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Selective Industrial and Trade Policies in Developing Countries: Theoretical and Empirical Issues

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This paper analyses the case for selective industrial and trade policies in Africa, drawing upon the lessons of East Asia. It reviews the theoretical arguments for government intervention in the context of technological learning, and relates this to the new environment of rapid technical change and globalisation of production. It also considers the risks of government failure in mounting selective policies, and concludes that the degree of selectivity has to be much less than in East Asia. The case for selective policies nevertheless remains strong, if Africa is to make any industrial progress.

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1. Introduction

The present climate for industrial policy is hostile. The 'rules of the game' set by the Bretton Woods institutions, WTO and major donors, are set against most forms of government intervention to promote industry. In the near future, governments will have almost none of the instruments of policy used through history to promote industrial development. Yet, targeted interventions in trade, industry and supporting institutions have played a critical role in industrialisation through history. All major industrialised countries used extended protection and other selective measures to promote industry, and to develop the institutions needed to support industrial and technological activity. The benefits of protection have been long debated (Reinert, 1995, and Vernon, 1989); that of other interventions have been relatively neglected. This neglect continues today, to the detriment of the analysis of industrial policy.

The new consensus seems to be that *all selective industrial policy* is economically undesirable and harmful. While there has been some swing back from the extreme neoliberal position of the early 1990s, which denied any role for the government beyond providing essential public goods and security, mainstream economics strictly confines the role of governments. In the terminology developed by the World Bank (1993), this role is a 'market friendly' one of improving deficient factor markets. There is no legitimate government role in 'selectivity', altering the market-driven allocation of resources between productive activities (Lall, 1996, Soludo, 1998, Westphal, 1998). However, economic theory justifies selectivity where market failures affect some activities more than others, and restoring equilibrium calls for more intervention in specific activities. There is such a case in promoting industries and technologies once we relax certain simplifying assumptions on how information (and within this, industrial technology) is created, exchanged, absorbed and used. In practice, the experience of the most successful developing countries today – the East Asian Tigers – shows that selective industrial policy can work, economically and politically.

The purpose here is to clarify the case for industrial policy *in economic terms*, to show that industrial policy was *actually implemented* by developing country governments, and to consider their *relevance for Africa*. I fully accept that the removal of many existing policies (including 'classic' import-substitution strategies and interventions that give rise to rent seeking) is necessary for development, and that a substantial dose of liberalisation is a precondition for industrial success. I also accept that the progress of technology and globalisation over the past three decades limits the exercise of industrial policy today. However, I argue that there is still considerable scope for legitimate industrial policy, much greater than the new rule of the game allow. In fact, the very pace of technical change today, and the intensification of competitive pressures in liberalised trade regimes, makes it more important than before to mount industrial policy. Africa, suffering massive and widespread deindustrialisation, needs supportive policies that go well beyond the neoliberal consensus. To mount such policies, it is necessary to raise government capabilities: this becomes a critical part of the new industrial policy.

2. Basic Concepts

The economic argument for intervention rests on the presence of *market failure*. If markets worked perfectly, they would (by assumption) achieve 'optimal' resource allocation and there would be no

economic ground for intervention. If, on the other hand, markets were missing or functioned badly, intervention to restore optimality would be justified. This argument derives from *static* models of perfect competition, in which 'failures' are defined by departures from Pareto optimality with its host of simplifying and rigorous conditions. Textbook versions of market failure are imperfect competition, public goods and externalities. These are relatively restricted cases of failure that can, at least in theory, be corrected by governments – they do not seriously affect the theoretical case for perfect markets. However, as economists like Stiglitz (1994, 1996) point out, failures in information markets are much more widespread and diffuse and do threaten the theoretical case. When such 'diffuse' and pervasive market failures are present, it does not even make sense to think of conventional market failures, where it is possible to return to an equilibrium state with perfect information, certainty, lack of externalities and scale economies and full property rights. How then can the concept of market failure be used to analyse the need for policy?

The industrial policy literature draws a distinction between 'functional' interventions, that are not directed as specific activities, and 'selective' interventions, that are (Pack and Westphal, 1986, Lall, 1996). The mainstream position today, as noted, is that functional interventions may be justified but selective ones never are. It defines the former as market friendly and the latter as (undesirable) industrial policy. The case rests on two, mutually reinforcing, arguments. The first is economic, that governments cannot improve on the information processing capabilities of even imperfect markets to mount selective policies, though they can mount functional ones. The second is political, that governments are inherently corruptible and can never be trusted with selectivity. The argument is tendentious and biased. *Both functional and selective interventions are 'industrial policy'*, since both try to improve upon free market outcomes. Whether or not governments can improve upon free markets depends on the circumstances and stage of development: *a priori* generalisations are impossible. Similarly, whether or not governments can handle selectively efficiently is a context specific issue: political preconceptions should not be introduced to pass sweeping judgements.

While the distinction between functional and selective interventions appears to be useful at first sight, it is impossible to apply in practice. First, there are many possible levels of selectivity, ranging from supporting the whole of manufacturing, to supporting a wide range of related activities (e.g. metal working), to supporting particular activities (machine tools) and particular technologies (computer numerically controlled tools) and specific vintages of technology or firms. Second, the line between selective and functional interventions is very difficult to draw. The same policy can be functional or selective, depending on its intention, specificity and context. For instance, strengthening vocational training may be functional in one case, and selective in another (if training for, say, ship-building or CNC machine-tool operations were being targeted).

Establishing that markets can fail is not difficult. However, this does not automatically establish the case for intervention. Since most interventions have their own costs and risks, it has to be established that the *benefits outweigh these costs.* The outcome depends upon the extent and cost of the market failures in question, the ability of markets to develop solutions, and the ability of governments to design and implement the necessary interventions. The design of certain interventions calls for information and monitoring, while their efficient implementation requires autonomy, skills and impartiality. Many of these conditions are not met in developing countries. Thus, the cost of "government failures" has to weighed against the cost of market failures.

3. The Need for Industrial Policy

3.1 The Micro Foundations

The neoclassical case against government interventions rests on strong assumptions about market efficiency, in turn based upon a particular conceptualisation of *technology at the enterprise level*. It assumes that technology is freely available from a known 'shelf' on which there is full information. Firms optimise by choosing from this shelf according to their factor and product prices. Any intervention is necessarily distorting to resource allocation. The selected technology is absorbed costlessly and risklessly by the enterprise and used at efficient ('best practice') levels. There is no need for intervention to support the process: the underlying assumptions ensure that any observed industrial inefficiency is due to government interventions. The removal of such interventions then becomes the *necessary and sufficient* condition for restoring efficiency.

If there is any lag in efficiency it can, at most, only be for a brief period in which scale economies are fully realised or costs fall in an automatic 'learning by doing' process. However, these lags are predictable (scale economies are given by technical design parameters, while the learning curve is known) and a simple function of the quantity of output. Again, there is no need for intervention because firms can anticipate the process and raise money in efficient capital markets to finance the learning process. If capital markets fail, the correct solution is to improve their functioning rather than to intervene selectively to support particular activities. Thus, capital market failures and scale economies do not provide grounds for selective intervention in resource allocation. A second-best case for selectivity exists only when these failures cannot be remedied readily, and protection or subsidies are used as intermediate solutions.

An alternative to the neoclassical approach is the 'technological capability' approach.[1] This draws upon the evolutionary approach of Nelson and Winter (1982), and locates learning in markets prone to imperfections, satisficing behaviour and widespread failures. Its policy conclusions are based in deficient markets; it is explicitly *behavioural* and *institutional*, opening up the 'black box' of firms and markets (for an application to technology policy making, see Lall and Teubal, 1998). It inserts a layer of behavioural analysis between investment and performance. A distinction is made between *capacity* (physical installed capacity) and *capability* (the ability to use that capacity efficiently).

Technological capabilities are then the skills — technical, managerial or organisational —firms need to utilise efficiently the hardware (equipment) and software (information) of technology. Capabilities are *firm-specific*, institutional knowledge made up of individual skills and experience accumulated over time. Moreover, capabilities are not linearly added, but contain a synergistic element arising from the interaction between individuals and firms. Technological effort is not the same as 'innovation', the normal connotation of technological change in economics. In fact, most technological effort does not take place at the frontier of technology at all. It covers a much broader range of effort that every enterprise must undertake to access, implement, absorb and build upon the knowledge required in production. This is true as long as the technology is new to the enterprise or country buying it, whether or not it is new or mature elsewhere. *Technology cannot simply be transferred to a developing country like a physical product*: its effective implantation has to

[1] For a representative sample see Bell and Pavitt (1993), Dahlman *et al.* (1987), Enos (1992), Lall (1996, 1992) and Pack (1992).

include important elements of capability building: simply providing equipment and operating instructions, patents, designs or blueprints does not ensure that the technology will be effectively utilised. There are strong tacit elements in the technology that require effort and entail uncertainty.

In the evolutionary approach, as a result, there is no predictable learning curve down which all firms travel. *Much depends on the efficacy with which markets or institutions function, uncertainty is coped with, externalities tapped, and coordination achieved.* If the learning period, costs, uncertainties and leakages are very high, coordination with other firms in the supply chain exceptionally difficult, or information, labor and capital markets particularly unresponsive, 'difficult' knowledge may not be absorbed – even where it would be efficient to do so. The capability approach does not suggest that *no* industry will take root in free markets. Where there is a modicum of skills, infrastructure and cheap labour, simple labour-intensive activities will start. However, upgrading into more complex and demanding technologies may be limited in the absence of interventions to overcome learning costs. Such interventions cannot be functional — *since technologies differ in their learning needs, they have to be selective.*

The *protection of infant industries* is one, and historically the most popular and effective, means of selective intervention. However, protection can be a dangerous tool. Apart from the cost it imposes on consumers, it dilutes the incentive to invest in capability development, the very process it is meant to foster. Firms are very sensitive to competitive pressures in deciding to invest in capabilities, and the protection offered in typical import-substituting regimes tended to detract from costly and lengthy investments in competitive skills and knowledge. There may be many solutions: offer limited protection; impose performance requirements; or enforce early entry into export markets while maintaining domestic protection. The last has the added advantage that it taps the information externalities of export activity, and was the one used by the larger Asian NIEs.

It is important to distinguish the *ownership* of enterprises. Market failures are particularly binding for *local* enterprises, particularly smaller ones. Foreign investors tend to face fewer failures. Their *raison d'être* is the internalisation of intermediate markets (for capital, skills and technology). This is why MNCs may be an effective means of launching industrialisation (as long as complementary factors exist). Their significance is greatest where technologies are changing rapidly, production is tightly linked across nations, and market access is difficult for new entrants. However, the advantages offered by FDI does not mean that the best way to develop is to adopt passive "open door" policies that leave matters entirely to free markets. There can be two important types of market failures in the foreign investment process.

4. Lessons from East Asia

4.1 Background

Let us start with a brief historical sketch of the growth of competitive industry in East Asia, focusing on the leading Tiger economies. These were first countries to launch on export-oriented manufacturing, the Asian Tigers, adopted outward looking policies in the early 1960s (Hong Kong was always free trade) and led the first wave of LT assembly exports: garments, textiles, toys, footwear and the like. Over the 1970s and 80s, they upgraded their export structures in different ways and moved into more complex products. In Hong Kong, once the leader in the developing world in manufactured exports, there was quality improvement in the same products, but its *laissez*

faire policies led to relatively little structural deepening. As a result, with rising wages, most manufacturing shifted to lower wage countries, and industrial and export growth stagnated or turned negative. The export structure remained at low technology levels, the lowest among the Tigers.

