Industrial Development in Developing Countries and the Role of Government Interventions *

I. Introduction

Over the past four decades or so, most developing countries have mounted sustained efforts to build up modern manufacturing industries. They have experienced dramatic successes (as in the newly industrializing economies, NIEs, of East Asia) as well as dismal failures (as in much of Sub-Saharan Africa). Many factors have contributed to this highly uneven record. Countries started (around the 1950s) from very different points on the industrial scale, some with well-established manufacturing bases, others with rudimentary manufacturing facilities (and little of the skills, institutions and infrastructure that go with industry). They were exposed to very different external economic environments and managed their macroeconomic policies with differing degrees of success. Political and natural events were conductive to some countries' development efforts and not to others.

Even if these differences are taken into account, there remains considerable variation in the *efficiency* with which industrialization has been carried out. Industrial success depends not only on the ability to buy the capital goods and know-how needed. It depends also on the ability to absorb and efficiently deploy the new technologies, adapt it to local conditions, improve upon it and ultimately create new knowledge, what may collectively be termed "techno-

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logical or industrial dynamism". The real difference between the successful industrializers and others lies in this dynamism. Technological dynamism enables even resource-poor countries to invest their scarce resources effectively, enter export markets and substitute efficiently for imports, diversify their industrial and export structures and make manufacturing lead sustained structural transformation. What accounts for the uneven distribution of technological dynamism among developing countries?

The dominant explanation in the current literature is that industrial success is due to outward-oriented trade strategies. Such strategies are usually taken to involve, not just equal incentives to sell abroad as at home, but also "liberal" economic policies: low and uniform protection to domestic industries, free flows of foreign technologies and capital, investment patterns governed by market incentives, the absence of measures to promote local technologies or capacities and unrestrained domestic competition.[1] This "liberal" interpretation of recent industrial experience leads to strong policy recommendations: reduce government interventions, especially in trade, liberalize direct investment and technology flows, promote internal competition, restructure or privatize enterprises, remove controls on the financial sector, and so on (generally described as "getting prices right"). The ideal role left for the government is the minimalist one, to provide physical infrastructure and set the legal rules of the game.

This paper argues that while export orientation (in the sense of providing neutral incentives between foreign and domestic markets) is desirable, the experience of successful industrializers does not support the minimalist government role prescribed. On the contrary, the most successful industrializers have been dynamic precisely because they intervened heavily in the process of building up technological capabilities. Their interventions were both "functional" (to strengthen market forces without favouring particular activities) and "selective" (to promote particular activities or firms over others), though the extent and choice of intervention varied greatly. It is suggested that

[1] The "liberal" or neoclassical interpretation of the industrialization experience is represented by authors such as Balassa, Krueger, Harberger, Bhagwati and Lal. For reviews see J. Weiss, *Industry in Developing Countries,* London, Croom Helm, 1988, and Sebastian Edwards, "Openness, Outward Orientation, Trade Liberalization and Economic Performance in Developing Countries", New York: National Bureau of Economic Research, *Working Paper* no. 2908, 1989.

both sorts of intervention are necessary to overcome market failures associated with the liberal paradigm of optimal free markets. The nature of interventions needed may vary with the stage of development and national objectives, and with the ability of governments to mount interventions, but the need to intervene remains. This leads to very different policy implications from the undifferentiated "liberal" solutions now being imposed on a wide spectrum of developing countries.

II. The determinants of industrial dynamism

A country's technological dynamism in manufacturing has many elements. These can be grouped under two headings: first, the capabilities of its individual manufacturing enterprise; and second, the interactions between individual manufacturers and between them and the supporting environment. Firm-level capabilities consist of the skills, knowledge and institutional coherence which enable a manufacturer to do three things: first, to identify and engineer viable projects, purchase the relevant technology and capital goods, execute the investment efficiency (or "investment capabilities"); second, to master the process and product technology, achieve efficient levels of quality, maintenance and operating procedures, adapt the technologies to local materials and customer needs, improve the technology over time and diversify, innovate and add to the technological base ("production capabilities"); and third, to establish efficient flows of knowledge and information with suppliers, customers, consultants and science and technology institutions ("linkage capabilities").[2]

Some of these capabilities can be acquired by an enterprise "ready made" from the market. However, most of the skills needed to handle new technologies do not exist in developing countries and have to be acquired by the firm. Once skills are created, an enterprise has to blend them together effectively in an institutional sense. All

[2] The constituents of technological capability are further explored in C. Dahlman, B. Ross-Larson and L.E. Westphal, "Managing Technological Development", *World Development,* 1987, 15:6, pp. 759-75; J. Katz (ed.), *Technology Generation in Latin American Manufacturing Industries,* London, Macmillan, 1987; S. Lall, *Learning to Industrialize,* London, Macmillan, 1987; and S. Teitel, "Technology Creation in Semi-Industrial Economies", *Journal of Development Economics,* 1984, 16, pp. 39-61.

this entails a conscious (and often prolonged and expensive) process of training, acquiring new information, experimentation and interaction with other agents. Thus, even gaining mastery of a given technology is a "learning process" in developing countries, requiring effort and investment at all levels of operation.[3] Different firms achieve different levels of efficiency depending on their learning investments, the skills available on labour markets and the support provided externally. Technological mastery shades into improvement and, as the firm matures, into innovation (with formal R&D becoming prominent), but technological dynamism in essence is a process of constant capability building in every aspect of manufacturing activity.

As with any investment, that in acquiring capabilities is conditioned by incentives arising in the markets facing firms. Two aspects need mention here. First, the macroeconomic environment has strong effects. Stability, growth and a predictable policy structure are clearly conductive to investments in capability acquisition (just as they are to investments in physical capacity). A favourable growth setting also enables greater capability acquisition in a physical sense: enterprises have more opportunities and resources to repeat particular tasks and add to capacity. The economic stresses of the 1980s are likely to have been disruptive for technological development for a number of developing countries, apart from the larger problems they generated.

