

# TECHNOLOGY DIFFUSION IN SOUTHEAST ASIA THE ROLE OF FOREIGN INVESTMENT

by F. HARIANTO & E. SAFARIAN

**T**he term technology here is used in its generic sense; it encompasses all forms of physical assets, knowledge, human learning and organizational capabilities that enable the firm to produce products and services efficiently. In this regard, technology covers not only the manufacturing/production activities, but also the whole arrays of business processes, including research and development, marketing and distribution, finance, and accounting.

The process of technological change can be usefully considered as involving three phases: invention, innovation and diffusion. Invention refers to the generation of new scientific ideas or knowledge, while innovation refers to the development of these new ideas or knowledge into marketable products. Finally, diffusion refers to the adoption of these new products or processes in and across economies. As has been widely documented, it often involves a very long time before a new idea could be transformed into marketable products. We are more interested in technological innovation and diffusion here.

The economic growth is characterized by the interaction of two conflicting processes: innovation which tends to increase economic and technological differences between economies, and diffusion which tends to reduce the gap between economies.

There are two basic approaches for technology policy. The first option



is to put heavy emphasis on invention and innovation. The second option is to foster technology diffusion. It should be noted that whatever the path of technology policy pursued by a country, in the process the country should also develop its absorptive capacity to sustain and exploit the benefit of the knowledge generated by the innovation, regardless of the origin of the technical innovation.

Technology diffusion takes place through foreign direct investment, import of capital goods, licensing and informal trading of knowledge. International trade can facilitate the diffusion of technology across economies. The participation of economic agents of a particular country in world market will allow them to gain access to a larger pool of technical knowledge (sellers may provide buyers with

technical assistance, and buyers often advise the sellers on how to modify their products to meet their domestic requirements). The international competition will discipline the firms and induce them to generate ideas that are competitive internationally. Finally, the integration of an economy into world markets can expand the size of the potential customer base which, in turn, may further the incentive for industrial research.

The role of international trade in promoting technological invention and innovation, however, is not unambiguous. A country endowed with relative abundance of natural resources and unskilled labor but lack of skilled workers (e.g., Indonesia) may be induced under international trade to specialize in the production activities that make use of those resources, at the expenses of R&D activities which are crucial for the sustainability of the country's long-run growth.

At the firm level, the firm can be depicted as a bundle of resources embodied its two types of activities: (1) operating activities applying knowledge to production, marketing, distribution and finance, and (2) activities to increase the knowledge base of the firm.

Technological advancement at the firm level follows the nature and evolution of technology which varies across industries. In certain industries, it is the suppliers of the firm that dominate and provide the critical source of technology for the firm. In

other industries, they are the users or the firms themselves. These external sources of general knowledge and specific technology have to be supported by and combined with in-house skills if they are to be effectively adopted. It is the existing stock of knowhow within the firms, in tandem with its organizational capacities, as a product of cumulative learning, which drives and at the same time, limits the area of improvements that the firms can effectively carry out. It is the interaction between the two, the internal dynamics of the firms and the external inducements, that eventually shapes the direction of technological advancement that firms will undertake.

#### 1. MNEs and technology diffusion

It has been argued that any additional unit of capital investment not only increases the stock of physical capital but also increases the level of technological knowledge for all firms in the economy through knowledge spillovers. In the case of foreign investment, multinational enterprises (MNEs) bring in with their investment a bundle of technologies embedded in their financial, production, management and marketing capabilities. Usually, MNEs can transfer to their foreign subsidiaries their advanced knowledge about the latest products, markets, production techniques, and sourcing of parts and components. The MNEs could also affect the local economy through their decisions to purchase raw materials and intermediate products locally, and through their technical linkages with both the domestic suppliers and buyers.

The domestic suppliers and buyers can gain directly from MNEs through various forms of technical linkages. These include, among others: (1) information linkages - specific technical information about machinery, materials, parts and components, or general information about markets and government regulations; (2) technical assistance, in the areas of plant design and layout, tooling, machinery selection, maintenance, trouble shooting, product design; (3) managerial and organizational assistance; (4) financial assistance and (5) procurement assistance. Certainly, the end results - how much the local firms can benefit from the MNEs- depend on the quality of their workforce, their age and experience to deal with MNEs, their existing technological and organizational capacities, as well as on the nature of the MNEs themselves and on the host country regulatory framework.