In Singapore, by contrast, there was considerable deepening, allowing it to combine rising wages (nearly 20% higher than in Hong Kong) with continued output and export growth. Singapore moved rapidly from LT to petrochemicals and then producer electronics and equipment, simultaneously raising its technological levels from simple assembly to high-end manufacturing, design and development. The process was dominated by MNCs, which provided state-of-the-art technologies and access to their global networks. This gave Singapore the most hi-tech export structure in the developing world, though its research base remained relatively small and the sources of innovation remained overseas. The deepening was driven by strong industrial policy, using FDI targeting along with selective investments in skills, technology and infrastructure, all directed at meeting the specific needs of the sponsored activities (Lall, 1996).

In Korea and Taiwan, MNCs played a much smaller role: domestic firms led the deepening and upgrading. Their governments used infant industry protection (offsetting its harmful effects by strong export incentives), credit allocation and subsidies, FDI restrictions, and skills and technology support, to induce them to enter difficult activities, raise local content and take on advanced technological functions. Korea's interventions were very pervasive and detailed, and involved fostering the *chaebol*, the conglomerates that spearheaded its heavy industry and high technology drive, learned the most advanced technologies, and became major multinationals in their own right (below). Taiwan intervened less directly in the industrial structure, though it used public enterprises to enter several heavy industries. It supported its small and medium enterprise dominated structure with an array of technology, training, finance and export marketing policies and institutions (Wade, 1990, Lall, 1996).

As a result, *Korea and Taiwan have the greatest technological depth in the developing world, and their exports embody the most intense learning*. This has been supported by the massive investments in R&D and technical skills, described at greater length below.

4.2 Learning among the Leaders

4.2.1 Introduction

The mature Asian Tigers had many common elements in their industrial development. According to the World Bank (1993), they had sound macroeconomic management, a good initial base of human capital and strong export-orientation. They provided stable and predictable incentive frameworks for investment. They had high rates of saving and investment — some of the highest in recent history — which financed investments in the hardware and software of learning. They invested in administrative and institutional capital, both necessary to making markets work better and to mounting effective policies. Their governments had close and continuous dialogue with the private sector, and the granting of privileges was closely monitored and made to depend on export performance. They used 'contests' to monitor performance and to ensure that favours were returned, unlike other countries where privileges were generally granted to industry with no monitoring or performance requirement. Finally, they benefited from their location, being near Japan

and what became the world's most dynamic region. They interacted with, and learned from, each other. They gained from the spillovers of a favourable investment image.

What was ignored by neoclassical analysts was that these common elements went together with *striking differences* in development 'visions', which shaped crucial elements of their strategies, each involving different kinds and levels of intervention. It is difficult, in fact, to describe their policies are 'remedying market failures' in the conventional sense. The Tigers were not trying to make markets work better to achieve some static equilibrium. They were choosing between countless potential equilibria, and bending their resources to obtain the ones they had (more or less clearly) selected. Though there were some generic problems they addressed in similar ways (improving the technology infrastructure or providing basic education and training), they used various tools of policy differently to pursue their different visions (Lall, 1996). Since they were all successful (to a greater or lesser extent), because of the coherence of their policies and good administrative capabilities, clearly there are not only 'many roads to heaven' but also many heavens. The tools were not that different from those used in less successful economies — the secret lay in the *combination* of policies and the efficacy of their *implementation*.

4.2.2 Different Incentive Regimes

Korea had the strongest ambitions to develop a diverse, technologically advanced, nationally-owned industrial structure, and had to mount the most comprehensive set of interventions to achieve this. These included quantitative and tariff restrictions on imports, strong export subsidies and targeting, subsidised and guided credit and the promotion of giant conglomerates (Westphal, 1990). FDI was kept to the minimum, with foreign technology sought aggressively in all non-equity forms. Korea was at the time the largest importer of capital goods in the developing world. The government, to ensure better terms and deeper knowledge transfer, vetted other forms of technology import, such as licensing, consultancy and turnkey contracts. It shaped industrial development at a very detailed level, and with it the technological effort that was needed to compete in world markets, export orientation disciplining both firms and bureaucrats. Entire sets of heavy industries were promoted together to exploit linkages and externalities, with changes being made as events unfolded and some activities proved unviable. As its conglomerates grew in strength and spread, they were encouraged to establish affiliates overseas, to increase market presence and seek new technologies.

Taiwan lacked the political economy to mount such detailed interventions. Nevertheless, it used trade and credit policies to guide the technological upgrading of an economy dominated by small and medium sized enterprises. Public enterprises were used to enter areas where the private sector was reluctant. Enterprises were encouraged into skill and technology-intensive activities, with inputs from selectively used FDI and a superlative extension and technology support system (Dahlman and Sananikone, 1990). The government guided and co-ordinated the import and absorption of exceptionally difficult new technologies. Taiwan did not achieve the extent of heavy industrialization of Korea, but retained a more flexible, less concentrated structure. The government encouraged outward investment to relocate labor-intensive activities that were became uncompetitive over time. As with Korea, it had a series of comprehensive technology plans that guided the allocation of resources in this area; and, similarly, it encouraged outward investment to seek cheaper locations and new markets and technology.

Singapore, the smallest of the Tigers, started with a weak entrepreneurial base and decided to rely heavily on FDI, which it targeted and guided to enter more complex activities and functions within a free trade setting. As with Taiwan, public enterprises were used to spearhead particularly difficult activities. It developed the perhaps the most efficient and honest system of administration in the region. Its FDI targeting worked not only because of this, but also because the government could build up a base of technical and managerial skills geared specifically to the industrial targets it set (Singapore reputedly has one of the most skilled and efficient work forces in the world). The result was that it built up the most high-tech export structure in the region.

Hong Kong was closest to *laissez faire* among the Tigers. Its industrial development started with a unique base: developed financial and trading services, excellent infrastructure, and a supply of entrepreneurs, engineers and technicians. It provided cheap land to manufacturers, extension and information services to producers and exporters, and then let firms follow the dictates of the world market with little interference. However, its neglect of technological deepening left it with a light industrial structure and low R&D capabilities, leading to massive deindustrialization and the relocation of much of its manufacturing base to cheaper wage areas. This process did not reverse its overall growth, since its unique location and its developed services structure allowed it to move into other activities (very dependent on the mainland). However, Hong Kong has been the only Tiger to suffer a consistent decline in manufacturing output; the share of manufacturing in GDP has fallen from 27 percent at its peak to under 7 percent today.

4.2.3 Accessing Technology

Foreign knowledge is the primary input into the development of local capabilities, and it is available in many forms. Facilitating access to knowledge in all its forms is vital to development policy; as noted, however, not all forms of transfer have equal effects on domestic learning. Foreign direct investment (FDI) inflows are perhaps the most important form of access, but developing countries used this channel to very different extents (Table 1). Others include a variety of links with technology suppliers, from the purchase of equipment to lengthy licensing and other arrangements. The Tigers were open to international information flows and sought foreign knowledge, embodied and disembodied, avidly. Nevertheless, each adopted a different approach to how it tapped this knowledge, and how it combined it with differing strategies for promoting local learning. Let us recount the main strategies used.

Table 1: Inward FDI flows as Percentage of Gross Domestic Investment

	1985-90	1991	1992	1993	1994	1995
WORLD	5.4	3.1	3.3	4.4	4.5	5.2
Regions						
All Developed	5.5	3.2	3.2	3.7	3.5	4.4
W. Europe	8.9	5.3	5.3	5.8	5.1	6.7
N. America	5.5	3.4	2.5	3.8	5.5	4.6
All developing	8.0	4.4	5.1	6.6	8.0	8.2
N. Africa	2.7	2.2	3.8	4.1	5.7	3.0
Other Africa	9.2	7.3	6.4	8.2	12.5	13.2
L. America	11.3	7.8	8.1	7.2	10.3	11.0
W. Asia	1.2	1.7	1.5	2.2	1.0	-0.6
S. & E. Asia	9.7	3.8	4.7	7.5	8.3	9.0
C. & E. Europe	1.0	0.4	0.8	7.9	5.0	5.2
Selected Developing Countries						
H Kong	12.2	2.3	7.7	7.1	8.2	8.4
Singapore	59.3	33.6	12.4	23.0	23.0	24.6
Korean Rep.	1.9	1.0	0.6	0.5	0.6	1.1
Taiwan	5.1	3.1	1.8	1.8	2.5	2.7
China	14.5	3.3	7.8	7.1	8.2	8.4
Indonesia	7.6	3.6	3.9	3.8	3.7	6.5
Malaysia	43.7	23.8	26.0	22.5	16.1	17.9
Thailand	10.2	4.9	4.8	3.4	2.3	2.9
Philippines	13.6	6.0	2.1	9.6	10.5	9.0
India	1.2	0.3	0.4	1.0	2.4	3.6
Pakistan	5.1	3.3	3.5	3.5	4.6	6.7
B'desh	0.3	0.1	0.1	0.4	0.3	..
S. Lanka	6.9	2.4	5.4	7.5	5.3	2.0
Argentina	13.0	15.1	25.5	31.0	4.8	11.7
Brazil	3.1	1.4	3.0	1.3	3.0	4.7
Chile	21.5	7.3	7.2	6.9	14.0	10.8
Mexico	16.9	8.5	6.4	6.0	14.3	17.1
Egypt	3.1	2.8	5.3	6.4	14.8	7.2
Morocco	8.5	5.1	6.6	8.0	8.8	4.1
Tunisia	14.7	4.0	12.5	13.7	10.2	6.1

Turkey	3.5	2.3	2.3	1.4	1.6	2.2
Cote d'Ivoire	-0.6	2.1	-29.1	10.7	3.3	1.5
Ghana	17.8	2.3	2.5	9.4	22.6	22.2
Kenya	1.3	1.2	0.5	0.2	0.3	1.7
Mauritius	4.5	2.4	1.7	1.6	1.9	1.9
Nigeria	34.9	19.8	26.3	36.5	50.5	50.0
Uganda	8.4	0.2	0.6	10.1	12.6	21.1
Tanzania	3.3	0.3	1.1	2.0	-0.4	..

Source: UNCTAD, *World Investment Report 1997*.

Hong Kong: In line with its *laissez faire* approach, the Hong Kong government did not influence the extent or form of technology imports. Its industrial and manufactured export growth was sparked off by an influx of seasoned textile and other entrepreneurs and technicians from Mainland China. This led to the growth of dynamic small and medium-sized exporters specialised in labor-intensive activities such as textiles, garments, toys and simple consumer electronics, mainly aimed at world markets. Given the initial endowment of skills and learning, they obtained the information and technologies they needed in mainly externalised forms, primarily capital goods.

The economy's colonial administration, its long experience of *entrepôt* trade, and the strong presence of expatriate-run trading, finance, property and other enterprises (the "Hongs"), strengthened the initial base of skills with an advanced physical, administrative, trading and financial infrastructure for export activity.