Second, competition, both domestic and international, provides a powerful stimulant to technological dynamism. However, it is a double-edged sword: the full force of external competition from mature enterprises can prevent new entrants from acquiring a base of capabilities and so retard capability development. This is the "infant industry" case for protecting the learning period, theoretically justifiable when firms cannot finance the learning process (capital market failures), cannot appropriate all its benefits (externalities) or

[3] A similar process occurs in enterprises in developed countries, with the important difference that most "routine" capabilities can be readily hired from the labour market and in-firm efforts can concentrate on mastering the more novel, innovative features of the technologies. Despite the broad availability of routine capabilities and open, competitive markets, however, individual enterprises in advanced industrial countries also display persistent differences in productivity (*i.e.* in technological mastery). See R.R. NELSON, "Research on Productivity Growth and Productivity Differences; Dead Ends and New Departures", *Journal of Economic Literature*, 1981, 19, pp. 1029-64. On developing countries, see H. PACK, "Industrialization and Trade", in H.B. CHENERY and T.N. SRINIVASAN (eds.), *Handbook of Development Economics*, Vol. I, Amsterdam, N. Holland, 1988.

underinvest in learning because they are risk-averse or unable to predict the outcome (information failure or "learning to learn" phenomena).[4] Protection is *not* justifiable, however, when the sources of high cost lie outside the firm, or when protection itself reduces incentives to invest in capability building: the mere existence of high costs that may come down over time does not in other words constitute a case for protection, though it may justify other forms of intervention (in developing capabilities, education, infrastructure and the like).

Thus, *economically efficient protection* must be temporary (geared to the learning period of the relevant technology), selective (not too many activities being protected at one time and protection not being given to compensate for inefficiencies arising outside the firm), and counter-balanced by incentives to achieve world standards of performance (for instance, by making exporting attractive even when protecting domestic sales). Efficient interventions of this sort can be directed at whole sets of activities tightly interlinked by externalities (so constituting "strategic sectors") or, at the other extreme, at single selected enterprises (to reap economies of scale, firm size or scope, or to internalize inefficient markets for capital, skills or other inputs). At the same time, protection that is excessive, prolonged, wrongly targeted and not supported by measures to reduce costs external to the protected activity, can lead to permanent "infants" that never mature to competitiveness in world markets. It is vital, in interpreting the development experience, to distinguish between economically selective and non-selective, non-economic interventions. This evidence, reviewed below, suggests that economically selective protection is necessary for entry and success in complex, technically demanding industrial activities.

Even given optimal incentive structures, firm-level technological development does not occur in isolation. It entails intense and continuous interaction with the industrial environment, which provides the human and financial resources needed for internal capability

[4] The case for infant industry protection is presented in H. PACK and L.E. WESTPHAL, "Industrial Strategy and Technological Change: Theory versus Reality", *Journal of Development Economics*, 1986, 22, pp. 87-128, and S. LALL, "Explaining Industrial Success in the Developing World", in V.N. BALASUBRAMANYAM and S. LALL (eds.), *Current Issues in Development Economics*, London, Macmillan, 1991 (forthcoming). "Learning to learn" is explored by J.E. STIGLITZ, "Learning to Learn, Localized Learning and Technological Progress", in P. DASGUPTA and P. STONEMAN (eds.), *Economic Policy and Technological Development*, Cambridge: Cambridge University Press, 1987.

development; a dense network of products, services and information flows, within which firms can specialize efficiently; and such "public goods" as standards, testing, basic R&D and other forms of institutional support that enable firms to conduct in-house technical work effectively. Thus, national technological dynamism is more than the sum of individual enterprises capabilities: it is the synergy arising from the interaction of enterprises, markets and a variety of institutions.

National technological dynamism is thus subject to policy interventions at three points.[5] First, in the *incentive structures* that induce enterprises to build up capabilities, requiring sound macro management and the provision of selective infant industry protection to activities with costly "learning" periods. Secondly, in the development of *capabilities* to respond to incentives, requiring interventions to develop the skill (education and training) base, to induce appropriate technology inflows, and to promote domestic R&D activity. Thirdly, in supporting a variety of *institutions* to facilitate the functioning of markets, in particular the flow of information and skills and the development of inter-industry linkages. Moreover, it is the complex interaction of these three factors that determines technological dynamism: simply providing incentives without building up capabilities or institutions, or *vice versa*, may be ineffective, even counterproductive. This simplified framework for analyzing the process of industrial development yields useful insights into recent experience. It also yields rich policy implications, sometimes quite different from the prevalent "liberal" orthodoxy.

III. Features of recent industrialization

The relative industrial and technological performance of developing countries can be gauged in many ways. Table 1 presents indicators of performance in 29 developing countries for 1970-1988. Some of the indicators are subdivided into two periods (1970-1980 and 1980-1988) to show the impact of the debt crisis and recent

[5] See S. LALL, *Building Industrial Competitiveness in Developing Countries*, Paris, OECD Development Centre, 1990.

