Industrial strategy and policies on foreign direct investment in East Asia*

Sanjaya Lall**

The debate on the role of industrial policy in promoting the development of the newly-industrializing economies of East Asia has implications for foreign direct investment policy. The newly industrializing economies pursued very different strategies on inward foreign direct investment, depending on their objectives of technological upgrading and deepening, and the extent to which deepening was sought to be indigenized. Countries with the strongest technological ambitions exercised the greatest selectivity on inward foreign direct investment, with their interventions geared to overcoming market failures in "learning". Taking account of the risk of government failure, there remains a role for intervention, in investment flows and affiliate activity.

Introduction

The role of government in economic life has been comprehensively reviewed in the economic development literature (e.g., Dunning, 1995a and 1995b). The intention here is not to go into the general debate, but to highlight the approach (or rather, the diverse range of approaches) of the leading East Asian newly industrializing economies (NIEs) to foreign direct investment (FDI) as one aspect of their industrial strategy. This leads to a consideration of the industrial policy debate, since the factors that attracted or kept out FDI in the NIEs were related to the creation of the specific "ownership" advantages of their national firms, and determined the form of their participation in trade. The focus in this article is on *technological* factors in FDI-

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** The author is Lecturer at Queen Elizabeth House, Oxford, United Kingdom.

related policy-making. The article focuses on the Four Tigers (Hong Kong, the Republic of Korea, Singapore and Taiwan Province of China).[1]

For much of the 1970s and the early 1980s, development economists regarded the NIEs of East Asia as market-driven economic systems that pursued practically free-trade, open-door policies to FDI and liberal resource-allocation domestically. Their astounding economic success was then traced to the efficiency of free markets and private enterprise; by contrast, the sluggish performance of other developing countries was blamed on inefficient government intervention. This portrayal had a strong basis in theory. Neoclassical economics provided the framework and tools for explaining how free markets optimize resource allocation, and the development community assumed that static optimization led to dynamic growth of the sort witnessed in East Asia. The creation of new competitive advantages in response to signals given by free trade and driven by the accumulation of the primary factors of production, the transfer and costless absorption of new technologies and information by FDI and trade, and the development of institutions supporting industrialization by the private sector, were all taken for granted.

The result was a formidable case for *wholesale* and *rapid* liberalization in all developing countries regardless of the level of development: not the improvement of government interventions, not the improvement of markets and the setting up of new institutions, but the wholesale rejection of the State as an organizer of economic activity. In the context of FDI policies, the case was for open-door policies to investment and technology flows in a liberal trade setting, letting market prices decide a country's comparative advantage and the reaction of transnational corporations (TNCs) to this advantage. No intervention was envisaged either in the flow of international investment nor in the behaviour of investors, since free markets were assumed to be fully efficient. This approach drew explicitly or implicitly on the success of East Asia.

This interpretation of the East Asian experience has been strongly challenged, on both theoretical and empirical grounds. The theoretical presumption that static optimization led to faster sustained growth is not part of traditional neoclassical growth theory, which assumes diminishing returns to investment and a convergence of growth rates. It then becomes necessary to introduce productive factors that enjoy increasing returns. "New" growth

[1] For an analysis of industrial policy in the "new NIEs" of Indonesia, Malaysia and Thailand, see the special issue of the *Journal of International Development*, September 1995, edited by the present author.

theory does this in the form of human capital and technology. Since these tend to have significant externalities they can suffer from market failure: optimal levels of investment may then require intervention. These interventions are generic in the sense that they do not favour particular activities over others; these are termed "functional" or "market friendly" in the current industrial policy literature, in contrast to "selective" interventions where governments pick particular activities to promote. Much of the current debate revolves around the desirability of selective interventions, since it is now accepted that functional interventions are widely needed in infrastructure, skill and technology creation.

Nevertheless, there are theoretical grounds for expecting other kinds of market failures in resource allocation (Stiglitz, 1989). Capital-market failures in developing countries are widely recognized, but failures in other markets can arise from several sources: externalities arising in industrial and technological activities, information market deficiencies, the need to coordinate interlinked investment decisions, risky and unpredictable learning processes (and the need to invest in learning the learning process itself), institutional gaps and so on. These failures may call for selective interventions rather than functional ones. In particular, externalities and learning processes are likely to differ substantially between activities, and their exploitation or remedying are likely to call for different policy interventions geared to the circumstances (Lall, 1994b). There is nothing in economic theory that says that functional interventions are better than selective ones. The recent trend to favour functional interventions has no theoretical basis if the relevant forms of market failure exist. The basis for rejecting selectivity must then lie in *empirical* reasoning: either that the relevant market failures do not exist or are trivial, or that they are important but in practice cannot be remedied efficiently by Governments.

On the empirical side, considerable evidence has accumulated that selective interventions can be of vital significance for accelerating and deepening the process of industrial development, and that under certain conditions governments can and do intervene effectively. This does not contradict the failures of earlier interventions, since the conditions for efficient industrial policy differ from those under which classic import-substituting strategies were devised and implemented. Moreover, theory suggests that not all forms of industrial development require selective interventions—it is mainly entry into complex and difficult technologies that faces severe market failures and calls for policy support. Here selectivity may be needed not just in product and capital markets but also in factor markets like education, technology,

information and institutional development normally considered the province of functional interventions. The essence of effective industrial policy seems to lie in selectivity in all these markets and in the integration of both factor and product market interventions around a well-defined strategic goal.

The evidence shows clearly that the governments of most Asian NIEs intervened pervasively, over long periods and often highly selectively, in factor and product markets (including FDI).[2] Each aimed at differing levels of industrial deepening, local content, local ownership of industry and indigenous mastery of complex technological functions. As a consequence, each pursued a different strategy, with different functional and selective interventions. There were clearly many strategies for economic success, and "success" was compatible with many ways of building up industry, ownership advantages and international integration. There was, in other words, no unique "East Asian model"—but a variety of models with a variety of results from differing interventions. It is these *differences* that are of most analytical and policy interest.

