. Industry, employment and poverty

It is obvious that there has been a sizeable expansion of manufacturing industries in Nepal since 1965. Not only has the number of establishments increased but there was also some increase, in absolute terms, in the number of persons engaged. Manufacturing value added, which is the increment to the value of goods and services created by industries and is a good measure of performance across industries and regions, also went up impressively in the last two decades. However, the growth in the number of industries has not matched the growth in

industrial employment. Industries are dominated by family or individual proprietorship. In 1987, about 75 per cent of them were sole proprietorships, 11 per cent were private limited companies and 10.6 per cent were partnerships; private limited and public limited groups had just 1 per cent each. Theoretically, legal status and the number of employees are not correlated; logically, however, legal status to a large extent determines the amount of capital. For example, 76 per cent of the dairy products industries were sole proprietorships and 88 per cent of them had fixed assets of less than NRs 700,000. In all, 84 per cent of the manufacturing industries had fixed assets of less than NRs 700,000. This is reflected in the limited employment opportunities created by industries that are sole proprietorships and that fall into the grey area between small and medium-size industries. For example, the dairy products sector employed 1.4 per cent of all persons engaged. Similarly, of the 404 grain mill products enterprises, some 76 per cent were sole proprietorships. Some 70 per cent of the industries in this group were small or medium-size, i.e. they had fixed assets of less than 700,000 NRs. This group accounted for only 5 per cent of the total persons engaged. However, it should be noted that 13 per cent of the industries in this group were privately owned.

The creation of employment opportunities and value added by this sector was not commensurate with its large size. On the other hand, the 2,054 industries that employed 10 or more people accounted for 94.1 per cent of employment, 91 per cent of output and 94 per cent of value added [10]. As stated in a UNIDO report, "overall, there is a slow shift in shares of total manufacturing production from the cottage industry to the organized sector" [9]. Cottage industry activities are concentrated on food processing, grain and cereal milling and the making of clarified butter. Other activities that satisfy market needs are cotton fabrics, floor coverings and bamboo products. The urban-oriented consumer goods sector (for example, grain milling and brick making) is relatively large. Most of the industries are family concerns, and growth in their number did not really do much to absorb the unemployed or underemployed labour force. For example, of the total of 3,633 industrial establishments, about 19 per cent, or some 697 establishments, employed between 1 and 4 persons; of these, 431 establishments belonged to two sectors: grain products and saw mills. The greatest proportion of industries, 26 per cent, employed between 10 and 19 persons. Industries that employed over 100 persons numbered 366, or some 10 per cent of all industrial establishments; this category was dominated by one industry, structural clay production: of the 366 industries engaging more than 100 employees, 187 fell into this category. Industries producing wearing apparel numbered 41. A few industries, especially a few urban-based industries such as baked goods, cigarettes and *biris* (local cigarettes), soft drinks and carpets and rugs, could be considered large-scale industries, having employed over 200 people per unit. Only six industries had over 1,000 employees each. These industries were in the eastern and

central regions. Even in the category engaging between 500 and 999 persons, 14 of the 15 industries were located in these two regions. The western, mid-western and far-western regions had mainly small and cottage industries. Particularly since the early 1980s, export-oriented industries producing carpets, garments and fabrics have emerged as a result of the trade concessions offered by industrialized countries to developing countries.

It is clear that despite the considerable increase in the size of industries, the industrial sector has not contributed much to reducing unemployment and underemployment in the country. Only a few industrial units engage unskilled labour, which means that poor people have extremely limited access to industrial employment. One report estimated that "only about 20 per cent of the jobs are unskilled, and because plants are located in urban areas where the poor are not" ([11], p. 63). Most of the industrial employment demanding unskilled labour is concentrated in weaving and construction in the Kathmandu Valley and in *biri* making, jute and grain mills in the Tarai area. The wages and salaries paid to unskilled workers ranged between NRs 50 and NRs 60 per day in the Kathmandu Valley and between NRs 40 and NRs 50 in the Tarai area in 1989/90, which was slightly higher than the estimated income needed to meet basic needs.