RECENT INDUSTRIAL PERFORMANCE OF SELECTED DEVELOPING COUNTRIES

29 Developing countries by geographical region	MVA as % of GDP	MVA Growth	MVA capital goods industry [b]			Capital stock per employee in manufacturing [c]			Productivity [d]		ICOR [e]		World market share in manufactured exports			External patenting [f] accumulated 1962-1987	
			Growth		% GDP	Growth		Value	Growth				Change		%		
	1987	1970-1987	1970-1980	1980-1987	1987	1972-1980	1980-1988	1988	1970-1980	1980-1987	1970-1979	1980-1988	1970-1980	1980-1988	1988	No. [g]	No. [h]
Côte d'Ivoire	9	3.3	1.3	2.0	2.1	2	-3	4	-0.4	1.3	3.3	17.2	-0.002	0.006	0.013	4	0.49
Egypt	11	6.2	-0.8	4.2	1.3	11	4	1	3.3	3.3	2.8	2.7	-0.045	0.060	0.076	35	0.84
Kenya	12	7.6	-4.3	-5.6	0.7	6	-1	1	2.1	1.3	5.6	6.2	-0.004	-0.003	0.005	23	1.37
Nigeria	4	5.2	21.0	-17.2	0.7	16	-1	2	0.0	-0.8	5.1	..	-0.013	-0.004	0.003	22	0.27
Tanzania	7	0.5	6.7	-12.0	0.4	3	-9	1	-3.7	-3.8	6.5	15.1	-0.002	-0.001	0.002	9	0.48
Tunisia	14	9.7	11.9	4.3	1.8	8	3	3	3.3	2.0	4.2	9.1	0.024	0.011	0.048	13	2.03
Zambia	20	1.6	5.7	1.7	3.0	..	..	5	-2.0	0.6	44.0	44.0	-0.076	-0.019	0.037	11	1.95
Argentina	24	0.5	-1.3	1.9	7.0	6	-1	30	3.1	2.5	9.0	..	0.017	-0.007	0.083	520	18.71
Brazil	25	5.7	1.8	-0.4	5.7	6	-1	13	1.0	1.3	3.2	7.1	0.250	0.134	0.486	478	3.94
Chile	21	1.0	-6.5	-2.8	1.5	0	-1	7	2.8	2.4	13.4	11.9	-0.021	-0.021	0.109	79	7.10
Colombia	22	4.6	2.3	-1.9	2.0	3	4	6	1.8	4.2	3.1	6.0	0.017	-0.007	0.029	110	4.26
Costa Rica	19	5.1	5.2	-3.1	1.2	..	..	..	..	..	3.8	11.9	0.004	-0.007	0.008	32	14.04
Ecuador	17	5.8	8.0	-1.1	1.4	8	2	4	0.5	1.9	..	..	0.003	-0.002	0.001	33	4.06
Guatemala	16	3.1	-0.1	-5.7	0.5	4	-6	1	1.9	0.1	3.3	..	-0.003	-0.017	0.003	45	6.51
Mexico	21	4.3	1.9	-3.2	2.9	3	3	7	3.6	2.3	3.5	23.1	-0.041	0.147	0.252	1301	18.75
Peru	21	3.0	6.5	-9.0	1.7	3	-2	5	0.1	2.9	6.9	..	-0.006	-0.035	0.037	67	3.87
Uruguay	22	1.5	0.4	-0.1	2.8	0	2	4	3.4	5.5	3.8	..	0.003	-0.002	0.016	..	..
Venezuela	19	4.1	9.2	-0.3	2.2	4	3	11	-2.7	3.6	6.0	41.2	0.018	-0.007	0.027	220	14.64
Hong Kong	30	13.4	..	..	6.1	..	..	..	..	6.7	3.8	4.2	0.590	0.650	1.640	387	76.81
India	19	5.7	1.3	3.2	2.9	3	9	3	0.1	7.6	7.4	3.9	-0.071	0.015	0.237	301	0.44
Indonesia	17	11.8	22.0	7.4	1.1	18	4	2	7.4	-0.5	2.1	6.4	0.041	0.136	0.183	75	0.50
Korea, Rep. of	34	13.6	9.7	8.7	10.3	15	11	15	5.8	6.9	2.7	4.0	0.543	0.703	1.412	331	8.68
Malaysia	24	9.9	13.8	1.3	3.5	7	10	4	0.9	6.5	3.1	8.0	-0.002	0.070	0.232	74	5.38
Pakistan	17	6.9	2.6	-0.2	0.9	1	9	2	5.0	8.2	3.4	4.0	-0.055	0.024	0.080	15	0.17
Philippines	24	3.8	0.9	-10.8	0.8	-4	1	1	-2.6	5.6	3.5	54.6	0.077	0.031	0.133	132	2.73
Singapore	27	8.1	8.7	1.9	16.9	11	8	18	1.7	6.5	4.8	8.5	0.362	0.331	0.813	76	31.48
Taiwan Prov. of China	43	11.2	..	..	10.3	..	..	..	11.9	7.7	3.9	4.1	0.497	1.080	1.630	1289	72.40
Thailand	22	8.4	6.1	0.6	3.0	3	8	4	3.4	8.1	3.6	4.7	0.067	0.124	0.236	19	0.41
Turkey	27	6.7	5.6	1.2	2.7	7	6	11	0.9	5.7	4.3	3.1	0.020	0.170	0.206	41	0.92

[a] Manufacturing value added.
[b] Capital goods industry defined as output of ISIC 381 to ISIC 385.
[c] The values in 1988 are in constant thousand US$ of 1980. They are estimated on the assumption that the share of capital goods in the manufacturing sector is proportional to the share of the manufacturing sector in total GDP.
[d] Value added per employee in the manufacturing sector.
[e] Incremental capital output ratio.
[f] External patents granted in the United States.
[g] Accumulated patents 1962 to 1987.
[h] Per million population (1980).

Source: UNCTAD secretariat computations based on data from UNSO, UNIDO, IMF, OECD, and United States Patent Office.

terms-of-trade shocks on the sample countries. These data need careful interpretation in order to arrive at some meaningful picture of recent performance, partly because there is no unambiguous measure of dynamism and partly because of the effects of the shocks of the 1980s.[6]

In terms of the levels of industrialization, the four NIEs of East Asia (Hong Kong, Republic of Korea, Singapore and Taiwan), have the highest shares of manufacturing in GDP (27 to 43%). These NIEs also record among the highest growth rates in manufacturing over 1970-87 (from 8-14% p.a.), though some of the "New NIE's" (Indonesia, Malaysia, Thailand) and Tunisia also fall in this range. The complexity of the manufacturing sector, as indicated by the share and growth of capital goods production, is also the highest in East Asia, though Hong Kong is distinctly below the others in level and is close to Argentina and Brazil, while Singapore shows low growth in the 1980s. Capital employed per worker (calculated from data on domestic capital goods production and accumulated capital goods imports, net of exports, from 1960, depreciated over an assumed life of 13 years), has risen fastest in East Asia, and shows relatively high values for Singapore and Korea (Hong Kong and Taiwan data are not available) by 1988, but Argentina (with the longest established industrial base), Brazil, Venezuela and Turkey also show high levels.