Policy issues in international investment

Two broad inter-related policy issues arise for developing countries in the context of international investment.[3] The first is whether and how much FDI to allow in, i.e., whether or not to exercise selectivity in letting in TNCs. The second is, having allowed in FDI, whether or not to intervene in resource allocation by TNCs, in setting conditions for their operations, and in attracting more FDI or investments of higher "quality". Both forms of intervention may be desirable if there is a perceived divergence between private and social returns from TNC activity in free markets. The first set of issues is determined by the costs and benefits of FDI to developing host countries as compared to alternative ways of accessing capital, technology and skills. The second is determined by market failures in domestic (and foreign) markets which guide TNC activities and which may be altered to obtain larger social benefits for the host economy.

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[2] Of the vast literature that now exists on this subject, see Amsden (1989, 1994), Chang (1994), Fishlow *et al.* (1994), Lall (1991, 1992, 1993 and 1994), Moreira (1994), Pack and Westphal (1986), Rodrik (1994), Wade (1990), Westphal (1990), World Bank (1992 and 1993).

[3] This abstracts from traditional concerns about transfer pricing, bargaining, predatory conduct and so on.

The entry of FDI. The literature on international investment attributes the existence of TNCs to the presence of failures in the markets for the intangible assets that constitute their "ownership advantages" (Dunning, 1988). Without such advantages there would be no reason for TNCs to come into being: the essence of transnationalization is the internalization of imperfect intermediate markets. This by itself has no particular policy implications. As long as the internalized markets of TNCs are efficient, not just for the firm, but also for host economies, there can be no divergence between private and social interests. If, however, there is such divergence, the imposition of (privately efficient) internalized markets by TNCs may not always be beneficial for the host economy.

Transnational corporations are among the most powerful means available for transferring modern technologies to developing countries and overcoming obstacles to their utilization. By virtue of their large internal markets for capital, skills, technology and information, they face fewer market failures than local firms. In most circumstances, therefore, there is no reason to place restrictions on their entry—their presence can only benefit local productivity and competitiveness. Moreover, since TNCs are at the forefront of innovation, their presence provides an effective means of keeping up with technical progress. Their established brand-names, global marketing presence and international flows of information all add to their technological advantages.

What case can there be for exercising selectivity on FDI? Three reasons can be found in the development literature:

- First, there is an important distinction between the transfer and utilization of production technologies and the transfer and development of more complex design, development and innovative capabilities. Innovative activity by TNCs tends to be concentrated in a few developed countries, because of the location of management and decision-making centres, availability of advanced and specialized technical skills, large local markets, linkages with established suppliers and buyers, closeness to advanced science and technology institutions, and proximity to central decision-making. The upgrading of capabilities in developing countries to the levels needed for high-level technological activity generally involves high learning and other costs which foreign investors tend to be unwilling to undertake. In less developed economies TNCs may hold back the development of innovative capabilities while enhancing production capabilities; it is mainly the more advanced industrial countries that can attract and fully benefit from the transfer of

innovative capabilities by TNCs (Dunning, 1991). Thus, a passive reliance on TNCs to upgrade and deepen technological capabilities may take a very long time to bear results.

- Second, the development of high-level capabilities in local firms may be more beneficial for technological diffusion than a similar development within TNC affiliates. This would be the case where technological development by local firms leads to a greater spillover of benefits and linkages (to local suppliers and institutions) within the host economy.

- Finally, a strong TNC presence in an industry, while stimulating local competitors to be more efficient in their production, can inhibit them from deepening their technological capabilities. Because of the higher risks and longer learning periods involved in creating a design and development capability, local firms exposed to full TNC competition may prefer to import foreign technologies proven and "ready made" from overseas rather than invest in their own research and development capabilities.

There may, therefore, be deficiencies in technological deepening in relying *passively* on transfer of technology through TNCs, leading to a relatively static pattern of specialization as far as capability development is concerned. But it may be in the interest of the industrializing country to promote technological deepening. Technological deepening would allow countries to import and absorb new technologies more economically, enter into more advanced activities, keep abreast of new developments, develop new products and processes, and better utilize local resources and linkages. The argument for restricting reliance on internalized means of technology transfer to induce technological development is rather similar to the case for intervening to promote comparative advantage by fostering infant industries, and rests on the remedying of similar market failures in information, capital, technology and other markets.

The deepening of local technological capabilities is not an argument for wholesale exclusion of FDI. On the contrary, it suggests a need for selectivity only in activities and at times when the local technological development is feasible and desirable. In circumstances where the host economy is not capable of economical technological deepening, or where the technology is so closely held or advanced that local development is not possible, a reliance on FDI may be unavoidable. Moreover, in some cases technological deepening could be achieved not by keeping out TNCs but by inviting them in and influencing their activities (see below). Technological deepening can

itself become a major factor in attracting higher "quality" and more FDI: if local innovative capabilities advance, it would be in the interest of TNCs to transfer more complex activities and research and development itself to those countries.

If it is accepted that *some* interventions are needed to speed up technological development, then one can distinguish two broad strategies for intervention to promote technological deepening:

- The first is to increase dependence on FDI, but to also induce TNCs, by a mixture of incentives, rules and negotiations as well as investments in local skills and institutions, to enter activities with more complex technologies, upgrade local technological capabilities within given activities, establish closer linkages with local technology institutions and set up local research and development units.
- The second would be to adopt a more independent strategy, restricting technology import via FDI and promoting it in "externalized" forms (such as licensing, joint ventures or other means, in which local firms retain control and invest in deepening and extending their technological capabilities) in circumstances where this is warranted. It must be noted, however, that local ownership or control *per se* would not ensure that deeper innovative capabilities would develop (Lall and Najmabadi, 1993). Local firms may choose to remain passively dependent on imports of foreign technology and skills, and, if they had lower technical skills and managerial capabilities, and were more risk-averse, might develop less technological capabilities than foreign affiliates. The development of deeper capabilities requires other *complementary* interventions to ensure that incentives exist for local firms to invest in such risky activity, the necessary skills and information are available, and capital markets are able and willing to finance the process, or local firms are promoted to a size that enables them to internalize capital and other relevant markets.