Despite open door policies to FDI, Hong Kong's manufacturing was dominated by indigenous firms. MNCs went mainly into service activities, while those that entered manufacturing specialised in more advanced technologies within the same broad labor-intensive set of activities as local firms. The government made no effort, at least until recently, to target high technology FDI or to induce industrial deepening and technological upgrading. Technological information needs were relatively simple, and were fulfilled by scouting international suppliers of equipment (greatly helped by the liberal trading environment and the Hongs), growing contacts with export markets, and some government technology support institutions. The presence of foreign buyers was a vital source of technological information and assistance. Over time there was significant upgrading of equipment and products within the low-technology activities that the colony started with, but there was relatively little entry into complex and research intensive technologies that the other NIEs were targeting.

Singapore: Singapore has a much smaller economy than Hong Kong's, but has deepened its industrial structure much more by deliberate knowledge strategies. It started, like Hong Kong, with a strategic location and established *entrepôt* facilities but with a smaller base of trading and financial activity. Despite a tradition of shipbuilding, Singapore had a weak entrepreneurial base and did not have an influx of experienced businessmen and technologists from mainland China. Nor did it have access to a large, poorer but culturally similar hinterland to which it could sell its services. After a spell of import substitution, it switched to free trade and pursued growth through seeking and targeting foreign direct investment, while raising domestic resources by various measures. Moreover,

it deepened its industrial and export structure by using incentives to persuade MNCs to move from labor to capital, skill and technology-intensive activities. Its knowledge policy was directed at consciously acquiring, and subsequently upgrading, the most modern technologies in highly internalised forms.

To attract foreign investment and induce upgrading, Singapore invested heavily in education and training and physical infrastructure. It developed an efficient, industrially oriented, higher education structure, along with one of the best systems in the world for specialised worker training. Its policies for attracting FDI were based on liberal entry and ownership conditions, easy access to expatriate skills, very efficient and honest administration, and generous incentives for the activities that it was seeking to promote. It set up the Economic Development Board (EDB) to co-ordinate policy, offer incentives to guide foreign investors into targeted activities, acquire and create industrial estates to attract multinational corporation, and generally to mastermind industrial policy. The public sector played an important role in launching and promoting some activities chosen by the government, acting as a catalyst to private investment or entering areas that were too risky for it to enter. In recent years the government has sought to increase linkages with local enterprises by promoting subcontracting and improving extension services.

Taiwan: Taiwan started on import-substitution in the 1950s with a strong base of human capital and a large population of SMEs. As with Korea, it switched to export orientation in the 1960s, but retained protection and targeting to promote and guide industrial growth. It combined these with interventions in technology transfer to support technology development by local enterprises. It drew upon the whole gamut of technology imports, but changed the balance and the policy regime over time. In the 1950s, it sought to attract FDI, with no discrimination by origin, destination (only services were restricted for foreign entry) or degree of ownership. In the 1960s, FDI was sought in labor-intensive industries like textiles, garments and electronics assembly. In the 1970s, with rising wages and a need to upgrade industry, the government targeted higher technology, discouraging labor-intensive FDI and favouring it in automation, informatics and precision instruments. Targeting was strengthened in the 1980s.

Thus, as the industrial sector developed and technologies deepened over time, FDI policy in Taiwan became more discriminatory. The government exercised more detailed surveillance (often on a case-by-case basis) to ensure that the technology was in line with changing national priorities. It targeted emerging technologies, and placed strict conditions on investors to benefit the technology development of domestic firms. Where domestic firms were strong, FDI was actively discouraged; where they were weak, foreign firms were made to diffuse technology and contribute to local capabilities. With yet more development of local capabilities, controls on FDI were relaxed but support of technology development continued. In the meantime, Taiwanese firms themselves became major investors overseas, spurred by the need to relocate labor-intensive activities and an enormous balance of payments surplus.

The government sought to maximise benefits from FDI for local firms by promoting local sourcing and subcontracting — an exceptionally successful strategy for enhancing technological and skill linkages with foreign firms (Dahlman and Sananikone, 1990). This involved local content rules, backed by provisions that foreign firms transfer skills and technology to subcontractors and raise the technological capabilities of local firms. The Taiwanese government also played a *direct* role in developing technologies, where it found the private sector unable to develop the necessary

capabilities. It often set up strategic research alliances on the behalf of local firms and co-ordinated their efforts to build upon these to build competitive new capabilities.

Foreign firms accounted for a relatively small part of Taiwan's industrial and export success. Local enterprises, led by SMEs, led the export drive, first by using the 'Chinese connection' in Asia and then, as their horizons widened, by tapping Japanese trading companies and American mass-market buyers. In the 1960s, about 60% of textile exports were sold through Japanese trading houses (the *sogo shosha*), and even today these handle a third to half of Taiwanese exports. Such are the economies of scale and information collection in world markets that small firms find it difficult and costly to export alone even after years of experience (this is in contrast to Korea, where the government internalised these functions within local trading houses, part of the *chaebol*). US buyers grew more important over time, with the government facilitating contacts with small suppliers, with aggressive assistance from industry associations and other private organisations. In addition, there also emerged many (relatively small) local trading houses, which proved to be valuable sources of technical, design and marketing information to exporters. Large multinational producers, that sourced complex electronic and related products under OEM (original equipment manufacture) arrangements in Taiwan, were even more significant sources of technology transfer.

Korea: Korea preferred externalised technology imports even more strongly. It relied primarily on capital goods imports, licensing and other technology transfer agreements to acquire technology (Westphal, 1990). FDI was permitted when it was the only way of obtaining the technology or gaining access to world markets. Even then the government encouraged majority Korean-owned or equal joint ventures; in some cases foreign investors were forced to sell out after the technology had been absorbed locally. As a result, Korea had the lowest level of reliance on FDI of almost any developing countries with a non-communist economy. The government also intervened often in technology imports to lower prices and strengthen the position of local buyers, but in a flexible way that did not constrain access to expensive know-how. The regime encouraged reverse engineering and R&D by technology importing firms to develop indigenous technological capabilities; many of the larger firms were later able to enter into collaborative ventures with world technology leaders on a more equal basis. In the field of plant and process engineering, the government stipulated that foreign contractors transfer their design knowledge to local firms, which quickly absorbed design technologies in some process industries.

4.2.4 Building Human Resources

Using knowledge more effectively requires higher levels of human resources within enterprises and elsewhere. Building human resources involves two distinct processes — *skill development* and *capability formation*. 'Skill development' means formal education and training (including that in firms). 'Capability formation' means the development of skills and knowledge derived from technological and managerial effort (both formal, in the form of R&D, and informal).

As the industrial sector grows more complex and sophisticated, the challenge of providing better and more appropriate human capital becomes more important. In the process, relevant institutions develop and firms become more conscious of the need for skill development and training. However, given the complexity of the information involved, the long-term nature of skill investment and the inherent externalities, purely market-driven sources may fail to keep up with skill needs. At low levels of industrial development, the way forward is relatively straightforward: raising the quantity

and quality of primary schooling and basic technical education, and encouraging all firm training. At higher levels, there has to be greater emphasis of high-level, specialized training, with close interaction between education and production. This is a more difficult process, and many developed economies worry about the quality and content of their educational structures.

Table 2 shows educational patterns in the Tigers and other countries. Formal education is not the ideal way to measure skill creation: on-the-job learning and training are often more important. Enrolment data may not be a sound indicator even of formal education: dropout rates differ across countries. Moreover, the quality and relevance of the education system for modern needs differ greatly by country. Nevertheless, enrolment data are available on a comparable basis, and the rates say something about the base for skill acquisition.

Table 2: Recent Gross Enrolment Ratios

Country	Primary	Secondary	Tertiary
	Percentage of age group		
Asia			
Hong Kong	108	..	21
Singapore (c)	107	68	19 (c)
Korea	95	99	55
Taiwan	100	88	38
China	118	55	4
Indonesia	115	45	10
Malaysia	93	61	10
Thailand	87	49	21
Philippines	111	80	27
India	103	49	6
Pakistan	69	25	3
Bangladesh	79	19	4
Sri Lanka	105	75	6
Turkey	97	64	20
Latin America			
Argentina	111	67	36
Brazil	114	46	11
Chile	99	68	27
Colombia	117	55	10
Mexico	112	58	14
Africa			
Egypt	100	80	17
Ghana	76	37	1
Kenya	91	25	2

Mauritius	106	54	4
Morocco	69	28	10
Nigeria	76	20	4
South Africa	117	82	16
Tanzania	68	5	0
Tunisia	117	43	11
Uganda	71	13	1
Zimbabwe	115	44	6
East Europe			
Czech Rep.	99	86	16
Hungary	95	81	17
Poland	98	84	22
OECD			
Japan	102	98	29
France	105	106	50
Germany	97	101	36
UK	114	94	41
USA	107	97	81
Sources: *World Development Report 1996, 1997*. UNESCO, *Statistical Yearbook 1995*.			

Primary education is almost universal in all the Tigers and new Tigers, and there is relatively little to differentiate between countries at least according to official enrolment figures. Secondary enrolment rates are very high in the Tigers, with Korea and Taiwan at developed country levels. Hong Kong and Singapore are slightly behind, followed by Malaysia, Indonesia and Thailand. However, there are reasons to differentiate between school education in terms of *quality*. Educational quality is always very difficult to judge, and the best we can do is to look at indirect proxies. In terms of dropout/completion rates, the Tigers perform far better than other countries; Sub-Saharan Africa is particularly weak in these terms, as are parts of South Asia. In terms of facilities and relevance of curricula to technical needs, the East Asians also do much better.

Korea and Taiwan have tertiary enrolments at developed country levels, followed by Hong Kong and Singapore. Singapore has very large enrolments in polytechnics, reflecting its strategy of concentrating on production-related skills for technologically advanced activities. If we include these with universities Singapore's total tertiary enrolments reach 46%, near Korean levels.

