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INDUSTRY AND DEVELOPMENT

No. 26

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**UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION**

Vienna, 1989

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Industry and Development attempts to provide a link between practitioners and theorists working on economic and related aspects of industrialization. The focus of the journal is on applied economics, particularly in areas emphasized in the Lima Declaration and Plan of Action on Industrial Development and Co-operation.

The journal is published an average of four times a year as an integral part of the work programme of the Studies and Research Division of the United Nations Industrial Development Organization. It is prepared under the general guidance of a Supervisory Panel, composed of staff members from the Division, with the Head of the Global Studies Branch as its chairman. Responsibility for the detailed supervision of a specific issue is rotated among the members of the Panel. The responsible member for this issue was J. Cody.

The Supervisory Panel of *Industry and Development* welcomes readers' opinions and comments, and will be glad to consider for possible publication articles relevant to the aims and scope of the journal (see "information for contributors", back cover).

ID/SER.M/26

UNIDO PUBLICATION
Sales No.: E.89.III.E.1
ISBN 92-1-100231-4
ISSN 0250-7935
02100P

Explanatory notes

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

In tables:

Totals may not add precisely because of rounding.

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:

EPZ	export processing zone
FEFZ	free export processing zone
GNP	gross national product
HMT	Hindustan Machine Tools
IIASA	International Institute for Applied Systems Analysis
MFA	Multi-Fibre Arrangement

EXPORT PROCESSING ZONES: THE CASE OF THE REPUBLIC OF KOREA

Derek Healey* and Wilfried Lütkenhorst**

Introduction

The establishment of export-processing zones (EPZs) as a means of attracting foreign investment and promoting manufactured exports has become a widely applied industrial policy approach in a broad range of developing countries. The number of countries with EPZs in operation increased from 10 in 1970 to about 35 in 1985. During the same period, the number of EPZs rose from 10 to around 80. By 1985, approximately 1.3 million people were employed in such zones.***

The role played by EPZs in promoting industrialization in developing countries has always been a controversial topic. Experience in many countries, in particular in East and South-East Asia, has shown that such zones can contribute substantially to the generation and promotion of manufactured exports and to the provision of productive employment opportunities. However, they have more often than not been characterized by a concentration on only a few industrial branches, by the use of simple and fragmented production technologies, and by a lack of backward linkages with the domestic economy.

There have been remarkable success stories as well as drastic failures. Three different sets of factors have been the major determinants of EPZ performance in individual cases. First, the international economic environment has exerted an important influence. The EPZs established at a time of rapidly expanding international trade and at the beginning of the first wave of international restructuring and redeployment benefited from more favourable initial conditions than the "latecomer" EPZs set up during the 1980s. Secondly, the domestic environment in terms of the level and structure of industrial development and the economic

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***The figures given here are by necessity imprecise. In the relevant literature any figure between 80 and 180 can be found for the total number of EPZs. This is mainly due to the widespread inclusion of free ports and to specific problems when it comes to counting industrial estates in countries or areas with near-zone conditions (for example, Hong Kong and Singapore). The present study adopts a narrow definition of EPZs. It does not intend, however, to contribute to definitional questions nor to provide yet another calculation of existing EPZs world-wide. On such overviews, see [1], [2], [3] and [4].

policy approach adopted have had an impact on the attractiveness and development potential of EPZs. Thirdly, a number of micro-level factors have been crucial, including the location of the EPZs, the available infrastructure and the efficiency of their administration. EPZs are thus a concept with many variations. They differ according to location and time. Indeed, many zones have been gradually changing their features in response to a changing economic environment. This being so, a case-study approach would be required to assess the developmental impact of EPZs. By analysing the specific reasons and determinants of the performance of individual EPZs, it may then be possible to derive certain structural preconditions for success and eventually to conceive corresponding policy recommendations.

The Republic of Korea was one of the first developing countries to make use of EPZs to attract export-oriented foreign direct investment, with the establishment of the Masan EPZ in 1971 and the Iri EPZ in 1974. Hence the country's EPZs have gone through the infancy stage of their life cycle and reached a certain level of maturity. What have been the preconditions and determinants of their success? What has been the role and impact of domestic economic policies? How can the advanced EPZs of the Republic of Korea meet the challenges of a changing economic environment? A review of their achievements may provide valuable information on their actual developmental impact and the gradual transformation of the zones. The findings are expected to be relevant for other developing countries in designing policy measures to multiply the longer-term spin-offs and to enhance the catalytic role of EPZs for overall industrial development, although the concrete issues and tasks ahead in the case of the Republic of Korea may be immediately relevant for only a few other developing countries. Moreover, EPZs should be conceived as being constantly in transition. They are not a static concept, not a once-for-all investment but a dynamic mechanism that needs to react to changing external demands.

The study proceeds along the following lines. In section A, the EPZs of the Republic of Korea are put into the perspective of the country's overall industrialization strategy and the special role and objectives assigned to them are described. Subsequently, in section B, the actual performance of the EPZs of the Republic of Korea is analysed in terms of various criteria (for example, investment, employment, exports and profitability). The focus will, however, clearly be on examining the extent and potential of backward linkages between EPZ enterprises and the domestic economy, primarily in terms of material inputs and of subcontracting activities (section C). Attempts will also be made in section C to draw some conclusions regarding the crucial determinants of linkage creation, in particular as to the question whether they have been primarily market-induced or policy-induced. Finally, in sections D and E, consideration will be given to the future role and functions of EPZs in the Republic of Korea and to some of the lessons that the case of that country may hold for other developing countries.

A. Establishment of export processing zones in the Republic of Korea

1. Overall policy framework

The purpose of this section is to provide a frame of reference for the in-depth analysis of EPZs in the Republic of Korea which will be undertaken in subsequent chapters of this paper. In doing so, no account is given of the Republic of Korea's industrialization strategy per se.^{*} Instead, a brief look is taken at the role of foreign trade and related policy measures with a view to arriving at a better understanding of the functions assigned to EPZs.

Following the adoption of an outward-looking development strategy in the early 1960s, exports have become the engine of the Republic of Korea's industrial development.^{**} The close inter-linkage of the economy of the Republic of Korea with the world economy is reflected in the high share of foreign trade in the country's gross national product (GNP) (see table 1). While the import share increased from 22.6 to 30.5 per cent between 1970 and 1986, the export share more than trebled during the same period to reach a level of 34.8 per cent. Total foreign trade thus reached 65.3 per cent of GNP in 1986. Both the trade balance and the current account balance remained in deficit throughout the 1970s and the first half of the 1980s. In the 1980s, however, both the trade and current account deficits as shares of GNP have fallen, and by 1986 they were in surplus.

Table 1. Shares of exports, imports and the current account balance in the GNP of the Republic of Korea: 1970, 1975 and 1980-1986 (At current prices)

Year	Export share	Import share	Exports plus imports as percentage of GNP	Share of trade balance	Share of current account balance
1970	11.0	22.6	33.6	-11.6	-7.8
1975	23.9	31.9	55.8	-8.0	-9.0
1980	28.5	35.8	64.3	-7.3	-8.8
1981	31.2	36.7	67.9	-5.5	-7.0
1982	30.1	33.9	64.0	-3.7	-3.8
1983	30.5	32.9	63.4	-2.3	-2.1
1984	32.7	34.0	66.7	-1.3	-1.7
1985	30.4	30.4	60.8	0.0	-1.0
1986	34.8	30.5	65.3	4.3	4.8

Source: Economic Planning Board, Major Statistics of Korean Economy 1987.

^{*}For a condensed overview of its salient features, see [5].

^{**}The Republic of Korea's total exports can almost be equated with its manufactured exports - the latter accounted for more than 95 per cent of the former in 1984.

To arrive at a clear understanding of the economic strategy of the Republic of Korea it should be noted that the rapid export expansion was not only preceded but also accompanied by import substitution efforts. It was only when the benefits of early import substitution started to decline that the country adopted its outward-looking policies in the early 1960s. However, import substitution subsequently (as of the early 1970s) moved into heavy and chemical industries, which only in the wake of the 1973 "oil shock" and the resulting balance-of-payments pressure became partly reoriented towards export markets.

From the point of view of this study, it is important to determine in which ways and to what extent EPZ incentives differed from general export incentives in the economy. A list of 24 types of export incentive offered by the Government of the Republic of Korea is therefore presented below ([6], p. 93). They were in operation at different times from 1950 up to, and in many cases beyond, 1975.

- 1959-1975 Tariff exemptions on imports of raw materials and spare parts
- 1965-1975 Tariff and tax exemption, granted to domestic suppliers of exporting firms
- 1961-1972 Domestic indirect and direct tax exemptions
- 1966-1975 Accelerated depreciation
- 1965-1975 Wastage allowance subsidies
- 1951-1955
and
- 1963-1965 Import entitlement linked to exports
- 1957-1975 Registration as an importer conditional on export performance
- 1967-1975 Reduced rates on public utilities
- 1950-1961 Dollar-denominated deposits held in Bank of Korea by private traders
- 1967-1971 Monopoly rights granted in new export markets
- 1965-1975 Incentives provided by the Korean Trade Promotion Corporation
- 1955-1956
and
- 1961-1964 Direct export subsidies
- 1962-1975 Export targets by industry

Credit subsidies:

- 1950-1975 Export credits
- 1950-1954
and
- 1971-1975 Foreign exchange loans
- 1959-1975 Production loans for exporters
- 1950-1975 Bank of Korea discount of export bills
- 1964-1975 Import credits for exporters
- 1964-1975 Capital loans by medium industry bank
- 1964-1975 Offshore procurement loans
- 1965-1975 Credits for overseas marketing activities

The first, and probably the most important, of the incentives listed above - tariff exemptions on imports of raw materials and spare parts - is the siège à la non of EPZs. However, that incentive to export was applied generally in the Republic of Korea from 1959 to 1975 in the form of tariff exemptions as imports for export production cleared customs. As of July 1975, the system was changed to one in which tariffs on such imports are paid at the time of importation but, through a customs drawback system,* are refunded at the time of export. For about one half of the exports the drawback amount is the tariff that has actually been paid. For the other half, the drawback is calculated on a product-by-product basis and represents a weighted average of the levies (that is, indirect taxes) paid on domestic inputs and imported inputs, the weights being proportional to the industry's average ratios of use of domestic and imported inputs. Thus, if an individual producer used relatively more of domestic inputs than the industry as a whole he would be overcompensated; that is an effective way of stimulating the use of domestic inputs.

All that has been said so far means that in the early 1970s, by the time that EPZs were established, the Republic of Korea had already for quite some time embarked on a strong export promotion policy. In other words, EPZs were not assigned a vanguard role in initiating manufactured exports but came to be set up to complement and strengthen a generally prevailing export orientation of the economy. This appears to be especially noteworthy as in many other countries a different sequence was and is to be observed, with EPZs being utilized as incubator to bring about a shift to export production - not always successfully so.

Hasan EPZ began operations in 1971 and Iri EPZ in 1974; both had the older, simpler and more direct incentive built into their structure, that is, imports of raw materials and components were completely free of tariffs. However, as will now be apparent, that concession is only a matter of degree, since, effectively, all manufactures for export are produced without the payment of import duty on inputs. However, the added complexity, and therefore cost to the producer and Government of the drawback system, must be borne in mind. One of the costs to the producer represents the opportunity cost of the use of funds tied up for a period, monies which must initially be paid out in duties.

Furthermore, tariff exemptions were (and are) granted to all firms producing for export in bonded factories located either

*A system by which import duties paid are refunded to the importer upon presentation of documentary evidence of payment. The refund is usually made on the export of the commodity incorporating the imported input.

within general industrial estates or, indeed, anywhere in the Republic of Korea.*

In sum, it cannot be concluded that the EPZs were established to make use of a previously unused system of export incentives or because that system was being phased out generally in the economy and transferred to the EPZs. A free trade régime applied to exports even prior to the establishment of the EPZs; it is summed up by Balassa as follows: "Exporters had the freedom to choose between domestic and imported inputs; they were exempted from indirect taxes on their output and inputs; and they paid no duty on imported inputs. The same privileges were extended to the producers of domestic inputs used in export production" ([8], p. 149)**.

Given the success of its export policy, why then did the Republic of Korea turn its attention towards the establishment of EPZs at all? What did it offer in particular which had not been previously available generally? The answer seems to be that it was the necessity to attract foreign direct investment to sustain the export momentum which loomed large in the minds of the policy-makers. Towards the end of the 1960s the view was developing that the early export successes were not going to last indefinitely: "Korean planners, much like their Japanese counterparts of the fifties, had begun to evince disquiet over the growth potential of light industries and Korea's future competitiveness in the face of rapidly rising real wage rates, and an onslaught from countries where labour was cheaper" ([9], p. 23).

For that reason it was decided to switch the developmental effort towards the next stage, that of basic process industries such as steel, chemicals, shipbuilding, machinery and transport. The shift in emphasis towards a much more capital-intensive process of development was coupled with the perceived necessity to devote capital resources to the defence industry following reduced United States assistance. To a large extent it was the private sector that was expected to invest in the heavy industries now to be developed - only the Pohang steel plant was in the public sector. To assist the private sector, credit was extended by government-controlled financial institutions. It is true that the domestic savings rate had been increasing from 11.8 per cent in 1966 to 15.7 per cent in 1970*** but the demands about to be made on domestic and foreign savings were becoming so large as to warrant the tapping of direct equity financing as a new source.

*It may be further noted that customs duties, special excise tax and value added tax are not payable in respect of the importation of capital goods that are brought in by a foreign investor for his initial investment or that are imported by an enterprise in which a foreign investor invests through dividends received from foreign investment or through foreign exchange provided by the foreign investor ([7], pp. 22-23).

**Emphasis added.

***See [10].

Direct equity financing can be made by foreigners in two ways, by foreign direct investment and by the purchase of stock, that is, foreign portfolio investment. In the case of the Republic of Korea, however, both types of capital inflow have never been used extensively. For instance, foreign direct investment has rarely amounted to more than 10 per cent of annual capital inflow and has, in fact, been frequently less than 5 per cent. Foreign portfolio investment was small until the early 1980s when foreigners were permitted to purchase stocks of the Republic of Korea through mutual funds (the process was liberalized in 1986). One area to which foreign direct investment could be attracted was export production in the EPZs, where inflows would alleviate pressures on capital resources.

As mentioned before, the 1970s saw a mushrooming growth of EPZs world-wide. Between 1971 (establishment of Masan EPZ) and 1975 (one year after the establishment of Iri EPZ) 23 new EPZs were set up in 11 countries, mainly in Asia ([1], pp. 21-22). It is highly likely, therefore, that the initiation of the system of EPZs in a world context stimulated many countries to follow suit, if only for fear of losing out in acquiring a proportion of what was regarded as a fixed supply of foreign direct investment. Potential recipient countries were then placed in the classical "prisoner's dilemma" situation: when one country increases its incentives to attract foreign capital, all will be obliged to do so, and the competitive bidding for capital will result in the general level of incentives being higher than necessary, with rents being skimmed off by incoming capital, and with the final distribution of foreign capital among countries being no different from what it would have been with all-round lower incentives. However, in that scenario, the absence or lower level of incentives will affect international capital's choice of location. The point is "that while the decision to relocate is generally independent of incentive policies, the latter nevertheless have some influence on the choice of host country" ([1], p. 58).*

In conclusion, it can certainly not be claimed that the establishment of EPZs in the Republic of Korea was essential for the initiation of an export-oriented growth strategy. By the time Masan EPZ came into being in 1971, the country had experienced a decade of vigorous growth in GNP and exports. Two reasons for the establishment of EPZs thus remain: on the one hand, to help maintain the rate of growth of exports in the face of enhanced domestic demand for capital-intensive projects that would not increase foreign exchange earnings in the short-term; and, on the other, to ensure that the Republic of Korea would get an appropriate share of whatever internationally mobile private capital was available and would otherwise have been attracted to competing countries that were themselves engaged in establishing EPZs.

*On this point, see also [1], pp. 50-51.

2. Role and objectives of EPZs

In its Economic Survey for 1970, the Economic Planning Board of the Republic of Korea set out an "Export Promotion Policy", introduced during 1969. Some twenty measures were listed, among them the following:

"First, in order to modernize production facilities and to facilitate mass production:

- Three industries (cotton fabrics, woolen fabrics and raw silk) were excluded from designated export-oriented industries ...
- A total of \$60 million was made available through the Korean branches of foreign banks to export industries for procurement of equipments ...
- To facilitate the establishment of free export zones including Masan, the Law on the Establishment of Free Export Zone was promulgated on 20 December 1969.

Secondly, in order to strengthen competitive power of export industries and to increase foreign exchange earnings:

- Utilization of domestically produced raw materials was given financial and administrative support.

Thirdly, in order to widen export markets ... :

- Efforts to diversify export markets were made, developing new commodities and strictly inspecting export goods.

Fourthly, in order to strengthen financial and administrative support to export industries:

- Import of raw materials and equipment for export industries was exempted from customs, and their foreign exchange earnings were also exempted from internal taxes. Special accelerated depreciation was allowed to promote capital investment of export industries.
- Export-import link system and export subsidy were adopted by the Government, and administrative procedures were also simplified.
- Despite tight monetary policy and upper reserve base limits, as agreed upon with IMF, a maximum financial support was given to export financing.

Fifthly, foreign exchange credits were extended to develop designated export-oriented industries and to finance the conversion into export industries and the import of industrial facilities for export industries."

The list puts the Masan and Iri EPZs into perspective; they were clearly established to be part of a package of new measures designed to stimulate exports. At the same time, no specific mention is made of foreign investment in the zones in the Foreign Capital Inducement Act (law No. 2598, promulgated on 12 March 1973)* - the implication obviously being that investments made within the zones are broadly within the scope of the Act. In fact, the language of the Act, when dealing with the criteria for granting authorization for foreign investment, is quite similar to the language used when outlining EPZ investment criteria, with emphasis placed on high foreign exchange earnings, labour-intensive production processes and transfer of sophisticated technologies.

It appears that the criteria for investment in EPZs are quite broad, as indeed they are for investment in the Republic of Korea generally, where, under the terms of the Act, capital is welcomed which develops "key industries or public utilities" and which "contributes to the development of the national economy and social welfare". The question thus emerges in what way EPZs in the Republic of Korea can be considered to be "special"? Not a great deal of attention is paid in official government publications or in the publications of commercial institutions to the special nature (if any) and operation of EPZs, and often, where mention is made, they are lumped in with industrial estates in general. An EPZ is indeed an industrial estate, but in the interest of clarity it is desirable to maintain the distinction.

In the context of the Republic of Korea, very little is special about EPZs. As has already been mentioned, their chief underpinning is the facility offered to firms within them to import inputs duty-free in the expectation that all output will be exported. But that possibility is also open to other factories in the country if they are "bonded", and, in any case, a customs drawback system operates in respect of imported inputs for exports. Certainly in the "free export zones generous tax incentives are provided for foreign-invested enterprises" ([13], p. 149) - but they are so provided generally for foreign investors in the Republic of Korea. There are no extra tax incentives for firms establishing in EPZs.

The next benefit claimed for operating in an EPZ is that all the administrative procedures necessary for operation of the occupant enterprises can be easily processed on the spot ([13], p. 151). It would seem, however, that similar provisions exist

*A revised Foreign Capital Inducement Act became effective on 1 July 1984 but the main purpose remains the same. The essential difference is that under the old Act a positive list system was operated under which foreign investment was permitted only in specific listed sectors. Under the new and more liberal Act, there exists a negative list which excludes foreign investment from fairly limited specific areas of the economy, all the rest being automatically approved. For a summary of the provisions of the law, see [12].

generally in industrial estates. In answer to the question "What are the advantages of locating in an industrial estate?", the Ministry of Finance writes:

"All the enterprises located in industrial estates enjoy preferential advantages. Plant sites can be easily purchased or leased at considerably lower prices than in other areas. Further, various support facilities and services such as electric power, industrial water, transportation, telecommunication, stevedoring, and packing are provided. In addition, these estates offer a full range of infrastructure and other auxiliary services such as a customs office, a bank, a labour office, a quarantine station, and an immigration office ([14], p. 38).

Hence, it appears to be a fair assumption that services provided in all estates are similar. No doubt in practice there would be variations in the extent of the services and the efficiency with which they are provided; an extensive study would be needed, however, to ascertain that. What, then, remains as specific characteristics of EPZs in the Republic of Korea? They appear effectively to boil down to, on the one hand, the waiving of certain laws and regulations, and, on the other, the existence of a "one-stop" investment office:

"The zone functions as a bonded area where the implementation of laws and regulations pertinent to foreign investment, which are normally applied elsewhere, are waived or relaxed" ([14], p. 38).

"The procedure for authorization of foreign investment is simplified and handled at an office in the zone."²

As to the waiving or relaxation of specific laws and regulations, it is not spelled out in detail what exactly this means. Presumably it is of greatest significance in connection with labour legislation (working hours, trade union activities etc.). The existence of a one-stop investment office was frequently commented on favourably by firm representatives within the EPZs. In practice it means that the potential investor is freed from the necessity of "making the rounds" of government authorizing departments and agencies in Seoul and of departments of local government.

The role and objectives of EPZs in the Republic of Korea may be summarized as follows. Both Masan EPZ and Iri EPZ were set up to attract foreign capital for export-oriented industries. Their net foreign exchange earnings were expected to be high. Generally speaking, it was labour-intensive industries that were attracted,

²See [14], p. 38. No information is available as to whether the simplification involves anything more than the handling of the authorization procedure within the zone itself.

so that one of the other objectives of development - employment creation - could be achieved. To bring in foreign capital various incentives were offered, but it seems that many of the incentives were also available to foreign capital locating elsewhere in the Republic of Korea, and especially in the general industrial estates which had been in existence since the early 1960s. It is a moot point as to how much of the foreign capital attracted to the EPZs would have entered the country in any case, given the history of dynamic expansion since the beginning of the 1960s and given the low wage rates, skilled labour force and relatively stable political environment which characterized the country. It may be that, in effect, part of the economic rents accruing to the projects undertaken were lost to the Government of the Republic of Korea through its provision of redundant incentives.*

The following chapter reviews to what extent the EPZs have achieved their main objectives, namely the attraction of foreign investors, the provision of industrial employment opportunities and the generation of net foreign exchange earnings.