The choice between an FDI and a nationally-led strategy of technological development depends partly on a country's political economy (some countries, for instance, are committed to open FDI policies or lack the tools of intervention or the local entrepreneurship to mount effective national technological strategies), and partly on the size and spread of the industrial sector (smaller economies with more specialized industries may prefer the FDI-led route while larger ones with diverse sectors may prefer the national route). The East Asian experience shows successful examples of both strategies.

The upgrading of competitive and technological advantages. Market deficiencies may make it necessary to introduce measures to strengthen a country's attractiveness to TNCs, guide TNC entry into activities conducive to industrial upgrading, and develop factor markets in ways that lead to upgrading in the "quality" of FDI. Given the basic pre-conditions for attracting foreign investors, for instance, governments may have to promote their countries in international investment markets and target their promotion to particular home countries or TNCs (Wells and Wint, 1991) to overcome deficiencies in information markets.

In responding to free market forces, foreign investors would focus on activities that exploit a host country's given competitive advantages rather than those that could be developed with some additional effort. The upgrading of investment activities would thus wait for the accumulation of production factors and the reflection of this in relative factor prices; even so host countries with high wages and rising stocks of capital may not attract complex and high-skill industrial investments. Intervention could be used to promote the upgrading of TNC activities from simple, labour-intensive and low technology to more complex and demanding ones, by guiding foreign entry or providing strong incentives to all investors. Intervention could also be needed to induce TNCs to deepen their technological activities in host countries, from those needed for final assembly and processing to those needed for adaptation, design, development and finally innovation. Such intervention may involve inducing TNCs to strengthen local technology activities, to establish closer links with local technology institutions and to set up in-house research and development activities, or to strengthen the base of local supplier firms, technical skills and technology institutions, or a mixture of both.

These are not merely hypothetical policy issues. As shown below, they guided policy makers in East Asia. The need for selective and other interventions to promote industrialization was widely (though not universally) recognized. However, each government perceived different policy needs in line with its own strategy, identifying different market failures and adopting different solutions. Some chose to intervene very little in either the entry of TNCs or their subsequent activities; some chose to rely heavily on FDI but to intervene in TNC operations; and some chose to reduce reliance on FDI and to intervene extensively to promote local enterprises and indigenous technological capabilities. All this took place in a common setting of strong export-orientation, private-sector primacy, well-managed macroeconomies and strong, capable governments. These common factors, while providing the necessary conditions for industrial success, are not sufficient to explain

the nature and effects of the particular industrial and internationalization strategies followed by the different NIEs.[4]

FDI strategies in East Asia

Table 1 shows the most recent available data on values of FDI inflows and outflows in the leading Asian NIEs as well as the "new NIEs". It shows that the largest host countries of FDI among the NIEs were Singapore and Malaysia, which were relatively small economies by regional standards, while the large economies of The Republic of Korea and Taiwan Province of China were fairly small recipients, with the amount of FDI inflows declining in the past two-to-three years. Hong Kong was a relatively large recipient but with stagnating inflows; Indonesia was on a rising trend, while Thailand seemed to be stagnant or declining. The biggest destination for FDI in the region was not one of these NIEs but China, with inflows rising from $3.5 billion in 1990 to an estimated $27.5 billion in 1993. However, this is not shown in the table since China lies outside the ambit of the present discussion. As far as the NIEs and second-tier NIEs are concerned, there are large variations in their propensities to attract FDI.

Table 1. Annual FDI inflows into Asian NIEs, 1982-1993

(Millions of dollars)

Country	1982-1987	1988	1989	1990	1991	1992	1993
Hong Kong	1 014	2 627	1 077	1 728	538	1 918	1 667
Indonesia	282	576	682	1 093	1 482	1 774	2 004
Korea, Republic of	253	871	758	715	1 116	550	..
Malaysia	844	719	1 668	2 332	3 998	4 469	4 351
Singapore	1 605	3 655	2 773	5 263	4 395	5 635	6 830
Taiwan Province of China	306	959	1 604	1 330	1 271	879	917
Thailand	287	1 105	1 775	2 444	2 014	2 116	1 715
Total NIEs	5 953	15 694	15 719	20 382	21 171	30 489	44 999

Source: UNCTAD-DTCI (1994, 1995).

[4] In a recent study by the World Bank (1993) it is claimed that good macro management, export orientation and "market friendly" interventions to strengthen human capital are sufficient to explain East Asian industrial success; but this fails to take into account the very marked differences in industrial policy objectives, instruments and achievements in the region; see Lall (1994a).

Table 2. Share of FDI in gross domestic investment in selected Asian countries, 1981-1992

(Percentage)

Country	1981-1985	1986-1990	1991	1992
Hong Kong	6.5	13.6	2.3	..
Indonesia	1.0	2.0	3.7	4.1
Japan	0.1	..	0.1	0.2
Korea, Republic of	0.5	1.3	1.0	0.5
Malaysia	10.8	10.6	23.9	..
Singapore	18.1	33.9	26.2	30.6
Taiwan Province of China	1.5	3.5	3.0	..
Thailand	3.2	5.9	5.6	..

Source: UNCTAD-DTCI (1994), annex table 5.

These large disparities are further illustrated in table 2, which shows the share of FDI in gross domestic capital formation in the above countries and Japan. It shows, in very broad terms, that the countries that developed the most diverse, deep, complex and technologically dynamic industrial sectors (Republic of Korea, Taiwan Province of China and Japan) had the least reliance on FDI. It was clearly not the lack of income, growth or competitive potential that led to this low reliance: the reason lay in their deliberate policies to restrict FDI inflows. Certainly, their industrial strategies were directed, among other things, at the promotion of local enterprises and the development of indigenous technological capabilities, and restrictions on FDI was one important aspect of their strategies.