In the specific area of technologi-

cal innovation by MNEs in their host countries, some notable patterns have emerged. First, the proportion of MNEs' R&D activity outside their home countries is generally quite small and sometimes negligible. Second, the MNEs' R&D activity is heavily directed to the adaption of specific products, production techniques or organizational practices of the firm rather than to basic research. Such adaption are made by the host-country-specific conditions in terms of materials availability, supply capabilities, human capital capacities and organizational practices. Third, basic research undertaken by MNEs' subsidiaries in the host countries, if any, usually involves: (1) immobile inputs for the research and (2) heavy interaction with domestic customers and/or local government. In any case, such a basic research requires the availability of scientists and engineers and will be most likely to flourish when the host countries have developed proper innovative infrastructure.

In general, the relative new industrializing countries such as ASEAN are in no way, at the moment, in a position to push forward the technology frontier. The national technology base of these countries has just developed; their R&D expenditure is relatively very low (ranging from about 0.2% of GDP for Indonesia and Thailand, to about 1% of GDP for Singapore), and the institutional framework for promoting R&D has not been in place yet. In addition, the technology capacity of the private sectors is still shallow, and their ability to invest in R&D is limited. Therefore, the natural technology policy will be to emphasize the effective diffusion of foreign technology and, at the same time, to build up their absorptive capacity in the forms of effective learning, adaption and possibly improving upon available foreign technology to gain competitive advantage. As these countries move up the technology ladder over time, the emphasis can be shifted toward new knowledge creation -particularly knowledge relevant for each individual country's condition. Diversification and specialization can then be expected to develop in the region.

#### 2. The role of foreign direct investment and technology

All the ASEAN countries have now adopted export-oriented development policies, which explain partly their export drives in the past few years. The success of their export drives, however, can be largely attributed to the investment of multinationals operating in the region. The

share of multinationals in total country exports is generally very high. The figure ranges from 22.3% for Indonesia, to 34.7% for the Philippines, 48.6% for Thailand, and as high as 59.6% for Malaysia and 88.1% for Singapore. The presence of these foreign direct investments (FDI) has spurred exports from the region. Compared to the other ASEAN countries, Indonesia seems lagging behind in capitalising on multinationals in its drive for industrial and export development.

The magnitude of FDI inflows ratio into ASEAN increased significantly in the 1980s. The FDI inflows ratio to GDP increased from 1.3% in 1980 to 3.3% in 1990, while its ratio gross domestic capital formation also increased from 5.1% in 1980 to 9.4% in 1990. Among the ASEAN countries, Singapore is the most dependent on FDI, followed by Malaysia which is catching up rapidly. The success of ASEAN countries in attracting FDI can be attributed largely to a combination of the following factors: political stability, rapidly growing domestic markets, favourable resource endowments (natural resources and labour supply in ASEAN, and human capital and infrastructure in Singapore), development-oriented governments with FDI-friendly policies. It should be noted that although all ASEAN countries tend to have broadly similar investment incentives (e.g., tax facility, export incentives, import duty exemptions), they differ quite substantially in terms of bureaucratic efficiency, restrictive rules (on ownership of equity and of land, and other restricted sectors) and performance requirements (export, local content, technology transfer and training). In the past few years, however, with the on-going liberalization of trade and investment in the region-particularly with the conception of the ASEAN Free Trade Area and also in a response to ever-increasing competition from China and Vietnam in attracting FDI - there has been a tendency for policy convergence on FDI in the ASEAN countries. Japan has emerged as a major investor in ASEAN in the 1970s, followed by the East Asian Newly Industrializing Economies (NIEs) in the post-1987 period. Japanese FDI in ASEAN has grown significantly in the 1980s, reflecting its domestic structural transformation, increasing labour and land costs in the 1970s, and the appreciation of the yen in 1985. The Japanese FDI in ASEAN tends to concentrate in selected manufacturing sectors such as electrical and electronic products,

chemicals and, to a lesser degree, machinery and metal products. It appears, as normally expected, that Japanese investments have contributed significantly to the industrial and export performance of the region.

While ASEAN's success in attracting FDI has contributed significantly to the local economies, in terms of providing employment and of promoting exports, the ASEAN countries are still in the process of learning how to diffuse the foreign technology to local firms. With only a few exceptions, foreign multinationals have generally not developed significant linkages with local firms, despite various attempts by governments to promote subcontracting schemes involving large and small enterprises in the region. The industrial sectors in Thailand, Indonesia and the Philippines are still relatively shallow. There is only a small base of reliable local suppliers. Many key industrial inputs still have to be imported. Also, there is only an embryonic, albeit growing, local capital goods industry. The industrial structure of Thailand and of Indonesia, for example, is dominated by a small number of large conglomerates and a large number of very small enterprises. As a result, particularly in the protected sectors, the large firms tend to be vertically integrated. The local content requirements generally promote only inefficient local producers protected by government regulations.