B. Analysis of selected performance elements

1. The firms: number and sectors

Tables 2 and 3 provide an overview of total investment (foreign plus domestic) and the number of firms in the two EPZs, Masan and Iri.** Although 1970 is given as the starting date of Masan, production and exports did not effectively get under way until 1971. Iri commenced operations in 1974. In the case of Masan, the maximum number of firms in the zone, 115, was soon reached, in 1973 (see table 2). Since then, there has been a decline to 79 in 1985 and 78 in the first half of 1986. Those bare numbers unfortunately fail to provide a complete picture of the "oncoming" and "outgoing" firms during the period. Nor is any information available

*Two studies explicitly make a cost-benefit analysis of Masan EPZ. Boun Jong Choe ([15], p. 248) estimated the marginal benefit-cost ratio to be between 1.24 and 2.34, depending on assumptions about the discount rate and the shadow wage rate. Peter Warr ([16], p. 183) calculated the internal rate of return at from 5.9 to 15 per cent, depending on the wage differential between inside and outside the zone - effectively, again, the shadow wage rate - and assumptions on the life of the zone. Both results appear to be dependent on a number of assumptions which might or might not be correct. Moreover, by their nature, calculations of this sort do not deal with the counterfactual situation: what if the capital would have come in anyway and gone elsewhere in the economy?

**Hereafter, unless reference is made to the contrary, the names by themselves refer to the EPZs.

concerning the reasons for the withdrawal of firms.* For Iri, the number of firms continued to grow to 20 by mid-1986, but, again, the numbers of incoming and outgoing firms are not known.

Table 2. Masan and Iri EPZs: number of enterprises a/ and cumulative total investment, 1970-1986

Year	Number of firms			Investment (millions of dollars)		
	Hasan	Iri	Total	Hasan	Iri	Total
	EPZ	EPZ		EPZ	EPZ	
1970	4	--	4	1.8	--	1.8
1971	22	--	22	5.3	--	5.3
1972	70	--	70	36.9	--	36.9
1973	115	--	115	82.8	--	82.8
1974	110	1	111	88.9	2.3	91.2
1975	105	6	111	89.0	3.3	92.3
1976	99	14	113	98.0	5.3	103.3
1977	99	15	114	103.9	6.7	110.6
1978	97	14	111	111.9	6.7	118.6
1979	94	14	108	115.0	6.9	121.9
1980	82	12	100	112.9	7.5	120.4
1981	89	17	106	117.2	11.9	129.1
1982	83	16	99	116.2	11.8	128.0
1983	83	18	101	118.2	15.7	133.9
1984	79	19	98	128.2	16.8	145.0
1985	79	20	99	125.9	14.3	140.2
1986 <u>b/</u>	78	20	98	132.4	17.5	149.9

Sources: Jong-Nam Kim, Business Activities in the Korean Export Processing Zones (Seoul, Ministry of Trade and Industry, 1986), table 3; and NTI, Administration Offices of the EPZs.

a/ "Registered" enterprises. See note f to table 3.

b/ As of 30 June for Masan; as of 31 May for Iri.

*It would, for instance, have been valuable to have ascertained whether firms which left the zones did so in order to locate elsewhere in the Republic of Korea - and what induced them to make that move - or whether they ceased their operations in the Republic of Korea altogether. An analogous statistic - again, apparently, on which no records are maintained - concerns the number, if any, of foreign firms that have applied to come into the zones but have been turned away for lack of physical space. One would like to know whether, if such firms exist, they located or are deciding to locate elsewhere in the Republic of Korea.

In current value terms, cumulative total investment (foreign and domestic) in the two zones combined has increased year by year, so that by 1985 it was 54 per cent greater than, for instance, in 1974, the first year of the existence of the combined zones. However, in real dollar terms, cumulative investment has fallen. Depending on the deflator used (the GDP deflator or the wholesale price index), real cumulative capital investment in the two zones declined between 30 and 60 per cent.

The average size of firms, in terms of investment, has been and is small, ranging from \$0.24 million in 1971 to \$1.5 million in 1984 and 1986. But again, after deflating for price movements,² the average size in real terms has declined by 55 per cent.

Table 3, based on statistics available at the end of June 1986, provides a branch breakdown of firms and investments. The two EPZs display distinctly different branch structures, with Masan being dominated by the electronics and electrical branch and Iri by the textiles and garments branch. More specifically, in Masan 30 per cent of the firms and 58 per cent of investment are in the electronics and electrical branch, while in Iri textiles and garments account for 17 per cent of the firms and 53 per cent of investment. Taking the two zones together, the electronics and electrical branch ranks first: 25 per cent of the total number of firms and 52 per cent of total investment. Nevertheless, with metal activities accounting for 17 per cent and precision machinery for 9 per cent of all investment, the branch structure of EPZs in the Republic of Korea is more diversified than that of most others world-wide.

2. Investment: foreign and domestic

Tables 4 to 7 present data referring to investment, foreign and domestic, by country and sector. Comparisons are made between the structural patterns within the EPZs and those in the Republic of Korea. The emphasis is on Masan, ³ the country breakdown of investors in Iri is not available.

Table 4 reflects the following two main features of the investment situation in Masan:

(a) Japan is overwhelmingly dominant as a country source of investment, accounting for 83 per cent of the total. With domestic investors of the Republic of Korea generating 11 per cent⁴ and the United States of America another 4 per cent of overall investment, just 2 per cent comes from further sources.

(b) The share of joint ventures in total investment is 16 per cent. On a branch basis, metal, footwear and textiles show the

²Using the wholesale price index.

³Only from 1980 onwards were nationals of the Republic of Korea permitted to own an occupant enterprise in its entirety ([17], p. 3).

Table 3. Masen and Iri EPZs: firms and investment by industrial branch
(as of 30 June 1986) a/

Industrial branch	Number of firms b/				Investment (thousands of dollars)			
	Masen EPZ	Iri EPZ	Total	Percentage	Masen EPZ	Iri EPZ	Total	Percentage
Electronics and electrical	23	1	24	25.3	76 107	1 384	77 492	51.7
Metal	16	1 c/	17	17.9	22 480	3 501	25 981	17.3
Precision machinery	8	--	8	8.4	13 840	--	13 840	9.2
Textiles and garments	8	8	16	16.8	5 424	9 184	14 607	9.7
Machinery	4	--	4	4.2	2 039	--	2 039	1.4
Footwear	5	--	5	5.3	6 543	--	6 543	4.4
Non-metal	5	4 d/	9	9.5	1 319	--	1 319	0.9
Leather	--	-- e/	--	--	--	2 270	2 270	1.5
Stone-processing	--	3	3	3.2	--	908	908	0.6
Others	8	1	9	9.5	4 688	227	4 915	3.3
Total f/	77	18	95	100.0	132 440	17 475	149 915	100.0

Sources: Ministry of Trade and Industry and Administration Offices of Masen and Iri EPZs.

a/ The Iri figures refer to 31 May 1986.

b/ Operating companies.

c/ In addition, one compan, is preparing to operate.

d/ In addition, one company is preparing to establish in the zone.

e/ As of 31 March 1986, Iri EPZ had five companies in this branch with a total investment of \$2.3 million, of which \$1.5 million was foreign-owned capital.

f/ The total number of firms refers to operating companies, hence the slight discrepancy with table 3, which refers to registered companies.

Table 4. Masan EPZ: investment by country, industrial branch and ownership pattern, as of 30 June 1986
(Number of firms (in parentheses) and thousands of dollars)

Industrial branch	Japan			United States			Republic of Korea	Others			Total		
	Wholly foreign	Joint ventures	Total	Wholly foreign	Joint ventures	Total		Wholly foreign	Joint ventures	Total	Wholly owned g/	Joint ventures	Total
Electronics and Electrical	70 554 (18)	728 (2)	71 283 (20)	1 500 (1)	423 (1)	1 923 (2)	--	--	2 901 (1)	2 901 (1)	72 054 (19)	4 052 (4)	76 107 (23)
Metal	6 929 (5)	8 143 (5)	15 072 (10)	--	550 (2)	550 (2)	6 858 (4)	--	--	--	13 787 (9)	8 693 (7)	22 480 (16)
Precision machinery	9 983 (4)	3 153 (3)	13 136 (7)	--	204 (1)	204 (1)	500 (1)	--	--	--	10 483 (5)	3 357 (4)	13 840 (9)
Textiles	--	1 109 (4)	1 109 (4)	--	--	--	4 015 (3)	--	300 (1)	300 (1)	4 015 (3)	1 409 (5)	5 424 (8)
Machinery	1 845 (3)	--	1 845 (3)	--	194 (1)	194 (1)	--	--	--	--	1 845 (3)	194 (1)	2 039 (4)
Footwear	2 430 (3)	--	2 430 (3)	--	2 474 (1)	2 474 (1)	1 639 (1)	--	--	--	4 069 (4)	2 474 (1)	6 543 (5)
Non-metal	224 (1)	--	224 (1)	205 (1)	--	205 (1)	890 (3)	--	--	--	1 319 (5)	--	1 319 (5)
Others	3 685 (6)	1 004 (2)	4 688 (8)	--	--	--	--	--	--	--	3 685 (6)	1 004 (2)	4 688 (8)
Total	95 650 (40)	14 137 (16)	109 787 (56)	1 705 (2)	3 845 (6)	5 550 (8)	13 902 (12)	--	3 201 (2)	3 201 (2)	111 257 (54)	21 183 (24)	132 440 (78)

Source: Administration Office of Masan EPZ.

g/ Including the Republic of Korea.

highest shares of joint ventures (with 39 per cent, 38 per cent and 26 per cent, respectively), whereas in the dominant electronics and electrical branch only 5 per cent of investment is in the form of joint ventures. On a country basis, Japanese investment is predominantly fully owned (87 per cent), whereas in the United States case only a minority is fully United States-owned (31 per cent). That clearly reflects different attitudes towards the perceived desirability or necessity of having a partner from the Republic of Korea.

Table 5 refers to Masan again and depicts the position in June 1986 with respect to the proportion of investment held in various branches by different countries. Most Japanese investment clearly is made in the electronics and electrical industry (65 per cent). On the other hand, United States investment is concentrated in the footwear branch (45 per cent). The Republic of Korea has no investment in the electronics and electrical branch, holding about one half of its total investment in the metal industry (of small importance in Masan EPZ to Japan and the United States and of zero importance to other countries).

Table 5. Masan EPZ: proportion of investment a/ held in various industrial branches by country (as of 30 June 1986) (Percentage)

Industrial branch	Japan	United States	Republic of Korea	Others	Total
Electronics and electrical	64.9	34.7	--	90.6	57.5
Metal	13.7	9.9	49.3	--	17.0
Precision machinery	12.0	3.7	3.6	--	10.5
Textiles	1.0	--	28.9	9.4	4.1
Machinery	1.7	3.5	-	--	1.5
Footwear	2.2	44.6	11.8	--	4.9
Non-metal	0.2	3.7	6.4	--	1.0
Others	4.3	--	--	--	3.5
Total	100.0	100.0	100.0	100.0	100.0

Source: Table 4.

a/ Including wholly foreign-owned and joint ventures.

When comparing the structure of Masan investment with investment patterns throughout the Republic of Korea, it stands out that the relative role played by the electronics and electric branch is much larger in Masan. This in turn is basically due to Japanese investment, which accounts for more than 80 per cent of Masan investment (but for only slightly more than 50 per cent nation-wide), and which is very much concentrated in this specific branch.

Tables 6 and 7 present a wide range of statistics from 1970 to May 1986 on EPZ-related and nation-wide cumulative investment in order to obtain a general picture of the importance of the EPZs in the economy of the Republic of Korea. For both Masan and Iri, statistics are presented for domestic and foreign investment so as to ascertain the growth in the relative importance of domestic investment in both zones.

In the case of Masan, during the initial years of its existence domestic investment formed 6 or 7 per cent of the total (see table 6). From 1977 onwards, it began to increase in relative terms, reaching a peak of 28.7 per cent of total investment in the zone in 1982. Subsequently, it fell steadily to 22 per cent in May 1986 - a figure somewhere between the 1980/81 proportions. Since 1981, about one quarter of the cumulative value of total investment in Masan has been owned by nationals of the Republic of Korea.

In the case of Iri, the reliance upon domestic capital from very early years is even more pronounced. As early as 1975, one year after the establishment of the zone, 28 per cent of total cumulative investment was coming from nationals of the Republic of Korea. After three successive years of reduced domestic proportions, an upsurge began in 1979/80 and continued until at least May 1986, when 57.5 per cent of cumulative investment was sourced domestically. Clearly the permission granted in 1980 for nationals of the Republic of Korea to fully own an EPZ enterprise had an effect, but whether permission was granted because of a shortage of new foreign entrants or because of pressure from domestic manufacturers who wished to avail themselves of EPZ facilities must, in the absence of further information, remain a moot point.

Considering the two zones together, domestic investment reached 30 per cent of the total investment in the zones in 1983 and fell to 26 per cent in May 1985.

Table 7 (penultimate column) shows the importance of investment in Masan and Iri together in relation to total foreign direct investment in the Republic of Korea. If Masan is considered separately, it will be seen that in 1970 foreign investment in that zone constituted 8.6 per cent of total foreign direct investment in the Republic of Korea (calculated from tables 6 and 7). It reached a 1970-1985 peak of 27.3 per cent in 1973. Thereafter its relative importance steadily declined to 8.9 per cent in 1980 and 3.7 per cent in 1985. The addition of Iri adds about half a percentage point to the Masan proportions. For instance, in 1974 Masan's cumulative foreign investment alone constituted 22.6 per cent of cumulative foreign direct investment in the country; the addition of Iri makes the proportion 23.2 per cent. In 1980 the combined proportion was 9.4 per cent; in 1985, 4 per cent. What this series reflects is the increasing attractiveness of the Republic of Korea in general to foreign capital; hence, it was only to be expected that the EPZs would decline in relative importance.

The final column of table 7 serves merely to underscore the last comment. Taking together the domestic and foreign capital

Table 6. Masan and Iri EPZs: cumulative g/ foreign and domestic investment, 1970-1986
(Millions of dollars)

Year	Masan EPZ			Iri EPZ			Masan and Iri EPZs		
	Domestic Foreign	Total	Domestic as proportion of total (percentage)	Domestic Foreign	Total	Domestic as proportion of total (percentage)	Domestic Foreign	Total	Domestic as proportion of total (percentage)
1970	0.2	1.2	14.2	--	--	--	0.2	1.4	14.2
1971	0.4	4.9	7.5	--	--	--	0.4	5.3	7.5
1972	2.0	34.9	5.4	--	--	--	2.0	36.9	5.4
1973	4.0	78.8	4.8	--	--	--	4.0	82.8	4.8
1974	6.7	82.2	88.9	0.07	2.1	3.2	6.8	84.3	7.5
1975	6.2	82.8	89.0	1.9	4.9	27.8	8.1	87.7	95.8
1976	6.6	91.4	98.0	1.8	5.8	23.7	8.4	97.2	105.6
1977	10.5	93.5	103.9	2.8	11.4	14.2	13.3	104.9	118.2
1978	14.6	97.4	111.9	2.4	7.2	9.6	17.0	104.6	121.6
1979	13.0	101.6	115.0	2.4	6.1	8.5	15.4	107.7	123.1
1980	19.7	93.1	112.9	2.2	5.7	7.9	21.9	98.8	120.7
1981	31.1	86.1	117.2	4.4	7.6	12.0	34.5	93.7	129.2
1982	33.3	82.9	116.2	28.7	3.3	28.7	36.6	91.3	127.9
1983	33.4	84.8	118.2	7.1	8.6	15.7	40.5	93.4	133.9
1984	30.5	97.7	128.2	7.6	9.2	16.8	38.1	106.9	145.0
1985	29.5	96.4	125.9	6.8	7.4	14.3	36.3	103.8	140.1
1986 ^{h/}	29.1	103.3	132.4	10.0	7.4	17.5	39.1	110.7	149.8

Sources: See table 7.

g/ Statistics in this table are cumulative from 1970.

h/ As of 31 May 1986.

Table 7. Relationship between cumulative investment in Masan and Iri EPZs and investment in the Republic of Korea, 1970-1985 ^{a/}

Year	Republic of Korea		Masan and Iri EPZs	
	Foreign direct investment ^{b/} (millions of dollars)	Domestic and foreign direct investment ^{b/} plus other net capital inflows (= total domestic capital formation) (millions of dollars)	Foreign investment as proportion of total foreign investment in the country (percentage)	Domestic and foreign investment as proportion of total domestic capital formation in the country (percentage)
1970	14	2 065	8.6	0.07
1971	39	4 011	12.6	0.13
1972	133	6 094	26.2	0.61
1973	289	9 258	27.3	0.89
1974	363	13 181	23.2	0.69
1975	532	18 498	16.5	0.52
1976	605	25 406	16.1	0.42
1977	671	35 385	15.6	0.33
1978	799	50 806	13.1	0.24
1979	906	71 962	11.9	0.17
1980	1 047	89 956	9.4	0.13
1981	1 192	106 811	7.9	0.12
1982	1 380	129 745	6.6	0.10
1983	1 648	153 133	5.7	0.09
1984	2 067	178 266	5.2	0.08
1985	2 599	203 082	4.0	0.07

Sources: Masan and Iri investment from the Administration Offices of the EPZs; total Republic of Korea domestic capital formation from Economic Statistics Yearbook, 1985 (Seoul, Bank of Korea, 1985) and Monthly Statistical Bulletin (Seoul, Bank of Korea) (the current won figures were converted to dollars on the basis of the exchange rates for the appropriate year from International Financial Statistics (Washington, D.C., International Monetary Fund), before cumulating); total investment in the Republic of Korea by foreign sources from Investment Guide to Korea (Seoul, Ministry of Finance, 1986), appendix 2, p. 97.

^{a/} Statistics in this table are cumulative from 1970.

^{b/} Foreign direct investment should represent a net concept, that is, net of repatriation of foreign capital and exports of capital by nationals of the Republic of Korea. However, the figure used is called "foreign investment by year" by the Ministry of Finance and appears to be essentially a gross concept. Thus, the importance of Masan and Iri are understated in the table. But irrespective of the definition of direct investment, the domestic capital formation column is correct (since the other net capital inflows effectively take care of the problem), and therefore the last column in the table is also correct.

invested in the two zones combined, it is found to have risen, as a proportion of total domestic capital formation, to a peak of 0.89 per cent in 1973, and fallen consistently to a marginal 0.07 per cent in 1985.

3. Exports, net foreign exchange earnings and value added

In 1985, total exports of Masan and Iri amounted to \$890 million, the bulk of which (\$809 million) was contributed by Masan alone. To put that figure into perspective, in 1985 Masan and Iri exports taken together constituted 3.1 per cent of total manufactured exports of the Republic of Korea; the peak level of their combined share in the total was 4.3 per cent in 1979.* Not surprisingly, the share of Masan plus Iri employment in total manufacturing employment of the Republic of Korea was even lower; it peaked at 1.2 per cent in 1977 and reached 0.9 per cent in 1985.

As to exports by branch (tables 8 and 9), a strong correspondence to the investment patterns observed above is obvious: Masan exports are clearly dominated by the electronics and electrical branch (64 per cent in 1985), whereas textiles exports stand out in the case of Iri (again 64 per cent in 1985). The export structure of Iri has become slightly more diversified in recent years, with textiles losing 10 percentage points between 1981 and 1985, while both metals and electrical items tripled their relative importance during those four years, with annual growth rates of 47 and 44 per cent, respectively. On the other hand, within Masan the dominance of electronics and electrical items markedly increased during the period of 1975 to 1985. However, the item showing the greatest increase in relative importance was precision machinery (from 4 to 14 per cent between 1975 and 1985) as a result of a 33 per cent annual growth in current value terms.

Interestingly, in the Republic of Korea - unlike in the case of EPZs in most other countries - the zones have not been export growth leaders. During the period from 1975 to 1985, Masan exports grew at 17 per cent annually as against 24 per cent for the country's total manufactured exports.

Before turning to a closer look at net foreign exchange earnings, a few definitional remarks are in order in view of the often confused use of value added terminology and foreign exchange terminology in the relevant literature. For the sake of clarity it is essential to differentiate between the two concepts, bearing in mind the following:

*All output sold abroad or to firms in the Republic of Korea is regarded as being exported. The inclusion of the latter category of sales in exports results from the fact that users in the Republic of Korea must pay in foreign exchange for such parts and components. However, sales of intermediate products by EPZ firms to other EPZ firms are treated as domestic sales. For further elucidation see section C.3 of this paper.

**Table 8. Masan EPZ: exports by industrial branch,
1975, 1980 and 1985
(Percentage shares)**

Industrial branch	1975	1980	1985	Average annual growth rate, 1975-1985
Electronics and electrical	53.4	62.9	64.4	18.8
Ferrous metal	16.7	8.1	7.9	8.2
Non-ferrous metal	-	0.4	0.4	-
Machinery	4.3	1.2	2.7	11.3
Precision machinery	4.0	12.7	14.3	33.0
Textiles and garments	4.8	1.9	2.8	10.3
Footwear	4.6	6.1	4.5	16.4
Other	<u>12.1</u>	<u>6.7</u>	<u>3.0</u>	1.5
Total	100.0	100.0	100.0	16.6
Total as percentage of manufactured exports of Republic of Korea	3.6	2.9	2.8	-

Source: For Masan EPZ, Ministry of Trade and Industry; for the Republic of Korea, Economic Planning Board, Major Statistics of the Korean Economy, 1986 (Seoul, 1986).

**Table 9. Iri EPZ: exports by industrial branch, 1981,
1983 and 1985
(Percentage shares)**

Industrial branch	1981	1983	1985	Average annual growth rate, 1981-1985
Textiles	73.8	65.8	63.6	6.8
Leather	19.0	22.5	21.9	14.8
Metals	0.6	1.4	1.9	47.1
Electrical	3.2	6.8	9.2	44.3
Stone processing	<u>3.2</u>	<u>3.4</u>	<u>3.4</u>	11.2
Total	100.0	100.0	100.0	10.8

Source: Ministry of Trade and Industry.