Productivity growth, measured simply by value added per employee, is consistently high for Korea and Taiwan, with the latter in the lead. Data for Hong Kong are only available for the 1980s and are high, while Singapore performs well in the '80s but poorly in the '70s. The productivity performance of several other Asian countries (India, Malaysia, Pakistan, Philippines, Thailand and Turkey) improves significantly in the '80s, while Latin American and African countries have a relatively weak showing in *both* periods, suggesting a long term deficiency in industrial dynamism. ICORs tend to rise in most countries in the '80s (India is a major exception, because of strong agricultural growth and better utilization of previous capital stock due to some internal liberalization of industry) due to two different factors: first, the rising complexity of manufacturing activities (as in the East Asian NIEs) or of worsening capacity utilization (Philippines and most African and Latin American countries).

[6] It may be argued that the impact of the shocks on particular countries itself reflects, at least in part, past industrial dynamism: countries with undeveloped or inefficient industrial structures fared worse in the deteriorating international environment because of their inability to diversify and grow on the basis of manufactured exports.

Productivity and ICOR data may reflect, in large part, the impact of external shocks on investment and capacity utilization, and cannot be taken as straightforward indicators of the efficiency of the industrialization process. Since TFP (total factor productivity) estimates are not available on a comparable basis, we have to take recourse to other measures of efficiency. Manufactured export performance, as measured by market share and changes in these shares, is one indicator of the competitive strength. Here the East Asian NIEs are the best performers (though Singapore lags behind the other three). This is well known; what is less well known is that all other Asian countries also record increases in market shares in 1980s, in contrast to most African and Latin American countries. Brazil, with its large industrial sector and enormous pressures to raise export to service its debt (enhanced by domestic recession) was able to raise its world market share in the 1980s, but to a much lower extent than the East Asian NIEs. Finally, Table 1 gives data on patents taken out in the U.S. This is a very crude indicator of technological dynamism, since the true economic "value" of patents is difficult to judge, propensities to patent abroad may differ, and some national patents may in fact be taken out by resident foreigners. Nevertheless, the data (normalized by population in the last column) reinforce the impression of dynamism in the East Asian NIEs, though Korea lags behind the other three. Some Latin American countries (Argentina, Costa Rica, Mexico and Venezuela) also have impressive patent records, perhaps testifying to latent capabilities that have not revealed themselves in industrial performance (see below).[7]

IV. Explaining contrasting experiences

While it is difficult to evaluate recent industrial performance because of the impact of external shocks, it appears nevertheless by

[7] International patents by three East Asian NIEs (Hong Kong, Korea and Taiwan) and three Latin American countries (Argentina, Brazil and Mexico) were used in a growth accounting exercise in a larger sample of (mostly developed) countries. The results suggested that the faster growth of the East Asian countries was largely due to their greater innovativeness as measured by patenting abroad. See J. FAGERBERG, "Why Growth Rates Differ", in G. DOSI, C. FREEMAN, R. NELSON, G. SILVERBERG and L. SOETE (eds.), *Technical Change and Economic Theory*, London, Pinter Publishers, 1988.

many indicators that the NIEs of East Asia, and to a lesser extent, the "new NIEs" of Asia, manifest greater and more sustained dynamism than other developing countries. It is precisely this difference that has formed the empirical basis of the current orthodoxy on industrialization: *viz.*, industrial success is explained by liberal incentive structures, as manifested in outward-oriented trade regimes.

The "liberal" school argues that such regimes lead not only to better export performance (*i.e.* the exploitation of existing comparative advantage) but also to greater technological dynamism (the creation of new competitive advantages). In other words, providing a neutral structure of incentives not only encourages competitive industries to export, but it also does more: it lowers ICORs by enforcing efficient specialization over time (initially in labour-intensive activities), leads to the realization of economies of scale (as capital-intensive industries emerge), promotes faster and healthier accumulation of skills and technological capabilities (by providing correct signals and competition), provides an additional (and largely free) channel of information to exporters. In addition, by easing foreign exchange constraints, it permits steadier growth and greater availability of imported equipment, inputs and technologies. Export-orientation provides, in other words, static gains of specialization according to given endowments, as well as dynamic gains from a faster increase in those endowments. The case for free trade seems doubly vindicated.

These arguments clearly have a lot of validity. Incentives do matter, and specialization by comparative advantage does offer benefits. International competition and contacts with world markets do stimulate technological dynamism and a diversified export base does help steady long-term development. The record of industrialization supports a broad association between export orientation, export growth and industrial development, though the relationship may not hold for all periods or for the degree of export orientation (some "moderately inward-oriented" countries do better than some "moderately outward-oriented" ones).[8] The East Asian NIEs are the best performers and also the most outward-oriented regimes, and the new NIEs appear set to follow them down the export-based growth path: there is little reason to doubt these "stylized facts" that are the staple of much of the industrial strategy literature.

[8] See WORLD BANK, *World Development Report,* 1987.

The lessons that can be drawn from this are not, however, as simple and straightforward as current orthodoxy suggests. "Export-orientation" does not represent a uniform set of policies, nor does it necessarily carry the "liberal" connotations noted earlier. There are two major sets of qualifications to the liberal interpretation. The first concerns *incentive structures in product markets*, the second the role of *intervention in factor markets*. These are discussed in turn.

A neutral structure of incentives between domestic and foreign product markets can coexist with liberal trade regimes (low and uniform protection) or with highly variable protection for import-substituting activities. Export success may be based on immediate entry by producers into world markets, or it may derive from long periods of "learning" based on serving protected domestic markets. It is misleading to confuse "liberal" with "neutral" regimes and to ignore differences between competitiveness that is attained quickly and that calling for long learning periods.

The East Asian NIEs display a wide range of export-oriented strategies. Hong Kong is the closest to the "liberal" paradigm: free trade policies from the inception of industrialization. Korea is at the other extreme: a high degree of selective intervention (to pick and promote "winners", especially in heavy and high-technology activities) and high rates of protection sustained for long periods for new activities offset by export incentives, combined with low protection for mature industries.[9] Singapore had an initial period of import substitution followed by liberal trade policies. Taiwan is closer to Korea with selective and often high rates of protection, but it has been less interventionist in promoting heavy industry.