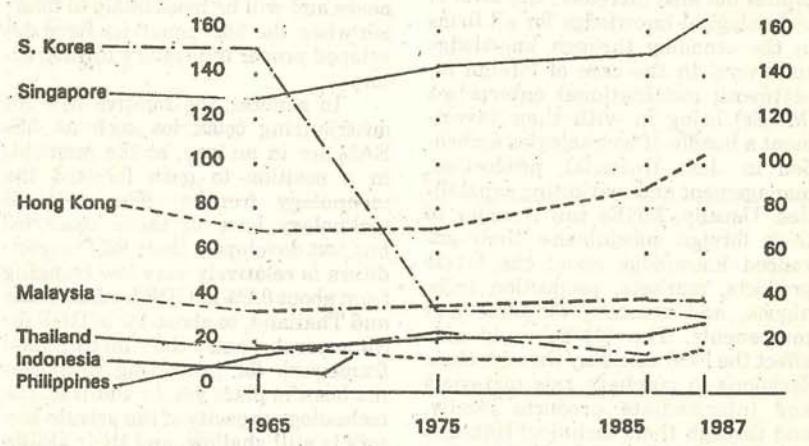
Another source of foreign technology is through imports of capital goods. Data on these imports indicate several interesting observations (Figure 1). During 1965-1987, the pattern of capital goods imports almost did not change. Singapore was the highest in terms of capital goods importation. The ratio of its capital goods import to GDP was 129% in 1965 and increased slightly to 163% in 1987 (these percentages are so large because of the entrepot trade through Singapore). Malaysia was next, with the ratios of 35% and 39% respectively in the same period. Thailand

increased slightly its use of capital goods imports; the ratios were 17% in 1965 and 27% in 1987. Indonesia and the Philippines were the lowest; their imports were about 15% of their GDP, and the figures did not change a lot in the period 1965-1987. It could be the case the Indonesia, the Philippines and, at some extent, Thailand, suffered from the relatively high import duties of capital goods, particularly for non-exporting firms or for investments not under their Boards of Investment scheme, for firms who did not enjoy import duty exemption. As a result, firms in these countries were not able to take as much advantage of importing foreign technology embedded in capital goods as were their counterparts in the East Asian NIEs.

trial performances, in terms of the revealed comparative advantages in capital- and science-intensive sectors as well as in the role of metal products and machinery sectors in the manufacturing value added, are correlated positively with better flows of trade and investments in each of the ASEAN economies, measured as the ratios of FDI inflows and of capital goods imports to GDP and the effective tariff rate.

If one is willing to make a crude rank-order of technology development in ASEAN based on the indices of export and industrial development above, with a great risk of oversimplification, then a case can be made that Singapore is leading the way, followed next by Malaysia and then, Thailand, albeit at a rather distant.

Figure 1



The above survey provides a picture about the role of foreign direct investment in promoting technology diffusion within the ASEAN economies. Table 1 summarizes the comparative features of the trade and investment regimes in ASEAN, and their export and industrial performance. From Table 1, there appears a relatively strong correlation between the rankings of industrial and export performance indices and trade and investment regime indices. It suggests that better export and indus-

Indonesia and the Philippines are unambiguously laggard compared with the other three. An argument can be made that in the case of ASEAN, the most relevant technology policy for the region is the one which promotes the diffusion of foreign technology. More specifically, it can be argued that the more permeable the trade and investment regimes of a country are, the further the country will be able to move up the technology ladder.

TABLE 1 : Comparative indices of trade and industrial regimes and industrial performance in ASEAN

Nuoc	INDICES OF INDUSTRIAL PERFORMANCE			TRADE AND INVESTMENT INDICES		
	Sectorial ranking of RCA		Ranking of the role of metal products and machinery in manufacturing value added	FDI-Inflows/GDP	Ranking of:	
	Capital-in- tensive	Science-in- tensive			Imports of capi- tal goods	Effective tariff rate
Singapore	1	2	1	1	1	1
Malaysia	2	1	2	2	2	2
Thailand	3	3	4	3	3	3
Indonesia	4	5	3	4	4	4/5
Philippines	5	4	N.A.	5	5	4/5

(From the document presented in a workshop organized by University of Toronto)