This suggests that the Governments of the industrially more advanced countries were seeking to exploit causal relationships between the restricted entry of FDI, the growth of domestic enterprises and the development of local innovative capabilities. However, most of the other NIEs have more modest technological ambitions and less desire to promote local enterprises. At the cost of some simplification, the group may be divided into four categories as far as FDI strategies are concerned:

- Passive open-door policies on TNCs without intervention in other ways to promote selectively industrial development (e.g., Hong Kong).

- Active industrial policies and promotion of local enterprises in certain activities, but effectively open-door, non-interventionist policies in most export-oriented industries (e.g., Thailand, Malaysia).

- Heavy TNC participation in manufacturing without seeking to promote local industrialists, but pervasive and selective intervention to guide and induce investors to upgrade their activities and increase local technological activity (e.g. Singapore).

- Selective restricted FDI to maximize reliance on externalized forms of technology transfer in the context of a comprehensive set of industrial policies to deepen the manufacturing sector, promote local linkages and increase local innovative capabilities (e.g. Republic of Korea and Taiwan Province of China, and earlier Japan). These industrial policies encompassed interventions in trade, finance, skills, technology and institution building, with strongly selective aspects to practically all interventions.

The important features of the industrial and FDI strategies of the NIEs can be summarized as follows:

First, the most liberal regime, **Hong Kong**, was able to combine free trade and substantial inward FDI with a dynamic indigenous industrial class that was very successful in export markets. Hong Kong was, however, a very special case by virtue of its location, long *entrepôt* tradition and established infrastructure of trade and finance, the presence of large British companies (the "Hongs"), and the influx of entrepreneurs and trained textile and metalworking engineers and technicians (with considerable learning embodied in their skills) from mainland China. This unique background allowed it to launch into export-oriented light manufacturing under free trade, but it *started and stayed with* light labour-intensive manufacturing industry, where the learning costs were relatively low and predictable. Hong Kong's success was based on the development of operational and marketing capabilities, but there was little industrial deepening and research and development growth. There was some "natural" progression up the ladder of industrial complexity as product quality was upgraded and new products added within existing areas of strength, but it was relatively limited in relation to other NIEs.

As wages and land costs rose, firms relocated their manufacturing to other countries, mainly mainland China, and suffered a significant loss of industrial activity at home (during 1986-1992 it lost about 35 per cent of its manufacturing employment, and the process is continuing[5]). The growth of

[5] *Financial Times*, 4 May 1993, "Survey of Hong Kong", p. 6. Manufacturing employment declined from 45 per cent to 23 per cent of the total in 1980-1992, and its contribution to GDP from 27 per cent to 16 per cent.

its own manufactured exports (as opposed to re-exports) slowed down considerably, and may even have gone into decline in 1993-1994; its manufacturing production is also practically stagnant. Hong Kong did not seek to use TNCs in any deliberate sense, and increasingly its FDI structure is specialized in service activities geared to China. Its impressive overseas investment performance, especially in China, is a reflection of its advanced entrepreneurial and limited technological capabilities rather than of broad industrial strengths. At the same time, the lack of a strong technology base worries the government, and it is launching initiatives like the Hong Kong Industrial Technology Centre to promote selectively local high-technology companies.[6]

The economy is continuing to grow and prosper, but the lessons of the Hong Kong "miracle" for the rest of the developing world are ambiguous. In view of the exceptional initial circumstances of the territory, *laissez-faire* would not by itself be sufficient to lead to the Hong Kong-kind of industrial or export development in typical developing countries. Furthermore, the lack of industrial deepening and the massive deindustrialization over time follow directly from its absence of industrial policy, and in the absence of a gigantic and thriving hinterland to service a similar policy would be deemed undesirable in other developing economies. In brief, the case does not conclusively establish a general case for fully liberal policies on trade or FDI.

In contrast to Hong Kong, **Singapore** illustrates clearly the consequences of a more interventionist policy regarding FDI and industrial targeting, combined with free trade. Singapore has half the population of Hong Kong, but has developed a far deeper industrial structure (in terms of the sophistication of production and exports) and has continued to sustain high rates of industrial and manufactured export growth despite having higher industrial wages. It has the highest reliance of any country on TNCs, deriving many benefits for its economic growth; but, unlike Hong Kong, the government targeted industries and services for promotion and aggressively sought and used TNCs as the tool to achieve its objectives.

The economy started with a base of capabilities in *entrepôt* trading, ship servicing and petroleum refining. After a brief period of import substitution, it moved into export-oriented industrialization, based overwhelmingly on investment by TNCs. Unlike Hong Kong, there was a weak tradition of local entrepreneurship, with little influx of technical and entrepreneurial know-how from China. There was a decade or so of light industrial activity

[6] *Far Eastern Economic Review*, 26 May 1994, p. 69.

(garment and semiconductor assembly), after which the Government of Singapore acted firmly to upgrade the industrial structure. It intervened to guide TNCs to higher value-added activities, and to create the specific high-level technical skills that would be needed.[7] The Government also set up a number of public enterprises to enter activities that were considered in the country's future interest and where FDI was considered unfeasible or undesirable; the public sector in Singapore accounts for a substantial proportion of GDP.

Specific areas of manufacturing and services were selected for promotion, with the policy instruments including incentives that guided the allocation of foreign and local resources and lowered the cost of entry into difficult activities (by providing the requisite skills and infrastructure). Manufacturing activity was upgraded into specialized processes and products, though the base of local capabilities was important in guiding this process.[8] Such specialization, along with the heavy reliance on foreign investments for technology and skill transfer, greatly reduced the need for indigenous technological investments (compared to the Republic of Korea). At the same time, the Government mounted strong efforts to induce TNCs to establish research and development facilities there to counter the fact that the technological depth of the affiliates was still comparatively low.[9] It has had some success in this.

A typical case of industrial targeting by Singapore is shown by its recent decision to promote the biotechnology industry. The Government undertook to set up an Institute of Molecular and Cell Biology at the cost of $13.8 million and with an annual funding of $17.5 million. To nurture the industry, the Government established Singapore Bio-Innovation Limited,

[7] See Lim (1994) on industrial policy; for a comprehensive analysis of Singapore's selective interventions in education see Selvaratnam (1994).