(a) Net foreign exchange earnings are the sum of wages, rents, services and domestic raw materials (material inputs);*

(b) Value added is the sum of factor costs, that is, wages, rents and profits;

(c) Hence, albeit largely overlapping (wages and rents are part of both net foreign exchange earnings and value added), the two concepts are not identical. For instance, value added in production increases along with higher profits without, at the same time, increasing net foreign exchange earnings. In turn, a higher utilization of domestic raw materials results in higher net foreign exchange earnings without having any effect on factor costs and hence value added.**

The above definitions permit a quantitative analysis of the EPZ's net foreign exchange earnings, domestic raw materials ratio and value added ratio, and thus a first crude measure of the magnitude of their interactions with the domestic economy.

In the case of Masan (see table 10) in particular two significant observations can be made. First, the share of net foreign exchange earnings in total exports went up sharply within only 5 years, reaching 49 per cent in 1976. This share is conspicuously high when seen in terms of international EPZ experience. However, since then the share has more or less stagnated. After a peak in 1982 (which brought the figure up to 54 per cent), it went down again to approximately its 1977 level. The same holds true for the ratio of value added to gross output, which, after having reached higher values in the initial years of Masan's operation,** stood at 14 per cent in 1977 and, following minor fluctuations, again in 1985. The overall impression thus emerges that Masan went through a highly dynamic early phase in terms of creating domestic linkages, but since 1977 there has been hardly any perceptible increase in the relevant indicators.

The evidence in the case of Iri (see table 11) is distinctly different. Net foreign exchange earnings were relatively high in the beginning (48 per cent in 1977, 55 per cent in 1978), but have since shown a downward tendency which brought them to only 39 per cent in 1985. Again quite contrary to the Masan experience, the value added ratio has consistently gone up, reaching 21 per cent in 1985.***

*Theoretically, non-repatriated profits would have to be included as well, whereas salaries of expatriate staff accruing abroad would have to be excluded. Owing to lack of information, those aspects have been neglected in the present study.

**Needless to say that this applies only in a ceteris paribus sense.

***This implies that non-factor inputs have subsequently been growing more rapidly than exports.

****During the period 1977-1985 it averaged 15.2 per cent, while in Masan over the same period the average ratio was 11.7 per cent.

Table 10. Masap EPZ: net foreign exchange earnings and value added ratio, 1971-1985

Year	<u>Net foreign exchange earnings</u>		Value added as proportion of gross (percentage)
	Millions of dollars	Percentage of exports	
1971	0.2	22.2	22.2
1972	3.0	30.9	20.6
1973	25.9	36.8	23.0
1974	70.1	38.6	18.1
1975	72.0	41.2	17.6
1976	149.1	49.2	11.9
1977	180.9	49.2	13.9
1978	251.2	51.8	9.0
1979	311.0	51.8	12.3
1980	333.0	53.0	10.2
1981	371.6	53.4	10.8
1982	324.5	54.0	14.0
1983	373.7	52.9	12.1
1984	444.0	50.5	9.6
1985	412.6	51.0	13.7

Source: Calculated from data provided by Masap EPZ Administration Office and the Ministry of Trade and Industry.

Table 11. Iri EPZ: net foreign exchange earnings and value added ratio, 1977-1985

Year	<u>Net foreign exchange earnings</u>		Value added as proportion of gross output (percentage)
	Millions of dollars	Percentage of exports	
1977	8.9	47.8	7.0
1978	18.5	54.9	8.5
1979	18.2	42.8	8.9
1980	19.4	42.1	14.5
1981	21.8	40.8	17.4
1982	22.4	39.2	18.4
1983	23.3	37.6	19.5
1984	30.2	40.4	21.8
1985	31.2	38.8	21.1

Source: Calculated from data provided by Iri EPZ Administration Office and the Ministry of Trade and Industry.

C. Creation of linkages with the domestic economy

Following the preceding broad overview of the performance of EPZs in the Republic of Korea, this section focusses on the empirical evidence available concerning the scope and the nature of linkages that have been established between enterprises located within EPZs and the domestic economy of the Republic of Korea. The two main types of backward linkages, namely utilization of domestic raw material inputs and subcontracting arrangements with domestic firms, are investigated in more detail. This is followed by a brief section on sales in the domestic market by EPZ firms (which may be considered a forward linkage). Finally, the question whether linkages have been policy-induced or market-induced is looked into.

1. Utilization of domestic raw materials*

The enclave character of EPZs is an established topic in the relevant literature. In fact, it has been demonstrated time and again that EPZs tend to remain isolated from their hinterland because of a distinct preference of EPZ-based companies for sourcing their raw materials from abroad, often by means of intra-firm transactions. As will be shown below, the EPZs of the Republic of Korea provide an exception to this traditional pattern at least as regards the degree of backward linkages that have been created.

Firms both in Masan and Iri EPZ have substantially expanded their domestic sourcing links within a relatively short period of time after the establishment of the zones (see table 12).

In the case of Masan EPZ, the share of domestically supplied raw materials in total raw materials used surged from 3.3 per cent to roughly one quarter (24.4 per cent) within just four years. In the second half of the 1970s it further increased to reach more than one third by 1979. Since then, the share has remained at that level with minor fluctuations (reaching a peak level of 35.8 per cent in 1982).

*The term "domestic raw materials" is used here in accordance with data provided and definitions applied by the EPZ Administration Offices. This implies two important qualifications:

(a) Raw materials are meant to encompass also parts and components;

(b) "Domestic" in fact means "non-imported", in other words raw materials supplied by other EPZ firms have been regarded as being domestically supplied. It is this broad concept of domestic sourcing that the figures presented in this section refer to. In section C.3, domestic sourcing proper and intra-EPZ sourcing will be looked at separately.

Table 12. Masan and Iri EPZ: indicators of utilization of domestic raw materials, 1977, 1975 and 1979-1985

Year	Share of domestic raw materials in export value		Share of domestic raw materials in total raw materials	
	Masan	Iri	Masan	Iri
1971	2.2	--	3.3	--
1975	17.3	..	24.4	..
1979	24.0	22.8	33.8	28.6
1980	22.8	..	33.0	..
1981	21.7	21.5	32.7	28.2
1982	23.7	18.5	35.8	24.5
1983	22.0	31.3	32.9	34.8
1984	22.3	29.9	31.4	35.5
1985	22.0	28.4	32.3	34.0

Source: Calculated from data provided by Masan and Iri EPZ Administration Offices.

A similar development must have taken place in the case of Iri EPZ, although corresponding data for the first years of operation are not available. Again, it took only four years until the domestic share in total raw materials reached the significant level of 28.6 per cent. As in the case of Masan EPZ, a certain saturation point appears to have been reached after a bit less than a decade of operation. With 34 per cent the 1985 share was slightly higher in Iri. Within a narrow range of deviation, however, both zones have shown a very similar performance in this regard.

As is to be expected, various industrial branches display distinct differences in their input sourcing behaviour. A branch breakdown of data on the domestic share in total raw materials is only available for Masan EPZ (see table 13). It shows that the manufacture of footwear and of ferrous metal products rely to the largest extent on domestic supplies of raw materials; their domestic raw materials ratio stood at 69 per cent and 77 per cent, respectively, in 1985. At the other end of the spectrum, it was the non-ferrous metals branch (8 per cent) and the manufacture of precision machinery (16 per cent) which had the lowest ratios in that regard. Textiles and garments showed a ratio of 37 per cent in 1985 - which put it above the average for all Masan EPZ companies - following, however, a significantly lower value in 1984 (19 per cent).

With regard to domestic sourcing trends over time, two developments stand out. Whereas both in electronic and electrical goods and in general machinery the domestic raw materials ratios went down, the opposite is true for precision machinery. The reasons for those trends could not be ascertained. They may, however, be indicative of, on the one hand, increasing competition from external suppliers of cheap standard electronic and electrical

components, or, on the other, an emerging capability of suppliers of the Republic of Korea to produce the more sophisticated components required in precision machinery manufacture.

Table 13. Masan EPZ: domestic share in total raw materials, by industrial branch, 1980 and 1983-1985 (Percentage)

Industrial branch	Domestic share in total raw materials			
	1980	1983	1984	1985
Electronic and electrical	33.0	29.0	29.0	29.0
Ferrous metals)		65.0	61.0	69.0
)	40.0			
Non-ferrous metals)		19.0	18.0	8.0
Machinery	..	43.0	35.0	34.0
Precision machinery	9.0	11.0	16.0	16.0
Textiles and garments	33.0	31.0	19.0	37.0
Footwear	70.0	75.0	81.0	77.0
Other	<u>29.0</u>	<u>31.0</u>	<u>42.0</u>	<u>41.0</u>
Total	33.0	32.9	31.4	32.3

Sources: For 1980: Peter G. Warr, "Korea's Masan free export zone: benefits and costs", The Developing Economies, vol. 22, No. 2 (1984), p. 175; for 1983-1985: calculated from data provided by Masan EPZ Administration Office.

Table 14 builds upon data presented by Young Koo Boha ([18', p. 195) on the domestic sourcing behaviour of foreign companies in the Republic of Korea in general and compares the backward linkages found for Masan with those for the country as a whole. As the country-level data are available only for the period of 1974 to 1978, the comparative exercise unfortunately has to be limited to those years.

Considering first the most direct linkage effect, namely the share of domestic raw materials in total production value, it can be seen that this share increased relatively steadily both for Masan EPZ firms and for foreign firms country-wide, from around 15 per cent to more than 20 per cent. The intriguing point, however, is that the Masan linkage ratios were consistently higher than those for the national average, in 1977 by as much as 58 per cent. Exactly the same pattern can be observed for the second linkage indicator used, that is, for the domestic share in total raw materials.

Table 14. Comparison of domestic raw materials utilization by Masan EPZ and foreign companies in the Republic of Korea, 1974-1978

Item	1974	1975	1976	1977	1978
Percentage share of domestic raw materials in production value					
(1) For Masan EPZ	15.2	17.3	21.0	24.2	22.4
(2) For foreign firms	14.9	13.3	15.6	15.3	20.7
(1)/(2) x 100	102	130	135	158	108
Percentage share of domestic raw materials in total raw materials					
(3) For Masan EPZ	22.0	24.4	30.0	33.4	31.1
(4) For foreign firms	18.1	17.3	21.2	22.3	30.0
(3)/(4) x 100	122	141	142	150	104

Source: Calculated from data provided by Masan EPZ Administration Office and from Young Koo Bohn, "Direct foreign investment in Korea", in Foreign Trade and Investment: Economic Development in the Newly Industrializing Asian Countries, W. Galenson, ed. (Madison, Wisconsin, University of Wisconsin Press, 1985), p. 195.

At first glance, this appears to be a surprising finding in view of the general enclave nature of EPZs. Several explanations may be offered. First, and most obvious, the branch structure of investment within Masan EPZ is distinctly different from the overall branch structure of foreign investment in the country: electronics accounts for almost 60 per cent of investment within Masan EPZ, but for less than 20 per cent of nation-wide foreign investment in manufacturing. At the same time, foreign investment in the chemicals industry is the most important area at the national level, yet it has remained insignificant in Masan EPZ. Given that different industries vary in their propensity to establish links to domestic suppliers, this structural factor may help to explain the evidence to some degree.

Secondly, the industrial agglomeration in Masan EPZ may have been of influence. It appears reasonable to assume that the high industrial concentration in general, and the specific branch focus in particular, attract small and medium-scale suppliers by offering them a big enough market to specialize in parts and components production.

Thirdly, it may also be the case that either individual firms in Masan EPZ or the EPZ Administration Office have actively promoted the establishment or stimulation of domestic industries

designed specifically to supply inputs to EPZ firms. However, no specific information is available on that point.

Whatever the exact explanation, the figures taken at face value show that in the Republic of Korea EPZ companies not only maintain substantial linkages with domestic suppliers of inputs, but in this regard even outcompete foreign companies as a whole.*

2. Subcontracting arrangements

Soon after the establishment of Masan EPZ in 1971 it became obvious that EPZ firms were interested not only in the domestic sourcing of material inputs, but increasingly also in the partial subcontracting of production to domestic firms. While the exact origin of the subcontracting system in Masan appears to be unknown, the practice obviously grew from the earliest years of the EPZ. This may partly be explained by the extremely favourable conditions for exports of the Republic of Korea which coincided with the EPZ's establishment. World trade was expanding rapidly in the years immediately preceding the first oil price increase of 1973. In that situation of booming markets, the newly established Masan firms found it impossible to meet all export orders and the practice developed, with official approval, of arranging for some of the simpler work to be done outside the zone. As a reflection of that trend, the 1971 Free Export Zone Law under which Masan EPZ had been established was revised in 1973 to include detailed regulations on the preconditions and organization of the so-called outzone processing, in other words, subcontracting arrangements. That was now to be allowed under the following conditions:

- (a) The process of manufacturing made its use essential;
- (b) The partial processing outside the EPZ did not exceed 30 per cent** of the total manufacturing process, calculated in terms of production costs;
- (c) The goods processed or produced by the outzone activity were components or intermediate products for production processes finalized in the EPZ.

Subcontracting historically has formed and still forms to a large extent an essential part of the Japanese industrial structure. It seems clear that the advantages which have led to its use in Japan are also perceived to exist in EPZ out-processing arrangements. For instance, a firm inside the zone can operate with a

*This result is not necessarily invalidated by the information provided in section C.3 on the significance of intra-EPZ transactions which are statistically included among domestic supplies. Foreign firms outside the EPZs may also be expected to rely heavily on inputs from other foreign companies. The exact degree to which this is the case is unknown, however.

**Recently this has been increased to 60 per cent.

standard-sized labour force and can utilize outzone processing to meet sudden increases of orders. In addition, a firm within the zone can concentrate its capital, space and expertise on the more complex aspects of production and make optimum use of its resources by subcontracting the more standard, simpler processes.

As far as the "entrusted" firms* outside the zone are concerned, they may operate entirely to satisfy demands of the "trusted" firm within the zone, in which case they are effectively subsidiaries. Or the relationship may be even closer with the entrusted firms being a branch of the trusted firm. A third possibility is that no permanent structural relationship exists, but that the entrusted firm stands ready to execute orders from time to time for the trusted firm and makes its own arrangements for increasing or decreasing its labour force, transportation, purchase of supplies etc.

What, then, has been the order of magnitude of outzone processing? Does it represent a significant linkage factor? The situation in Masan EPZ is well documented and is analyzed in more detail below (see table 15).**

A remarkable increase in the number of entrusted firms took place from 1978 to 1985. In 1978 there were 99 firms outside Masan EPZ allowed to perform subcontracting work for EPZ-based firms. By 1984 the number had more than doubled to 252; in 1985 it dropped back to 193. However, the number of orders more than doubled between 1978 and 1985 and the value of orders tripled in current prices. Properly deflated, the real growth in the value of orders reached 38 per cent - a rate of increase of 4.7 per cent per annum.

The final column of table 15 shows the outzone processing ratio, defined as labour payments to entrusted firms as a proportion of total labour payments by EPZ firms. This ratio rose from 12.6 per cent in 1978 to 21.4 per cent in 1985, implying that in 1985 for every \$1 spent on wages in Masan \$0.21 was spent on wages by subcontracting firms outside Masan.

From table 16 it emerges that the share of outzone processing employment in total Masan EPZ employment was 25.7 per cent in 1985. This was 4.3 percentage points higher than the wage-based outzone processing ratio, indicating lower wages being paid to outzone workers. Moreover, table 16 provides insights into the

*In the terminology used by Masan EPZ, a "trusted" firm is a firm within the EPZ that is given permission to arrange for some of its manufacturing processes to be undertaken outside the EPZ. An "entrusted" firm is the firm outside the EPZ permitted to produce on behalf of a trusted firm, including the processing of duty-free inputs.

**Data availability is less comprehensive in the case of Iri EPZ. However, the value of Iri's outzone processing orders in 1985 was only 7 per cent of the corresponding value in Masan.

Table 15. Masan EPZ: outsource processing 1978-1985

Year	Number of entrusted firms	Orders to entrusted firms			Price index a/ (1978=100)	Value in constant price index (1978=100) (10 ³ dollars)	Labour payments to entrusted firms (10 ³ dollars)	Outsource processing ratio b/ (percentage)
		Number	Value in current price index (1978=100)	Value in constant price index (1978=100)				
1978	99	2 982	7 179	100.0	7 179	6 900	12.6	
1979	99	3 239	9 682	120.9	8 008	9 700	12.9	
1980	108	3 386	12 400	174.2	7 118	12 300	18.0	
1981	114	3 754	13 623	189.8	6 578	13 700	18.9	
1982	117	4 497	14 881	207.3	6 811	16 900	21.7	
1983	207	5 173	18 575	238.7	8 532	17 500	20.5	
1984	232	6 448	24 032	334.8	10 994	24 000	23.1	
1985	193	6 408	21 599	300.9	9 894	21 700	21.4	

Sources: Administration Office of Masan EPZ and the Economic Statistics Yearbook and Monthly Statistical Bulletin of the Bank of Korea.

a/ Wholesale price index for manufactured products.

b/ Labour payments to entrusted firms as proportion of total labour payments by EPZ firms.

subcontracting "intensity" of different industrial branches. It is seen that the manufacture of electronics and electrical goods accounts for almost two thirds of all outzone employment (as a result of its predominance in the EPZ), whereas the production of textiles and garments exhibits by far the highest propensity to engage in subcontracting. On the whole, almost 7,500 persons were employed in outzone processing on Masan EPZ orders.

Table 16. Masan EPZ: employment effects of outzone processing by industrial branch, 1985

Industrial branch	Number of employed in Masan EPZ	Number of employed in entrusted firms	Share of outzone processing employment in Masan EPZ employment (percentage)
Electronics and electrical	17 926	4 821	26.9
Ferrous metals	960	148	15.4
Non-ferrous metals	198	14	7.1
Machinery	456	6	1.3
Precision machinery	3 982	1 012	25.4
Textiles and garments	775	472	60.9
Footwear	3 608	763	21.1
Other	<u>1 078</u>	<u>225</u>	20.9
Total	28 983	7 461	25.7

Source: Administration Office of Masan EPZ and Ki-Suk Lee, "Hidden effects of Masan EPZ on regional spatial structure" (Seoul, National University Department of Geography, 1985) (mimeo), p. 8.

Two further characteristic features of outzone processing have been determined by recent research [19] on the regional economic impact of Masan EPZ:

(a) The entrusted firms tend to be small-scale enterprises. In 1985, 62 per cent of all entrusted firms had less than 50 employees, another 30 per cent less than 200 employees;

(b) As to location, 34 per cent (1985) of entrusted firms were to be found in Masan City, 52 per cent in urban areas outside Masan City and 14 per cent in rural areas of the country. Further, it was found that 74 per cent of total employment induced by Masan EPZ orders was accounted for by non-Masan City areas.

Masan EPZ firms have obviously distributed their outprocessing orders widely over the Republic of Korea. Orders which they gave to areas outside Masan City generated employment of 2,400 in 1985. Thus one of the conclusions to emerge on the topic of outzone processing is the widespread nation-wide interrelationships having been established between Masan EPZ firms and their subcontracting partners. It is expected that subcontracting will continue to grow if investment increases in Masan EPZ. Demands are already being made for a simplification of the relevant administrative procedures. Those demands may be expected to meet with a positive response from the Government, in whose view outzone processing "has accelerated the use of local raw materials and absorption of the urban and rural labour forces without any additional movement of the population" ([19], p. 4).

3. Sales to the domestic market and intra-EPZ sales

It has already been noted that domestic sales and purchases of EPZ firms, as defined in the available statistics, also include those transactions taking place between different EPZ firms.* It will be shown below in detail that intra-EPZ transactions have assumed significant orders of magnitude and have to be accounted for properly when discussing the linkage issue.

For the sake of clarity, this section first reviews domestic sales proper (referred to as "sales to the domestic market"), before then turning to transactions between EPZ firms (referred to as "intra-EPZ sales" or "intra-EPZ purchases", as appropriate).

Sales of part of EPZ production to the domestic market may be regarded as a forward linkage. Originally such sales were not envisaged; all EPZ output was to be for export. But over the years some relaxation of official policy has occurred, and firms are now allowed to sell to the domestic market up to 30 per cent of their previous year's exports. Frequently, however, it is only components that may be sold locally and not the finished products. Nevertheless, all industrial branches in Masan EPZ availed themselves of the possibility of selling in the domestic market in 1985 and 1986 (see table 17).

In practice, sales to the domestic market represent but a marginal share of the total value of production of Masan EPZ. In 1981 they amounted to \$1.9 million or some 0.3 per cent of total production value; in 1985 the figure had risen to \$4.6 million (0.6 per cent). It may be observed, however, that the growth rate of sales to the domestic market was quite high during the period of 1981 to 1985, reaching 25 per cent per annum in current value terms. As to the branch composition of the sales, it is clear from table 21 that engineering and metal industries in general, and electronics and electrical industries in particular, account for the major share, whereas textiles and garments and footwear rely almost exclusively on exports. This pattern indirectly confirms the predominance of components in sales to the domestic market.

*These may be located either in the same or in different EPZs in the Republic of Korea.

Table 17. Masan EPZ: sales to the domestic market by industrial branch, selected years
(Thousands of dollars)

Industrial branch	1981	1983	1985	1986 <u>a/</u>
Electronics and electrical	487	1 728	2 582	2 215
Ferrous metals	72	80	113	351
Non-ferrous metals	90	372	333	398
Machinery	1 136	1 222	791	671
Precision machinery	6	309	371	718
Footwear	-	-	15	17
Textiles and garments	-	9	63	2
Others	<u>116</u>	<u>262</u>	<u>358</u>	<u>334</u>
Total	1 907	3 981	4 626	4 706

Source: Administration Office of Masan EPZ.
a/ To the end of July.

A full account of the destination of sales from Masan EPZ firms is given in table 18. From the table it emerges that since 1977 some 14 per cent of total production was not directed to export markets; the non-export share peaked at 20 per cent in 1982. As data available for the years 1981, 1983 and 1985 further indicate, those sales went almost entirely as intermediate inputs to other EPZ firms where, for statistical purposes, they are regarded as being domestically supplied inputs. The implications of this will be discussed in the following section, which provides a summary view of the linkages created by EPZs of the Republic of Korea.