G. Industry and agriculture: the missing nexus

One fundamental flaw in the industrial planning and strategy of the *panchayat* system was its failure to establish not only interindustry linkages but also industry-agriculture linkages. Too much importance was given to structural changes that neglected the role of agriculture. Until the 1970s, investments were heavily biased towards socio-economic overheads and industry. The Government realized the problems the agricultural sector was facing, especially when it started to lag behind population growth, turning the country from a food exporter into a food importer. Although there are industries that are agro-based, such as the rice mills and oil extraction industries, they do not contribute directly to increased agricultural productivity. There has been very little investment in industries such as fertilizers, affordable agricultural tools and equipment, rural financial institutions, agricultural and non-agricultural marketing boards etc. The development of modern industries led to the demise of the cottage and informal sector, which was based on traditional technology and skills. Because industries were located in urban areas, there could not be direct industry-agriculture linkages owing to transport and other institutional bottlenecks. It should be reiterated that without first increasing productivity and thereby the incomes of the majority of the agricultural population, it will be difficult to attain economic development in the country. The history of the industrial revolution in

Nepal suggests that it was more nearly an agricultural revolution ([12], [13]). According to Bairoch, "agriculture played a major part in the birth of the modern iron and steel industries in England without which all the technical advances that characterized the industrial revolution would have been made impossible" [14]. Industrial development implies changes in the attitudes, beliefs and habits of the population, and these changes cannot be brought about without changing the agricultural sector, which is the hub of sociopolitical and cultural activities in Nepal as well as the main livelihood for an overwhelming proportion of the population. Industry should bring about a change in rural society by modernizing the agricultural sector, thereby creating, nationwide, the conditions for sustained industrial development.

H. Industry, trade and balance of payments

Industry, trade and balance of payments are directly interrelated. Some countries have followed an outward-oriented industrial strategy to augment the flow of export earnings so that greater industrial efficiency could be attained at home. Others have followed an inward-oriented, or import-substitution, strategy to restrict the outflow of foreign exchange so that they could maintain a favourable balance of payments position and also attain allocative efficiency in meeting at least the most essential imports. However, no country can follow one or the other strategy exclusively, and there has been some policy mix between the two strategies. In an import-substituting type of strategy, the main goals are to attain allocative efficiency in the use of foreign exchange so that over time either the domestic industrial base is widened or domestic goods are produced at prices that are economically efficient compared with international prices. An outward-looking industrial strategy has an even stronger effect on the industrial structure. Industries expand their economies of scale, they import technology and they increase the use of local resources. The balance of payments position should be more favourable under an outward-oriented strategy. However, countries that have followed import-substitution strategies generally have an unfavourable balance of payments position.

Nepal has sought to follow a dualistic industrial strategy, especially since the mid-1970s, by adopting both inward- and outward-oriented policies, with the emphasis, however, having been on the former. Both strategies have implications for the country's balance of payments and external trade. One of the arguments in favour of an import-substitution strategy was declining export earnings. It was thought that over time the country would not only become self-reliant in the supply of some essential goods but also save foreign exchange. However, the experience of the 1960s and 1970s indicates that although Nepal partially succeeded in producing some of the essential commodities, the strategy did very

little to save foreign exchange. It was for this reason that the Government also began to emphasize exports. However, despite its promotion of exports, they have been lagging far behind the volume of imports. In 1967-1990, exports grew at an average annual rate of 10.5 per cent and exports of manufactured goods grew at 43 per cent. At the same time, however, imports grew at 38 per cent and imports of manufactured goods grew by 72 per cent. Although exports of manufactured goods seem to be highly correlated with imports of manufactured items (the regression equation between these two variables shows that $R^2 = 0.909$), the gap between the two is substantial and has been widening. The trade gap increased from $3 million in 1967 to over $400 million in 1990. Similarly, the gap between manufactured imports and exports also increased, from $17 million in 1967 to $375 million in 1990. Rising imports and stagnating exports are quite damaging for the country's weak macro-economic structure. On average, exports during this period constituted about 6 per cent of GDP whereas imports constituted 15 per cent. The ratio of manufacturing exports to GDP was 2, as against 9 for imports of manufactured goods. This means that the country's savings and investments possibilities are being eroded by rising import bills.