[8] Hobday (1995).

[9] Singapore established the National Technology Board to attract functional headquarters of TNCs for research and development. It will direct the expansion of a research-and-development infrastructure for new industries, such as agro-technology, biotechnology, robotics and automation. Singapore also established several government-support research centres, including the Singapore Science Park, the Institute of Molecular and Cell Biology, the Institute of Systems Science and the Information Technology Institute. A new university devoted to science and technology will double Singapore's research-and-development expenditure to over half a billion dollars. Singapore's Technology Development Centre helps local companies identify their technology requirements and design appropriate strategies for upgrading their operations. Since its establishment in 1989, the centre has sent its multidisciplinary staff of consultants and engineers on over 300 plant visits, and provided more than 130 companies with various forms of assistance including sourcing of foreign experts and equipment, and advice on process improvement and product development.

through which it had invested $41 million by 1991 in 12 biotech startup firms. The investment in the Institute of Molecular and Cell Biology is paying off scientifically. An Institute group is at the forefront of research on tyrosine phosphates (for cancer research). Another group is sequencing the genomes of several fish species, which could serve as a reference vertebrate genome for the human genome project. The investment in the Institute appears to be paying off scientifically. An Institute group is at the forefront of work on tyrosine phosphates, used in cancer research. Another group is sequencing the genomes of several fish species, which could serve as a reference vertebrate genome for the human genome project. The Institute's laboratories' innovative assay systems convinced Glaxo, a large TNC in the pharmaceutical industry, to establish a $31 million trust fund for a drug screening centre within the Institute. Glaxo also invested $30 million for a neurobiology lab focusing on genes that are expressed only in the brain.

Encouraged by these successes, the Government expanded the Institute's research base by establishing the Bioscience Centre, which provides facilities for research at the National University of Singapore and the Food Biotechnology Centre. The Bioprocessing Technology Unit, opened in 1990, seeks to improve purification, synthesis and fermentation methods for commercial production. The lab recently achieved large yields of TNF-[beta] which other companies, including Genzyme in the United States and Boehringer Mannheim in Germany, are keen to put into clinical cancer trials. The National University Medical Institute, being built near the Institute and the National University Hospital, is modelled on the United States National Institutes of Health.

One obstacle to Singapore's quest for scientific success is its shortage of well-qualified scientists and engineers. To overcome this, the Institute of Molecular and Cell Biology recruited scientists in developed countries offering them research freedom, ample funding and salaries of up to $50,000 for principal investigators. Those who accept the Institute's offer may qualify for renewable three-year contracts. Singapore's own students represent the largest source of scientific talent. Singapore's two polytechnics are training technicians to fill the growing demand from biotech labs and industries. In addition to tuition, graduate students at the Institute receive a salary of $10,000 a year.

This form of selective intervention is typical of the Government's hands-on approach to industrial and technological development. The strategy clearly identifies the complex of market failures that holds back entry into high-technology and high-skill activities that it has (correctly) identified

as its future comparative advantage. It then goes about addressing each in a systematic (and well funded) way. There is clearly more to be learned by other developing countries from this approach than from the Hong Kong one of leaving everything to free markets.

The larger NIEs—the Republic of Korea and Taiwan Province of China treated FDI in very different ways from the above-mentioned cases, and also from each other. They have shown a clear preference for promoting indigenous enterprises and for deepening local technological capabilities. As such, they always assigned FDI a secondary role to that of technology import in other forms. Their export drive was led by local firms, and a series of interventions (mostly selective and integrated across product and factor markets) allowed local firms to develop impressive technological capabilities. The domestic market was not exposed to free trade; a range of quantitative and tariff measures were used over time to give infant industries "space" to develop their capabilities. The deleterious effects of protection were offset by strong incentives (in the case of the Republic of Korea, almost irresistible pressures) to export and face full international competition. Given the significance of their experience in the present context of the role of government in FDI, it is worth considering their approaches at some length.

The Republic of Korea went much further in developing advanced innovative capabilities and heavy industry than Taiwan Province of China.[10] To achieve this compressed entry into heavy industry, the Government's interventions had to be more detailed and pervasive. The Republic of Korea relied primarily on capital goods imports, technology licensing and other technology transfer agreements to acquire technology.[11] It used reverse engineering, adaptation and own product development to build upon these forms of arm's length technology imports to develop its own capabilities. Some of the costs of technology imports were quite high: in the area of semiconductors, for instance, Korean companies paid more than $1 billion a year to both Japan and the United States for components and technology. However, the Republic of Korea is one of the few developing countries that has been able to use imported technology to feed into its domestic technology and to develop an independent innovative base. Its research-and-development expenditures are now around 2 per cent of GDP, and over 80 per cent of this

[10] For a summary description see Lall (1994.b). For details on the Republic of Korea see Amsden (1989), Moreira (1994), Westphal (1990), Kim (1994) and Lall and Najmabadi (1993).

[11] Korean strategy in technology development in electronics is analysed by Hobday (1995).

comes from private enterprises, by far the highest in the developing world (and ahead of all but a handful of leading OECD countries). While not a leading innovator in the normal sense, its enterprises have considerable technological muscle, and are able to utilize leading-edge technologies in a variety of industries.