Table 3: Tertiary Enrolments in Technical Fields (most recent year)										
Country	Natural Science		Maths/Computing		Engineering		'Core' Tech. (a)		All Tech. (b)	
	Number	% pop.	Number	% pop.	Number	% pop.	Number	% pop.	Number	% pop.
Africa										
Egypt	26,602	0.04%	2,333	0.00%	44,545	0.07%	73,480	0.12%	158,111	0.26%
Ghana	1,179	0.01	227	0.00	712	0.00	2,118	0.01	3,317	0.02
Kenya	3,598	0.02	0	0.00	1,046	0.00	4,644	0.02	7,168	0.03
Mauritius	86	0.01%	130	0.01%	269	0.02%	485	0.04%	737	0.07%
Morocco	71,143	0.27%	./.	..	1,051	0.00%	72,194	0.28%	81,037	0.31%
Nigeria	29,526	0.03%	./.	..	15,085	0.01%	44,611	0.04%	63,978	0.06%
South Africa	21,693	0.07	30,498	0.10	19,958	0.06	72,149	0.23	97,729	0.32
Tanzania	180	0.00%	13	0.00%	664	0.00%	31,441	0.00%	1,096	0.00%
Tunisia	11,520	0.13%	2,213	0.03%	7,233	0.08%	20,966	0.24%	31,441	0.37%
Uganda	940	0.00%	268	0.00%	1,474	0.01%	2,682	0.01%	3,621	0.02%
Zimbabwe	1,799	0.02	399	0.00	4,718	0.04	6,916	0.06	9,271	0.08
Asia										
Bangladesh	75,503	0.07	7,523	0.01	5,830	0.01	88,856	0.08	96,793	0.09
China	95,492	0.01	174,862	0.02	1,156,735	0.10	1,427,089	0.13	1,831,966	0.16
Hong Kong	5,503	0.09%	6,441	0.11%	14,788	0.25%	26,732	0.46%	35,068	0.60%
India	869,119	0.10	./.	..	216,837	0.02	1,085,956	0.12	1,236,414	0.14
Indonesia	22,394	0.01	13,117	0.01	205,086	0.11	240,597	0.13	315,325	0.17
Korea	81,222	0.18	171,147	0.38	437,537	0.98	689,906	1.55	730,346	1.64
Malaysia	8,776	0.05	4,557	0.02	12,693	0.07	26,026	0.14	32,222	0.17
Pakistan	29,433	0.03	./.	..	41,244	0.04	70,677	0.06	75,168	0.06
Philippines	17,444	0.03	5,609	0.01	201,701	0.29	224,754	0.33	510,525	0.74
Singapore (c)	1,281	0.05	1,420	0.05	13,029	0.47	15,730	0.56	16,767	0.60
Sri Lanka	8,198	0.05	148	0.00	3,865	0.02	12,211	0.07	18,722	0.10
Taiwan	16,823	0.08	32,757	0.16	179,094	0.86	228,674	1.09	303,964	1.45
Thailand	77,098	0.14	1,292	0.00	105,149	0.19	183,539	0.32	249,952	0.44
Turkey	39,327	0.07	25,276	0.04	134,408	0.24	199,011	0.35	339,004	0.60
Latin America										
Argentina	69,727	0.21	./.	..	96,205	0.29	165,932	0.49	295,936	0.88
Brazil	46,322	0.03	92,701	0.06	149,660	0.10	288,683	0.19	487,967	0.33
Chile	8,577	0.06	./.	..	85,483	0.61	94,060	0.67	134,263	0.96
Colombia	261	0.00%	9,520	0.03%	117,941	0.35%	127,722	0.38%	185,407	0.55%
Mexico	42,457	0.05	97,575	0.01%	221,867	0.27	361,899	0.45	518,396	0.64
East Europe										
Czech Rep.	2,600	0.03	3,299	0.03	36,847	0.36	42,746	0.42	56,342	0.55
Hungary	1,766	0.02	1,588	0.02	10,614	0.10	13,968	0.14	41,718	0.41
Poland	19,047	0.05	12,819	0.03	119,912	0.31	151,778	0.40	213,761	0.56

Industrialised										
Japan	59,030	0.05	20,891	0.02	488,699	0.39	568,620	0.46	730,637	0.59
France	304,093	0.53	./.	..	50,845	0.09	354,938	0.62	614,159	1.07
Germany	310,435	0.39	./.	..	389,182	0.49	699,617	0.88	805,801	1.01
Israel	7,972	0.16	6,144	0.12	23,207	0.46	37,323	0.74	45,780	0.91
Italy	93,761	0.16	64,099	0.11	200,749	0.35	358,609	0.63	610,642	1.07
Spain	82,751	0.21	65,807	0.17	176,702	0.45	325,260	0.82	473,159	1.20
Sweden	9,076	0.10	13,452	0.16	37,324	0.43	59,852	0.69	141,258	1.63
Switzerland	11,396	0.16	2,950	0.04	22,217	0.31	36,563	0.52	57,041	0.81
UK	105,983	0.18	76,430	0.13	219,078	0.38	401,491	0.69	596,404	1.03
USA	496,415	0.19	525,067	0.20	801,126	0.31	1,822,608	0.70	3,676,985	1.41

Notes: (a) 'Core' technical subjects are natural science, math's and computing and engineering.
(b) 'All technical' subjects include core technical plus medicine, architecture, trade and crafts, and transport and communications.
(c) Singapore's tertiary enrolment figures exclude polytechnics, which enrol 27% of the age group. If these are counted as tertiary institutions, this would greatly increase all its tertiary enrolment figures.

The breakdown of *tertiary enrolments in technical subjects* is probably more relevant than general enrolment for assessing capabilities to absorb technological knowledge. The data (Table 3) show much higher differences between countries than general enrolments (note that the figures are now expressed as percentages of the total population rather than of the relevant age group). The most relevant indicator of skills related to industrial technology is enrolments in *'core' technical subjects* (natural science, mathematics, computing and engineering).

In Asia, Korea and Taiwan are now ahead of the technological leaders in the OECD, taking first and second places in the ranking. Singapore comes just after France, with Hong Kong coming two places later, after Argentina. The ranking of the Tigers matches the general intensity of their policy interventions to develop their technological capabilities. At the other extreme, Sub-Saharan Africa (except for South Africa) hovers below 0.02%, with Zimbabwe standing out at 0.06%.

4.2.5 Stimulating Technological Activity

All developing countries are highly dependent on imported technologies. However, they undertake a lot of technological activity themselves, to absorb, adapt and improve upon imported knowledge. Such activity is difficult to measure — it takes place at all levels of the firm and cannot be separated from production, engineering, quality control, procurement, design and so on — and so cannot be compared across countries. What can be compared is *formal R&D* (Table 4).

While R&D does not capture the full extent of technological activity, it is still a useful indicator of technological effort. Its relevance rises as countries mature industrially: basic technological capabilities are then more standardised, and formal R&D is a more accurate measure of differences technological effort. Note that R&D does not mean that countries are on technological frontiers: R&D can be used for absorbing and monitoring technologies as much as for 'innovating', and being a follower in innovation is a very respectable way of keeping up with new technologies.

R&D financed by industry is generally regarded a better indicator of directly productive technological effort. Korea leads the world with 2.27% of GDP, a direct consequence of its strategy of creating *chaebol* and pushing them into export markets. This R&D is highly concentrated: the 20 top spenders account for some 65% of the total. Korea is followed by Japan and the OECD technological leaders, with Taiwan as the next developing country in 11th place; unlike Korea, more than half of Taiwanese R&D is financed by the government because of the large presence of SMEs. Singapore, at 20th place, is the next developing country on the list.

R&D propensities diverge widely in the developing world, and the ranking (at least at the top) is very similar to that yielded by the skill figures. Korea and Taiwan lead the developing world, the former by a large margin, followed by Singapore and then other countries. Hong Kong does not figure in R&D, with the total only coming to 0.1% of GDP (the industry-financed figure is not available but is likely to be very low as well). At the very bottom are some large African and Asian countries (the smaller African countries do not even have R&D data). So, surprisingly, are most of the new Tigers, highlighting the very low technological content of their industrial activity. This has not held back their past export growth, but is likely to become a constraint in the future as their main competitive advantage, in low cost assembly, is challenged by newer entrants.

The most interesting lessons for technological development thus come from the *three mature Tigers*. How did they stimulate technological activity? Take them in turn.

Korea: The Korean government supported technological effort directly in several ways. Private R&D was directly promoted by a incentives and other forms of assistance. There were a number of *direct incentives*. These included tax exempt TDR (Technology Development Reserve) funds, which were subject to punitive taxes if not used within a specified period. The TDR funds could, however, be used for investment in the first venture capital fund (Korea Technology Development Corporation, launched with World Bank assistance) and in collaborative R&D with public research institutes. The government also gave tax credits for 125% of R&D expenditures as well as for upgrading human capital related to research and setting up industry research institutes, accelerated depreciation for investments in R&D facilities and a tax exemption for 10 percent of cost of relevant equipment. It reduced import duties for imported research equipment, and cut excise tax on technology-intensive products. The KTAC (Korea Technology Advancement Corporation) was set up to help firms to commercialise research results; a 6 percent tax credit or special accelerated depreciation provided further incentives.

Table 4: R&D Expenditures (by region)

Country	Year	As % GNP or GDP	Ent. Fin. RD as % GNP/GDP(a)	R&D p.c. 1995 ($) (b)	Country	Year	As % GNP or GDP	Ent. Fin. RD as % GNP/GDP(a)	R&D p.c. 1995 ($) (b)
Developing Countries					Industrial and East European Countries				
Hong Kong	1995	0.1	N/A	23.0	USA	1996	2.5	1.50	674.5
Singapore	1994	1.1	0.69	294.0	Canada	1996	1.6	0.77	310.1
Korea	1995	2.7	2.27	261.9	Japan	1995	3.0	2.01	1189.2
Taiwan	1994	1.8	1.00	198.0	Austria	1996	1.5	0.66	404.7
China	1993	0.6	0.11	3.7	Belgium	1993	1.6	1.01	395.4
Indonesia	1993	0.2	0.04	2.0	Denmark	1995	1.8	0.90	538.0
Malaysia	1992	0.4	0.17	15.6	Finland	1995	2.3	1.31	473.3
Philippines	1984	0.1	0.02	1.1	France	1995	2.3	1.13	574.8
Thailand	1991	0.2	0.02	5.5	Germany	1996	2.3	1.40	632.7
India	1995	1.1	0.14	3.7	Greece	1993	0.5	0.10	41.1
Pakistan	1990	0.3	0.00	0.8	Iceland	1996	1.5	0.48	374.3
Sri Lanka	1994	0.2	0.02	1.4	Ireland	1995	1.4	0.94	205.9
Argentina	1996	0.3	0.05	24.1	Italy	1996	1.1	0.54	209.2
Brazil	1985	0.4	0.08	14.6	Netherlands	1994	2.0	0.90	480.0
Chile	1994	0.8	0.16	38.6	Norway	1995	1.6	0.71	500.0
Colombia	1982	0.1	N/A	1.9	Portugal	1995	0.6	0.11	58.4
Mexico	1995	0.4	0.09	13.3	Spain	1996	0.8	0.32	108.6
Peru	1984	0.2	0.05	4.6	Sweden	1995	3.0	1.89	712.5
Venezuela	1992	0.5	0.00	15.1	Switzerland	1992	2.7	1.82	1097.0
Egypt	1991	1.0	N/A	6.0	UK	1995	2.1	1.01	392.7
Turkey	1995	0.4	0.12	11.1	Australia	1994	1.6	0.73	299.5
Tunisia	1992	0.3	N/A	5.5	New Zealand	1993	1.0	0.34	143.4
Israel	1990	2.1	0.82	334.3	Total OECD	1995	2.2	1.30	..
Jordan	1986	0.3	N/A	4.5	N. America	1995	2.3	1.35	..
Nigeria	1987	0.1	0.00	0.3	Czech Rep.	1995	1.2	0.76	29.4
South Africa	1991	1.0	0.50	31.6	Hungary	1995	0.8	0.34	33.0
Mauritius	1992	0.4	0.01	13.5	Poland	1995	0.7	0.22	19.5

Sources: UNESCO, *Statistical Yearbook 1995;* national sources. OECD, Main Science and Technology Indicators, 1997, 1. US N.S.F., *Science and Engineering Indicators, 1996.*

(a) R&D financed by productive enterprises (UNESCO), or by industry (OECD) as % of GNP.

(b) Last available total R&D as % of 1995 income ($) using income figures from *World Development Report 1997*.