Table 18. Masan EPZ: production and destination of sales, 1971-1985
(Thousands of dollars)

Year	Total production	Exports	Non-exports			
			Value	Percentage of production	Domestic market share	Share of other EPZ firms
1971	857	857	--	--	--	--
1972	9 739	9 739	--	--	--	--
1973	70 374	70 374	--	--	--	--
1974	181 547	177 782	3 765	2.1	..	..
1975	174 803	169 415	5 388	3.1	..	..
1976	303 001	285 716	17 285	5.7	..	..
1977	367 918	347 076	20 842	5.7	..	..
1978	484 789	416 374	68 415	14.1	..	..

continued

Table 18 (continued)

Year	Total production	Exports	Value	Non-exports		
				Percentage of production	Domestic market share	Share of other EPZ firms
1979	600 558	512 957	87 602	14.6	..	..
1980	628 100	538 285	89 815	14.3	..	..
1981	696 341	592 793	103 548	14.9	1 907	101 641
1982	601 342	489 198	112 144	18.6	..	..
1983	706 537	563 778	142 759	20.2	3 981	138 778
1984	878 601	739 472	139 129	15.8	..	..
1985	809 319	698 007	111 312	13.8	4 626	106 686

Source: Administration Office of Masan EPZ.

4. Structure of linkages: a summary view

To arrive at a summary view of the scope and structure of linkage creation, a closer look is taken below at the composition of the value of production in Masan EPZ. The year 1985 has been taken for this exercise, as it is the latest year for which all the data required are available. However, that particular year may be taken as fairly representative of the structure of production in Masan EPZ in recent years.

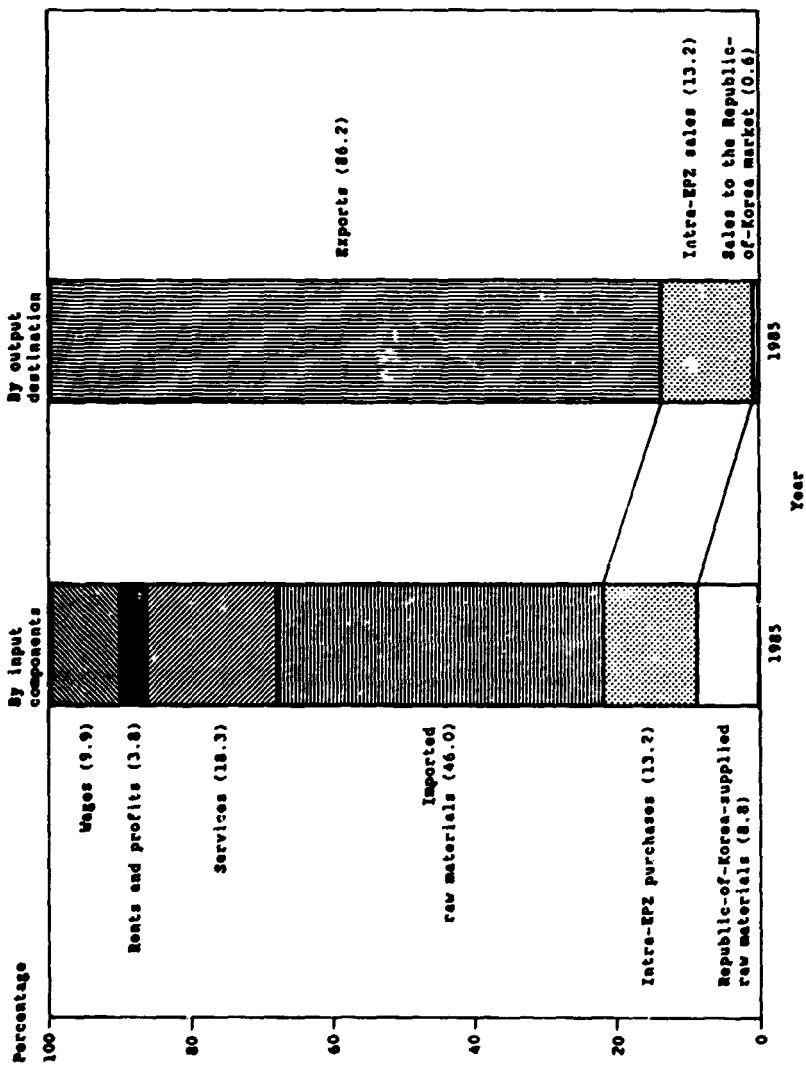
Figure I provides a breakdown of the 1985 value of production (\$810 million) in two different respects: it shows how the production was generated and to which markets it was directed. The following conclusions emerge.

The value added ratio, that is, the share of value added in the total value of production, stood at 13.7 per cent, indicating a relatively low degree of industrial processing. Wages alone accounted for 9.9 per cent of the production value, profits and rents for another 3.8 per cent.*

The domestic raw materials ratio, that is, the share of domestically supplied raw materials in the total value of production, reached 22 per cent when applying the broad definition which includes intra-EPZ purchases (13.2 per cent). Raw materials supplied from outside the EPZ alone accounted for 8.8 per cent of production value. It appears to be a moot point whether intra-EPZ purchases should be regarded as domestic supplies or not. On the one hand, they tend to perpetuate the enclave nature of EPZs rather than fulfilling the expectation of linkages leading to economic spread effects. On the other hand, intra-EPZ purchases do generate additional domestic value added if the alternative were to import

*The share of rents alone reached a negligible 0.2 per cent.

Figure I. Masan EPZ: composition of the value of production, 1985



the same raw materials from abroad. In addition, raw materials supplied from outside the EPZ may also have a high import content, which would tend to further blur the distinction between domestic supplies in a narrow and in a broad sense.

The local content ratio, that is, the combined share of wages, rents, services and domestically supplied raw materials in production value,* reached 50.4 per cent, largely as a result of the high importance of services, which alone accounted for 18.3 per cent of the production value.

As to the destination of sales from Masan EPZ in 1985, figure I shows that 86.2 per cent were exported, 13.2 per cent were sold to other EPZ enterprises, and 0.6 per cent reached the market of the Republic of Korea.

Figure II throws more light on the changing role of intra-EPZ purchases over time. It can be seen that during the period of 1975 to 1985 the share of imports in total raw materials remained fairly stable in the range of 65 to 70 per cent, and accordingly, domestically supplied raw materials accounted for 30 to 35 per cent of the total.

However, substantial and quite erratic changes took place with regard to the sources of domestic raw materials. Up to 1977, the share of intra-EPZ purchases in total raw materials was below 10 per cent; in 1978 it more than doubled to 19.5 per cent within just one year. With the exception of 1982 and 1983 (when it further increased to approximately 30 per cent), it remained at a level of around 20 per cent. The obvious conclusion to be drawn is that in 1978 a drastic shift in sourcing behaviour must have taken place in favour of EPZ-based firms and at the expense of Republic of Korea-based suppliers. No information about the nature and the determinants of that shift is available. It is conceivable, however, that supplying companies (or just one big supplier) of the Republic of Korea relocated their production from outside to within the EPZ. Whatever the reasons, the significant and changing role of intra-EPZ transactions in itself is an important finding which in

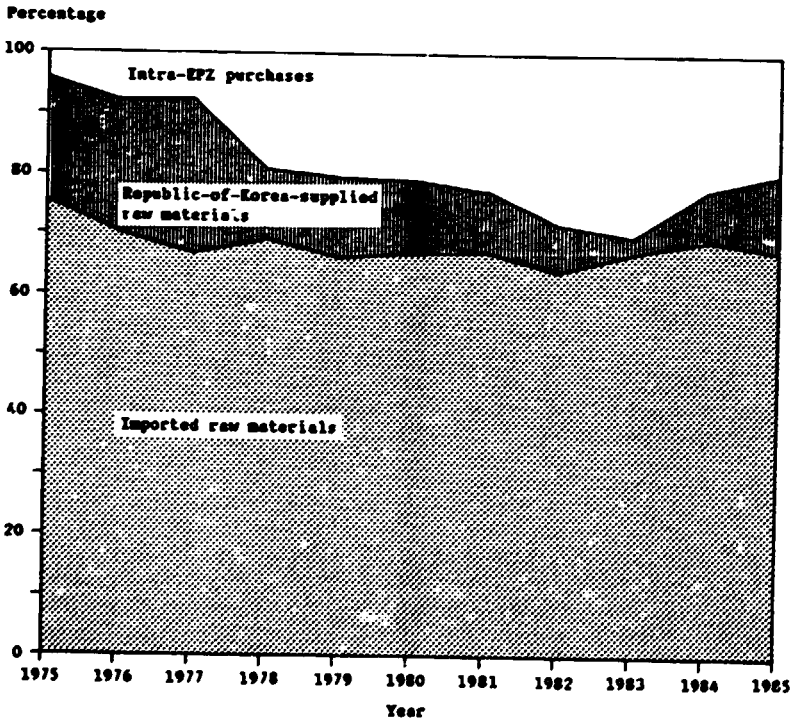
*This definition of the local content ratio is based on the following counterfactual assumptions necessitated by the lack of further data:

(a) All wages have been included, thus neglecting the role of expatriate labour;

(b) All profits have been excluded, thus neglecting the role of reinvested profits;

(c) Only direct effects have been taken into account, thus neglecting the import content of domestically supplied raw materials which (at least in the case of those supplied from within the EPZ) can be expected to be very high.

Figure II. Masan EPZ: composition of raw materials used, 1975-1985



in the past has received hardly any attention at all in the relevant literature. Further research would be required, however, to determine the following:

(a) The intensity of intra-EPZ transactions: are only a small number of companies involved or has a dense network of intra-EPZ transactions been established?

(b) The branch origin of intra-EPZ transactions: are many branches involved or are they confined to electronic components?

(c) The generation of intra-EPZ transactions: have they developed in an unplanned or planned manner? In the latter case, was it more by complementary foreign investment or by pulling Republic of Korea-suppliers into the EPZ?

To sum up, it has been shown that the very high domestic share in total raw materials of Masan EPZ (32.3 per cent in 1985) must not be equated with linkages having been created between EPZ firms and firms located outside the EPZ. The latter supplied only 12.9 per cent of all raw materials in 1985. Put into a regional comparative perspective, this share stands out, however, as being conspicuously high: in Sri Lanka's Katunayake EPZ the domestic share in total raw materials reached 4.9 per cent (1978-1985); in the Philippines the corresponding figure was 0.6 per cent for the Baguio EPZ and 4.1 per cent for the Mactan EPZ (both figures for the period of 1981 to 1985);* for all EPZs in Malaysia taken together, just 2.9 per cent (for 1980 to 1982) of all raw materials were supplied from domestic firms outside the EPZs and another 5.7 per cent by way of intra-EPZ purchases.**

5. Linkage determinants: policy-induced or market-induced?

In the preceding sections it has been demonstrated that EPZs in the Republic of Korea have established significant linkages with the domestic economy, though only to a minor degree with domestic firms outside the EPZs. Yet they clearly represent an exception to the general rule of EPZs being almost entirely dependent on imported raw materials.

In general, EPZs both in the Republic of Korea and elsewhere are characterized by a bias in favour of import-intensive operations, and EPZ-based firms show a preference for buying material inputs from their parent companies abroad, unless they can buy locally products of the same quality standard and at internationally competitive prices. To the extent that local suppliers meet those conditions, there is no reason to believe that EPZ-based firms will not take advantage of local supply. Not only are there

*Figures for Sri Lanka and the Philippines have been taken from UNIDO studies. They presumably even include small amounts of intra-EPZ purchases.

**Calculated from data given in Warr [20], p. 39.

some transport cost advantages, but the very act of establishing contacts with domestic firms can lead to a growing involvement in the domestic economy, with the prospect of being allowed to sell an increasing proportion of output in the Republic of Korea in future.

Industrial production in the Republic of Korea has become increasingly competitive at the international level. In 1987 the country's estimated current account surplus was \$10 billion. As from 2 January 1989 the country will no longer receive special treatment under the generalized system of preferences in the United States. The appreciation of the yen since 1986 has further contributed to making goods of the Republic of Korea more competitive internationally. More than anything else, it is this growing competitiveness and the increasing industrial sophistication that have induced EPZ firms to use more material inputs from suppliers in the Republic of Korea.

That conclusion was borne out by a number of firm-level interviews carried out in Masan and Iri in the context of this study.* The case-studies clearly revealed that in no case did management suggest that its decision on the domestic-imported material inputs ratio was governed by anything other than commercial principles. If the domestically produced inputs were priced competitively with overseas sources of supply and if the products were of sufficiently high quality then all firms indicated perfect willingness to buy locally. In fact, some firms were even willing to give a certain margin of preference to inputs produced in the Republic of Korea - possibly in order to establish long-term commercial links with industry in the Republic of Korea which might be useful in the future, or possibly also to indicate to the Government that they were "responsible" companies. Indeed, a few companies pointed out that they were buying locally produced components even though the quality was slightly inferior to the previously imported variety. That had caused productivity to decline because of higher rejection rates, but the impression left at the interviews was that this was being tolerated temporarily, and that efforts were being made to help suppliers improve quality control.

None of the interviewed firms seemed particularly interested in selling on the domestic market, presumably because export sales were buoyant and, frequently, foreign marketing was arranged by the parent company. The impression created was that while firms welcomed the increasingly liberal attitude of the Government in permitting domestic sales, they were as yet only willing to "sound out" the market and to establish a small niche which could possibly

*No attempt was made to select a statistically significant sample of firms. Selection was governed by an attempt to identify firms in a range of industries and by the willingness of company management to be interviewed. The Administration Offices of the two EPZs are particularly thanked for their assistance in the selection of firms and in the practical arrangements for the interviews.

be extended in the future. One firm (in the garment industry) expressed no interest at all in the domestic market because the firm's products would be treated as foreign products so far as the Republic of Korea was concerned, thus making them subject to a high tariff and consequently uncompetitive with the domestically produced goods.

In no instance did a firm suggest that any pressure was brought to bear on it by the Government of the Republic of Korea or the zone administration to purchase material inputs locally. Rather, the Government has "encouraged" firms in the EPZs to do so. It has realized, sensibly, that it cannot compel an EPZ firm to buy locally, yet firms are under no illusions about the Government's desire for them to purchase local inputs. Japanese firms in particular, which comprise the majority of those in the EPZs, are well aware of the advantages in their home country of following government guidance.

To sum up, all the indications are that while it is a policy objective of the Government of the Republic of Korea to encourage EPZ firms to use local materials, there has been no directive to do so, nor has any subsidy or other policy instrument specifically tailored to EPZ firms been used to make effective that encouragement. Local sourcing has been brought about largely by moral suasion on the part of the Government (and of the zone administration) and commercial reasoning (including expected long-term benefits) on the part of the EPZ-based firms.

However, there do appear to be at least two general economic policy measures that may have stimulated the use of local material inputs:

(a) In 1979, the Government established a Machinery Purchase Fund to finance the procurement by private business of machinery made in the Republic of Korea. Presumably there is no reason why firms (or, at any rate, firms of the Republic of Korea) in the EPZs could not avail themselves of that facility. It appears that demands on the Fund were heavy in 1986. While in previous years 50 per cent of the Fund remained unused owing to the lukewarm response of business, in the first eight months of 1986 225 billion won, or 83 per cent of the available loanable funds, were borrowed. The surge in demand has come from the general dynamism of the economy and the growing price-competitiveness, sophistication and variety of machinery made in the Republic of Korea;

(b) The second promotional measure is the use of variations in the loanable funds rate on letters of credit. In what is effectively a "rediscount" operation, the Bank of Korea from time to time sets new won rates per United States dollar for four categories of transactions: production of export goods; purchase of domestic raw materials; import of raw materials for export use; and purchase of domestic finished goods. The rates, and how they have changed since 1985, are set out in table 19.

It appears that the exchange rate applied for the purchase of domestic raw materials has consistently been the most favourable.

Table 19. Letters of credit: loanable amount for various economic activities, 1985-1986

Item	Won per dollar in value of letter of credit		Percentage of letter of credit value borrowable a/	
	1985 to 24 July 1986	25 July 1986 to 12 Sept. 1986	1985 to 24 July 1986	25 July 1986 to 12 Sept. 1986
Production of export goods	750	730	84.5	82.2
Purchase of domestic raw materials	820	800	92.3	90.1
Import of raw materials for export use	570	550	64.2	61.9
Purchase of domestic finished goods	630	610	70.9	68.7
Weighted average	740	720	83.3	81.1

SOURCE: Bank of Korea as quoted in Korea Times, 25 July 1986, and Korea Herald, 11 September 1986.

a/ On basis of exchange rate of W 888 = \$1.

In addition, from 1985 to 24 July 1986, for example, it was possible to borrow 92.3 per cent of the face value of a letter of credit when buying Republic of Korea inputs. If raw materials were being imported for export use, only 64.2 per cent of the value could be borrowed. All the rates were subsequently reduced twice, but relativities remained constant (the reason for the general reduction in the rates was the desire on the part of the Government and the Bank of Korea, fearing renewed inflation, to remove some of the "heat" from the economy by a step towards reducing liquidity).

The relatively favourable won-dollar rate for letters of credit for the purchase of domestic materials is applicable to all manufacturers of the Republic of Korea. Thus producers in the EPZs are not especially favoured. This observation again underlines the importance in the case of the Republic of Korea of not regarding the EPZs as being radically different from the rest of the economy.

D. The future role of EPZs in the Republic of Korea

The quotation presented below - taken from a recent study of the Organisation for Economic Co-operation and Development on free export processing zones (FEPZs) - succinctly summarizes the life cycle concept of EPZs and specifies the various stages through which EPZs in general may be expected to go. The framework is suitable for examining the possible future of the Masan and Iri EPZs.

"The life of the FEPZ would thus follow a succession of cycles in which successive kinds of specialization are acquired in turn, with each cycle comprising the following phases:

- In the first phase the FEPZ is provided with basic infrastructures and appropriate facilities. This phase is characterized by significant foreign investment flows;
- In the second phase of expansion the foreign investment flows continue to increase in absolute terms, but decline in relative terms. Exports expand strongly while the FEPZs occupancy rate reaches its maximum;
- The third phase is that of maturity. While the foreign investment flows tend to level off, exports increase at a slower rate than before and small marginal businesses tend to be replaced by larger enterprises employing staff with better technical training;
- The characteristic feature of the fourth and final phase is disinvestment by the foreign enterprises whose assets are as a rule taken over by local interests.

The end of this final phase should mark either the start of a new cycle in which the FEPZ turns towards more sophisticated manufactures, or the beginning of the phasing out process as the zone has become superfluous with the creation of industrial structures capable of developing independently.

This second possibility leads on to the more general question of the relationships that may exist between the life cycles of FEPZs, and the development cycle of the country in which they are established. Thus changes in conditions in the host country will affect the manner in which that country's authorities perceive the role of the FEPZs, independently of their age. For example, insofar as employment ceases to be the primary objective, the zone might play an important role in attracting foreign investment involving high value added. This would no longer mean a decline in investment in the FEPZ as it "matures", but simply a change in the zone's industrial structures accompanied by new partners, in conformity with the pace and objectives of development in the host economy" ([1], pp. 60-61).

In the case of Masan it is fairly evident that the third phase of maturity has been reached; in real terms cumulative investment in 1985 was practically the same as in 1981. As for Iri, its cumulative investment is still increasing, albeit not rapidly; in 1985 it was 13 per cent higher in real terms than in 1981. Occupancy rates in both EPZs are effectively 100 per cent, but "occupancy" is measured only in terms of a physical concept, ignoring economic criteria. It would probably be true to say that Iri is about to enter the third phase.

There is no strong indication, however, that Masan has entered the fourth stage in the scheme, where foreign disinvestment takes place and the assets are taken over by indigenous capital. In Masan only 10.5 per cent of cumulative capital investment as of June 1986 was owned solely by nationals of the Republic of Korea; data on the Republic of Korea equity share in joint ventures are not available. With regard to the number of firms, however, there do seem to be signs of increasing investment by firms of the Republic of Korea in Masan, and in Iri the number is quite large. In Masan the number of those firms grew from 7 to 12 between June 1983 and June 1986; in the former year there were 10 such firms in Iri.

However, the fourth phase is not necessarily the way in which Masan and Iri are likely to develop. A more probable path is the one characterized as leading to "a change in the zone's industrial structures accompanied by new partners, in conformity with the pace and objectives of development in the host economy". What this could imply in the development context of the Republic of Korea will be outlined further below.

What is clear is that Masan and Iri EPZs have effectively reached the end of the road so far as their status as EPZs is concerned. That seems to have been realized in the Republic of Korea as long ago as 1983, as the following quotation shows:

"The future of Korean EPZs is undetermined. Expansion of existing EPZs or creation of a new one is hardly predictable. However, to utilize the existing EPZs for other purposes is an immediate issue to be resolved by policy-makers. Some participating foreign enterprises are primarily interested in exploitation of the tax incentives accorded to them and the low-cost labour. But several foreign investors in the EPZs have voiced their intention to sell their equity and repatriate their capital. It is worthwhile to note that the tax exemption and reduction period is running out. Of the Masan EPZ participating enterprises, for example, 68 are already beyond the tax exemption and reduction period, and only 5 firms are in the tax reduction period. To most of them, the scheme of tax incentives accorded to foreign investors is losing its attractiveness Iri EPZ could be very likely viewed as in its late maturity stage Masan EPZ ... was fully occupied by 1974 and its tax exemption period is expiring for most of the occupant enterprises. In the future, new investment could be accepted only if, as and when some of the existing firms decide to withdraw from Masan EPZ. The Korean Government is encouraging participating enterprises to increase their investment, introduce superior technology to produce technologically more intensive products, and expand subcontracting to firms outside Masan EPZ."^{*}

If such perceptions were gaining ground in 1983, the trend of events since that time will have led undoubtedly to a strengthening of the view that new roles must be found for the EPZs. As long ago as in 1978 the need was recognized in the Republic of Korea to restructure production in a skill and technology-oriented direction, as the following statement by the Korea Development Institute shows:

"In view of the limited availability of financial and natural resources, Korea is better suited for attaining a comparative advantage in the skill and technology-intensive industries than in the highly capital-intensive industries. In particular, it is reasonable to expect that we will have a greater comparative advantage in such high value-added and resource-saving industries as electronics and machinery in the future. In these areas Korea is less constrained in terms of land, water, and other industrial environ-

^{*}See Jong-Nam Kim [21], pp. 2, 23 and 24. In 1983 Jong-Nam Kim was Director-General of the Industrial Policy Bureau in the Ministry of Commerce and Industry.

mental conditions than the major industrial countries in Europe and Japan are. Furthermore, the nation has the advantage of being able to choose the most up-to-date production processes and equipment, and high-quality labour is still available at costs much lower than in advanced countries." ([22], p. 55)

The country has indeed been moving in that direction. To some - albeit partial - extent the EPZs have followed suit. It would appear though that so far not enough has been done actively to stimulate resources to move from labour-intensive and low-skill-intensive activities in Masan and Iri into high-technology, skill-intensive vanguard industries. If such a transformation is not accomplished, the zones will decline even more rapidly and lose their relative importance in the production and exports of the Republic of Korea. The zones will thus fall behind the country's new industrial development pattern.