One of the pillars of Korean technological strategy, and one that distinguishes it from the other NIEs (but parallels earlier Japanese experience), was the deliberate creation of large private conglomerates, the *chaebol*. The *chaebol* were hand-picked from successful exporters and were given a range of subsidies and privileges, including the restriction of TNC entry, in return for pursuing the Government's industrial strategy of setting up capital and technology-intensive activities geared to export markets.[12] The rationale for fostering size was obvious: in view of deficient markets for capital, skills, technology and even infrastructure, large and diversified firms could internalize many of their functions and undertake the cost, risk and long-term perspective needed to absorb very complex technologies (without a heavy reliance on FDI), further develop it by their own research and development,[13] set up world-scale facilities and market their products abroad by creating their own brand image and distribution networks. This was a costly and high-risk strategy, since the dangers of fostering giant firms in a rela-

[12] One interesting example is in the field of semiconductors (Hobday, 1995). Samsung Electronics, the largest Korean producer of semiconductors, now a world leader in the production of DRAM chips, started in 1980 by licensing its technology from Micron Technology of the United States, then forming its own company in Silicon Valley in 1983 to gain access to Unites States technology and skills. It developed its own 64- and 256-kilobit chips, but sustained heavy losses. In 1987 it joined the race for the 1- megabit chip in direct competition with Japanese leaders, and started mass production of chips in the Republic of Korea—by 1988 the firm had invested $800 million in semiconductors but had failed to make a profit. Thereafter prices and profits picked up, and by 1989 its semiconductor sales reached $1.4 billion. It continued to invest heavily in technology development and soon reached world frontiers in design of 4-, 16- and 64-megabit chips, beating most Western companies and coming just behind the leading Japanese firms. In 1989-1990 Samsung undertook a patent swap with IBM and forged partnerships with Toshiba, NEC, Texas Instruments, Oki and Corning. In 1992 it joined with Toshiba in developing flash memory chips and was the world's first company to produce a working model of the 64-megabit chip in 1992. By 1993, Samsung had invested $3 billion in chip technology, and had taken 15 years to catch up and establish an independent technological role in global terms. In 1995 it announced a 450-million-pound consumer electronics plant in the United Kingdom, and a collaboration with NEC to set up a plant in Portugal to make memory chips for the European market. While there was little direct government involvement in all this, the fact that Samsung was able to undertake it at all is due to the earlier strategy of creating such a large firm, protecting its domestic markets in a range of products and giving it privileged access to finance.

[13] On semiconductors alone, four leading *chaebols* spent won 1.8 trillion on capital investment and won 300 billion on research and development in 1989-1990. Their size and financial resources give them a clear advantage over similar companies in Hong Kong, Singapore and Taiwan Province of China.

tively small economy are obvious. They were contained by the strict discipline imposed by the Government in terms of export performance, vigorous competition among the *chaebol* (except when they were bidding for international contracts) and deliberate interventions to ensure rationalization of the industrial structure.

Since the technological strategy of the Republic of Korea is of direct interest to its FDI and globalization philosophy, it is useful to describe its main features (see box 1). The most important point to note is that, while FDI was an important input into the country's industrialization, TNCs were used by the Government mainly to further the acquisition of technology by local firms—a very different approach from Singapore. The internalized markets of TNCs were not allowed to weaken the deficient factor markets of the host economy, but were tapped in such a way that local innovative capabilities were strengthened. As these capabilities grew, FDI was allowed to play a larger role, but it never became the engine of technological or industrial development.

The Government also undertook various measures to encourage the diffusion of technology. It put pressures on the *chaebol* to establish vendor networks; such pressures were very effective and led to a rapid localization of components among subcontractors. It enacted a law to promote subcontracting by the *chaebol,* designating parts and components that had to be procured through small and medium-sized enterprises and not made in-house. By 1987, about 1,200 items were so designated, involving 337 principal firms and some 2,200 subcontractors, mainly in the machinery, electrical, electronic and shipbuilding fields. Generous financial and fiscal support was provided to subcontractors, to support their operations and process and product development. In addition, subcontractors were exempted from the stamp tax and were granted tax deductions for a certain percentage of their investments in laboratory and inspection equipment and for the whole of their expenses for technical consultancy. Subcontracting promotion councils were set up by each industrial subsector and also within the Korea Federation of Small Business, to represent the interests of small firms and to arbitrate disputes and monitor contract implementation.

Apart from the array of direct interventions to support local enterprise to develop its technological capabilities without relying on TNCs, the Government provided selective and functional support by creating general and technical skills. The Republic of Korea today has the highest rate of university enrolment in the developing world, and produces nearly as many engineers each year as the whole of India. While much of higher education is

Box 1. Encouragement of technological activity in the Republic of Korea

The Republic of Korea is the best-known example of the use of strategic industrial policy to develop indigenous technological capabilities. It combined import-substitution with forceful export promotion, selectively protecting and subsidizing targeted industries that were to form its future export advantage. This strategy had many remarkable successes, though in the 1970s (when a compressed and diverse drive into heavy industry was attempted) it generated large costs and macro-economic imbalances. The Republic of Korea drew extensively on foreign technology, but in forms that promoted local control: it was one of the largest importers of capital goods in the developing world, and allowed its firms unrestricted access to the latest equipment (except when it was promoting particular domestic products); it encouraged the hiring of individual foreign experts; it allowed licensing and, where necessary, foreign minority ownership (but foreign majority ownership was discouraged unless deemed necessary to gain access to closely held technologies or to promote exports in internationally integrated activities). It intervened in major technology contracts to strengthen the negotiating position of domestic firms, and sought to maximize the participation of local consultants in engineering contracts.

Technological effort in the Republic of Korea was supported by the Government in several ways. Private-sector research and development was directly promoted by a number of incentives and other forms of assistance. These included tax-exempt technology/development/reserve funds, tax credits for research-and-development expenditures as well as for upgrading human capital related to research and setting up industry research institutes, accelerated depreciation for investments in research-and-development facilities and a tax exemption for 10 per cent of cost of relevant equipment, reduced import duties for imported research equipment, and a reduced excise tax for technology-intensive products. The commercialization of research results was encouraged by a 6 per cent tax credit or special accelerated depreciation of the relevant investments. The import of technology was promoted by tax incentives: transfer costs of patent rights and technology import fees were tax deductible; income from technology consulting was not taxed; and foreign engineers were exempted from income tax.