(c)

The import of technology was promoted by further tax incentives: transfer costs of patent rights and technology import fees were tax deductible; income from technology consulting was tax-exempt; and foreign engineers were exempt from income tax. In addition, the government gave *grants* and *long term low interest loans* to participants in 'National Projects', which gave tax privileges and official funds to private and government R&D institutes to carry out these projects. The Korea Technology Development Corporation provided technology finance. However, the main stimulus to industrial R&D in Korea came less from specific incentives than from the *overall strategy* that created large firms, gave them finance and protected markets, minimised their reliance on FDI, and forced them into export markets. This is why, for instance, why Korea now has 25 times higher R&D by industry as a proportion of GDP than Mexico which has roughly the same size of manufacturing value added but has remained highly dependent on technology imports.

Taiwan: While the growth of Taiwanese R&D has some similarities to Korea, there are important structural differences. The Taiwanese government has a more arm's length relationship with industry and did not promote the growth of large private conglomerates. It started to promote the development of local R&D capabilities in the late 1950s, when its growing trade dependence reinforced the need to enhance local innovative effort to upgrade and diversify its exports. A Science and Technology Program was started in 1979, targeting energy, production automation, information science and materials science technologies for development. In 1982, biotechnology, electro-optics, hepatitis control and food technology were added to this list. The S&T Development Plan (1986-95) continued strategic technology targeting, aiming at total R&D of 2 percent of GDP for 1995; it did not quite achieve this — it reached 1.8 percent by that year.

Around half of R&D in Taiwan is financed by the government, though the contribution has come down over time. Private sector R&D has been weak relative to Korea because of the preponderance of small and medium enterprises (SMEs), which cannot afford the large minimum investments involved in much of industrial research. However, enterprise R&D has risen over time as some local firms have grown and (like Acer and Tatung) become significant multinationals. Such R&D has been encouraged over the years by a variety of incentives: provision of funds for venture capital; financing for enterprises that developed 'strategic' industrial products (of which 151 were selected in 1982 and 214 in 1987); measures to encourage product development by private firms by providing matching interest-free loans and up to 25 percent of grants for approved projects; full tax deductibility for R&D expenses, with accelerated depreciation for research equipment; special incentives for enterprises based in the Hsinchu Science Park (with government financial institutions able to invest up to 49 percent of the capital); and requiring larger firms to invest (0.5-1.5 percent of sales, depending on the activity) on R&D. The government also launched large-scale research consortia, funded jointly with industry, to develop critical products such as a new generation automobile engine, 16M DRAM and 4M SRAM chips.

Singapore: The Singapore government launched a S$2 billion five year technology plan in 1991. A number of sectors (information technology, microelectronics, electronic systems, materials technology, advanced manufacturing technology, energy and water resources, environment, biotechnology, food/agrotechnology and medical sciences) were selected for development. An R&D target of 2% of GDP by 1995 was set; as with Taiwan, however, the target was not met (in Singapore's case by a larger margin). The new science and technology plan, launched in 1997, doubled S&T expenditures, to S$4 billion over 5 years, of which 30% is directed to strategic industries picked by the government.

There are several schemes to promote R&D by the private sector. The Research Incentive Scheme for Companies (RISC) gives grants to set up 'Centres of Excellence' in strategic technologies, and is open to all companies. The R&D Assistance Scheme (RDAS) gives grants for specific product and process research that promotes enterprise competitiveness, and is also open to all companies. The Cooperative Research Program gives grants to local enterprises (at least 30% local equity) to develop their technological capabilities by working together with universities and research institutions. The National Science and Technology Board initiates research consortia to allow companies and research institutes to pool their resources for R&D, and five consortia are already in existence (on marine technology, aerospace, enterprise security architecture, digital media and advanced packaging). The Innovation Development Scheme (IDS) provides a 50 percent grant to all promising innovation projects; the latest round provided S$130 million to 90 companies, local and foreign, in April, 1997. According to the government, these schemes have succeeded in raising the share of private R&D to 65% of the total. The Singapore government also plays a catalytic role in promoting selected technologies.

4.2.6 Financing Technological Investments

This section is not concerned with financial interventions in general but with the ability to finance investments in technology development. Such ability becomes increasingly important at higher levels of economic development. At low levels of industrialization, when firms are small and using 'easy' technologies, with low capital requirements and limited possibilities of improvements, specialised technology finance is not an important consideration. Working capital covers most technology development activities (production engineering, quality improvement and productivity improvement); though even here there is a risk that sufficient financing will not be available to small firms without proper collateral. As development proceeds, the financing gap may be more serious. Enterprises need to undertake long-term and risky investments in new technologies, and new technology-based start-ups, without a track record, need to raise initial risk capital. The normal financial system is generally unable to finance such investments; large firms can cross-subsidise their R&D activity while smaller ones have to depend on internal or family sources. All the well-known capital market failures in developing countries apply with even more force to technological investments, since the capacity to assess risk and the willingness to undertake it add to the usual problems of asymmetric information and moral hazard.

Korea: Korea's policies to encourage activities and firms *via* credit allocation and subsidisation were inherent to its industrial policy from the start (World Bank, 1993). As the industrial sector matured and entered more demanding areas of technology and the government reduced the direct allocation of credit, its role in technology financing increased rather than decreased. This was also aided by the fact that the emerging 'rules of the game' made other forms of subsidies and grants to industry unacceptable, while technology financing remained a permissible form of intervention. The government provided technology financing in the form of both grants and loans (often directed and subsidised). A variety of institutions, like venture capital companies, banks, credit guarantee companies and others were used to channel funds to a variety of users in a variety of forms.

The scale of technology financing in Korea was truly impressive, though the government feels that it is still inadequate for its needs. This accounts for the constant setting up of new schemes, targeted at smaller firms and the fostering of collaboration with research institutes. The figures also indicate that there is tremendous technological dynamism in the SME sector, though the *chaebol* continue to

account for the bulk of R&D expenditures. The extent of selectivity in technological activity remains very high, with no remission in the strategy of identifying and targeting specific areas for research activity. It is not possible to evaluate how effective the various schemes have been in stimulating new research or how well the targeting has worked. Some of the financing may well have been wasteful, and university and research institute linkages with industry remain weak and could be further strengthened (Kim, 1996). However, it is likely that the schemes have generated several commercially useful technologies and led to valuable spillovers and linkages among the actors. The research institutions may also have created a lot of useful learning on research techniques that fed into private sector R&D.

Taiwan: Taiwan has also developed a comprehensive system for financing technology activity. In the early 1980s, the government felt the financial system was failing to meet the need of technology-based enterprises. It set up a capital investment fund of NT$ 800 million in 1983, which it augmented in 1991 by a second fund of NT$ 1.6 billion. By mid-1993 it had 23 venture capital companies, which had invested some NT$ 9 billion (US$ 340 million) in nearly 400 companies in high technology industries (nearly half the funds went into two activities, information and electronics).

4.2.7 Technology Infrastructure and SME Support

The technology infrastructure consists of four sets of institutions. The *MSTQ structure* (consisting of metrology, standards, testing and quality institutions) provides the basic 'language' and measures of all technological activity. Public, private and collaborative *R&D institutions* conduct basic, applied and contract research. The *university and technical college system* does basic research as well as applied work for industry. *Technical extension services* help small and medium enterprises. Some countries also have institutions to provide information on foreign sources of technology, help firms to match-make with potential technology suppliers, commercialise technologies developed in public research bodies, stimulate innovation networks and promote new entrepreneurs.

This is in addition to the physical infrastructure that supports R&D — science parks, technology cities and the like — and the institutions that provide the human capital for technology. A significant part of the knowledge infrastructure is intended to provide the 'public goods' of technological activity, such as standards, information, extension or basic research. Some fills in for the private sector until sufficient capabilities have developed to undertake the activity. And some substitutes for private services. In general, these institutions are a country's 'antenna' on knowledge creation in the world, monitoring trends, translating them to practical local use, training people in their use, creating new technologies and diffusing information to enterprises and researchers.

Unfortunately, the reality of public technology institutions in developing countries tends to be very different. Many institutions do not support productive technological activity. Research bodies are generally delinked from the sectors they are to serve, doing basic research of poor quality and no practical use. Many are out of touch with international trends, have outdated equipment and libraries and employ underpaid, badly managed and unmotivated personnel. Even service providers like extension or quality bodies tend to be badly staffed and managed, and do little to help their prospective clients. Universities do little research, and cannot link what they do to what enterprises need. As a consequence, in most developing countries enterprises have little regard, and even less time, for public sector technology institutions or universities. Nevertheless, the need for good

knowledge infrastructure is undeniable. The technological leaders in Asia have invested heavily in improving their infrastructure institutions, as the following examples illustrate.

Korea: The Korean government set up a large array of technology infrastructure institutions. In 1966 it launched KIST (Korea Institute of Science and Technology) to conduct applied research for industry. In early years, KIST focused on solving problems of technology transfer and absorption. In the 1970s, the government set up other specialised research institutes related to machinery, metals, electronics, nuclear energy, resources, chemicals, telecommunications, standards, shipbuilding, marine sciences, and so on. These were largely spun off from KIST, and by the end of the decade there were 16 public R&D institutions. In 1981 the government decided to reduce their number and rationalise their operations. The existing institutes were merged into 9 under the supervision of the Ministry of Science and Technology. KIST was merged with KAIS (Korea Advanced Institute of Science) to become KAIST, but was separated again — as KIST — in 1989.

The government's strategic thrust in this sphere was mainly a series of *National R&D Projects* launched in 1982. These were large-scale projects regarded as too risky for industry to tackle alone but considered in the country's 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 set up to boost long-term competitiveness in these fields. National Projects were a continuation of policies to identify and develop Korea's dynamic comparative advantage, orchestrating the different actors involved, underwriting a part of the risks, providing large financial grants, and filling in gaps that the market could not remedy.

Since the early 1980s a number of laws were passed to *promote SMEs*, leading to a perceptible rise in their share of economic activity (over 1975-86 the share of SMEs in employment, sales and value added rose by at least 25 per cent). This policy support was crucial to the reversal in their performance: it covered SME start-up, productivity improvement, technology development and export promotion. A host of tax incentives was provided to firms participating in these programs, as well as finance at subsidised rates for using support services, credit guarantees, government procurement and the setting up of a specialised bank to finance SMEs. A number of other institutions were set up to help SMEs (such as the Small and Medium Industry Promotion Corporation to provide financial, technical and training assistance and the Industrial Development Bank to provide finance). The government greatly increased its own budget contribution to the program, though SMEs had to pay a part of the costs of most services provided to them.

To promote subcontracting to SMEs, the government enacted a law designating parts and components that had to be procured through them and not made in-house by large firms. By 1987 about 1200 items were so designated, involving 337 principal firms and some 2200 subcontractors, mainly in the machinery, electrical, electronic and shipbuilding fields. By this time, subcontracting accounted for about 43% of manufacturing output and 65-77% of the output values of the electrical, transport equipment and other machinery industries. Generous financial and fiscal support was provided to subcontracting SMEs to support their operations and technology. Subcontracting SMEs were exempted from stamp tax and were granted tax deductions for a certain percentage of their investments in laboratory/inspection equipment and for all their expenses on technical consultancy. Subcontracting promotion councils were set up by industry and within the Korea Federation of Small Business to help SME contracting, arbitrate disputes and monitor contract implementation.