Among the factors that can be expected to accelerate the structural changes outlined above is an upward pressure on wages. The tendency of real wages to rise has resulted from a number of interlinked developments such as emerging labour scarcities in specific skill categories, the strengthening of trade unions and the introduction of minimum wage legislation. The latter is to eradicate salaries of less than 100,000 won per month (approximately \$115 at the 1986 exchange rate). As those industries predominant in EPZs (textiles, garments, electrical and electronics goods) account for the major part of salaries below that level, EPZ industries will be subject to increased labour costs. Some of the most labour-intensive companies are then likely to relocate to cheaper locations or, alternatively, to introduce new labour-saving technologies.

The major issue in this context is to define the role to be assigned to the country's EPZs in an environment of accelerated structural changes towards more sophisticated, skill-intensive and increasingly research-and-development dependent industries. The choice is obviously between phasing them out or transforming them to suit the new economic environment. Depending on which route will be taken, they will soon become either a "relic of the past" or be turned into a "mechanism of the future" ([23], p. 22).

The obvious approach to be taken is to phase out inappropriate unskilled-labour-intensive activities and to build up a new estate structure that will stimulate the entry of high-technology, skill-intensive industries funded by either Republic of Korea or foreign capital. That could be achieved either through a gradual process of change induced by applying more specific targeted approval criteria or by forward-looking political efforts and investments to establish the kind of technological infrastructure required to speed up the envisaged transformation process. The latter would essentially imply a close association of local

universities and technical colleges with product and process innovation in the zones within a broader science park environment.*

In general, the establishment of high-technology industrial zones or science parks is a long-term commitment often bearing fruit only after an incubation period of 10 to 15 years and involving large-scale public or private expenditures. Its success depends on a number of important preconditions, among them above all "a good research and teaching structure in at least one branch of technology; an environmentally attractive site ... and ... the availability in the region of a nucleus of persons of both the required calibre and the conviction that they can drive the project along" ([24], p. 22).

The number of science parks so far established in developing countries is extremely small. The most prominent example is the Hsinchu Science-Based Industrial Park in Taiwan Province of China ([25], [26]), which testifies to the possibility of rapid progress in a realistic planning framework. Founded only in 1980, the Hsinchu Park has attracted 73 research-based companies (some 40 per cent locally owned), predominantly from the electronics industry. In 1987 those companies generated a total production value of approximately \$700 million (which was close to the Masan EPZ production value of \$810 million in 1985). The main objectives in establishing the Hsinchu Park were to speed up industrial restructuring towards more knowledge-intensive production in view of the declining role of traditional EPZs, to create proper jobs for highly skilled local workers and to promote domestic entrepreneurship. The Hsinchu Park occupies a total area of 2,000 hectares, of which approximately 10 per cent have been designated duty-free; that limited area of 200 hectares may thus be considered a true science-based EPZ.

All three of the above-mentioned objectives would be equally valid in the context of the Republic of Korea, so that in general terms the establishment of a science park would appear to be a suitable step to be taken in the country's current stage of development. However, two important caveats need to be made.

*The development of special zones focusing on high-technology industrial development is a fairly recent trend in many, mostly industrialized countries [24]. Terminology is not yet well-established; the following distinctions, however, appear appropriate [2]:

(a) Innovation centres: restricted space intended primarily to induce the establishment of small high-technology companies, including new ones in the initial phases of operation;

(b) Science parks: larger areas of land suitable for knowledge-based firms of differing sizes and stages of development. Research-intensive manufacturing is permitted and encouraged;

(c) Research parks: similar to science parks, but permitting manufacturing only up to prototype level.

First, the intention being to convert an already existing EPZ into a science park, it would be crucial to ascertain the interest of the present EPZ companies in the new approach. Should they be reluctant to participate in an overall upgrading effort (including hiring of more highly qualified staff, introduction of new technologies and carrying out research and development), then the whole concept is likely to fail. It is hardly conceivable to start a new high-technology investment drive with a massive walk-out of existing foreign industries. If, however, particularly the more sophisticated companies (electronics, precision machinery) were to co-operate in the restructuring exercise, then the existing EPZs could become nuclei of large science parks to be built up in the medium run.

Secondly, any endeavour in the direction set out above would need to be reconciled with the country's overall strategic planning in research and development and high-technology industries. In particular, it would need to be analysed if and how new science parks could be complementary to and linked with the ongoing efforts to establish the Daeduk Science Town [27] close to Daejeon. Daeduk Science Town, located at the centre of the country's transport systems, is to become the focal point of research support for high-technology industries. The initial master plan of Daeduk Science Town was prepared as early as in 1973; it was subsequently revised in 1978, 1981 and 1984. According to the current plan, the target year for completion is 1991, when Daeduk Science Town is expected to host 10 government-funded research institutes and 23 private-industrial research institutes. Table 20 provides an overview of those institutes already established in Daeduk.

All in all, it appears that the conversion of the two existing EPZs in the Republic of Korea into elements of science-based industrial parks would be a logical step in their development. As the present study has shown, conditions in the zones have never been radically different from the country's overall economic conditions. In the future, however, they may increasingly become so, should industrial policies fail to make them an integral part of imminent structural changes in the economy of the country.

E. Conclusions and implications for other developing countries

In the Republic of Korea EPZs have been in operation for approximately 15 years. They have contributed to industrial employment and manufactured exports without, however, having reached substantial shares of the national totals in either case. From the very beginning, EPZs in the Republic of Korea have been an integral element of a general export-oriented industrialization strategy and an overall industrial estates concept. The latter in particular may have facilitated and induced the provision of local material inputs, although additional research would be required to establish the exact relationship between EPZs and other industrial estates, particularly those located at the periphery of EPZs.

As has been shown, significant linkages have been created by EPZ enterprises in terms of purchases of domestic material inputs, reliance on domestic services (transport, finance, insurance,

Table 20. Research institutes located in Daeduk Science Town, June 1987

Research institutes	Date (when moved or constructed)	Functions	Personnel
A. <u>Government-funded research institutes</u>			
The Korea Standards Research Institute	1978	Establishment of national standards system	394
The Korea Research Institute of Chemical Technology	1978	Testing and research on technology related to technical industries	422
The Korea Advanced Energy Research Institute	1978	General research and development related to atomic power	1 438
The Daeduk Shipbuilding Research Station of KINS a/	1978	Research on machinery, metals and shipbuilding	208
The Korea Institute of Energy and Resources	1979	Geological exploration and research on utilization of land and marine resources	357
The Korea Electronics and Telecommunications Research Institute	1983	Testing and research and development related to electronics and telecommunications	1 278

The Korea Ginseng and Tobacco Research Institute	1984	Testing and research and development related to cultivation and ingredients of ginseng and tobacco	341
Institute of Space Science and Astronomy	1935	Research on astronomical observation and space sciences	60
The Korea Science and Engineering Foundation	1987	Enhancement of research capabilities, including international co-operation	51
B. <u>Private-industry research institutes</u>			
The Sangyong Central Research Institute	1979	Research on cement production processes and development of new products	135
The Lucky Central Research Institute	1979	Research on genetic engineering high polymer and medical supplies	242
The Hanyang Chemical Central Research Institute	1979	Research on petroleum-related industries	98

Source: Jung-Man Suh, "Science-based industrial park. Korean experience: past achievements and future prospects", resource paper for the Symposium on Export Processing Zones, Colombo, 26-28 August 1987 (mimeo).

a/ Korea Institute of Machinery and Metals.

packaging etc.), as well as subcontracting arrangements. While services of a non-tradable nature are a natural linkage component in all EPZs, domestic purchases, on the one hand, and subcontracting, on the other, have developed in EPZs of the Republic of Korea to an exceptionally high degree as compared with EPZs in other developing countries. In sum, the local content of production, that is, the value retained in the country, reached more than 50 per cent in Masan EPZ in 1985.

It has been further demonstrated that the establishment of backward linkages via domestic sourcing of inputs has not primarily been the result of specific local-content policies but rather a market-induced, that is, supply-oriented process initiated by the EPZ-based companies themselves, within an overall climate of government encouragement. The evidence from EPZs in the Republic of Korea as presented in this study is fully in line with the results of studies of linkage creation by transnational corporations in general, and those located within EPZs in particular ([20], [28]-[33]), as summarized below.

First, the degree of linkage varies between different industrial branches depending upon the production process, the complexity of technology and the extent to which economies of scale can be achieved. The electronics industry is an illustrative case showing how a highly separable production process coupled with high economies of scale in component manufacture has led to an intense reliance on subcontracting arrangements. When looking, however, at purchases of local raw materials, other industrial branches have proven to have a higher "linkage propensity" in accordance with raw material availabilities in different countries: in Masan EPZ in the Republic of Korea the manufacture of ferrous metals and of footwear exhibited the highest domestic share in total raw materials, whereas in Sri Lanka's Katunayaka EPZ the same applied to the manufacture of rubber and coir products.

Secondly, the creation of linkages is influenced by firm-level determinants. This concerns, inter alia, the degree of autonomy given to subsidiaries of transnational corporations in their sourcing decisions. In that sense, the linkage potential is a matter of corporate philosophy and thus, indirectly, also of the investing firms' country of origin.

Thirdly, and most importantly, the economic conditions prevailing in the host country effectively influence the scope for backward linkages spreading from EPZs. Although both the liberal regulations governing EPZs (duty-free import of raw materials and intermediates) and the motives of companies investing in EPZs (utilization of low-cost labour for export production) would appear to militate against attempts at integrating them with the host economy, there is ample evidence that EPZ-based firms are interested to take advantage of domestic supplies unless these fail to comply with cost and quality requirements. Moreover, as has been also confirmed by interviews carried out for the present study, "the multinationals were willing to bear the initial costs of encouraging and patronizing local suppliers, who in the long run

would be cost-competitive".* Hence it is hardly surprising that Spinanger, in a comparative study on Asian EPZs, found the share of inputs sourced from the domestic economy to be strongly correlated with per capita incomes, the obvious conclusion being that "the establishing of linkages is basically dependent upon the level of development of the host country" ([30], p. 66). Needless to say that time itself is another relevant factor, in the sense that the identification of competitive suppliers and the establishment of a commercial relationship require a certain period. In the case of the Republic of Korea that period has been shown to be relatively short, however.

To emphasize the relationship between the level of industrial development and the level of linkage creation may appear to be trivial. Yet, in many cases the frustration of policy-makers about their countries' EPZs remaining enclaves would be avoidable were only the sine qua non of local input availability assessed properly.

Indeed, in the absence of efficient local suppliers the impact of specific policy measures aimed at increasing the level of linkages is bound to remain small. For example, linking tax incentives to the level of purchases from domestic firms "will not in itself cause the domestic industrial development which must occur for a significantly greater linkage with the FTZs [Free Trade Zones] to be possible" ([20], p. 53). At the same time, compulsory linkage requirements will most likely be counterproductive just as local content regulations in general "can, if improperly applied, be inefficient and cause considerable waste of resources (through excessive unit cost of production and low quality of final output) and hence damage the development efforts" ([33], p. vii).

This leads back to the issue of incorporating the establishment of EPZs in a favourable overall policy framework. In the case of the Republic of Korea, a number of important policy reforms were in fact adopted prior to the establishment and in the early years of the existence of Masan EPZ. They involved changes in the import control system, a tariff reform as well as interest rate and exchange rate adjustments. This is not to say that the particular policies followed by the Republic of Korea may be considered suitable for every developing country. What is important, however, is that other developing countries, in their attempts to emulate the success of the EPZs in the Republic of Korea, should take into account the overall framework within which those EPZs have operated; all too often EPZs have been considered as though they operate in a vacuum.

In the case of the EPZs in the Republic of Korea, a number of factors conspired to work for their success. Masan EPZ came in on the heels of a realistic exchange rate, a partially liberalized import régime (with the switch from a positive list to a negative list system in 1967), a low inflation rate as well as rapidly

*The statement refers to electronics companies in Singapore. See [29], p. 591.

expanding international trade. Hence, it appears that it was the success of the industrialization strategy of the Republic of Korea, coupled with a conducive international economic environment, that made the country's EPZs work successfully, not the other way around.

Thus developing countries contemplating the establishment of an EPZ are left with a basic dilemma. "The poorer the industrial infrastructure of the country and the greater the incentives for import substitution, the more necessary a zone may be to achieve any significant growth of manufactured exports at all. On the other hand, the more a zone is an enclave, atypical of the infrastructure and incentives available outside, the less successful the zone is likely to be in achieving wider economic benefits." ([32], p. 39)* In other words, EPZs have proven to be a useful additional instrument to strengthen a country's overall export drive rather than a means of taking a leap from a domestic market orientation into manufacturing for the world market. This implies that in general the developmental impact of EPZs has tended to be overstated. Where they have been successful, only a small portion of the attracted investment may be considered of an additional nature, whereas they have often failed to reach their objectives when set up to initiate the attraction of foreign investment.

At present, developing countries thus would be well advised to act very cautiously when planning to establish new EPZs. First of all, as outlined above, any EPZ needs to be integrated into a country's overall industrial strategy. Secondly, the wave of newly established EPZs during the 1970s created global conditions of oversupply in what may be considered an international market for EPZ-type investment locations. The situation is one of fierce competition among already existing EPZs for obviously declining amounts of foreign investment. This explains - apart from domestic factors - why second generation EPZs such as those in Bangladesh and Pakistan have fallen short of expectations ([31], p. 94).

Thirdly, the benefits which may nevertheless flow from the establishment of an EPZ are not costless, since the Government has to consider the opportunity cost of allocating resources to the setting-up and maintenance of the zone as compared with other possible uses to which the resources might have been put in the economy. This entails such difficult issues as estimating revenue foregone by the Government through various types of investment incentives. Even beyond these calculations, two further questions remain. Would generalized incentives to attract foreign investment be able to lead to an equal (or greater) inflow of capital? Would different economic policy measures (such as a devaluation) induce greater exports than any EPZ was likely to produce?

In general, developing countries deciding to enter the EPZ competition would be well advised to adopt a modest and limited set of related objectives, particularly if their level of industrial development is relatively low. In such cases, the creation of

*See also [34], p. 49.

additional employment opportunities and the generation of a certain amount of net foreign exchange earnings would appear to be potentially realistic objectives, whereas other impact dimensions such as linkage effects or technology transfer may be regarded as "desirable externalities" ([35], p. 62). Again, rather than burdening EPZs with overly high expectations and far-reaching goals, they should be viewed as just a specific policy measure within an overall strategy.

For those countries already operating EPZs the essential task would be continuously to monitor their performance and review their functions and objectives with a view to responding to challenges emerging both from structural changes in the domestic economy and from new trends in the international economic environment, including the changing demands of foreign investors vis-à-vis potential investment locations. For example, attempts to attract technologically more sophisticated lines of production may necessitate a prior upgrading of an EPZ's infrastructure as well as the availability of highly specialized industrial services.* In the past, a number of EPZs have moved away from the rigid initial concept of being designed to host exclusively foreign investment producing goods exclusively for export markets. More flexible regulations have been adopted in many cases, and the process may be expected to continue in the future. The following specific elements of the process are noteworthy:

(a) The permission for EPZ companies to sell part of their output to the domestic market. While this meanwhile applies to many EPZs (including those in the Republic of Korea), the Mexican in-bond industries (maquiladora industries) are a particularly interesting case in point ([35], p. 15). Within a system of conditionality up to 20 per cent may be sold locally if certain local content requirements are met, if net foreign exchange earnings remain positive (after deduction of the foreign exchange cost of local sales) and if technical assistance is provided to local suppliers;

(b) The possibility for specific companies to locate outside an EPZ while taking advantage of EPZ regulations and administration. This has been the case in, for example, Sri Lanka with regard to some companies processing domestically available raw materials (rubber) where proximity to the supply sources has been considered essential for either economic or technical reasons;

(c) The admission of domestic investors into an EPZ, either on a joint venture basis or even in the form of 100 per cent domestically owned enterprises. The latter option was opened to nationals of the Republic of Korea in 1980;

*A recent UNIDO study [36] on foreign direct investment in the machine tool industry has found the existence of, for example, local computer software specialists to be a much more important investment precondition than generous financial incentives.

(d) The establishment of subcontracting arrangements between EPZ companies and domestic companies.

Such tendencies towards a greater flexibility in managing EPZs may contribute to enhancing their resilience and, by increasing the degree of their interactions with the whole economy, may also facilitate their gradual transformation in response to changing economic conditions, if and when required.

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MANAGEMENT OF TECHNOLOGICAL CHANGE

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The subject of management of technological change has acquired both urgency and complexity. Two trends at the international level account for the new situation. First, new management concepts and practices have been emerging over the last decade with emphasis on quality, excellence, creativity, innovation management and "intrapreneurship"^{**} [1]. It is important to note that those concepts are essentially technology-driven and denote the attempts of management to survive and succeed in a highly competitive international business environment. Secondly, technological change is occurring faster than ever before, with a convergence, intensity and speed that are remarkable. This paper deals with the subject essentially from the point of view of managerial perceptions and practices.

A. Dimensions of technological change

Technological change as a whole could be grouped into the following three categories:

(a) Technological improvements and changes internal to an industry;

(b) Technological changes aimed at energy conservation or reduction of energy requirements;

(c) Technological advances in fields such as micro-electronics and information technology, genetic engineering and biotechnology and new materials. Such technological advances also accelerate technological change in the other two categories mentioned above.

To the three categories could be added another dimension of technological change arising from new concepts and practices in manufacturing technology such as flexible manufacturing systems.

It is important to understand the pervasive impact of the technological advances, part of which has been felt already and part of which is in the offing. Micro-electronics and information technology could have an impact over the entire range of industries and service sectors, resulting in improvements in productivity and contributing to accuracy and ease of operation. Their impact on engineering industries and products has led to radical changes in

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**An "intrapreneur" is an entrepreneur operating within a large company rather than in his or her own business.

manufacturing technology mentioned earlier. Biotechnology also affects a range of industries such as food processing, chemicals and pharmaceuticals and energy-related industries. New materials emerge as outputs from several industrial branches such as the chemical, metallurgical and ceramic industries and figure as inputs for a whole range of industries. With such a multitude of impacts, product and process changes and productivity improvements could be expected in a variety of industries. The speed of such changes is, however, dependent on many considerations, including the age of the existing plant, the type and nature of the market and the industrial and technological capabilities available. It is ultimately the enterprises which are the agents of change.

B. Views on management of technological change

A relatively simple view of management of technological change will first be presented before explaining the factors of complexity arising from the impact of technological advances. The following view is offered on the basis of a sample of studies on how the task of managing technological change is tackled in the competitive environment of a developed country.

At the outset it should be noted that the record in various developed countries is still mixed. According to one view ([2], [3] and [4]), a few companies manage the transition to new technological fields effectively, but many others are unable even to begin the process and most find it impossible to complete the move successfully. Three elements are said to determine a company's ability to manage technological transition steadily, and they also constitute the basis of effective technology management. Those elements are as follows:

- (a) Which technology to pursue and when to pursue it;
- (b) How to manage the transition from one technology to another;
- (c) How to prepare the enterprise for technological change.

One of the goals of technological management is to identify at an early stage the limits of any given technology, in order to determine what finally can be accomplished with it. The enterprise can then determine how far it wants to go to approach those limits. It accomplishes this by applying research (knowledge acquisition) and development (knowledge application) to narrow the gap between the state of the art and the natural limit. During the early phase, extensive effort goes into achieving only limited performance improvement. But once the knowledge base is established, progress accelerates rapidly.

As the limit of a particular technology is reached, the company has to consider alternative approaches. It can then prepare to manage the transition. Engineers with different skills will be needed, new approaches will have to be taken in production and marketing and new financing must be arranged. Management must be certain that old customers are not left in vulnerable positions,

nor can resources be withdrawn from existing products that, though mature, may still be making money. At the same time, if technological efforts are not shifted early enough, the economic performance, once it begins to deteriorate, will collapse even for mature products. A firm has to sense its way up the "S-curve" and know the limits of a given technology. Exploiting technological potential requires a strong technological base and management vision. A firm has to span the processes of cognition, pioneering, gestation and diversification ([5], p. 109).

Major technological shifts can indeed be classified as "competence destroying" or "competence enhancing" because they either destroy or enhance the competence of existing firms in an industry ([6], p. 442). The former require new skills, abilities and knowledge in both the development and production of the product. They are so fundamentally different from previously dominant technologies that the skills and knowledge base required to operate the core technology shift. Competence-enhancing discontinuities are order-of-magnitude improvements in price and performance that build on existing know-how within a product class. Such innovations substitute for older technologies, yet do not render obsolete the skills required to master the old technologies. On the basis of a number of product-class case-studies, it is hypothesized ([6], p. 444) that technology progresses in stages through relatively long periods of incremental, competence-enhancing change elaborating a particular dominant design. Such periods of increasing consolidation and learning by doing may be punctuated by competence-destroying technological discontinuities (that is, product or process substitution) or by further competence-enhancing technological advance (for example, revitalizing a given product or process with complementary technologies). Technological discontinuities trigger a period of technological ferment culminating in a dominant design and, in turn, leading to the next period of incremental, competence-enhancing, technological change.

A recent study conducted by Arthur D. Little* of how companies in North America, Japan and Europe manage innovation came out with two important findings:

(a) Innovation can be managed and many companies have developed tools and techniques to keep innovative attitudes alive;

(b) Top management is taking the question of innovation seriously. Thus innovation management may well be the main managerial innovation for the late 1980s and beyond.

All companies may not hope to be leaders in innovation. Companies with no tradition of innovation might be wise to concentrate their efforts and resources on incremental innovations in various functional areas. They may not make spectacular breakthroughs, but they may very well achieve worthwhile innovation for a limited amount of investment. Innovative companies have begun to

*Quoted in [7].

consciously organize, manage and sustain a "top-down" and a "bottom-up" process. In the top-down process, the initiative - particularly for heavy innovations with long cycles and a high level of investment and risk - comes from top management. In the bottom-up process, sometimes called the "bubble-up" approach, ideas flow freely from employees to managers at any level. That process is crucial to the generation of minor innovations that often have short cycles and can quickly enhance the competitiveness and success of a company.