In addition to tax incentives, the Government also gave financial *grants* and *long-term low-interest loans* to enterprises that participated in "national projects" (below). Tax privileges and official funds were given to private and government research and development institutes to carry out these projects. Small and medium-sized enterprises were helped with shop-floor advice and guidance to upgrade technical capabilities and productivity by Korea Production Technology Corporation. It complemented the help provided by the Small and Medium Industry Promotion Corporation, which also gave technical, training, and other services to small and medium-sized enterprises. Small and medium-sized enterprises were further assisted by the Korean Academy of Industrial Technology, as well as by "technology guidance systems" operated by Government research institutes. The Korea Technology Advancement Corporation helped firms to convert research findings into commercial applications. Several *legal measures* to promote technology development were undertaken. In 1973, the Government enacted two pieces of legislation: the Engineering Service Promotion Law to protect and strengthen the domestic engineering services sector, in particular small firms; and the Law for the Development of Specially Designated Research Institutes to provide legal, financial and tax incentives for private and public institutes in selected technological activities.

The Government invested in a large array of *technology infrastructure institutions*. In 1966 it set up the Korea Institute of Science and Technology, charged with the responsibility of conducting applied research of various kinds for industry. In its early years, the Institute focused on solving simple problems of technology transfer and absorption. In the 1970s the Government set up other specialized research insti-

tutes related to machinery, metals, electronics, nuclear energy, resources, chemicals, telecommunications, standards, shipbuilding, marine sciences, and so on. These were largely spun off from the Institute, and by the end of the decade there were 16 institutions in public research and development. In 1981, the Government decided to reduce their number and rationalize their operations. The existing institutes were merged into 9 under the supervision of the Ministry of Science and Technology.

The Government launched a series of *national* research-and-development projects in 1982. These were large-scale projects which were regarded as too risky for industry to tackle alone but which were considered to be in the country's strategic industrial interest. National projects were conducted jointly by industry, public research institutes and the Government, and covered activities like semiconductors, computers, fine chemicals, machinery, material science and plant system engineering. "Centres of excellence" were formed in these fields to boost the Republic of Korea's long-term competitiveness. National projects were a continuation of the strategy of interventions to identify and develop the country's dynamic comparative advantage, orchestrating the different actors involved, underwriting a part of the risks, and directly filling in gaps that the market could not remedy. Strategic technological activities are still targeted and promoted.

Other policy measures to stimulate technological effort in the Republic of Korea include the setting up of *Science Research Centres* and *Engineering Research Centres* at universities around the country to support research-and-development activities and the common utilization of advanced research and development facilities, and the construction of *science towns*. Daeduk Science Town has been under construction since 1974, and a large number of research and educational institutions are already well established there. The construction of Kwangju Science Town has started; others are planned.

privately financed, the Government has been instrumental in setting up universities, guiding the curriculum in the directions needed by industrial policy (and involving private business in governing universities) and regulating the quality of the education.

Taiwan Province of China switched to an export-oriented strategy in the 1960s, but within this it implemented a comprehensive set of industrial policies, encompassing import protection, directed credit, selectivity towards foreign investors, support for indigenous skill and technology development and strong export promotion.[14] While this resembles Korean strategy in many ways, there are important differences. Taiwan Province of China did not promote giant private conglomerates, nor did it attempt the intense drive into heavy industry as the Republic of Korea did. Taiwanese industry is largely composed of small and medium-sized enterprises and, given the disadvantages to technological activity inherent in small size, these were supported by a variety of inducements and institutional measures in upgrading their technologies.[15]

[14] For a comprehensive analysis see Wade (1990). Also see Brautigam (1995) for a concise exposition of Taiwan Province of China's industrial policies and the role of selective interventions.

[15] Taiwan Province of China has perhaps the developing world's most advanced system of technology support for small and medium enterprises.

As with the Republic of Korea, Taiwan Province of China used a variety of means to acquire foreign technology in support of domestic development, though with less nationalistic fervour. In the early years of industrialization, the authorities sought to attract FDI into activities in which domestic industry was weak, and used a variety of means (below) to ensure that TNCs transferred their technology to local suppliers: "Taiwan restricted the entry and activities of multinational companies in many ways, tightening controls as goals of technological upgrading and foreign equity investments were reached.[16] As with the Republic of Korea, FDI was directed at areas where local firms lacked technological capabilities. Where necessary, the authorities themselves entered into joint ventures, for instance to get into technologically very difficult areas such as semiconductors and aerospace.[17] They also played an active role in helping small and medium-sized enterprises to locate, purchase, diffuse and adapt new foreign technologies.

There are around 700,000 small and medium-sized enterprises in Taiwan Republic of China, accounting for 70 per cent of employment, 55 per cent of GNP and 62 per cent of total manufactured exports. Programmes to promote subcontracting have therefore been of special significance to the country's industrial development. In 1981, the authorities set up the Medium and Small Business Administration to support the development of small and medium-sized enterprises and co-ordinate the several agencies that provide financial, management, accounting, technological and marketing assistance to these firms. Financial assistance was provided by a number of banks and institutions. Management and technology assistance was provided by the China Productivity Centre, the Industrial Technology Research Institute and a number of industrial technology centres, all subsidized heavily.[18]

The "Centre-Satellite Factory Promotion Program" integrates smaller factories around a principal one. This programme involved vendor assistance and productivity-raising efforts, and a rationalized sharing of tasks between participating enterprises. By 1989, there were 60 networks with 1,186

[16] Brautigam (1995), p. 171.

[17] In an attempt to acquire semiconductor design and production capability, the authorities formed in 1974 the Electronic Research and Service Organization authorizing it to recruit a foreign partner to help develop and commercialize technology. In 1976, it opened the first model shop for wafer fabrication, and a year later signed a technology transfer agreement with RCA in integrated circuit design (Wade, 1990, pp. 103-104).

[18] The authorities cover 50-70 per cent of consultation fees for management and technical consultancy services for small and medium-sized enterprises. In addition, the Medium and Small Business Administration has a fund of 10 billion Taiwanese dollars for the promotion of small and medium-sized enterprises.

satellite factories in operation, mainly in the electronics industry. The normal X-inefficiency effects of such promotion policies for small and medium-sized enterprises (as have been found, say, in India) were contained by the high degree of export orientation of both the principals and the suppliers, as well as the high levels of education and training that accompanied Taiwan Province of China's industrialization.