Of 56 industries, some 39 were dependent on imports of raw materials and intermediate goods. About 55 per cent of the raw material needs of these industries were met internally and about 80 per cent of the goods were for internal consumption. This shows that a large percentage of the industries were of the import-substitution type. However, there is a considerable foreign exchange deficit in the industrial sector. These industries imported NRs 2,485 million worth of goods in 1988/89 but exported some NRs 2,100 million worth of goods, 90 per cent of them to a market other than India. Thus, there was a deficit of NRs 385 million, approximately $13 million, in that year.

I. Conclusions

There has been substantial growth, at least in the number of industries, in the last two and a half decades. The ability of industries to meet some of the domestic needs has improved compared with the situation in the early 1960s; however, at that time demand was limited to demand for basic necessities. The contribution of industries in terms of employment, value added, domestic savings, investment, capital formation and balance of payments has, however, been very limited. Despite all the incentives and concessions offered by the Government, the industrial sector has not been able to absorb the surplus labour force. The fact that this sector, including the cottage and small industries, employs only about 10 per cent of the total labour force means that not much headway has been made in industrializing the country. Over 90 per cent of industrial establishments are cottage industries; they engage about the same

percentage of industrial employment but account for only about 20 per cent of manufacturing output. Stagnation in the agricultural sector and, more particularly, the fact that food production is growing more slowly than the population mean that the industrial sector has failed to link its activity with that of the agricultural sector.

Certain inherent difficulties have hindered the process of industrialization: the country's rugged terrain; its landlocked situation and great distance from the sea, accompanied by the onerous administrative and policy-oriented restrictions imposed by India on transit;* the fact that 60 per cent of the population has an income below the poverty line; the country's shortage of skilled labour, raw materials and natural resources; and the prevailing higher capital-labour ratios. The immature state of the banking system and people's preference for investing in real estate have posed additional problems. The Government has offered generous industrial concessions and facilities, but it has a dual policy so far as trade and industry are concerned. Nepal's trade policy has been guided by diversification so as to avoid political costs. In doing so, the Government introduced a liberal, or free-trade, regime. This policy was also looked upon as an effective means of resource mobilization. But it did not really favour domestic industries very much because domestic products could not compete with foreign products. The long but porous border on the south has seriously constrained Nepal's industrial development. However, as the country has to depend on imported raw materials and capital and intermediate goods, "there would exist the possibility of large-scale smuggling of goods imported from third countries to India and a consequent rundown of Nepali hard currency reserves" [11]. There has long been a market for the goods of agro-based industries such as rice mills, which account for the largest number of industrial establishments, and oil extraction plants. The inflow of aid, the expansion of tourism and an advocacy programme have encouraged modern, urban-centred industries that cater to the needs of the urban population. Over the years, the Government promoted, in theory, a wide variety of industries for investment. In reality, however, the people working for the *panchayat* system resisted implementing that policy. As stated in the interim government report, "the industrial sector has been led in an unwarranted direction beneficial only to a small class, and to smuggling, as trade, customs and industrial policies adopted over the past 30 years were not honestly implemented. Under the slogan of industrial

*This is a serious constraint: "Imported inputs entering Nepal by surface must be transshipped via Calcutta, the only point of entry for Nepal permitted in India. From the ship in Calcutta to the factory loading docks in Nepal, goods may require handling as many as 15-17 times for reasons such as the need to change rail system in India, trucking arrangements between the countries requiring separate handling on both sides of the border, delays in customs in both countries and lack of adquate handling equipment, particularly in Nepal" ([12], p. 34).