A study conducted by the International Institute for Applied Systems Analysis (IIASA) [8] found that the management approaches to strategy, organization or the human aspects of stimulating productivity, creativity and motivation must all take different forms in different settings. Process innovation is often associated with efficiency, and management techniques to achieve it are often oriented to careful organization of work and detailed planning of its accomplishment. The outputs are usually incremental improvements on the production of existing products, making it faster, less expensive, or of higher quality. Major product innovation usually implies using science or technology to devise a whole new product or tool, something that will need to find an entirely new market. Nurturing imagination and individual creativity is usually the dominant management approach in this case, and the organization of detailed planning steps may be counter-productive.

Key papers in the IIASA study highlighted the need to approach those two aspects of innovation with very different sets of management tools. None the less, it also became apparent that at some time the two kinds of innovation merged: advances in process innovation could be so striking as to catapult a technology into a whole new world of applications and products. Similarly, product innovations can completely change process approaches. Management systems must above all be flexible and rapidly adaptable to be able to deal with the problems and opportunities of those complex situations.

C. Special considerations relevant to new technologies

The somewhat general views on management of technological change outlined above require modifications in the light of the empirical research initiated by the UNIDO secretariat and others on the impact of technological advances. Five aspects may be discussed in that connection: realignments in the industrial and technological market structure [9]; changing concepts of university-industry collaboration; issues related to technology transfer; advances in manufacturing technology; and the emergence of a product continuum. Each of those aspects is dealt with below.

In the case of information technology, particularly in computers and software, telecommunications and semiconductors, there is a dynamic restructuring of the respective industries both within and among themselves. The reasons for such restructuring include

those specific to each industry and also those general to all of them. The growing importance of personal computers has relevance to the restructuring in the computer industry, while for similar reasons and in view of the close interrelationship between software and hardware, the restructuring of the software industry is also under way. In telecommunications the restructuring has mainly been triggered by United States court decisions relating to American Telephone and Telegraph (AT&T) and International Business Machines (IBM). In the case of semiconductors, the possibilities of vertical integration have been a major cause. But common to all the industries is the fact that technologies have been converging and product segregation has given way to a product continuum. Products have often to derive their technological content from more than one of the industrial branches referred to. In the case of user industries it has often happened that users have become producers of information technology turning out applications software or creating new systems. In the field of software in particular, the initial effort has been spearheaded by relatively small companies which are increasingly being taken over by large companies.

The last trend referred to is a particular feature of genetic engineering and biotechnology. Small firms often do pioneering work, distinguished for their technical excellence rather than managerial or marketing skills, and when they reach the constraints of funding they have to search for alternatives, one of which is to join, or be bought out by, transnational corporations. The trend towards an increasing role for transnational corporations is clear. For example, of the 500 largest United-States-based companies listed in Fortune, at least 83 have biotechnology-related activities. Among non-United-States-based firms, of the 500 largest companies also listed in Fortune, at least 62 have biotechnology-related activities. Petrochemicals and chemical companies have been active in this field, including the acquisition of a large number of seed companies. A whole set of firms dealing with biotechnology equipment and chemicals for biotechnology research and development has also emerged.

In the case of solar photovoltaics, the structure of the industry has been considerably influenced by the dominant conversion technology of single-crystal, polycrystal or amorphous silicon cells. Petroleum firms have shown interest in acquiring companies specializing in solar cells in view of the relevance to energy markets, while semiconductor firms have an obvious relevance from the point of view of silicon wafers.

In the limited number of cases of new materials that have been analysed, a similar trend in the industrial and technological market structure is seen. Firms moving into new ceramics include materials manufacturers diversifying into new materials, porcelain and glass industries that are upgrading themselves, and firms in processing and assembly industries that have identified uses for new materials. In the case of fibre optics, although it is dominated by a few companies, a considerable amount of vertical integration has been noticed between suppliers of fibres, cables and other components.

The position is no different in the case of manufacturers of flexible manufacturing systems and robots. They include robot users, machine tool manufacturers, software and engineering and construction firms, electric and electronic manufacturers and computer manufacturers.

The alignments noted in all the above cases have several implications. They not only indicate the alertness and resilience of firms in adopting offensive or defensive strategies and diversifying in an era of changing technology and emerging market possibilities, but they are also a testimony to the pervasiveness of the new technologies straddling across several industries. The figure is but one example of networks emerging between industries related either by the nature of the technology or its use. This has implications for corporate finance, corporate management and technology acquisition. For example, leading Japanese companies are reported to be committing themselves to a three-dimensional corporate strategy involving advanced technology development, diversification and internationalization ([10], p. 87).

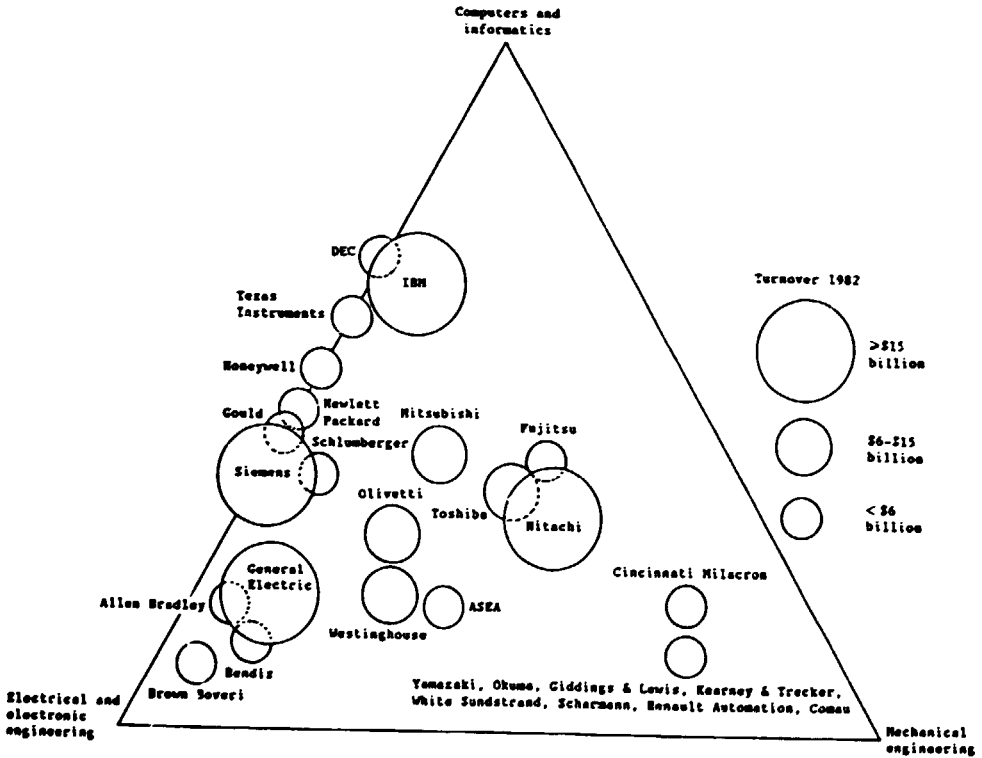
Another feature of the current scene is a renewed emphasis on the linkages between universities and industry. In developed countries, in the United States in particular, the fact that the ongoing technological advances are more and more science-based has led to intensive university-industry interactions, particularly in micro-electronics and biotechnology. In micro-electronics, several university centres have been established with pilot silicon foundry facilities, where industry can send its personnel to be trained or can commission specific jobs to be done. There are at least six important centres of this type in the United States and similar centres have also been established, for example in Australia, Belgium, Canada and Germany, Federal Republic of. As may be seen from table 1, in micro-electronics, the idea of explicit co-operation between many firms has become acceptable, and universities provide the setting in which they can meet and through which they can most easily establish co-operation. In the United States seven computer vendors alone have made recent commitments to contribute approximately \$180 million in cash and equipment to universities. Such policies are largely without parallel in Europe, except in so far as some of the same United States companies have made gifts on a smaller scale. Table 2 provides information on 27 of the largest agreements between universities and transnational corporations, smaller biotechnology companies and Governments both within and between developed countries.

New university-based initiatives have the following important characteristics in common:

(a) Institutional arrangements involve long-term, multi-year commitments with agreements that include facilities, equipment and human resources;

(b) The arrangements bring together multi-discipline, multi-institution, and multi-funding resources to support wide-ranging research and educational and development efforts;

Some major suppliers of automation equipment and their relative competitive strength in mechanics, computers and electrical engineering



Source: Recent Trends in Flexible Manufacturing (United Nations publication, Sales No. E.85.II.E.35), p. 72.

Table 1. Participants in some United States industrial research co-operatives, 1985

Company	RP11	RP12	CIS	MCC	SRC
Air Products		X			
Alcoa	X				
Altech	X				
Allied				X	
AMD				X	X
AMI (Gould)			X	X	
AT&T Technologies				X	
Bell Communications				X	
BMC Industries				X	
Boeing	X				
BTU Corp		X			X
Burroughs				X	X
CDC					
Cincinnati Milacron	X				
Computervision		X			
DEC	X	X	X	X	X
du Pont					X
Eaton		X			X
E-systems					
Fairchild Republic	X				
Fairchild Schlumberger	X	X	X		X
GCA					X
GE	X	X	X		
GI a/				X	
GM	X				X
Goodyear Aerospace					X
GTE		X	X		X
Harris		X		X	X
Hewlett-Packard		X	X		X
Honeywell			X	X	X
IBM	X	X	X		X
Intel			X		
ITT		X	X		
Kodak	X	X		X	X
Lockheed				X	
LSI Logic				X	
Martin Marietta					
Matheson		X			X
Monolithic Memories					X
Monsanto			X		
Mostek				X	X
Motorola			X	X	X
MatSemi				X	
NCR					

(continued)

Table 1 (continued)

Company	RP11	RP12	CIS	MCC	SRC
Northrop			X		
Norton	X				
Perkin-Elmer		X			X
PEW Memorial Trust		X			X
Phoenix Data Systems		X			
Polaroid		X			
Raytheon		X			
RCA				X	X
Rockwell			X	X	X
SEMI, Chapter b/ Signetics (Philips)			X		X
Silicon Systems					X
Sperry		X		X	X
Tektronix			X		
Texas Instruments			X		X
3M				X	
Timex	X				
TRW			X		
Union Carbide					X
United Technologies	X		X		
Varian					X
Westinghouse					X
Xerox		X	X		X

Source: "Global trends in microelectronic components and computers", Technology Trends Series: No. 3 (IPCT.33), p. 76.

Note: RP11 Rensselaer Polytechnic Institute, Manufacturing Productivity Programme

RP12 Rensselaer Polytechnic Institute, Integrated Electronics Programme

CIS Center for Integrated Systems, Stanford University

MCC Microelectronics and Computer Technology Corporation

SRC Semiconductor Research Corporation

a/ General Instrument resigned its SRC Membership in April 1985.

b/ SEMI, Chapter: Micrion, Micronix, Pacific Western, Probe-Rite, Pure Air.

Table 2. University, industry and government biotechnology agreements

Country	University	Transnational corporation biotechnology company or Government	Type of agreement	Amount involved
United States	Stanford University	Eugenics and Center for Biotechnology Research (CBR) (Elf Technologies, General Foods, Koppers, Bendix, Mead McLaren Power and Paper)	The six sponsors set up Eugenics and CBR, the former as a for- profit company, the latter to fund university research	\$2.5 million for CBR for four years; \$7.5 million for 30% equity in eugenics
United States	Michigan State University	Neogen and Doan Resources	Neogen was founded by Michigan State to provide limited part- nership funds for faculty and research results	\$230,000 in stock purchases by Michigan State; \$250,000 by Doan Resources
United States	Rockefeller University	Monsanto	Five-year agreement on photo- synthetic research	\$4 million
United States	Washington University	Monsanto	Support for faculty research in hybridomas	\$1.5 million
United States	Harvard University	Monsanto	Support of basic research on cancer	Long-term agreement
United Kingdom and United States	Oxford University	Monsanto	Five-year research project on oligosaccharides	£1.2 million
United Kingdom	Bristol, Birbeck College, Oxford, Imperial College, Leeds, York	Celltech, Glaxo, ICI, RTZ Chemicals/Sturge, Science and Engineering Research Council (SERC)	The parties have agreed to a four-year research "club" to study protein engineering and produce novel proteins	£2 million
Federal Republic of Germany and United States	Massachusetts General Hospital (Harvard University)	Hoechst A.G.	Research in molecular biology	\$70 million

continued

Table 2 (continued)

Country	University	Transnational corporation biotechnology company or Government	Type of agreement	Amount involved
United States	University of Illinois	Standard Oil of Ohio	Five-year grant establishing a centre for crop molecular genetics and genetic engineering	\$2 million
United States	Massachusetts Institute of Technology	National Science Foundation	Establishing centre for biochemical engineering, including research in genetics and molecular biology	\$20 million
United States Israel	Rockefeller University and the Weizman Institute	Rapid-American Corporation	Research on cancer biology, neuro-sciences, molecular genetics, immunology	\$5 million
United States	Northern Illinois University	Argonne National Laboratory State of Illinois	Project on crop plant growth rates, pest-resistant and chemical synthesizing plant strains	\$1 million for first year
United States	Washington University	Monsanto	Five-year contract for research projects, including fundamental research (30 per cent) and research into human disease	\$23.5 million
United States	Massachusetts Institute of Technology	Whitehead Institute (headed by the President of Technicon Corporation)	Institute to be built and funded, including funding of MIT biology department's faculty, graduate students and research assistance	\$20 million for structure, \$5 million to operate; \$100 million to Institute upon death of Whitehead; \$7.5 million to MIT, plus \$1 million annually

continued

Table 2 (continued)

Country	University	Transnational corporation biotechnology company or Government	Type of agreement	Amount involved
United Kingdom	University of Leicester	John Brown Engineers, Dalgety-Spillers, Gallahers and Whitbread and the Science and Engineering Research Council	Five-year research program	£1 million from the four companies, £183,000 from the Research Council to equip laboratories
United States	Cornell University	Union Carbide, Corning, Eastman Kodak	Establishment of biotechnology Institute	\$2.5 million each over 6 years by the companies, \$4 mil- lion by Cornell
United States	Massachusetts Institute of Technology	W. R. Grace	Research on micro-organisms	\$8.5 million
United States	Columbia University	Bristol-Myers	Investment in work of molecular biologist involved in gene cloning and rDNA technology	\$2.3 Million
France	University of Compiègne	Elf Aquitaine	Enzyme engineering	
United States	Harvard	DuPont	Five-year grant to head of new department at medical school	\$6 million
United States	Yale	Celanese	Three-year research and develop- ment in enzymes	\$1.1 million
United States	Washington University	Mallinckrodt	Three-year hybridoma research programme	\$3.88 million
Federal Republic of Germany	University of Heidelberg	BASF	Ten-year support of research	DM 1 million from BASF, three-year government grant of DM 18 million

Table 2 (continued)

Country	University	Transnational corporation biotechnology company or Government	Type of agreement	Amount involved
Federal Republic of Germany	Max Planck Institute, University of Cologne	Bayer	Support	DM 1 million per year
Federal Republic of Germany	Max Planck Institute of Immunology, Univer- sity of Munich	Hoechst	Collaborative project	..
Federal Republic of Germany	National Centres of Excellence at Cologne, Heidelberg, Munich and Berlin	BMFT (Federal Ministry of Science and Technology)	Support of biotechnology projects in universities and government institutes	DM 1.05 million in 1983, DM 1.15 mil- lion in 1984
United Kingdom and United States	University of Oxford and Cambridge, Imperial College of London	Monsanto, Nuffield Foundation	Advent Eurofund to finance biotechnology projects (among others)	£10 million initial capital, half from Monsanto

Sources: "Industry and universities prepare to study proteins", New Scientist, 20 June 1985; "Foreign funding of research", New York Times, 5 August 1985; "Eight universities get industrial grants", New York Times, 4 April 1985; "Industrialist gives \$5 million grant for biomedical research", New York Times, 24 March 1985; Bio/Technology, June 1985; Commercial Biotechnology: An International Analysis (Washington, Government Printing Office, 1985), appendix H; Monsanto Public Relations Department, "Monsanto's external investments and/or contracts"; "Monsanto Inks Research and Development pact with Oxford University", European Chemical News, 19-26 December 1983; "Monsanto Act", Nature, 5 August 1982; International Review Service, Trade and Economic Development, 1 September 1982; "\$2.3 million fund for gene research", New York Times, 13 September 1983; "Oil firm pins its hopes on genetic research", New Scientist, 11 March 1982; "DuPont gives Harvard gene research grant", Chemical and Engineering News, 6 July 1981; "Celanese, Yale get biotechnology agreement", Chemical and Engineering News, 22 February 1982; "Company funds university hybridoma research", Chemical and Engineering News, 7 September 1981; "Biotechnology taking root in West Germany", Bio/Technology, April 1984; "German firms move into biotechnology", Science, 24 December 1982.

Note: Table extracted from David Dembo and Ward Morehouse, "Trends in biotechnology development and transfer", Technology Trends Series No. 6 (UNIDO/IPCT.32).

(c) The arrangements involve leadership and support of individuals at the highest levels of universities, corporations and government.

Funding of academic research is not the full extent of the industry-university interface. In the United States especially, several universities and local governments have gone to great lengths to attract industry dollars through other means. The setting-up of science parks adjacent to universities is one such attempt. Such parks provide universities with monies to support their programmes, and give industry access to university research departments. In the United States, more than 150 science parks have been established since 1948. The Netherlands and the United Kingdom began many years ago to develop their own concepts. In the Netherlands there are about 45 technology parks and another 100 are reported to be in the planning stage. In the United Kingdom 13 parks were in existence in 1985, a further seven were under construction and others were planned. In France numerous technology parks are being established or are already in successful operation. The Federal Republic of Germany has eight technology parks. In fact, only a few countries in Western Europe are without the science-park type of arrangement. In Japan, a science city (Tsukuba) has been created to which as many as 47 major public research and development institutions have been relocated. The Government of Japan is reported to have also approved 18 regional technopolis programmes by 1986 as part of its new regional development policies.

The growing use of science parks as well as common European programmes suggest the increasing resort to co-operation by potential competitors in pre-competitive research. The establishment of industry associations, particularly for semiconductors and biotechnology in some of the OECD countries, is also an indication of the need for the industry to adopt a common approach to certain problems. Such arrangements cannot be compared to cartelization, but reflect rather the keenness of competing enterprises to share scarce technological expertise in regard to the generic or non-secret components of industrial technology and to evolve towards setting up industry standards. Firms dealing with basic or pre-competitive research and development have also emerged. Programmes like ESPRIT in information technology have been implemented, though the esprit de corps markedly declines nearer the competitive phase. All these developments have implications for industrial and technological competition and market structure.

The third aspect that needs to be noted relates to issues arising in technology transfer. At least three trends can be noticed. First, equity investments are made merely to have access to or a "window" on a technological development. Secondly, questions relating to intellectual property, particularly in the fields of software and biotechnology, are not fully settled, though several countries have now established practices and regulations in that respect. Thirdly, there is also a trend towards more flexible arrangements in regard to technology transfer. An analysis of some 50 enterprise-level agreements in the field of biotechnology reveals

considerable flexibility, sometimes involving technology and market "swaps" [11]. For example, the objectives of a joint venture cover joint research and development, joint development including complementary inputs from the two parties, and marketing. Some agreements are concerned with funding of research and development in exchange for such matters as: access to technology or the right to data, production and marketing; research co-operation; sharing of clinical test technology; marketing rights within a country or outside; agency arrangements; and supplies of commercial quantities of biochemicals. It is however argued that while external alliances are appropriate, initial responses to the strategic management challenges presented by radical technological change, the nature and significance of those alliances and associated corporate strategies change as the technology advances towards commercialization ([12], pp. 197-212).

The fourth aspect relates to advances in manufacturing technology, which is increasingly recognized as a driving force in corporate strategy. It should be first noted that in products tending to maturity, it is only the manufacturing technology that provides the competitive edge - a point which is particularly recognized by firms in Japan and the Republic of Korea. Corporate strategy must define distinctive competence also in terms of manufacturing systems capability, rather than solely in terms of product design or market sector dominance. Secondly, and more importantly, the advent of flexible manufacturing systems and related innovations such as robotics and computer-integrated manufacturing call for strategic decisions in terms of investment, human resources, and staying-power in the market. The approach to manufacturing technology seems to vary between firms in the United States, Japan and Europe. Nevertheless, "the picture now is one of a much closer relationship between the design of manufacturing systems, the selection of equipment and process technology, the management of the manufacturing operation, the design of individual products, the marketing mix choices, and segmentation and positioning decisions. In turn, this implies a reorganization of research and engineering activities; redefined linkages between marketing, production and technical activities; new communications patterns; new task allocation and reward systems; and redesigned cost accounting, marketing reporting and production conduct systems. But the strategic decisions required are most important of all" ([13], p. 35). There is also a need for replacing hit-or-miss planning for manufacturing technology by a careful monitoring of the deterioration of the current manufacturing technology over time ([14], pp. 125-133).

The fifth aspect to be noted relates to the fact that, particularly in information technology, product segregation has given place to a product continuum [15]. Thus, the boundaries of firms working in related fields become substantially blurred. Moreover, the fact that a given product involves application of more than one technological advance or competes with products generated by other technologies, or that one technological advance has application for a variety of different products, has created a broad banding of firms and technologies. Table 3 shows clearly the extent to which it has happened over a wide range of industrial

Table 3. Use of advanced technologies by various forms

Type of firm	Tele-communications	Computers	Semi-conductors	Software	Genetic engineering and biotechnology	Solar energy	Bio-mass	Petro-chemicals	Robotics	New materials	Agri-culture and seeds
Computer	X	X	X	X					X	X	
Semiconductor		X	X	X		X				X	
Telecommunications	X	X	X	X						X	
Software				X					X		
Mechanical engineering (including machine tools and automotive firms)	X			X		X		X	X	X	
Chemical					X		X	X		X	X
Pharmaceutical					X					X	
Food-processing					X						X
Petroleum					X	X	X	X		X	
Agriculture and seeds					X		X				X

firms and technologies. Clusters of firms interested in specific technologies can thus be identified, which brings one back to the changing industrial and technological market structure discussed earlier.