Taiwan: Taiwan's technology infrastructure for supporting its SMEs is comprehensive and well funded. In 1981, the government set up the Medium and Small Business Administration to support SME development and co-ordinate the several agencies that provided financial, management, accounting, technological and marketing assistance to SMEs. Financial assistance was provided by the Taiwan Medium Business Bank, the Bank of Taiwan, the Small and Medium Business Credit Guarantee Fund, and the Small Business Integrated Assistance Center. Management and technology assistance was provided by the China Productivity Center, the Industrial Technology Research Institute (ITRI) and a number of industrial technology centers (for metal industry, textiles, biotechnology, food, and information). The government covered up to 50-70 percent of consultation fees for management and technical consultancy services for SMEs. The Medium and Small Business Administration established a fund for SME promotion of NT$ 10 billion. The "Center-Satellite Factory Promotion Program" integrated smaller factories around a principal one, supported by vendor assistance and productivity raising efforts. By 1989 there were 60 networks with 1,186 satellite factories in operation, mainly in the electronics industry.

Several technology research institutes support R&D in the private sector. The *China Textile Research Center,* set up in 1959 to inspect exports, was expanded to include training, quality systems, technology development and directly acquiring foreign technology. The *Metal Industries Development Center* was set up in 1963 to work on practical development, testing and quality control work in metal-working industries. It later established a CAD/CAM center to provide training and software to firms in this industry. The *Precision Instrument Development Center* fabricated instruments and promoted the instrument manufacturing industry, and later moved into advanced areas like vacuum and electro-optics technology.

The most important center was the *Industrial Technology Research Institute* (ITRI). ITRI conducted R&D for technology projects considered too risky by the private sector. It had seven laboratories, dealing with chemicals, mechanical industries, electronics, energy and mining, materials research, measurement standards and electro-optics, but electronics was the institute's principal focus, with its Electronics Research & Service (ERSO) division accounting for two-thirds of the Institute's $450 million budget. ERSO has spun off laboratories as private companies including United Microelectronics Corporation (UMC) in 1979 and Taiwan Semiconductor Manufacturing Company (TSMC) in 1986, Taiwan's most successful integrated circuit makers. The Institute for the Information Industry (III) was set up to complement ITRI's work on hardware by developing and introducing software technology.

The government also occasionally played a lead role in importing very advanced technologies. It entered into a joint venture with Philips to set up the Taiwan Semiconductor Manufacturing Company, the first wafer fabrication plant in the country (today one of the leaders in the world). The government strongly encouraged industry to contract research to universities, and half of the National Science Council's research grants (about $200 million per year) provided matching funds to industry for such contracts. The Program for the Promotion of Technology Transfer maintained close contact with foreign firms with leading-edge technologies in order to facilitate the transfer of those technologies to Taiwan.

The *China Productivity Center* (CPC) promoted automation in industry to cope with rising wages and increasing needs for precision and quality. The CPC sent out teams of engineers to visit plants throughout the country and demonstrate the best means of automation and solve relevant technical problems, at the rate of approximately 500 visits making some 2000 suggestions per year. CPC also carried out more than 500 research projects on improving production efficiency and linked enterprises to research centers to solve more complex technical problems. The government set up a science town 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.

Singapore: Singapore is renowned for its infrastructure in technology as well as in other fields. Here we consider only its support for SMEs. In 1962 the Economic Development Board (EDB) launched a program to help SMEs modernise their equipment with funds provided by the UNDP. In the mid-1970s several other schemes for financial assistance were added; of these, the most significant was the Small Industries Finance Scheme to encourage technological upgrading. The 1985 recession induced the government to launch stronger measures, and the Venture Capital Fund was set up to help SMEs acquire capital through low interest loans and equity. A Small Enterprises Bureau was established in 1986 to act as a one-stop consultancy agency; this helped SMEs with management and training, finance and grants, and co-ordinating assistance from other agencies. In 1987, a US$ 519 m. scheme was launched to cover eight programs to help SMEs, including product development assistance, technical assistance to import foreign consultancy, venture capital to help technology start-ups, robot leasing, training, and technology tie-ups with foreign companies.

In addition, the Singapore Institute of Standards and Industrial Research (SISIR) disseminated technology to SMEs, and helped their exports by providing information on foreign technical requirements and how to meet them. The National Productivity Board provided management advice and consultancy to SMEs. The Technology Development Centre helped local firms to identify their technology requirements and purchase technologies; it also designed technology-upgrading strategies. Since its foundation in 1989, the TDC provided over 130 firms with various forms of technical assistance. It also administered the Small Industry Technical Assistance Scheme (SITAS) and Product Development Assistance Scheme to help firms develop their design and development capabilities. It gave grants of over $1 million for 29 SITAS in the past 5 years, mainly to local enterprises. Its earnings have risen to a level where its cost-recoverable activities are self financing.

The EDB encouraged subcontracting to local firms through its Local Industries Upgrading Program (LIUP), under which MNCs were encouraged to source components locally by ‘adopting’ particular SMEs as subcontractors. In return for a commitment by the MNCs to provide on the job training and technical assistance to subcontractors, the government provided a package of assistance to the latter, including cost sharing grants and loans for the purchase of equipment or consultancy and the provision of training. By end-1990, 27 MNCs and 116 SMEs had joined this program. Over 1976-88, the total value of financial assistance by the Singapore government to SMEs amounted to S$ 1.5 billion, of which 88% was in the Small Industries Financing Scheme. Grants of various kinds amounted to S$23.4 m. and the Skills Development Fund for S$48.6 m.

4.2.8 Export Promotion

New exporters, especially smaller ones, invariably face high costs in obtaining information on export markets: a major barrier to the development of competitive capabilities. The Tigers have invested heavily in overcoming this deficiency.

In *Korea*, in particular, the promotion system became a compelling means of forcing firms into export activity. Exports targets were set at the industry, product and firm levels (Rhee *et al.*, 1984) by firms and industry associations in concert with the government. There were monthly meetings between top government officials (chaired by the President) and leading exporters. Targets were also enforced by denying access to subsidised credit and import licences to poor performers, and subjecting them to severe tax audits. Successful exporters were given continued access to credit and licenses, and rewarded with perfunctory audits, publicity and prizes. Bureaucrats were also held responsible for meeting export targets in their respective industries, and had to keep in close touch with enterprises and markets. There regular studies of each major export industry, with information on world market conditions, competitors, technological trends, and so on. The selectivity of these promotion measures mirrored those used to promote infant industries.

Korea set up trading houses (owned by the *chaebol*) on the Japanese model, with preferential loans from the government for stocking products and preferential ceilings on foreign exchange holdings overseas. By 1976 there were 11 general trading houses that met the criteria set in terms of export volumes, paid-up capital and number of overseas branches. By 1982 they accounted for about half of Korean exports, with an average of 23 offices overseas (Rhee *et al.*, 1984, p. 53). The initial heavy reliance on foreign buyers was reduced as local marketing capabilities were built up. Today, the *chaebol* have a massive international presence in practically all foreign markets and are investing enormous sums in building up an 'image'.[2]

Taiwanese exporters were given preferential tax treatment and access to credit on favourable terms (above). According to Wade (1990), they were encouraged to form cartels and provided with quality assistance, marketing information and prizes. Local enterprises, predominantly SMEs, led the export drive, first by using the "Chinese connection" in Asia and then, as their horizons widened, by tapping Japanese trading companies and American mass-market buyers. In the 1960s, about 60% of textile exports were sold through Japanese *sogo shosha*, and even today these companies handle a third to half of Taiwanese exports. US buyers grew more important over time, with the government facilitating contacts with small suppliers, with aggressive assistance from industry associations and other private organisations. In addition, there also emerged large numbers of relatively small local trading houses, which proved valuable sources of technical, design and marketing information to Taiwanese exporters.In general, however, there was considerably less selectivity in promoting exports in Taiwan than in Korea; in particular, there was no targeting of specific products, industries or firms. While the Taiwanese government gave strong general incentive for its firms to go multinational and relocate uncompetitive facilities overseas, these were more functional than selective in nature.

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[2] At the same time, the *chaebol* used their technological strengths to sell OEM products (mainly in the electronics industry) to the world's leading innovative MNCs. OEM contracts proved a valuable means of accessing new technology, in particular the tacit knowledge that was difficult and costly to replicate locally.

An important institutional tool in all the Tigers was the establishment of *trade promotion centres*. The Hong Kong Trade Development Council is highly regarded for its 'matchmaking' between foreign buyers and exporters. Taiwan's China External Trade Development Council (CETDC) is, however, perhaps the most effective. The Singapore Trade Development Board (SRDB) started later and was doing extremely well within five years; again, its scope is fairly limited because over 80 per cent of manufactured exports are from MNC affiliates that do not need such assistance. The Korean Trade Promotion Council (KOTRA) was modelled upon the Japan External Trade Research Organisation; it is regarded as less effective than its Hong Kong and Taiwanese counterparts. Most Korean exports are handled by its giant trading companies that buy from smaller enterprises, or else emanate directly from the *chaebol*.

The main contribution of these organisations has been to help SMEs establish contacts with foreign buyers and break directly into new markets. They are highly skilled and professional. For instance, in the first three organisations "most of the officials …. come from overseas-Chinese communities that are business-oriented in the extreme and highly sophisticated in international trade. Many of their higher officials have MBAs, postgraduate degrees in practical fields such as engineering or design, or substantial previous business experience. Most have degrees from first-rate universities. Each gives its staff excellent training".[3] All four have large computerised information bases, and actively help enterprises in establishing contact, participating in trade fairs and missions, conducting research and often providing industrial and packaging assistance.

5. Limitations to Selective Industrial and Trade Policies

5.1 Limitations to Selective Interventions

While it is easy to establish a theoretical case for interventions to promote industry, and to show that it was effective in some countries, this does not prove that it will work in practice in all countries. It is vital to bear in mind the risk of *government failure*. The history of development is replete with failed policies; the current liberalisation is partly a reflection of such failure. By the same token, the failure of *some* interventions does not mean that *all* interventions are undesirable. As long as market failures exist, wholesale reliance on free markets has costs, and it may be desirable to see how government failures can be overcome. Any industrial policy must include a consideration of which interventions suit its government capabilities and how such capabilities can be improved. The main *constraints to selective policies* are as follows.

Lack of Clarity of Objectives: Governments often have unclear or conflicting objectives in their economic and trade policies, making it difficult to implement interventions that call for a strong, unambiguous pursuit of efficiency. 'Leaving it to the market' has the advantage that is imposes a clear set of priorities on policy makers and is easily understood by the actors. Clarity of objectives is

[3] Keesing (1988), pp. 9-10. Most institutions have substantial government financial support. The Singapore agency is fully funded by the government. The Korean one gets 70% of its funds from the government, the remainder from a levy on imports. That in Hong Kong is financed by an *ad valorem* levy on domestic exports and imports. The Taiwanese agency is funded by a fixed donation by exporters based on the value of exports. KOTRA had a staff of 933 in 1988, STDB of 350, HKTDC of 650 and CETDC of over 600.

a matter of political leadership rather than economic analysis, and its nature varies with the country's political system and over time.[4]

Information problems: A government using industrial policy needs information on technologies, markets, local capabilities and institutions. The failures that afflict markets in optimising resource allocation also affect governments. The government may not have access to better information than firms; in fact, at the detailed level of products, markets and technologies it is very unlikely to do so. However, the government is better placed than individual agents to tackle co-*ordination problems and externalities* (Stiglitz, 1994). Moreover, it is possible to over-stress information problems involved in 'picking winners' at the industry level. Neoclassical economists, in their quest for unique equilibrium solutions, cannot conceive how governments can ever optimise (overlooking the problems that private agents face in this respect). The issue facing governments is not, however, to solve a gigantic optimisation problem. Given the possibilities of multiple equilibria, they have to decide upon *which path* they set the economy upon, not to calculate in detail the costs and benefits of different outcomes. Stiglitz (1966) notes "Good decision-making by the government necessarily involves making mistakes: a policy that supported only sure winners would have taken no risks. The relatively few mistakes speak well of the government's ability to pick winners" (p.162).