Each of these economies is successful and competitive, yet the resulting industrial structures are vastly different. Hong Kong remains specialized in light consumer goods, with a high reliance on foreign equipment, complex intermediates and basic technology. Its technological capabilities are largely in efficient assembly or last-stage manufacturing activity and the ability to respond rapidly to changing consumer tastes overseas. Korea, at the other extreme, has built up a diversified industrial base, with a range of efficient heavy and technology-intensive industries, a high degree of local integration and

[9] This form of export-orientation is analyzed in detail for the Korean case by L.E. WESTPHAL, "Industrial Policy in an Export-Propelled Economy: Lessons from South Korea's Experience", *Journal of Economic Perspectives*, 4:3, 1990, pp. 41-59.

well-developed local design and innovation capabilities that call for intense R&D activity. Singapore has entered into much heavier industry than Hong Kong by intervening in the direction of investment flows rather than via protection, but its product range is narrow and its technology is almost entirely provided from abroad by transnationals that dominate its manufacturing.[10] Taiwan has a diversified structure, but less scale- and capital-intensive than Korea: the former's strategy has been more incremental and less aimed at large leaps into heavy industry than the latter. It is Korea that has come closest to emulating the Japanese strategy, and it is indisputable that it was only its massive interventions, within an export-oriented framework, that made this possible.[11]

While export-orientation is compatible with interventions in incentive structures, the form of intervention differs significantly from intervention as practised in inward-oriented economies. The key differences lie in *selectivity* and *offsetting safeguards*. The two larger East Asian NIEs did not give widespread, protracted, haphazard protection to all industrial activities started in their markets. They promoted a few new activities at a given time, letting mature activities operate effectively in a free trade regime; they geared protection to the "learning" period involved and forced firms to enter export markets as soon as possible to reap the competitive benefits of world exposure; and the overall incentive structure always favoured exports.[12] By contrast, most inward-oriented economies promoted industries with high, haphazard and widespread protection, giving net disincentives to exporting and sustaining activities regardless of their efficiency. It was not intervention (and protection) *per se* that was wrong, but the particular interventions utilized: the export-oriented interveners were truly selective, while the inward-oriented interveners were largely unselective and generally failed to offset the effects of protection.

[10] See L.B. KRAUSE, "Hong Kong and Singapore: Twins or Kissing Cousins?", *Economic Development and Cultural Change*, 1988, 36:3, pp. 45-66.

[11] See P.W. KUZNETS, "An East Asian Model of Economic Development: Japan, Taiwan and South Korea", *Economic Development and Cultural Change*, 1988, 36:3, pp. 11-43, A. AMSDEN, *Asia's New Giant: South Korea and Late Industrialization*, New York, Oxford University Press, 1989, and R. WADE, "The Role of Government in Overcoming Market Failure: Taiwan, Republic of Korea and Japan", in H. HUGHES (ed.), *Achieving Industrialization in East Asia*, Cambridge, 1988.

[12] On Korea, see PACK and WESTPHAL (*op. cit.*), WESTPHAL (*op. cit.*), and L.P. JONES and I. SAKONG, *Governments, Businesses and Entrepreneurship in Economic Development: The Korean Case*, Cambridge (Mass.), Harvard University Press, 1980. On Taiwan, see WADE, *op. cit.* and KUZNETS, *op. cit.*

The second major qualification to the "liberal" view on export orientation concerns the role of *government interventions in factor markets*. It seems to be generally assumed that the capability to respond to correct price incentives is present or can be developed fairly quickly without need for intervention (*i.e.* that factor markets are efficient). This may be unwarranted in theory; it is certainly untenable in practice. Each of the NIE governments intervened in a sustained manner to develop the capabilities and institutions necessary for technological dynamism. Some of this intervention was non-selective (or functional); but some was highly selective, aimed at promoting the growth of particular activities, particular capabilities, even particular enterprises. "Picking winners" was perhaps as common in factor markets as in product markets.

This can be partly illustrated (Table 2) for the sample countries with reference to the major components of national technological dynamism identified earlier: *human capital or skills, imports of technology* and *domestic technological effort* (institution building cannot be measured so is ignored for the present). The rate of investment in plant and equipment in manufacturing in the 1970s and 1980s is also shown. While such investment is governed to a large extent by exogenous macroeconomic factors beyond the concerns of this paper, it forms one of the necessary conditions for industrial growth (the data shown are of particular interest because they are calculated from actual production and import data on capital goods, rather than from national income statistics).

During the period 1972-88 the Asian NIEs and new NIEs had among the highest increases of equipment investment in manufacturing. What the data do not show is the role of government intervention in channelling those investments. With the exception of Hong Kong, each of the established East Asian NIEs influenced resource allocation in industry in ways distinct from interventions in the trade regime considered above. Singapore directed FDI inflows into more high value-added, high-tech activities, and set up a substantial public sector. Taiwan also directly took the public sector into heavy industry where private investment was reluctant to enter, and provided various inducements (such as government-foreign-local joint ventures, technological assistance and science parks) to attract private industry into areas of future competitiveness. Korea intervened most heavily of all, through its import-substitution programmes (accelerated in the 1970s in the "Heavy and Chemical Industries" drive), its