In general, a sense of declining technological self-sufficiency is a common factor in the growth of different forms of linkages discussed above. The resultant firm strategies are illustrated in the case of the semiconductor industry in table 4. Thus firms move into different fields and also adopt different strategies. Competition and co-operation between firms within and across sectors seem to coexist, arising essentially from the nature and extent of the current technological advances. But semiconductor firms are not alone in that respect. For example, Matsushita Electric Industrial of Japan had a strategic plan for the years 1983-1986, the major aim of which was a "metamorphosis from a manufacturer of home appliance products to a manufacturer of consumer and industrial electronics". Kawasaki Steel Corporation of Japan developed "a fifteen-year vision for 2000", a major theme of which was "changing from a steel manufacturer to a manufacturer of raw materials" [10]. A major challenge for large corporations, it is argued, is to develop the capability to generate simultaneously a number of diverse, and perhaps seemingly contradictory, strategic management approaches [16].

Table 4. United States semiconductor firms: network profile

Firms	Technology agreements (domestic)		Technology agreements (international)		Member of MCC a/	Member of SRC b/	University research groups c/
	3 or less	4 or more	3 or less	4 or more			
AMD		X		X	X	X	
AMI	X			X			
Narris	X		X		X	X	X
Intel		X		X		X	X
LSI							
Logic	X		X			X	
Mostek	X		X		X		
Motorola		X		X	X	X	X
National							
Semi-conductor		X		X	X	X	X
RCA	X			X	X	Y	
Standard							
Micro-systems	X			X			
Texas							
Instruments		X		X		X	X
Zilog	X			X		X	

Source: C. S. Haklisch, "Technical alliances in the semiconductor industry", study prepared at the Centre for Science and Technology Policy, Graduate School of Business Administration, New York University (February, 1987).

a/ MCC = Microelectronics and Computer Technology Corporation.

b/ SRC = Semiconductor Research Corporation.

c/ Excluding SRC.

The trends described above have obvious implications for management and, correspondingly, for management training. Managers in general will be increasingly called upon to display several traits, some of which will require reorientation of attitudes and departure from company traditions - decision-making in a wider range of uncertainty, understanding of the implications of new technologies and the perspective of the changing industrial scene, resilience and flexibility, interdisciplinary teamwork and a new attitude to competition and co-operation. However, an appreciation of those aspects has not been uniform even in developed countries. A survey carried out as late as 1984 of more than 500 company directors in five countries - Australia, Belgium, Germany, Federal Republic of, United Kingdom and United States - showed that one third believed that new technology had had little or no effect over the past five years on either the products they made or the way they make them ([17], p. 4). Of those companies that claimed to have a definite strategy for managing innovation and the application of new technology, the biggest emphasis was on applying current technology to exploit existing markets.

Considerations of management of technological change particularly relevant to developing countries will now be outlined.

D. The context of developing countries

The above analysis requires some modifications in the case of developing countries. The firms are typically smaller and, in the absence of internal or international competition, may not always have the same appreciation of technology as a strategic variable as in a developed market economy. Innovation is more likely to be of an incremental character or by way of adaptation to local conditions or raw materials. When firms in developing countries acquire technology, the changing industrial and technological market structure in the world will be a major relevant consideration in the access to, and continuing benefits from, world-wide technological developments. Before those aspects are discussed, it will be useful to review briefly the very limited empirical evidence available on the management of technological change in developing countries.

A study drawing upon 67 case-studies in a limited number of developing countries (Brazil, Kenya, Peru, Republic of Korea and United Republic of Tanzania), including 22 in the manufacturing sector, came to the following conclusions ([18], pp. 46-47):

1. Developing country firms lack the general managerial capability to establish long-term goals and match these goals to specific solutions through diagnosis of problems and opportunities. This basic activity is essential for successful technology transfer.
2. Projects addressing both system-specific and general management development have the greatest potential for long-term success. Though programs dealing with explicit technology improvements are important to the short-term development of the firm, they must be

coupled with general management development if the firm is to improve its capabilities over the long term. Since most firms do not perceive the need for or value of general management development, it falls to the consultant to introduce these techniques along with system-specific projects.

3. Few developing country firms comprehend the long-term value of technological improvements, whatever the type of technology, and thus do not actively seek to acquire technology.
4. Leading (activating) is the most important general managerial characteristic in terms of successful transfers of technology. Top management must understand the importance of long-term goal-setting before any fundamental changes in organizing, controlling, and planning can take place.
5. Those firms operating in a turbulent (unknown or rapidly changing) environment are hesitant to make any long-term commitments to technological change. This reluctance can sometimes be offset by a strong market demand or by the presence of a charismatic leader who can motivate personnel and is willing to take the risks required to exploit the opportunities for technological advancement.
6. Those firms that can identify and respond to market opportunities or internal crises will be more aggressive in seeking technology and better prepared to utilize it than those firms that are concerned only with modifying internal operations.
7. The lack of general management resources in the local environment is a major constraint to technology acquisition and utilization. The number of individuals with engineering and production skills far outnumber those with general planning, controlling, and organizing skills. Without these management skills, it is impossible to organize the firm to utilize and exploit technology improvements over the long term."

Some case-studies exist of public and private enterprises in India. A study [19] of Hindustan Machine Tools (HMT), a public enterprise, brings out the fact that in the early stages of development a broad-based joint venture or turnkey collaboration seems necessary, and having once acquired some knowledge, skills and experience, the recipient or buyer of technology can become selective. But the absorption of technology is dependent on a clear policy on technology acquisition, the existence of technological infrastructure and developing the required capability. HMT achieved significant advances in both adaptation and import substitution, the first through a process of rationalization and the second through development of ancillaries. The advances in

research and development have not been significant. The organizational structure of HMT gradually evolved from a centralized functional organization to a more decentralized organization, both territorially and on a product basis - though the rationale for the product mix and dispersion has not always been clear. Leadership played an important role in the growth of HMT, coping with the following four sets of circumstances: confronting the collaborators from whom technology was to be acquired to seek the best advantage; confronting the competitor or forces within the country that were lined up against HMT; counteracting a variety of forces, primarily socio-economic and socio-cultural, that were obstacles to developing and operating an industrial enterprise in a developing economy; and as a government-owned enterprise, HMT had to withstand the pressures of politicians and civil servants.

It is useful to juxtapose the experience of a large and diversified manufacturer of machine tools such as the HMT with a private enterprise, PHT Machine Tool Automatics Ltd., which started out as a marketing organization for imported and locally produced machine tools [20]. Its strategy has been to exploit the opportunity for increasing exports provided by the pullout of most foreign manufacturers from conventional machine tools. It has successfully absorbed foreign technology, is a regular exporter to hard-currency markets, and has, in the 1980s, diversified its product mix to include more complex and sophisticated machine tool technology. Its success is assessed as being in a large measure due to the fact that it started out with a strong technological base, built upon it and benefited substantially from the marketing network in terms of identifying domestic needs, timing and choice of collaborators and target markets at home and abroad.

Another case related to HMT, this time in the field of tractors, is that of the "Swaraj tractor", an indigenous tractor successfully produced by Punjab Tractors Ltd., a state government enterprise. In this case, the Planning Commission of India took a decision to develop an indigenous tractor design, which was successfully accomplished by the Central Mechanical Engineering Research Institute, a government-funded institution. HMT, at that time, wanted to diversify into tractors, but decided to assemble a foreign design since that would be quicker and perhaps less risky. But in Punjab State, where the field trials of the indigenous tractor had been carried out and the opportunities for supply of ancillaries were considerable, a state enterprise took up the manufacture successfully, guided by a team of highly motivated technologists and backed by an industrial finance institution, the Industrial Development Bank of India [21].

Before closing the discussion of Indian cases, reference should be made to Hindustan Photo Films and Bharat Heavy Electricals (Tiruchirapalli), two public sector companies [22]. Both imported technology from abroad, and in some years found the technology becoming outdated. In the latter case, the possibility of exports of boilers provided an additional incentive, and further technology imports and diversification were easily accomplished. In the case of the former, negotiations with various collaborators

had mixed results, with the company having limited bargaining strength in an oligopolistic market.

Considering the case of a State-owned enterprise in Brazil, th. EMBRAER experience highlights the importance of identifying a "niche" in international markets that an enterprise from a developing country could hope to dominate (for example, turboprops for commuter airline operators) as opposed to competing across the board with established foreign firms [23]. Ideally, the niche selected should build on special strengths and skills gained by the enterprise in tackling problems peculiar to its home market. EMBRAER also approached vertical integration in production very carefully and cautiously, since a higher use of imported components initially can reduce resistance to the product in foreign markets (in contrast to the Indian State-owned aircraft company where the emphasis from the beginning was on technological learning). The high level of managerial autonomy and long tenure of its top management allowed EMBRAER to follow a fairly consistent business strategy which included continual and systematic upgrading or modification of existing products to exploit or create new market opportunities.

The case of the microcomputer industry in Brazil, supported no doubt by a protective State policy and the available technical competence, suggests the idea that technological change offers certain moments of transition that may provide special possibilities to third world countries ([24], pp. 791-808). In those moments of transition, technological change not only takes a new direction but is also accompanied by a disjunction in established corporate control over technology. In the case of the computer industry, the move to smaller machines was made by new companies in the United States without established international operations, and a fundamental technological breakthrough (the microprocessor) was available on the open market, controlled by firms with no proprietary interest in final sales.

The emergence of "third-world multinationals" is a subject of increasing study. One of their advantages is the technological experience gained in developing country conditions. Moreover, "as far as standardized technologies and small-scale operations are concerned ... earlier doubts about the entrepreneurial vision, adaptability and speed of LDC* firms have been cast aside" ([25], p. 130). Though company strategies of exporters of technology from India differ, the expansion of at least one group of companies is marked by aggressive and imaginative entrepreneurship, with the competitive edge lying in good management, marketing and productivity (including the ability to select appropriate technology). Foreign direct investment by the Republic of Korea, of which more than 50 per cent is reported to be suggested by top managers, has been essentially to access growing foreign markets, mostly in developing countries and in some cases in developed ones. In recent years, firms of that country have also set up wholly-owned

*Less developed country.

research and development firms in the United States as an overseas base for development and import of appropriate technical knowledge, new processes and new product designs. However, in general, "the successful multinationalization of Korean firms, like most other firms from developing countries, will depend upon accumulating managerial experience and deepening international management techniques" ([26]. 167).

While the foregoing evidence of developing country experience is not exhaustive, it can be safely said at the same time that case-studies in this respect are relatively limited. However, particularly in the context of new technologies, certain considerations discussed below become specially relevant for developing countries.

There are several important aspects, outlined below, requiring managerial attention related to the selection and acquisition of technology:

(a) The selection of the right technology whether for use of a product or its manufacture becomes extremely difficult in the context of rapid technological change, and the penalty for inappropriate choice of technology can be severe and durable for an enterprise. The case of the telecommunications industry is an example;

(b) The question of "entry point" to a given technology becomes important for economic reasons and for capability building. In any given technology where costs are falling the decision as to the point at which, in a declining cost curve, an enterprise should enter the field becomes crucial. The earlier the phase in the product life cycle, the greater are likely to be the monopoly profits, but if costs are rapidly falling, too high a price might be paid for the early entry. The case of solar photovoltaic equipment is an example;

(c) In view of the above, firms should develop capabilities for monitoring and assessing world-wide technological trends in given fields. In developing countries the firms may have to be helped by government agencies or appropriate consultancy services. In case of uncertainty, incremental investments may be preferable to heavy commitments;

(d) Firms in developing countries have to strengthen their capability for the negotiation and acquisition of high technology;

(e) Cheap labour is no longer a sufficient condition for international competitiveness, which is contingent on product innovation, flexibility and resilience to respond to changing market needs. The adoption of a market niche strategy is often considered to be the optimum strategy, particularly for small- and medium-scale enterprises, but a niche captured has to be kept, or there must be the capability to move from one niche to another. A sound technological and marketing capability is essential for the strategy to be successful;

(f) Rehabilitation of existing industries in developing countries has to be based on a well-thought-out approach to management of technological change;

(g) The approach has to vary from industry to industry. In several industries, existing technology has to be pushed to its limits through incremental improvements, before "competence-destroying" changes are introduced.

Management of technological change also implies an investment in equipment, processes and training or retraining of workers. The rapid technological change in some industries requires frequent investments in equipment that may have to be discarded before the end of its life-span.

Human resource development stands at the core of management of technological change. At the enterprise level, technological change should ideally be based on a corporate consensus among managers and workers and address the need for training and retraining of managers, engineers and workers. Above all there must be managerial recognition of change as a necessary feature of a firm's survival, as well as its growth.

A workshop organized by UNIDO on the institutional and structural responses of developing countries to technological advances [27] concluded that at the level of the firm, the following technological advances were needed:

(a) Minimum in-house research and development capability to be established in the larger industrial units;

(b) Internal reorganization into interdisciplinary task forces charged with specific development or production targets;

(c) Stricter quality control and higher levels of workmanship and emphasis on full and detailed documentation;

(d) Good, flexible and responsive information systems within the firm and with the outside world;

(e) Emphasis by management on the encouragement and easy flow of innovative ideas;

(f) Interest, support and financial participation in the exploitation of prototypes of useful applications developed in academic or research and development circles;

(g) Encouraging firms to formulate and implement long-term corporate strategies and plans for exploiting technology advances, based on current and expected states and directions of development of the technologies.

It should also be recognized that the management of technological change in general is not a matter wholly confined to firms and their managers. While they continue to be the primary agents

of technological change, policy-makers in government departments have an important role to play, as evidenced by the increasing role of Governments in developed countries in fostering the growth and application of new technologies. Government intervention takes various forms, but common to most countries is an increase in public funding of basic and applied research, attention to public procurement and the grant of subsidies. The various policy initiatives undertaken reflect an implicit or explicit recognition by the various governments of the need for an orderly management of technological change. Such considerations apply with greater force in the case of developing countries. Their government policy and decision-makers have necessarily to display a due appreciation of the need to facilitate technological change.

It is clear from the above that enterprises and governments should closely follow technological developments and use that information to review and modify firm strategies and government policies. An alerting system would also facilitate the timely upgrading or rehabilitation of existing plants.

The subject of management of technological change in developing countries accordingly requires more collection and analysis of empirical evidence, a sound conceptual base and actions on the part of governments and enterprises in developing countries.

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IMITATION, ADAPTATION AND INNOVATION: A NOTE ON
TYPOLOGY AND CONSEQUENCES

Syed Ahmad and Atif Kubursi*

Introduction

Conceptual and empirical analysis of the process of transfer of technology indicates that the modes employed in the transfer as well as the terms and conditions under which it takes place have had a serious impact on the development process of most developing countries ([1], [2] and [3]).

The nature of the impact and its sensitivity to the different manifestations of the process of technology transfer have not, however, been based on an adequate theoretical foundation. In particular, the attendant costs of the alternative options of imitating, adapting, and innovating are neither clearly described nor adequately defined. The literature continues to be dominated by and mainly preoccupied with the classifications of technological change ([4] and [5]).

In this paper an attempt is made to delineate the technological choices open to developing countries and to ascertain the opportunity costs (in terms of capital) embedded in any given choice. The point of departure is a simple analytical tool associated with the induced innovation hypothesis ([6] and [7]).

A. Typology and consequences of technology transfer

The idea of induced innovation is essentially an extension of the idea of factor substitution in response to changing factor prices, when such a change not only causes factor substitution, given the production function, but also determines the choice of a new production function.

Generally, a country may simply import technology embedded in a given technique or machine. In that case it takes the factor proportions involved in the technique or in the use of the machine as given. That is the case of an imitating country. Alternatively, the receiving country may strive to be free to choose its factor proportion and to adapt the techniques or machines to suit its own factor endowments. That is the case of an adapting country. But if a given country is able to develop its own new techniques or machines, it is said to be an innovating country.

The differences between the three conditions and their implications are clarified using the figure.

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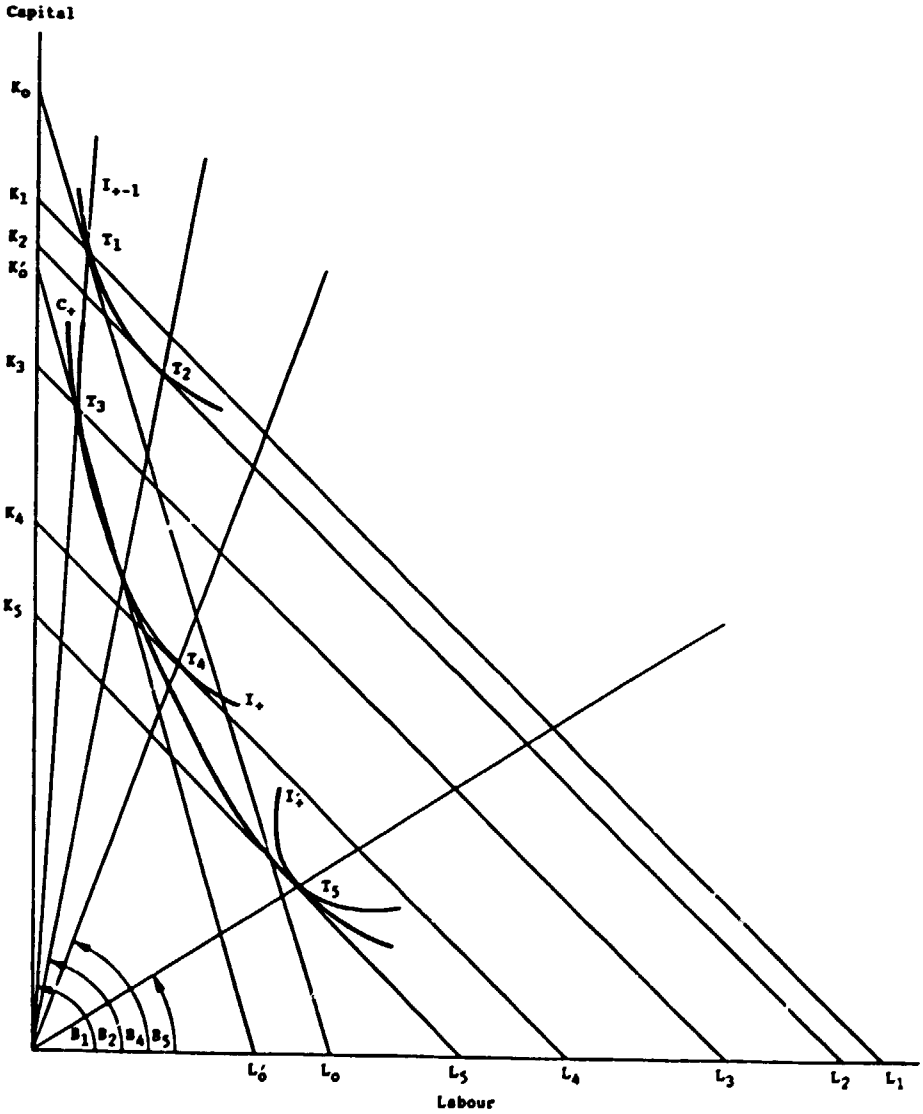
In the figure, the two axes represent two factors, namely capital and labour. Now let I_{t-1} be the isoquant representing one unit of output produced in period $t-1$. That isoquant was developed in response to the price ratio of the factors represented by the slope of K_0L_0 (the meaning of "response" will become clear as the argument unfolds). If the factor price ratio of the economy is represented by the slope of K_1L_1 (or K_2L_2 etc.), and the economy is technically free to choose its factor proportion, then it will choose the point T_2 on I_{t-1} where K_2L_2 is tangent to it. However, if for some reason that option is unavailable, the choice will be on K_1L_1 and T_1 rather than the T_2 combination. Being unable to substitute would have cost the economy K_1K_2 (measured in capital) per unit of output. The cost saving from being able to move from T_1 to T_2 is the result of factor substitution and innovation.

But let it now be assumed that in the next period, t , there exists the possibility of developing new production functions (isoquants) through innovation. There are a number of such possibilities represented by I'_t, I''_t etc., and an envelope (which, although drawn as smooth and twice differentiable, need not in fact be so) of these is represented by C'_t , which is the innovation possibility curve. The choice of one of the isoquants, such as I_t or I'_t on C_t , which takes account of the relative factor scarcity, is "induced innovation". Thus the choice of innovation in response to the price ratio K_0L_0 will be I_t , given the traditional assumption of cost minimization; and similarly, the choice of innovation in response to the price ratio K_1L_1 will be I'_t .

The benefits of cost reduction through substitution and induced innovation will depend on whether the economy is innovating, or is importing innovation (imitating) or doing neither. If the country is imitating, the benefits of cost reduction will also depend on whether it is also importing physical factors that require fixed input coefficients, or whether there is still some possibility of substitution among factors.

Let us take an innovating country that has a factor price ratio of K_1L_1 at time t , while it had a factor price ratio of K_0L_0 in period $t-1$, when the choice of the production function I_{t-1} was made. For the subperiod for which no substitution can be made after the change in price, the cost per unit of output, measured in terms of capital, will be OK_1 . Later on, when substitution becomes possible, the cost will go down to OK_2 . As the country is the innovating country in period t , it can choose the isoquant on the C_t curve which minimizes cost. The choice will be that of I'_t . The cost per unit, when the choice has been made, will be OK_3 . Thus K_3K_1 will be its full reduction in cost per unit. Its factor ratio will change from $\tan \theta_1$ to $\tan \theta_3$.

The innovation possibility curve



Let us now take an imitating country that has the price ratio K_1L_1 , but the innovation is made by an economy with a factor price ratio of K_0L_0 . The choice of isoquant in period t is not I_t' , but I_t . The total reduction in cost for the country, if it is free to substitute once innovation has been made, will be from OK_1 to OK_4 , and not to OK_5 . Thus K_4K_5 is the cost of non-innovation. The factor ratio will change from $\tan \theta_1$ to $\tan \theta_4$, and not to $\tan \theta_5$. If the imitating country also has to import physical factors that make factor substitution untenable, the additional cost for the imitating country will be K_5K_3 , an increase of K_4K_3 per unit of output. The factor proportion would not change and remains at θ_1 .