Developing countries choose technologies that are established elsewhere and, with some effort, they can obtain full information on the parameters involved. This is much easier than picking winners at the frontiers of innovation, the problem in advanced industrial countries. It does not matter very much which particular activity countries choose to promote between a reasonable range of technological choices. A coherent and integrated series of interventions can *create winners*, just what the interventionist Tigers did. Each defined a set of favoured activities (within a strategic framework), then mobilised factor and product markets with appropriate interventions to guide enterprises and industries. To offset some dangers of intervention, they imposed export discipline. Mistakes were made, as with private investments, but flexible and rapid response ensured that the costs were kept down.

This does not mean that *any* set of activities would have worked equally well. The choices have, as noted, to be 'reasonable', but what does this mean? Given the incremental and cumulative nature of technological learning, the activities had to rely on the existing base of skills and capabilities and the rate at which these could be increased. The technologies developed had to have commercial applications, and the private sector that was to use them had to have the financial wherewithal to mount the necessary investments. The main demands were organisational rather than informational. The mistake of import substituting governments was to ignore efficiency and international markets, and to assume away capability problems. In effect, they believed that the necessary capabilities existed within the country, or would be created automatically and without extra cost.

[4] The Tigers had different degrees and types of government commitment. For instance, Korea, with its tight government-*chaebol* nexus, was very different from Taiwan, where relations between government and business were much more arm's length. Over time, tensions developed between the Korean government and the *chaebol*, especially in the 1980s as the government started to reduce its direct interventions and the *chaebol* felt they could do better without such interventions. However, what was common to all successful industrial policy was the commitment to achieving dynamic competitiveness: it was the realisation of this commitment that varied.

The best guide to the design of economic strategies is the experience of countries further along the road of industrial development that pursued successful policies. Of course, the particular model chosen has to suit the political and social conditions of the country: many governments firmly believe in market oriented policies and may not wish to emulate the Korean strategy. Many may wish to do so but lack the political economy to direct and control enterprises: Taiwan is a more useful model for them. For those that believe in liberal trade policies and openness to FDI, the best model is Singapore.

Skills: Industrial policy is very demanding of the technical and administrative skills in short supply in most developing countries. Of course, the need for skills is not uniform, and depends on the level of industrial development and the degree of selectivity aimed for. The more advanced the industrial base and the more adventurous the strategy, the higher the levels of skills involved. In countries with small and simple industrial activities, the strategies can be devised far more easily and their implementation may need a smaller range of technical skills. The degree of selectivity must be geared to the capabilities of the bureaucracy and the pace at which it can be improved. Note that strong administrative capabilities are not required only for selective strategies; they are just as important for market friendly policies to provide education, manage competition policy, collect and allocate revenues and so on. Government skills are not given in perpetuity. Improved training, selection, salaries, promotion and incentives can improve them. The social status of the civil service is a determinant of its confidence and ability to liaise with the private sector.

Agency Problems: Policy makers have to devise suitable incentives and monitoring mechanisms to ensure that the 'contract' between them and agents (mainly in the private sector) is enforced. The Tigers did this in different ways: the most important and common one was export performance as a monitoring and allocation device ('creating contests'), but there were others. Banks acted as agents of monitoring export policy. Regular meetings between industry and government permitted the inter-flow of information, backed by detailed industry and strategy studies. Close contact between the bureaucracy and industry was promoted, with personnel moving between the two. Korea's promotion of the *chaebol* allowed the government to limit the number of agents, and to use them as interlocutors with the rest of the industrial sector. Industry associations also acted as interlocutors. They also ensured close co-ordination with the private sector (World Bank, 1993).

Inflexibility: Many interventions turn out to be costly not so much because they are poorly designed (private business makes huge mistakes all the time) but because changing course is difficult for governments and there is little accountability for the outcome. Clearly, all interventions have to be designed flexibly and monitored constantly so that mistakes can be rectified as they appear. There are precedents in the corporate sector on how this can be done, but the use of export performance is perhaps the best way to monitor export policies.

Sectional interests: While the 'hijacking' of policies by sectional interests is a danger in most countries, regardless of the nature of policies, the danger is greater where the government has selective as opposed to functional interventions. Strong leadership and institutions, and internal checks on the allocation of favours, can offset this. That national interests can indeed dominate sectional interests is illustrated by the Asian experience.

Corruption: There may be several levels of official corruption: the higher the level the more difficult it is to solve. At lower levels, changes in monitoring, employment conditions, salaries and incentives

may help reduce rampant corruption. At the top levels, however, if there is no one able to impose sanctions on wrong-doers and there is no genuine commitment to economic development, there is really no way of mounting selective, or indeed any useful development, policies. Venality at the top will also tend to breed and condone that lower down the scale, and it follows that the greater the risk of corruption the less selectivity should be exercised.

In general, the lower the capabilities, accountability and commitment of the government, the lower the degree of selectivity that it can safely be entrusted with. The lower the level of selectivity, the lower also the risks involved as well as the payoff in transforming the competitive structure. If a rational choice of strategy differentiated by country were possible, the optimal one would take into account present and future government capabilities. *Unfortunately, governments do not choose strategies on a realistic assessment of their capabilities and limitations.* External advisors or analysts may be able to provide such an assessment, but there is little guarantee that a government will base its strategy on such advice.

5.2 Changing Environment for Policy

Developing countries are faced with a world in which industrial policy faces more limitations than at the time the Asian Tigers mounted their interventions. Four factors affect this, two to do with the changing economic reality and two with the policy framework adopted by national governments or imposed upon them by the international 'rules of the game'. They are taken in turn.

Accelerating Technical Change: So rapid and sweeping is technical change that analysts see the emergence of a new 'technological paradigm' (Freeman and Perez, 1988). New technologies are highly intensive in the use of information: new IT skills and the ability to network are among the most important determinants of success. Innovation is changing the nature of knowledge and product flows across countries (flows of people remain more limited and controlled), with rapid and often striking changes in national comparative advantages. Transport and communications costs are falling, and a growing portion of knowledge is available *via* the Internet at negligible cost. Part of the flow of information is in the private domain, within companies or closed networks; a great deal is publicly available, at least to those with equipment and skills to tap it.

Thus, today's world is different from that when the strategies described above were formulated. Rapid technical change reduces the scope for, and raises the risks of, some forms of industrial policy: isolation from rapidly moving technologies may hold back the development of competitive capabilities and make targeting more difficult. At the same time, however, there is greater need to build the (more advanced) capabilities to absorb new technologies. Free market forces are not conducive to costly and prolonged learning processes, and simply exposing a developing economy to trade and investment may not take it much beyond the exploitation of static skills and low wages.

Globalization of production: Technical change and globalization are reflections of the same phenomenon. The pace and rising costs of innovation make it necessary to sell to world markets and to set up global production and distribution structures, while falling transport and communication costs and new organisational techniques make this more feasible. MNCs are increasingly integrated production structures across countries (within their own networks as well as between themselves and independent firms) and rationalising supply and distribution structures. This is leading in many countries to export specialisation in narrow industrial activities geared to MNC needs. MNCs

themselves increasingly dominate trade, so that their participation becomes essential for certain kinds of export dynamism.

However, as noted, globalization is a *highly uneven process*. Market driven trade and investment are not leading to an equitable distribution of the benefits of new technology. The spread of underlying comparative advantages is even less equitable. Innovation continues to be the preserve of a handful of countries; within them the process is concentrated in a relatively few large enterprises. While the main innovators are the large multinationals, the engines of globalization, their foreign investment activity does not lead the knowledge *base* to be more widely diffused. The technology that MNCs deploy in any location depends on the ability of that location to absorb that knowledge — to provide the 'immobile elements' (UNCTAD, 1999). Those with low capabilities receive the simplest operational know-how, with the danger that their competitive base remains static. Those with high capabilities receive more advanced forms (in some cases the R&D process itself) and the base advances over time in interaction with MNC activity. There *is* new entry from developing countries, but from a small number led by the Tigers analysed here. The majority of developing countries remain on the periphery, facing the risk of increasing marginalisation.

As with technical change, globalisation renders some past industrial policy instruments less useful or most risky and costly. For instance, the exclusion of FDI is less feasible as a means of boosting domestic technologies: few countries have the ability to match international innovation on their own. The same applies to exporting scale-intensive products like automobiles or high technology ones like electronics: few developing countries have domestic enterprises with the ability to mount export drives to match MNC integrated production networks. The ability to impose conditions on MNCs is also more limited, as more countries seek FDI. Even the independence of MNC affiliates from parent companies is circumscribed by tighter organisational and information controls.

However, this does not imply the need for a *laissez faire* policy in investment or capability building. As rational profit-making enterprises, MNCs exploit existing rather than potential competitive advantages in host countries – it is up to the countries to improve their advantages by raising skills and capabilities. Many simple manufacturing activities are not undertaken by MNCs, and their affiliates also need a strong base of local suppliers to boost local content: both need policies to promote domestic enterprises. In fact, the stronger the domestic enterprise base, the higher the 'quality' of inward FDI and its spillover benefits. Then, as the Singapore example shows, attracting FDI into high value activities needs targeting and intervention. Thus, a strong role of government remains in a globalising world, in some respects stronger than before.

Policy liberalization: The most direct influence on industrial policy is the widespread move to liberalisation. Practically developing countries are reducing trade and investment barriers, willingly or under pressure from the Bretton Woods institutions, aid donors and, increasingly, the WTO (below). The forces driving liberalization are partly ideological in nature, but they also reflect disillusionment with import substituting, state-ownership strategies. Many effects of liberalization have been beneficial. Existing comparative advantages that were held back by inefficient controls are now better exploited. Increased competition has forced enterprises to raise efficiency or die out. Improved resource allocation between enterprises and activities has sometimes promoted growth and investment. The more open access to information has not only raised the flow of productive knowledge but also raised awareness of the need for policy reform.

At the same time, liberalization is damaging industry in many countries. The case of SSA is the most striking (Lall, ed., 1999), but there are examples elsewhere, particularly in Latin America. Even where enterprises survive and upgrade production technology, there are instances of lower technological effort as they become more dependent on imported know-how. This holds back their technological deepening and affects their longer-term competitiveness in complex activities. Most important, the renunciation of trade interventions takes away the most powerful tool for promoting new activities and developing infant industries. The theoretical basis for liberalization is weak (Lall and Latsch, 1998), unable to support the massive superstructure of neoliberal policy built upon it.

New rules of the game: Policy liberalisation within developing countries is shaped, forced and reinforced, by the 'rules of the game'. These are the rules, procedures and norms embodied in international trade and investment agreements; the arbiters are the donors, along with international institutions like the IMF, WTO and World Bank. These rules narrow further the role of government in economic life, and subject economies to competition and globalization more strongly (though advanced countries are able to manipulate the rules better than others). Under the WTO, they acquire greater force, since the rules now have sanctions to back them up. The rules are spreading to FDI, local content, government procurement, intellectual property rights, and services: under present trends, they will impose a 'level playing field' on all participating countries. If the level playing field restrains the development of national capabilities, the new rules will increase the dominance of the strong and hold back the weak. This seems to accord with current trends.