development and trade diversification, conditions have been created whereby investors are more interested in making millions overnight" [15]. There appears to have been a coalition of interest between politicians and businessmen. Rent-seeking activities were sought after by businessmen and potential investors. They lobbied for industrial permits or licences that would lead to (a) duplicity of capital investment, (b) protection of the monopoly of another business or industrial group and (c) distortions in economic development in general and industrial development strategies in particular. Corruption and lobbying by interest groups paved the way for two kinds of benefits for the industrialist and business community: obtaining licences in areas that had previously been restricted and receiving foreign exchange and other concessions that could be misused by overinvoicing or other means. Licences were issued for industries that did not contribute much in terms of value added (for the assembly industries, for example, which misused resources). According to the interim government report, "under the pretext of simplifying licensing procedures, priority has been placed on setting up industries based on foreign raw material. To justify such practices, further licenses are then issued, under pressure, and in the name of competition. But in practice, the licensee, far from being interested in setting up his enterprise, has found an easy way of extracting money from existing industries. ... Similarly, unnecessary customs hikes are imposed on imports to promote industries like synthetic fabric, protecting the investor's capital, but at the same time promoting an artificially created high cost industrial sector" ([15], p. 10).

Study shows that the Government's industrial policy was guided by two interrelated goals: to promote import-substitution industries and to reduce the country's dependence on India. A greater dependence on India for both consumer and capital goods often led to political problems for Nepal. The huge trade deficit on the one hand and the dependence on transit for overseas goods on the other hand caused considerable political tensions between the two countries. Hence the Government made every effort at the domestic level (for example, a liberal trade policy) as well as at the foreign level (seeking assistance from China or the former Soviet Union in developing industries) to reduce its economic dependence. Most of the industries that enjoyed high tariff protection, both nominal and effective, produced consumer goods for the urban population. The country also had a sizeable proliferation of cottage and small industries. However, most of them produced for household consumption and served a market of only a small radius, and they were labour-intensive and dependent on local raw materials and technology.

As industries grew in scale, their degree of capital intensity increased. Although most of the large industries used more capital than labour, they were mainly in the consumer goods sector and supplied goods for the consumption of the urban population. On the basis of technical efficiency by size and type of economic activity, the medium-size

industries were more efficient because they had a lower cost per unit value added. It is also observed that large industries were less efficient in respect of both labour and capital productivity owing to diseconomies of scale. The situation in Nepal supports a great deal of recent empirical research that "has buttressed the case against the view that contemporary economic development depends and will continue to depend almost entirely upon large firms" [16]. The per capita income level and geographical constraints both explain the relative inefficiency or diseconomy of scale of large plants in Nepal. However, owing to lack of data, economic efficiency could not be measured. Generally, larger firms used more labour per unit of output.

These results imply that Nepal should focus on enhancing the capabilities and potentials of its cottage and small industries as well as its medium-size industries. It has been observed that "comparative studies of the industrial structure of economies in different countries do not suggest any correlation between the importance of large firms and level of output, or the rate of economic growth" [16]. The growth in the number of large firms depends on the expansion of socio-economic overheads as well as on the improvement of economic relations between Nepal and India. Prospects for the latter are promising as India introduced economic liberalization measures in 1991. Its export-import policy, announced in the first week of April 1992, also relaxed many licensing restrictions and quotas on foreign trade. This will require Nepal to refocus its industrial and trade policies. However, in view of the geographical constraints (i.e. the mountainous terrain, which impedes industrial diffusion in the country), the Government should encourage the development and expansion of the cottage and small industries. It should set up a commission or board to examine the problems these industries face in regard to capital financing, markets, technology and raw materials. It must be emphasized that significant gains in employment and output can spring from the cottage and small industries. Wherever possible, it should try to establish linkages between industries so as to create favourable conditions for medium-size as well as large industries.