Finally, let us take a country which neither imitates innovation nor innovates, but still substitutes factors. The additional cost for such an economy will be K_5K_2 . If the non-imitating, non-innovating country also imports physical factors that make factor substitution untenable, then the additional cost to the economy, as compared with a country with all the advantages, will be K_1K_5 , there being no possibility of reduction in the cost of production. The last case is approximated by countries that continue to import outdated equipment that they have been using for some time.

B. Summary

The drift of the argument presented in this paper is that success in reducing the cost of production and therefore the cost of technology transfer depends on the degree of adjustment through factor substitution and innovation. The costs of research and innovation are not depicted here. The net benefits of adjustment and innovation would entail subtracting the costs of development from the current value of the discounted stream of cost savings in production. Those benefits are clearly an increasing function of adjustment and innovation, but may or may not be positive all the time.

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THE MULTI-FIBRE ARRANGEMENT AND THE LEAST DEVELOPED COUNTRIES

H. Peter Gray*

Introduction

The Multi-Fibre Arrangement (MFA) is the most structured arrangement so far worked out by developed countries to shelter those of their industries which have lost their ability to compete with imports from the third world. In principle, the purpose of MFA is to slow down the rate of growth of imports, thereby reducing the rate at which home-country production units are closed down and factors of production displaced from those industries. Despite a good deal of verbal commitment in the original (1973) version of the MFA to the continued development of poorer countries,** the MFA has become a serious impediment to exports of clothing to the industrialized world. It is fair to say that developed countries have done little to expedite the process of adjustment (the reallocation of resources out of declining or non-competitive industries and into expanding sectors) so that increased imports from developing countries would not cause dislocations in the importing country. Given that clothing (and, to a lesser extent, textiles) is the quintessential first step in the industrialization process and that MFA discriminates in favour of established suppliers,** the MFA discriminates particularly against the economic development of the very poor or least developed countries. The proposal made in this paper requires that the emphasis be exclusively on small least developed countries, on the basis of the United Nations definition**** of least developed, which currently includes 41 small countries.

*Professor of economics and management, Rensselaer Polytechnic Institute. This paper was conceived while the author was Gastforscher at the Kiel Institute for World Economics. He is greatly indebted to Dean Spinanger for the provision of data and for long discussions on the costs of MFA, and to Brenda Brockman for assistance on current MFA regulations and on data relating to United States quotas on Bangladesh exports of apparel.

**See Arrangement Regarding International Trade in Textiles (Geneva, General Agreement on Tariffs and Trade, 1974), article 6, paras. 2 and 3.

***Martin Wolf ([1], p. 257) refers to the process as that of "first come, first served".

****In its resolution 2768 (XXVI) of 18 November 1971, the General Assembly approved a list of hard-core least developed countries. The main criteria used at that time for identifying such countries were that they had, in terms of 1971 dollars, a per capita gross domestic product (GDP) of \$100 or less (or \$120 for certain borderline cases), a share of manufacturing in total GDP of 10 per cent or less, and a literacy rate of 20 per cent or less (in the age group of 15 years and over).

The purpose of this short paper is to show that the efficiency of the MFA in terms of both the interests of the mass of people in developed countries and the Arrangement's commitment to economic progress in the developing world could be enhanced by giving special treatment to exports of manufactures of clothing from the least developed countries. Since the MFA sets a precedent for similar arrangements and controls on imports of other kinds of manufactures from the third world, some erosion of MFA could have positive externalities. Recasting the MFA could also put pressure on the authorities in developed countries to place greater emphasis on measures designed to assist in the process of adjustment and, in that way, to make MFA (and similar measures) less necessary.

The recent (1986) imposition of restrictions by the United States on imports of clothing from Bangladesh under the procedures of the MFA can be used as an example of MFA inefficiencies.* Restrictions against imports from a least developed country are counter-productive in the following three ways:

(a) There is a real cost to consumers in the developed importer country (for example, the United States);

(b) The curtailment of the United States market has closed off access to the main growth market available to third world exporters;

(c) The restrictions send a negative (anti-development) signal to Governments and entrepreneurs in very poor countries that the "natural pattern of economic development" (to produce and export low-technology, labour-intensive goods) is less available to very poor countries than economic history requires or than the language of the original MFA implies.**

This paper first considers the question of the difficulties of adjustment in the developed world and the existing strains between the industrialized North and the developing South. A proposal is then made for elimination of restrictions on imports from least developed countries as a means of improving the innate efficiency of the MFA in terms of its own criteria.

*For a detailed description, see Dean Spinanger ([2], pp. 75-84). In October 1987, negotiations have built in a 6 per cent annual increase in the Bangladesh quota for some important categories, but the general tenor of the United States position is one of careful control of access of Bangladesh apparel exports to the United States market (see [3]). Note that the United States was not alone in imposing quotas; Canada, France and the United Kingdom also imposed quotas at about the same time. The importance of the United States move derives from the fact that the United States was the destination of 70 per cent of Bangladesh exports of clothing in 1984.

**On these points see section A.

A. Problems of adjustment

While the seventh session of the United Nations Conference on Trade and Development (UNCTAD), at least in terms of its final act,* may be said to represent a significant improvement in co-operation between developing and developed countries, it would be excessively optimistic to imagine that developing countries are satisfied with their treatment by developed countries (see [4], pp. 325-341). Discriminatory controls against imports from the third world into the affluent markets of the North are probably the single most important source of irritation in the South. A certain degree of tension was inevitable as developed countries were forced by the oil-price shocks of the 1970s to turn their attention inward and to focus on the economic strains created by the increase in oil prices. However, the release from those strains attributable to declining world oil prices over the last two or three years has not been seized by developed countries as an opportunity to turn their attention to the problems of the developing world in any constructive way. With the exception of the United States, the major countries have not had very high levels of domestic resource utilization and a lack of aggregate demand is not conducive to costless adjustment. The United States has proved an exception here, but has achieved its relatively high rate of economic growth at great expense to its own international net worth and at the cost of the potential instability of the global financial system. However, the root causes of the dissatisfaction on the part of the Group of 77 are the failure to reduce barriers to markets in developed countries and the growth of additional non-transparent or procedural barriers to imports. The strengthening of escape clauses in the renewals of MFA in 1981 and 1986 are visible examples of a failure to combat political pressures exerted by people in declining import-substitute industries. In fairness to developed countries, the adjustment problems inherent in the rapid growth of supply of manufactured goods by developing countries has been reinforced by the new wave of labour-replacing technological innovations (see [5], pp. 1-13, and [6], pp. 96-108). There has also been a vogue for maximum possible reliance on market forces and for minimizing the policy role of government: this vogue may help to explain (but not to condone) the lack of positive adjustment policies instituted in developed countries.**

The costs of measures such as MFA are not borne exclusively by developing countries whose exports are impeded. Consumers in developed countries have paid a heavy price for safeguarding employment in their senile industries.*** Numerous studies of such costs

*"Final Act of UNCTAD VII", adopted by the United Nations Conference on Trade and Development at its seventh session, Geneva, 9 July-3 August 1987 (TD/350).

**For a development of the concept of positive adjustment policies, see [7], pp. 42-48.

***The term "senile" here refers to an industry which has irrevocably lost its comparative-cost advantage and which would, in the absence of protection, be eliminated.

are available. Spinanger and Zietz (see [8], pp. 511-531) estimate that the loss in consumer surplus in the consumption of shirts in the Federal Republic of Germany amounted to better than 80 per cent of the total average import value of shirts for the period 1978-1982. In the case of restrictions on imports from Bangladesh (and other least developed countries), there is an additional adverse effect. As may be expected from a young industry in a country without a tradition of producing and exporting manufactured goods, Bangladesh clothing exports are at the low-price, low-quality end of the spectrum of clothing products. Restrictions on imports from Bangladesh must damage the interests of the poorer segments of the population in the countries that impose such curbs. The quotas effectively skew real income distribution even more unequally than the existing sets of markets and institutions. It is here that the innate inefficiency of such practices becomes clear. It is extremely improbable that the proscribed Bangladesh exports compete with domestically produced clothing in the United States or any other developed country. The restrictions, therefore, provide no help to the domestic industry, thus defeating the essential purpose of any protective measure. Any impediments to imports of that kind must discriminate among foreign suppliers. Given that it is virtually impossible to determine objective criteria for such discrimination or to assess its effects, such discriminatory measures are not a good policy stance for developed countries.*

The restrictions imposed by the United States on Bangladesh exports of clothing are particularly noteworthy because they close out the prospect of increased exports to the biggest single market for clothing from the developing world and to the fastest-growing market for clothing and manufacturing generally. Tables 1 and 2 show that the United States has been the major source of demand or increases in third world exports of manufactures in general (table 1) and of clothing (table 2) in particular. The role of the United States market as a dominating source of demand for clothing imports is the more important as it affects countries that are in the relatively early stages of development and industrialization. For developing countries or areas excluding the "four little dragons" (Hong Kong, Republic of Korea, Singapore and Taiwan Province), the United States accounted for almost three quarters of the total increase. It is important here to recognize the inter-country dynamics of protectionist measures and political opposition to imports. If one group of countries manages to reduce the growth of its imports from third world manufacturers, the exporting firms have no alternative but to devote an even greater part of their sales and marketing effort to the remaining "accessible" markets. That, in turn, imposes more severe disruption (heavier needs for adjustment) in the economies of the "open countries" and more seriously strains those countries' declining industries (with obvious effects on the degree of politi-

*But note that this criticism can be applied to the proposal contained in this paper - namely to eliminate or severely curtail the scope for limitations of imports of clothing from the least developed countries.

cal pressures for protectionism). Such a dynamic may offer a partial explanation of the failure of the East Asian middle-income exporters to allow their currencies to appreciate significantly against the United States dollar between 1985 and 1987

Table 1. Growth in imports of manufactures from developing countries as a percentage of apparent consumption, 1976/77 to 1982/83
(Percentages for the six-year period)

Exporters	Importers		
	European Economic Community	North America	Japan
Developing countries, excluding major petroleum exporters			
Major exporters of manufactures	30	60	17
Remaining countries	12	14	8
Total	21	42	9

Source: United Nations Conference on Trade and Development, Supplement 1986 - Handbook of International Trade and Development Statistics (United Nations publication, Sales No. E/F.86.II.D.4).

Table 2. Change in trade in clothing, 1980-1985
(Millions of dollars)

Item	Level (1980)	Increase (1980-1985)	Importers		
			European Economic Community	United States	Japan
Total clothing imports	38 091	7 811	-1 664	8 966	524
Imports by developed from developing countries or areas					
Total	16 369	8 593	-101	8 459	570
Excluding Hong Kong, Republic of Korea, Singapore and Taiwan Province	5 926	4 818	730	3 455	252

Source: Dean Spinanger, "The impact on employment and income of structural and technological change in the clothing industry" (Kiel, Institute of World Economics, 1987) (mimeo).

The reason why the clothing industry cannot successfully serve as a leading sector in development for the least developed countries must be that developed countries have not been making large enough efforts to promote their own internal adjustment out of those industries in which they have irrevocably lost their comparative or competitive advantage. Spinanger and Zietz* note the tremendous increase in the number of times article 115 of the Treaty of Rome has been invoked in recent years by Ireland and other members of the European Economic Community. The failure to promote positive adjustment policies is a flagrant neglect of what is needed and of the spirit of the MFA itself. Multi-Fibre Arrangement IV, signed in 1986, states explicitly in paragraph 13 that:**

(a) Restraints shall not normally be imposed on exports from small suppliers, new entrants and least developed countries;

(b) If circumstances oblige the importing country to introduce restraints on exports from least developed countries, the treatment accorded to these countries should be significantly more favourable.

There is also the danger that the reluctance to take positive adjustment action sets a pattern by which the newly industrializing countries or areas, with the exception of Hong Kong and Singapore, restrict access of foreign clothing to their own consumer markets from countries significantly further down the development ladder. That problem ties into the more general question of the willingness of developed countries (and the middle-income developing countries) to open their markets for manufactures of all kinds to the third world. It is doubtful that developed countries have either the will or the capacity to insist that countries that export to them should allow equal degrees of access to markets to countries further down the development ladder.

To close off an export outlet for a young manufacturing industry in a country that lacks a tradition in manufacturing is to deny to that industry and that country the fruits of the learning curve and the impetus that a leading sector can provide to the development process. The policy also deprives the country of the hard currency needed for non-competitive capital-goods imports. The transition to a manufacturing economy takes place by building on industries that are labour-intensive and low-technology. Surplus labour is drawn into the industry and spread effects emerge as an

*See [8], table 3, p. 518. Article 115 allows a member country to restrict imports of a good for the community as a whole when its own industry is being damaged.

**See Madihavi Najmudar [9], who suggests that the latest version of MFA has positive implications for exporters of clothing. However, he does not distinguish among developing countries to the point that he identifies the plight of the least developed.

understanding of the industrial process permeates through the country and as skill acquisition and the capacity for skill acquisition, improves steadily. There can be little hope for further development of indigenous entrepreneurial effort or of alternative sources of industrialization if the development of a clothing industry is effectively precluded.*

B. Proposal

As a first step toward reducing the impediment to early development that the MFA has become, and as a means of ensuring that the least developed countries are not discriminated against by the "first-come, first-served" procedures, separate treatment for the least developed countries in international (that is, North-South) trade warrants consideration. Such a measure has the additional advantage that it would not unduly aggravate problems of adjustment for developed countries because of quality differences between domestic clothing and imports from the least developed countries.

The least developed countries would be allowed to export clothing to all signatories of the MFA without the imposition of quotas. Such a measure would allow the least developed countries to take the first steps on the road to industrialization without the fear that some bureaucratically determined obstacle could suddenly be thrust in the way of their exports. It seems improbable, however, that the signatories, including the middle-income "super-exporters" of East Asia, would be willing to accept so complete an exception, hence a second-best solution may well be required. Any least developed country would be allowed to provide without discriminating impediment (that is, MFA quota), exports of clothing up to, for example, 5 per cent of any signatory's total imports of clothing by value. The valuation of such imports would be based on value added within the bloc of least developed countries and would exclude any intermediate inputs produced in the importing country. In this way, there could be co-operative specialization within least developed economies, and it would be possible for textiles from the importing country to be used to supply that country without using up the allotment. Such a set of conditions would allow entrepreneurs in least developed countries a much better idea of how to plan their investment and would allow markets to determine the mix of quality desired by consumers. Either the best proposition or some second-best alternative would assist the process of economic development in least developed countries. Either would also benefit poorer consumers in the importing countries.

There is a danger that transnational corporations might come to dominate clothing production in the least developed countries. While transnational corporations can undoubtedly play a positive role in economic development, especially if the production of two or more least developed countries is to be combined or if importing-country textiles are to be used in exports, the encouragement of

*This stricture also applies to any other industry which meets the labour-intensive, low-technology criterion.

indigenous entrepreneurial talent is nevertheless an important component of economic development. The variant MFA might therefore reasonably impose a limit on the percentage of exports produced in factories in which transnational corporations held operating control.*

Good relations between the North and the South and a prosperous South are important for the prosperity of the industrialized world. It behoves the developed countries to increase their contribution to economic development. The proposal made here would be one small but not unsubstantial step in that direction.

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*Spinanger ([2], p. 79) notes in this context that firms of the Republic of Korea have been very useful as marketing intermediaries. The limit, if any, on the percentage of production by transnational subsidiaries in total exports would have to be defined for some future time, since their presence would be virtually required before local entrepreneurial talent would be expected to emerge.

SOMMAIRE

Zones industrielles d'exportation :
le cas de la République de Corée

Derek Healey et Wilfried Lütkenhorst

Deux zones industrielles d'exportation ont été créées en République de Corée au début des années 70. La présente étude fait le bilan de l'expérience en ce qui concerne l'investissement, l'emploi, les exportations, les profits et, plus précisément, les entraînements en amont. Elle conclut que la formule a eu plus de succès que dans d'autres pays en développement mais que ce succès n'est peut-être dû qu'à l'envoi des exportations de produits manufacturés dans l'ensemble du pays. Cette interprétation serait logique puisque les entreprises des zones industrielles d'exportation bénéficiaient à peu près des mêmes incitations que les autres. Au stade actuel, les zones industrielles d'exportation doivent faire l'objet d'une restructuration, qui pourrait aboutir à leur reconversion en parcs scientifiques de haute technologie. Parmi les enseignements déterminants que peuvent tirer les pays envisageant d'adopter la formule, il y a la nécessité de définir une politique d'ensemble et, pour créer des relations avec le reste de l'économie, de mettre en place un réseau local de fournisseurs et de sous-traitants efficaces.

Gérer les mutations technologiques

Krishnaswamy Venkataraman

L'article résume les liens entre gestion et mutations technologiques en mettant particulièrement l'accent sur les nouveaux systèmes et les nouvelles pratiques de gestion qui se sont imposés ces 10 dernières années ainsi que sur l'accélération des mutations technologiques imputable pour une large part aux progrès réalisés en microélectronique, dans le domaine de la collecte et de l'analyse de l'information et en biotechnologie. Les auteurs analysent la conjoncture mondiale et ce qu'elle entraîne pour les entreprises des pays en développement, ainsi que la relation entre stratégies de gestion et politiques gouvernementales.

Imitation, adaptation et innovation : typologie et conséquences

Syed Ahmad et Atif Kubursi

Les auteurs de l'article distinguent trois types de transfert de technologie vers les pays en développement : transfert par imitation, quand la technologie étrangère est transplantée "telle quelle"; transfert par adaptation, quand la technologie est modifiée en fonction des dotations en ressources et des coûts relatifs des facteurs dans le pays en développement considéré; et transfert par innovation, quand le pays est capable de mettre au point des techniques ou des machines nouvelles correspondant aux conditions qu'ils connaissent sur le plan économique. Les auteurs ont recours à une analyse graphique pour préciser les différences entre les trois types de transfert et leurs corollaires en matière de coût.

Pour un pays qui n'est pas en mesure d'adapter ou d'innover, le coût du transfert par imitation risque d'apparaître élevé si les différences des coûts relatifs des facteurs par rapport au pays exportent la technologie sont très élevées.

L'Accord multifibres et les pays les moins avancés

H. Peter Gray

L'auteur soutient que l'Accord multifibres (AMF) est un obstacle majeur aux exportations et au développement industriel des pays en développement et qu'il désavantage particulièrement les pays les moins avancés. Les textiles et vêtements exportés des pays les moins avancés vers les pays développés n'étant généralement pas des produits de qualité supérieure, ils ne concurrencent pas les produits des pays développés. Les consommateurs des pays développés, notamment ceux appartenant aux catégories à faible revenu, sont pénalisés sans raison par l'AMF. L'idéal serait donc que les exportations des pays les moins développés soient dispensées des contingents prévus par l'AMF. Si cette solution ne peut être retenue, il convient de trouver des formules de rechange pour assouplir le contingentement des exportations des pays les moins développés.

EXTRACTO

Export processing zones: the case of the Republic of Korea

Derek Healey y Wilfried Lütkenhorst

A comienzos del decenio de 1970, empezaron a funcionar en la República de Corea dos zonas francas industriales (ZFI). En este estudio se analizan sus logros en lo tocante a inversiones, empleos, exportaciones, rentabilidad y, más concretamente, su vinculación regresiva con el resto de la economía del país, y se llega a la conclusión de que dichas zonas han obtenido resultados más satisfactorios que la mayoría de las situadas en otros países en desarrollo, aunque han tendido a reflejar un elevado aumento general de la exportación de manufacturas en el país. Esta conclusión que no debe sorprender, pues los incentivos de política concedidos a las empresas de las ZFI no han diferido notablemente de los otorgados a las empresas situadas fuera de éstas. Actualmente, las ZFI se enfrentan a la necesidad de abordar una reestructuración que quizás las conduzca a convertirse en zonas dedicadas a actividades científicas de alta tecnología. Entre las principales lecciones que pueden extraer otros países que estén considerando la posibilidad de instituir ZFI figuran la necesidad de un marco político general favorable y, para establecer vinculaciones con el resto de la economía, de una red de proveedores y subcontratistas locales eficientes.

Management of technological change

Krishnaswamy Venkataraman

En este artículo se ofrece una visión panorámica de las relaciones existentes entre la gestión y el cambio tecnológico, con especial hincapié en las nuevas nociones y prácticas de la gestión surgidas en el último decenio y en el ritmo acelerado del cambio tecnológico, debido en buena medida a los progresos de la microelectrónica, del acopio y análisis de información y de la biotecnología. Se analizan las tendencias mundiales y sus consecuencias para las empresas situadas en los países en desarrollo, así como las relaciones entre las estrategias de gestión y las políticas de gobierno.

Imitation, adaptation and innovation: a note on typology and consequences

Syed Ahmad y Atif Kubursi

En este artículo se establece una tipología de la transferencia de tecnología a los países en desarrollo, conforme a la cual se diferencian tres tipos: la imitación, en virtud de la cual se transfiere la tecnología extranjera "tal cual"; la adaptación, que consiste en modificar una tecnología conforme a los recursos propios y a los costos factoriales relativos del país en desarrollo que se trate; por último, la innovación, proceso consistente en que un país elabora nuevas técnicas o máquinas adaptadas a sus circunstancias económicas. Se aplica un análisis geométrico para esclarecer las

diferencias entre los tres tipos y los costos que entrañan. Para un país incapaz de adaptar o innovar, el costo de la transferencia de tecnología mediante la imitación puede resultar elevado si sus costos factoriales relativos difieren notablemente de los vigentes en el país que exporta la tecnología.

The Multi-Fibre Arrangement and the least developed countries

H. Peter Gray

El autor de este artículo afirma que el Acuerdo Multifibras (AMF) constituye un considerable obstáculo a las exportaciones y a la industrialización de los países en desarrollo, y que es especialmente injusto para los países menos adelantados. Como las exportaciones de textiles y prendas de vestir de los países menos adelantados a los países desarrollados son por lo general de baja calidad, no compiten con los productos de los países desarrollados. Así pues, los consumidores de los países desarrollados -en particular los de bajos ingresos- resultan innecesariamente penalizados por el AMF. Por lo tanto, se debería tender a que las exportaciones de los países menos adelantados no se vieran afectadas por los cupos que determina el AMF. En caso de rechazarse esta posibilidad, se debería buscar alguna fórmula alternativa mediante la cual se mitigaran los cupos fijados a las exportaciones de los países menos adelantados.

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