To sum up, liberalisation, technical change and globalization mean that countries are faced with much stronger technological and competitive challenge than before. In theory, the new forces encourage and facilitate learning. They increase the efficiency with which knowledge is transmitted across countries, and remove many of the policies that cut countries off from information flows and distorted the incentives to utilise them. The exploitation of new technologies is undertaken with increasing rapidity in different locations, by MNCs or by local firms. Level playing fields remove information barriers and lower transaction costs to enterprises. The same trends make it more difficult to mount industrial policy, partly for economic reasons and partly for political ones. They raise the speed of technical change, the quantity of information available and the breadth and depth of skills and institutions needed to cope. If countries are thrust into this without the ability to cope, and *without the tools to build that ability*, they will remain beggars at the technological feast. In fact, they will be more marginal than before, since rapid exposure to competition would devastate their fledgling industrial sectors and destroy the small base of capabilities.

6. Industrial Policy in Africa

The poor performance of African manufacturing industry is well documented (see, for instance, Lall and Wangwe, 1998) The structure of manufacturing is backward, dominated by the (minimal) processing of natural resources and by simple consumer goods industries. Import liberalization (with competition largely from other developing countries) is devastating exposed industries, including the simple ones that led export growth in Asia. Despite low wages and welcoming policies on FDI, there is little sign of resources flowing into new, export-oriented manufacturing activities. Apart from primary resources, linkages of large firms with local suppliers remain minimal and superficial. Technological efficiency and dynamism remain low. In many cases manufacturing has been a drag on, rather than engine for, economic growth and structural transformation. Governments *have* intervened to promote industry, but with these abysmal results. Much has been written about the

failure of government in Africa (for comprehensive surveys see Soludo, 1997, 1998), and on drawing lessons from the Asian Tigers (Stein, 1995).

Part of the explanation for poor industrial performance in SSA lies in exogenous shocks: droughts, wars, internal conflict, political instability, adverse terms of trade and so on. Bad macroeconomic management, debt, inflation and uncertainty also played important roles. So did policies affecting industry: enforced public ownership, nationalisation, price controls, infrastructure lags and so on. All these taken into account, there is still a considerable part that is due to *poor industrial policy*: mistakes in trade, domestic competition and ownership policies, wrong interventions in technology transfer and development, weak human capital creation and neglect of institutional support. But *why* did industrial policies have such poor effects? Part of the reason lies in structural features and part in the design and implementation of policies.

Structural factors: The structural factors that deterred industrial development include the small size and fragmentation of local and regional markets, poor infrastructure, low entrepreneurial base and weak human, particularly technical, capital (with gaps with other regions rising over time).

Policy factors: These include

- Poor information and capabilities on the part of policy makers, neglect of lessons from other regions, insufficient data, inability to withstand analytical pressure from outside agencies and experts, weak negotiation in and preparation for WTO membership and so on
- Lack of clear industrial policy objectives, conflicts with other objectives
- Excessive and prolonged protection not offset by export promotion measures or pressures that would provide incentives for learning and upgrading
- Inadequate domestic competition policies to stimulate technological upgrading, permit the entry of dynamic new enterprises and enforce competitive behaviour
- Lack of coherence between product and factor market policies, such as education and training, technology support, capital markets and export promotion
- Inability to target and attract FDI into efficient manufacturing and facilitate the upgrading
- Weak, often non-existent, institutional structure for supporting capability development: training institutions, effective quality and standards bodies, R&D support and SME extension services; practically no linkages between institutions that do exist and the industrial sector
- Lack of involvement of industrialists in policy design and implementation
- No monitoring of industrial policy and its effects, no flexibility in adapting policies to changing world market and technological conditions
- Weak legal structures to facilitate property rights and contract, dispute resolution and so on
- Widespread and constant political intervention, corruption at all levels, lack of commitment and infighting by bureaucrats and leaders.

7. The Way Forward

What is the way forward for industrial policy in Africa? Most countries are already committed to liberalization and options have to be considered in this context. The base of technological capabilities in Africa (what remains of it) is weak. The liberalisation process is rapid and not guided by a strategy. There is little attempt to gear the opening up to the learning needs of different activities. Support policies are virtually non-existent; on the contrary, the institutions that can assist the adjustment process are weak and isolated from industry. This places the entire burden of adjustment

on firms that lack the knowledge, resources and skills to upgrade to international levels. Clearly industrial policy is necessary but in a new form.

The scope for industrial policy left under the new rules remains a grey area. Much may depend on the skills of the government concerned in designing measures that are permitted or camouflaging ones that are not. It also necessary to build strong government capabilities to deal with trade disputes in the WTO; all major exporting countries are now engaged (voluntarily or otherwise) in constant battles with importers or competitors on detailed, technical matters that can have important repercussions on their export and import performance. Countries that fail to develop the legal and economic expertise to cope with these disputes risk losing competitive advantage.

In any case, the new rules do not completely rule out industrial policies. The opening up is more complete in some countries than in others, and there is still scope to alter the pace and content of the opening up. Most countries have a grace period before they have to fully liberalise trade and investment. Depending on the WTO terms agreed upon, they might be able to further prolong the period or seek exceptions for particular industries or in particular periods. Measures such as export subsidies, local content rules, new quantitative restrictions on trade, discrimination against investors by origin are very difficult or impossible to launch now: the only flexibility remains on how quickly and uniformly they are phased out. For Sub-Saharan Africa, therefore, the *management of the liberalisation process* that offers one potential avenue for the exercise of industrial policy over the medium term. The other, considered below, is supply side policies of the type being increasingly used in industrial countries as part of competitiveness strategy.

The TC approach suggests the need for *gradualism* in the liberalisation process. It proposes the removal of high, sustained and indiscriminate protection and other barriers to competition. These distort the incentive structure and curtail or distort the process of capability building. However, the introduction of competition has to be subject to the time and resource needs of learning. Firms brought up in a protected environment have to relearn competitive capabilities, and this calls for clear signals on liberalization along with supporting measures in factor markets. The provision of these measures is a complex task, involving active government policies and guidance.[5] It has to be undertaken with a strategy, within a time-bound program and with the final objective of becoming fully competitive.

Asia offers lessons in liberalization as well as intervention. Korea, for instance, started to liberalise in the 1980s in a gradual manner, retaining considerable control over resource allocation during the process. It accompanied opening up with a strategy of restructuring and upgrading, rather than a rapid, indiscriminate and sweeping exposure to international market forces. The speed of liberalisation was based on a realistic, detailed and differentiated assessment of which activities were viable in the medium term, with the process geared to the learning and 'relearning' needs of various activities. At the same time, there were strong pressures on industries to invest in building up new capabilities to face import competition within a limited period. *It was designed to overcome market failures, not to ignore them.* It involved close monitoring of the progress of liberalisation, and it requires that the government is able to address the supply side needs of industries along with allowing a phased process of liberalisation. The strategy was developed in collaboration with the

[5] Interestingly, the case for infant industry protection is accepted by the World Bank study by Biggs *et al.*(1995), while the World Bank's 1994 report on adjustment does not mention this critical need.

industrial sector, and pre-announced so that enterprises had time to adjust. Once announced, however, governments were able to stick to the programme to minimise backsliding and 'hijacking' by inefficient performers.

This is clearly a better strategy of adjustment for African countries than the adjustment they are now undertaking. Note that to recommend a gradual and nuanced strategy of liberalisation is *not* to suggest that the sample countries simply abort the adjustment process. What is needed is not to delay the adjustment and then do little else, but to *actively prepare for it* in the grace period provided. Even with well-designed adjustment policies, the outcome cannot be expected to be the same as that of East Asia, since the initial conditions, capabilities, market size, location and infrastructures are very different.

Government capabilities have to be greatly improved (with information, training, better incentives and greater insulation from the political process) to make gradual liberalisation work effectively. In contrast to the neoclassical position that the removal of governments restores economic efficiency, it is the strengthening of governments that is needed to make markets work properly. The most difficult part of an effective industrial policy is perhaps to *design* a coherent strategy. Most governments are not geared to this. Decisions affecting industrial development and competitiveness are scattered over an array of ministries and institutions: finance, trade, industry, labour, education, science and technology. These often have different objectives and communicate poorly, if at all, with each other. The first step is to set up an agency that can mount a strategy cutting across competing interests and using the resources of each ministry to further national aims. Something like a high-powered '*Industrial Development Council'*, headed by a Cabinet minister and reporting directly to the head of government (who must be genuinely committed to industrial development), is an essential prerequisite.

Then comes the issue of *which activities* need to be specially promoted as engines of dynamic comparative advantage. This is ultimately a matter of informed judgement. Existing export activities have to be divided between those that need special efforts to be promoted and those doing well as they are. Among the former a distinction has be made between those which do not have a viable future ('sunset' industries) and those that do; the former should treated with benign neglect. Labour-intensive activities like garments are not necessarily sunset industries, even though many East Asian countries are treating them as such. The Italian example shows how well exports can be expanded in a low technology, labour-intensive activity, as long as quality, design and flexibility can be raised sufficiently. This type of upgrading has to be a vital part of export strategy, not just picking new winners in high-tech activities. The selection has to be based on the current base of capabilities, the example of other countries, feasible rates of improvement in domestic factor markets and the expected evolution of demand.

In the absence of trade interventions and subsidies, how are these activities to be promoted? Governments have to rely mainly on *supply side support* to selected activities. This can involve attracting FDI to targeted activities, with incentives for higher value added technologies, and building the skill, technology support and supplier base needed for foreign investors. It must also involve similar measures to strengthen domestic enterprises. Artificial constraints to competition have to be removed, and the usual biases in policy against SMEs removed. State owned enterprises must be reformed or privatised as necessary to make them efficient, and they must be subjected to the same market discipline as private enterprises. A range of support institutions must be built or improved. In

addition, governments must support 'horizontal' activities like training and technological effort by enterprises by giving non-specific incentives (Lall and Teubal, 1998). Exports must be supported by agencies that can help all firms to access information and markets.

Competitiveness policy as it has evolved in advanced industrial countries provides useful guides to acceptable strategies. Apart from the supply side measures noted, these countries use tools like benchmarking to help enterprises understand their weaknesses and reach best practice levels. There is an increasing use of benchmarking for support institutions as well. Governments invest heavily in education and training, and provide incentives to enterprises to strengthen their training systems. They promote R&D and high-tech clusters, and pay particular attention to the creation of technology oriented financial instruments. The upgrading of infrastructure, particularly that related to IT, is regarded as high priority. Technology policy is set by conducting 'Technology Foresight' exercises to develop a consensus on future needs between industry, research bodies, academics and governments.

The private sector (generally through associations) plays a closely collaborative, often lead, role in all these efforts. Support institutions and universities are given incentives to be more responsive to industry needs. Many public services and agencies are privatised or thrown open to private sector provision. This can be very effective in such areas as training, testing, consultancy and marketing. Some countries target support policies to industry clusters rather than individual activities.

Beyond these generalisations, the specific forms industrial policy takes must depend on a host of context-specific factors. It is to be hoped that this study will illuminate these factors.

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