TABLE 2

INVESTMENT IN TECHNOLOGY AND SKILLS

29 Developing countries by geographical region	Total capital stock [a] 1980=100		Technology inflows as % of GDI [b]			Human resources 1987 or closest available year				Research and development expenditure (latest available year)	
							Enrollment				
								Per 100,000 population:			
			MCG [c]	FDI [d]	TC [e]	Literacy rate %	At 2nd level as % of age group	Science and technology 3rd level [f]	Vocational training 2nd level	Total as % of GNP	of which the productive sector [g] as % of GNP
	1972	1988	1957-87	1957-87	1975-87						
Côte d'Ivoire	43	73	26.2	3.6	4.0	43	18	27	249	0.3	..
Egypt	26	184	62.0	14.6	6.4	44	69	167	1833	0.2	0.039
Kenya	56	103	30.2	2.1	7.3	59	21	22	25	0.8	..
Nigeria	22	74	18.2	3.4	0.3	42	29	24	98	0.3	..
Tanzania	42	68	20.8	0.6	11.3	46	4	3	..	..	..
Tunisia	28	133	28.4	5.6	3.0	51	40	126	1225	..	..
Zambia	78	87	42.3	7.1	8.2	76	17	18	38	0.5	..
Argentina	67	76	8.1	2.0	0.1	94	74	363	3834	0.4	0.179
Brazil	35	100	8.7	3.5	0.1	78	38	160	1092	0.4	0.268
Chile	96	88	21.5	3.8	0.9	91	70	538	1062	0.5	0.211
Colombia	56	119	20.4	9.5	0.9	85	56	387	1515	0.1	0.002
Costa Rica	49	92	20.9	6.9	3.4	93	41	312	981	0.3	0.000
Ecuador	29	101	26.3	2.8	4.6	80	56	636	2624	0.5	..
Guatemala	55	64	18.1	8.1	2.4	46	20	..	430	0.6	..
Mexico	61	111	21.0	3.5	0.1	90	53	453	1051	0.6	0.173
Peru	54	78	17.3	0.2	1.7	82	65	563	297	0.2	..
Uruguay	69	74	13.2	0.4	1.0	95	73	379	1359	0.2	..
Venezuela	38	96	22.6	0.6	0.1	85	54	558	304	0.3	..
Hong Kong	..	..	39.0	7.0	0.1	77	72	318	800	..	..
India	63	165	8.6	0.2	0.4	41	35	..	80	0.9	0.191
Indonesia	26	177	17.2	1.5	1.1	67	39	16	626	0.3	..
Korea, Rep. of	21	239	25.7	0.9	0.1	88	89	765	1970	2.3	1.543
Malaysia	33	167	34.9	9.0	0.8	70	59	85	122	..	..
Pakistan	80	165	20.4	1.3	2.4	26	18	28	51	0.4	0.327
Philippines	62	71	29.3	1.5	1.1	83	64	770	..	0.1	0.023
Singapore	25	169	88.4	16.8	0.3	83	69	704	372	0.9	0.521
Taiwan Prov. of China	..	..	33.2	3.3	..	92	91	795	2082	1.1	0.738
Thailand	49	147	23.6	3.0	1.4	79	30	..	648	0.3	..
Turkey	44	156	25.0	0.8	0.5	74	46	222	1402	0.7	0.532

[a] Capital stocks are calculated by adding domestic production of capital goods (net of export) to imports of capital goods for each year since 1960, and depreciating the stock over 13 years.
[b] Gross domestic investment.
[c] Capital goods imports.
[d] Foreign direct investment.
[e] Technical co-operation grants.
[f] Third level students in natural science, engineering, and transport and communications.
[g] The productive sector measured on two levels (integrated and non-integrated) covers domestic and foreign industrial and trading establishments which produce and distribute goods

allocation of credit via the state-controlled banking system, its promotion and subsidization of selected private businesses (which are giant conglomerates, the *chaebol*) to lead its heavy industry drive, its close direction of activity and exports in the business sector, and some public sector industrial investments (its famous Pohang steel mill). The *chaebol* strategy was clearly not one of "free competition" in the traditional sense, since domestic entry and growth were controlled by the government (although the giants competed fiercely with one another).

The accumulation of physical capital in manufacturing, whatever its composition, cannot be efficient if it is not accompanied by the creation of new skills, the import of technological know-how and the launching of domestic technological effort. Let us take them in turn. The *skills* needed for industrialization are diverse. At the lowest level, literacy helps the labour force to be productive and is an important determinant of labour productivity in very simple industries. Secondary education, and in particular vocational training, become increasingly important for shopfloor skills as industry grows more complex. Tertiary level skills, especially in science and engineering fields, are needed, to some extent, for all industries, but their significance increases sharply with growing industrial complexity.

The East Asian NIEs in general have invested heavily in creating the skill base needed for technological dynamism,[13] and this has been a vital ingredient of their dynamism. The data on human resources in Table 2 illustrate this clearly, with the figures on science and technology enrollments being the most relevant to industrial development. However, three important points have to be noted here. First, some other developing countries also invested heavily in human capital (particularly in Latin America), if not to the same extent as Korea or Taiwan, but performed relatively poorly. It was the interaction of human resources with incentives, physical investment and technological effort that drove technological dynamism. The possession of skills was a *necessary but not sufficient* condition for success. The poor performance of other countries with ample human re-

[13] Even in 1958, the larger East Asian NIEs, Taiwan and Korea, had the best developed human resources in the developing world, with the exception of Argentina. Some other Latin American countries (like Uruguay, Chile and Venezuela) also had substantial bases but lagged behind these three. Hong Kong and Singapore were not included in this assessment but are likely to have ranked high. See the classic study by F. HARBISON and C.A MYERS, *Education, Manpower and Economic Growth*, New York, McGraw-Hill, 1964.

sources may be traceable to such factors as inappropriate incentive structures (excessive protection in some, like Argentina, or insufficient protection for infant industries in others, like Chile), inadequate technological effort or institutional weaknesses. This point is borne out more strikingly by the record of Eastern Europe, where there has long existed an ample stock (even if of variable quality) of human capital and technical skills. Yet highly distorted incentives and factor markets, combined with institutional weaknesses and isolation from world technologies, led to very poor industrial performance.

Secondly, there are differences between the East Asian NIEs. The two larger NIEs appear to have a broadly stronger skill base than the smaller ones. Hong Kong appears weak in high-level technical skills and Singapore in vocational training.[14] This difference may reflect the drive of the two larger NIEs into technologically demanding activities as well as the utilization of high levels of skill in their mature industries (though Singapore's specialized high-tech industries are also very skill intensive). Some other countries, like Brazil and India, have even more complex, heavy industrial structures but have developed lower skill bases: one result is the lower competitive ability of many of their industries. Thirdly, enrollment figures have to be corrected for variation in dropout rates, overseas education, quality of training and relevance of curriculum content, to make them fully comparable. This is not always possible, but it is likely that such corrections would increase the observed lead of East Asia.[15] The data also exclude employee training undertaken by firms: here Korea (with 5% of sales of all larger firms required to be invested in training since the 1960s) is likely to lead the other sample countries.