Industrial development is only a means and not an end in itself. The Government should design an industrial strategy in the context of overall, country-wide economic objectives and not merely on a sector-wide basis. In devising an industrial strategy, national development goals and objectives should be well-defined and the role of the industrial sector should be examined together with that of the agricultural, infrastructural and social sectors. This would help not only to coordinate the various sectors of the economy but also to create conditions in which there would be continuous interaction between interdependent sectors. This is important for a country that is constrained by several demand and supply bottlenecks, one of which is the limited domestic market and another the low per capita income. Once the national development strategies or macro-economic objectives have been determined, a long-range industrial

strategy can be formulated that focuses on both sectoral programmes and specific projects and considers the complementary inputs, the existing infrastructure and the available resources, including human resources and foreign exchange. Of particular importance for Nepal are interindustry linkages as well as the linkages between industry and agriculture.

In view of Nepal's existing political and economic situation, the major goals an industrial strategy should pursue are gainful employment for the surplus labour force, the meeting of basic needs, a gradual uplifting of the living standard of the population and a reasonable degree of equality in income distribution. In formulating an industrial strategy with such goals, the Government should examine the existing bottlenecks and the possible contradictions in short-term and long-term goals and policy goals. One particular consideration in planning an industrial strategy in the Nepalese context is how to target the majority of the population that is poor and scattered over 4,015 villages. The existing road network and the moun-tainous and rugged nature of the country have inhibited a balanced industrial dispersion across regions and limited the size of domestic markets by imposing staggeringly high transport costs. However, it should also be borne in mind that the geographical diversity provides Nepal with different comparative advantages based on location; these should be exploited to reduce regional inequalities. This should help the Government to identify an output mix in its industrial strategy. Any industrial strategy should aim at exploiting locational advantages, although it should do this not by compartmentalizing the regions but by linking them together. The idea is not to support a balanced regional develop-ment but to achieve what Higgins described as "functional relationships among the major sectors and regions of an economy" [17].

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SOMMAIRE

Mise au point des technologies, impact des technologies et stratégie industrielle : étude de ces trois éléments

Sanjaya Lall

La mise au point de technologies est un processus mal appréhendé dans les études consacrées à l'industrialisation. L'article examine les résultats de travaux récents et recherche les liens existant entre la mise au point des technologies, la réussite industrielle et les importations de technologies. L'auteur analyse les problèmes que soulève, du point de vue des grandes orientations, la nécessité d'encourager la mise au point de technologies autochtones et soutient que des interventions réfléchies et sélectives de l'Etat ont un rôle positif important à jouer.

Changements techniques dans l'industrie chinoise : les systèmes d'incitations

Liu Wei

L'article analyse le système d'incitations destiné à induire des changements techniques dans les entreprises industrielles chinoises. Selon l'auteur, il faut distinguer deux catégories d'incitations : celles qui encouragent l'affectation efficace des ressources et celles qui stimulent l'innovation et les changements techniques ("l'efficacité dynamique"). Ces dernières, à leur tour, peuvent prendre la forme d'incitations directes ou indirectes.

L'analyse des systèmes d'incitations en vigueur en Chine porte sur deux périodes distinctes : la période d'économie planifiée allant jusqu'à la fin des années 70 et la période d'économie mixte, caractéristique des années 80. Elle révèle que, pendant la phase d'économie planifiée, des pressions contradictoires ont été exercées sur les entreprises pour qu'elles introduisent des changements techniques, tandis que durant la période d'économie mixte le gouvernement a progressivement mis en place un système d'incitations assez complet, principalement axé toutefois sur les incitations "indirectes". La conclusion de l'analyse est que le gouvernement devrait s'efforcer de mettre en place un système équilibré comprenant à la fois des récompenses et des pressions pour les changements techniques.