Transnational corporations were also made to play an important role in the process of promoting backward linkages. In the early years, the authorities applied minimum content requirements in industries like motor vehicles and consumer electronics. Over time, they moved to more indirect measures to promote linkages, by giving incentives for principal firms to use local subcontractors and by improving the technological and business capabilities of small and medium-sized enterprises. Local research and development was encouraged by tax incentives, and skill levels were improved through sustained investments in education and training. The purchase of local equipment and entry into "linkage-intensive" activities were encouraged by tax incentives. A science town was set up in Hsinchu, with 13,000 researchers in two universities, six national laboratories (including ITRI) and a huge technology institute, as well as some 150 companies specializing in electronics. The science town makes special effort to attract start-ups and provides them with prefabricated factory space, five-year tax holidays and generous grants. The authorities have invested $500 million in Hsinchu since 1980. In 1993, they also announced a three-year stimulus package which included $1.5 billion in loans to SMEs and $20 billion of New Taiwanese dollars for high-technology enterprises.

The best-known example of institutional support for local technology development is the Industrial Technology Research Institute, which conducts research and development in areas considered too risky for private firms, including electronics, advanced metals, chemicals, energy, and most recently, aerospace. Taiwan Province of China's flourishing integrated circuit industry was spun off from the Institute's research-and-development efforts, and its Electronics Research and Service Division accounted for two-thirds of the Institute's $450 million annual budget. The Institute has spun off laboratories as private companies, including Taiwan Province of China's most successful integrated circuit makers. Among other support measures provided to small and medium-sized enterprises, one of the most important has been to transfer "production-ready technology" that was imported and adapted. Another is to encourage industry to contract out research to universities; half of the National Science Council's research grants of about $200

million per year fund such contracts, with enterprises providing matching funds.

This sketch of the policies of the NIEs leads to the following generalizations:

- Selective as well as functional interventions played a vital role in the pattern of industrial and technological development in the NIEs.
- Governments showed an ability to devise and implement interventions effectively, partly because export-orientation imposed a strict discipline on both industry and governments, and partly because of the high levels of training, adequate remuneration and political insulation of bureaucrats.
- The nature and impact of interventions differed according to differing government objectives and political economies; however, the extent of industrial and technological deepening achieved was strongly related to selective interventions to promote such deepening.
- Foreign direct investment was treated very differently by each of the four countries and so played very different roles in their technological development. Those that wanted to promote *indigenous* technological deepening had to intervene to restrict foreign entry and to guide their activities and maximize the spillovers. Those that chose to rely on TNCs and upgrade within their global production structure had to intervene to target investors, guide their allocation and induce them to set up more complex functions than they would otherwise have done.
- The different approaches to FDI shown by the Republic of Korea and Taiwan Province of China as compared to Singapore partly reflect their objective situations in addition to their political beliefs. The options and compulsions applicable to the larger economies, with greater scope for internal specialization and local content, as well as better established indigenous enterprises, were different from those open to a small island state with weak indigenous entrepreneurship and a tiny internal market. Given the need to spread technological development more widely, the former had to take more direct steps to assist local firms.[19]

[19] There was, nevertheless, a strong political commitment to promoting local capabilities. There are other large economies with sizeable industrial sectors, such as Mexico, that have chosen to remain highly dependent on imported technologies. As a consequence, research and development by enterprises in Mexico is around 0.02 per cent of GDP as compared to 1.8 per cent in the Republic of Korea, when both have roughly equal values of manufacturing value-added (Lall and Najmabadi, 1993).

Conclusions

It has been argued here that *laissez-faire* policies to FDI were not the norm in East Asia, and that there are sound economic reasons for the kinds of interventions in investment flows seen among the leading NIEs. These interventions may or may not have involved restricting TNC entry (the normal sense in which FDI interventions are regarded); in some cases they entailed aggressively seeking out and attracting foreign investors. They always required functional interventions to strengthen basic factor markets and institutions, in order to upgrade competitiveness and the "quality" of FDI inflows. This was the kind of intervention practised by Hong Kong. In other economies, they entailed extensive selective interventions, aimed at upgrading technologies and technological capabilities. Two broad strategies of selective intervention were identified: the "target and guide" strategy of Singapore and the "restrict and exploit" strategy of the Republic of Korea and Taiwan Province of China. The latter strategy had sub-elements, with Korea mounting more detailed interventions than Taiwan Province of China, with stronger ambitions to enter heavy and high-technology industry and to set up its own giant firms with ownership advantages to rival those of traditional TNCs from the developed world.

The East Asian NIEs provide a fascinating panorama of experience in industrial development, government intervention and treatment of FDI. What is undeniable is that their governments played a critical catalytic role in forming their competitive (or ownership) advantages in trade and industry, which then determined their participation in the global economy.[20] The approach to FDI and globalization was an integral part of a larger industrial strategy, and TNCs were increasingly seen as a resource which could be exploited in the national interest (an important shift from earlier perceptions of TNCs).

There is nevertheless still considerable debate about the effects of the selective industrial policies in East Asia. Furthermore, there remain doubts about the extent to which the ability to mount such interventions is present elsewhere. The conditions under which governments can exercise efficient intervention are certainly not found in many developing countries. The risk of *government failure* is so great in some cases that it may be better to suffer

[20] This article has not been able to explore the outward FDI by these countries, though all the NIEs are active overseas investors. Their different patterns of outward FDI, and their relationship with their industrial strategies and the development of different ownership advantages, are explored in Lall (1991).

the consequences of market failure than to indulge in selectivity. In such cases the government should confine itself to "market friendly" interventions and entrust the custodian role to free markets in trade and investment. However, government capabilities are not static or given in perpetuity; they can be improved, and there are various levels of selectivity in intervention. Is it possible to gear the level of selectivity to the capabilities of governments? Is it possible to raise these capabilities by specific actions and institutional mechanisms?

As long as the development process is confronted with widespread market failures, there are good reasons that careful selective and functional interventions can speed up development. The recent swing of opinion in favour of free markets needs to be tempered with a proper consideration of the role of government. This applies to FDI as well as to other areas of industrial policy. ■

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