The growth of human resources for industrialization has been an *essential precondition* for export success, and this growth cannot be

[14] It should be noted that Singapore's vocational training figures may understate its skill creation at the shopfloor level because it has a large programme for post-employment worker training, regarded as one of the world's best. However, such worker training is likely to provide more specialized skills than vocational training and may be better suited to the narrower needs of Singapore than to the more diverse industrial structures of the larger NIEs.

[15] See S. LALL, 1990, *op. cit.*, pp. 47-48. According to UNESCO data, the East Asian NIEs have substantial numbers of tertiary students registered in foreign universities: Hong Kong 24,700, Singapore 8,900 and Korea 29,400, compared to Argentina 3,100, Brazil 6,700 and Mexico 8,200. If the proportion of students abroad in technical fields are the same as at home, the addition of these students raises Hong Kong's figure for third level science and technology enrollments per 100,000 population by 160, Singapore's by 205 and Korea's by 15. The figures for other countries do not change significantly.

traced to outward-oriented incentive structures. The successful countries were strong in human resources at the start of modern industrialization. The "education market" subsequently required heavy intervention to provide the level, quality and technical orientation of the resource base to keep up the industrial drive. This point is strengthened if in-firm worker training is taken into account: firms tend to underinvest in such training when there is a risk of leakage (workers moving to other firms) and government direction and support is needed to ensure adequate investments. Human resource interventions were partly functional, to create general skills, and partly selective, to create the particular skills needed by the activities being promoted by the government. Education markets do not function efficiently in developing countries,[16] but practically all the writing on industrial and trade strategy has tended to ignore the critical role of such intervention in the context of industrial policy and experience. The contribution of the intervention varied, of course. Human resources may not have been the binding constraint in the industrialization of some (mainly Latin American) countries, where other factors created earlier bottlenecks. They did, however, constitute major impediments to industrial development in others (mainly in Sub-Saharan Africa).[17]

Technological imports and effort are also essential ingredients of technological dynamism. To a large extent, they complement each other. Developing countries need to import a great deal of embodied and disembodied technology; they also need to do a lot themselves to absorb it and build upon it. Technology imports in the form of capital goods are the most accessible, but require the greatest local capabilities and efforts to operate efficiently. Most complex technology transfers generally need infusions of disembodied know-how, training, patents and the like; these are available via foreign direct investment (FDI), licensing or other forms of contractual arrangement. International technology markets can be fragmented and oligopolistic, and may call for official intervention to strengthen the

[16] The debate over skill gaps in the United States and United Kingdom suggests, moreover, that they do not always function perfectly in mature, open economies either. See, for instance, OECD, *Structural Adjustment and Economic Performance*, Paris, 1987; OFFICE OF TECHNOLOGY ASSESSMENT, *Making Things Better*, Washington, D.C., 1990.

[17] On the role of education and skills in constraining African industrialization, see S. LALL, "Structural Problems of African Industry", in F. STEWART, S. LALL and S. WANGWE (eds.), *Alternative Development Strategies for Africa*, London, Macmillan, 1991 (forthcoming).

informational and negotiating position of developing country buyers. They are, however, fairly open to all developing countries, with two qualifications: first, the more advanced, export-oriented enterprises may find it difficult to buy state-of-the-art technology at arms' length because of the competitive threat they pose (the leading Korean *chaebol* now have to develop many of their own new products because of the reluctance of technological leaders to license them). Secondly, some new technologies are very expensive to create and are being more tightly held than were earlier technologies. There is also a growing propensity for leading innovators to form "strategic alliances" in developing new technologies. These tendencies raise the cost of entry to all newcomers, in developed or developing countries,[18] and further raise the need for indigenous efforts as industrial structures grow more complex.

Different forms of technology imports have differing implications for technological development. FDI may be a very effective means of transferring rapidly the results of new innovations as they appear. It may not, however, be equally effective in transferring innovative capabilities: transnationals generally find it economical to centralize R&D in developed countries with an ample skill base and established linkage with highly advanced science and technology institutions. Thus, the building up of local innovative capabilities may require the promotion of indigenous firms by selective restrictions on FDI inflows. Experience shows that countries with technological ambitions have indeed been selective in allowing FDI at critical junctures. Korea is again a case in point. Table 2 shows that it has the lowest reliance on FDI of all the NIEs, and one of the lowest in the developing world, despite its advanced industrial structure. The resulting "gap" between imported technologies and the needs of its export-oriented industries has been made up with its own intense technological effort (see below), and by the promotion of *chaebol*, large and diversified enough to bear the cost and risk of entry into high-tech activities. This strategy is directly descended from the Japanese strategy some time earlier.

Heavy reliance on FDI does not stifle industrial growth; it may only reduce the indigenous technological content of industrialization. In this sense, Singapore displays the weakest indigenous

[18] D. Ernst and J. O'Connor, *Technology and Global Competition: The Challenge Ahead for Newly Industrializing Economies*, Paris, OECD, 1989.

entrepreneurial and technological base of the East Asian NIEs; whether this accounts for its rapidly rising ICORs and flagging growth and export performance relative to the other three is difficult to say. On the other hand, simply restricting FDI without providing the incentives or skills to develop local technologies can be very counterproductive, leading to inefficiency and obsolescence. If this is combined with restrictions on other forms of technology inflows and high inward-orientation, the cost can be compounded – as happened in India in the 1970s.[19]

The import of technology by successful industrializers like Korea has been subject to considerable interventions by the government. In turnkey projects, it insisted that local engineers participate in all stages of design and engineering. In licensing, local firms were provided information, guidance and assistance in bargaining.[20] "Reverse engineering" was encouraged and intellectual property laws were liberally interpreted (as also in Taiwan). Interventions with technology transfer were non-existent in Hong Kong and Singapore (though the latter strongly guided the nature and sophistication of FDI inflows), in keeping with their strategies to build up indigenous production rather than innovation capabilities.