Classification et dualisme des industries chinoises dans les années 80

Xiaohe Zhang

Utilisant une classification indépendante comprenant 40 branches de l'industrie manufacturière chinoise, l'auteur de l'article estime que l'émergence d'entreprises rurales a amélioré la structure industrielle du pays, mais que le phénomène n'a pas été assez fort pour éliminer le dualisme entre un secteur urbain à forte intensité de capital et un secteur rural à forte intensité de main-d'oeuvre (et qui a des activités tant agricoles que manufacturières). Or, de nouveaux gains pourraient être réalisés sur le plan économique si l'on parvenait à supprimer ce dualisme en encourageant la mobilité des facteurs et en éliminant les distorsions entre les prix.

Industrialiser l'économie agricole de subsistance du Népal

Narayan Khadka

Le Népal, pays très pauvre à la base industrielle très restreinte, s'est efforcé sans grand succès de transformer son économie. L'auteur de l'article examine les politiques industrielles suivies par le Népal au cours des 30 dernières années, évalue les caractéristiques de l'activité industrielle, en mesure le rendement par secteur et propose un changement de cap en vue d'améliorer la contribution de l'industrie à l'économie.

EXTRACTO

Desarrollo tecnológico, impacto de la tecnología y estrategia industrial: análisis de problemas

Sanjaya Lall

El proceso del desarrollo tecnológico no se suele captar adecuadamente en las distintas publicaciones sobre industrialización. En este trabajo se examinan las últimas conclusiones sobre el tema y se determinan las relaciones entre desarrollo tecnológico, éxito en la industria e importaciones de tecnología. También se analizan las cuestiones de orden normativo que plantea la necesidad de fomentar el desarrollo de tecnología nacional y se arguye que las medidas de intervención gubernamental cuidadosa y selectiva seguirán desempeñando un importante y positivo papel.

Cambios técnicos en la industria china: sistemas de incentivos

Liu Wei

El propósito del artículo es analizar el sistema de incentivos destinado a generar cambios técnicos en las empresas industriales chinas. En el artículo se señala que el concepto de incentivos entraña dos cuestiones diferentes: incentivos para la distribución eficiente de recursos e incentivos para la innovación y el cambio técnico (es decir, eficiencia dinámica). Se señala además que los incentivos para lograr una eficiencia dinámica a largo plazo adoptan dos formas: incentivos de "arrastre" e incentivos de "empuje".

El análisis de los sistemas de incentivos en China gira en torno a dos etapas diferentes: el período de economía planificada hasta los últimos años del decenio de 1970 y el período de economía mixta del decenio de 1980. El análisis indica que durante el período de economía planificada las empresas se vieron sometidas a presiones contradictorias para la generación del cambio técnico. Se señala además que durante el período de economía mixta el Gobierno estableció gradualmente un sistema de incentivos relativamente completo que, no obstante, se ha centrado principalmente en los incentivos de "arrastre". Se arguye, por tanto, que el Gobierno debe esforzarse por establecer un sistema completo que, a la vez que ofrece recompensas, ejerza presiones para lograr el cambio técnico.

Clasificación y dualismo de las industrias chinas en el decenio de 1980

Xiaohe Zhang

Aplicando una clasificación independiente de 40 industrias manufactureras de China, en la monografía se sostiene que aunque la aparición de empresas rurales mejoró la estructura industrial del país, no fue lo suficientemente fuerte como para eliminar el dualismo existente entre el sector urbano de gran densidad de capital y el sector rural de gran densidad de mano de obra (este último sector se relaciona tanto con las actividades agrícolas como con las de la industria manufacturera). En consecuencia, las ganancias económicas podrían ser mayores si se eliminara este dualismo alentando la movilidad de los factores y aboliendo las distorsiones de los precios.

Industrializando la economía agrícola de subsistencia de Nepal

Narayan Khadka

En Nepal, país muy pobre con una reducida base industrial, se ha intentado, con escaso éxito, transformar la economía. En el artículo se examinan las políticas industriales que se aplicaron en Nepal durante los últimos tres decenios, se evalúan las características de la actividad industrial, se enuncian medidas de eficiencia industrial por sectores y se sugieren cambios de política con el propósito de mejorar la contribución económica de la industria.

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