Technical assistance inflows were mainly used by countries with low industrial capabilities and limited recourse to other forms of technology transfer. The experience of technical assistance has not been a happy one, especially when (as in Sub-Saharan Africa) absorptive capacities are low, and it is difficult to monitor the content of technical assistance. In these circumstances, technical assistance can become a substitute for local capabilities rather than a complement. It can also lead to poor selection of projects that do little to develop industrial competitiveness.

Formal R&D efforts are shown in the last two columns of Table 2. Total R&D figures include agricultural, defense, construction and other forms of effort, but it is not possible to obtain manufacturing R&D data on a comparable basis for all sample countries. The nearest approximation is R&D in the "productive sector" (which includes trading); this is shown where available. By this latter measure, Korea

[19] S. Lall, *Learning to Industrialize, op. cit.*

[20] On Korean interventions in technology transfer see J. Enos and W.H. Park, *The Adaptation and Diffusion of Imported Technology in the Case of Korea*, London, Croom Helm, 1987. Also see J. Enos, "Transfer of Technology", *Asian-Pacific Economic Literature, 1989, 3:1, pp. 2-36.*

leads the field by far (1.5% of GNP), testifying to the needs generated by past policies to diversify and deepen industry and enter world markets. The bulk of Korean R&D, currently the highest in the developing world, emanates from its *chaebol*, themselves the result of highly selective intervention. Taiwan comes next (0.7%) followed by Turkey and Singapore (0.5% each). Brazil's total R&D has dropped sharply since the early 1980s (from 0.7% to 0.4% of GNP), presumably because of debt-induced problems, but the share of GNP going to productive sector R&D (0.2%) remains constant at low levels. Argentina, Chile or Mexico, despite their skill endowments, also spend little on productive sector research (0.2% or below); India is very similar (0.19%). Hong Kong data are not available, but impressionistic evidence suggest that its formal R&D is very low.

What accounts for these disparities in technological effort? Export orientation is part of the explanation, but it is not enough, in that export-oriented economies differ sharply among themselves (Korea is also far ahead of such open OECD economies as Spain). Clearly, government strategy has a lot to do with it, at several levels: deliberate attempts to enter technologically demanding industry, policies to reduce reliance on FDI, fostering of firms of a size able to launch massive R&D, setting up elaborate science and technology infrastructures – all these, in addition to export orientation, explain relative technological efforts. Intervention plays a central role.

Finally, although this cannot be demonstrated quantitatively, the successful industrializers have invested heavily in setting up industrial-support *institutions*, especially to promote technological activity and export marketing. Many institutional interventions have been highly selective, targeted at the needs of particular activities. While many other countries have also set up complex institutional networks, it is the combination of export-oriented incentives and high levels of skill that has enabled the NIEs to set up more effective institutions and exploit them better.

V. Conclusions: Implications of past experience

Technological dynamism cannot be explained by partial theories that stress selected aspects of the incentives-capabilities-institutions

nexus. In particular, the liberal interpretation, relying heavily on "getting prices right", has ignored the role of capabilities and institutions and has underemphasized the positive role of interventions, especially selective interventions, in the recent performance of industrializing countries.

The most successful industrializers, the East Asian NIEs, have all intervened in support of industrialization. Hong Kong has intervened to provide a broad base of skills, excellent infrastructure and institutional support of its industries. This low level of (essentially functional) intervention has enabled it to build a light, specialized and efficient manufacturing base which, despite past dynamism, lacks technological depth and is, therefore, vulnerable to rising costs.[21] Korea, in contrast, has intervened very heavily, by protection, subsidies and direct instruction, in incentives and factor markets and in technology transfer, and has succeeded in establishing probably the most competitive and advanced industrial structure among developing countries. The depth of this structure renders it far less vulnerable to rising labour costs. The structure, capabilities and ownership of its industries largely reflect the pattern of strategic interventions undertaken to "pick winners" and promote them by a comprehensive battery of measures.

While interventions are necessary for sustained industrial development, however, not all interventions are efficient or desirable. Development experience is replete with cases of uneconomic interventions. Excessive, haphazard, across-the-board protection has bred, not technological dynamism, but many "infant" industries that have never matured. The setting up of heavy industrial structures without providing the capabilities needed (*i.e.* an adequate skill or institutional base) has often led to inefficiency. Creating skills, on the other hand, without proper incentives has wasted human resources, while "getting prices right" without offering infant industry protection or institutional or skill back-up has led to industrial stagnation. Chile seems to be an example of poor industrial and manufac-

[21] Hong Kong has survived by rapidly shifting its manufacturing offshore, mainly to China, because it could not diversify into more complex activities at home. Its own manufactured exports are now growing much slower that its exports from other bases. A similar phenomenon is observable for low-tech small and medium enterprises in Taiwan. By contrast, the Korean *chaebol* are investing abroad mainly in sophisticated activities (and mainly in developed countries) to serve local markets, while upgrading into higher technology activities at home to cope with rising wages.

tured export performance despite many years of "right" prices, outward orientation (with very low uniform tariffs), and high levels of skill, because of its lack of selective promotion of activities, firms or supporting institutions, while African countries are examples of failure due mainly to lack of skills and institutions. The secret of success has been combining incentives with adequate capabilities and institutions, each supported by a proper mix of selective and functional interventions. The poor performers have often intervened in the wrong way, and many have intervened too much while some have intervened too little. This does not deny the need for interventions (of the right sort) in the future. What it does suggest is that the pattern of interventions be changed.

The proper mix of interventions varies over time and by national context. As markets and capabilities develop, the need for interventions declines and the mix changes. The availability of capabilities to design and implement interventions itself affects feasible policy options. These considerations lead to a very different set of recommendations, more differentiated and more directed to helping governments to intervene, than current orthodoxy. It is beyond the scope of this paper to consider the political economy issues involved,[22] but the economic reasoning underlying current structural adjustments and other liberalisation measures needs serious reconsideration.

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[22] The political economy of interventions is lucidly reviewed by H. SHAPIRO and L. TAYLOR in "The State and Industrial Strategy", *World Development*, 1990, 18, pp. 861-78.