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9 Technology Transfer in the Asian Pacific Region: Implications of Trends since the Mid-1980s

Tran Van Tho

In the past quarter century, the Asian Pacific region has experienced rapid economic growth characterized by rapid industrialization. Not only Asian newly industrialized economies (NIEs) but also many Association of Southeast Asian Nations (ASEAN) countries and China have shown a substantial rise in the manufacturing sector as a percentage share of GDP or total exports.

These facts imply that the structure of comparative advantage of each country and thus the pattern of specialization in the region have changed over time. In fact, for example, Taiwan and Korea have increasingly penetrated Japan's domestic market for capital and technology-intensive products, and two-way trade in manufactured products between Japan and ASEAN and between Japan and China has increased substantially. The share of manufactured products in Japan's total imports from ASEAN-4 (Indonesia, Malaysia, the Philippines, and Thailand) has risen from 6 percent in 1980 to 14 percent in 1987 and 23 percent in 1989. The corresponding figures for Japanese imports from China in the same years were 22, 40, and 52 percent, respectively.[1]

Behind the process of catching up by Asian Pacific developing countries in manufacturing production and exports have been changes in the factor endowments of each country. For latecomers to industrialization, this means that capital/labor ratios and technological levels have risen over time. In addition to the domestic accumulation of capital and technological development, capi-

Tran Van Tho is professor of economics at Obirin University, Tokyo, and senior economist at the Japan Center for Economic Research (JCER), Tokyo.

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1. Calculated from the December 1980, December 1987, and December 1989 issues of *The Summary Report Trade of Japan*, published by the Japan Tariff Association (Tokyo).

tal movement and technology transfer from other countries have promoted changes in the factor endowments of Asian Pacific developing countries. In particular, since the mid-1980s, factor movement from Japan to these countries has accelerated, and Asian NIEs have increasingly participated in the supply of capital and technology in the region.

This paper focuses on the role of technology transfer in the industrialization of the Asian Pacific region. It will provide some observations on the trends in the second half of the 1980s and discuss their implications for the future industrialization and division of labor in the region. In this paper, the Asian Pacific region is defined as including Japan, Asian NIEs, ASEAN, China, and Vietnam, but the last two countries will not be examined in detail. I will also confine my discussion to the manufacturing sector.

In what follows, section 9.1 will summarize the characteristics and effects of the channels through which technologies are transferred. In particular, some controversial issues regarding the relationship between foreign direct investment (FDI) and technology transfer will be discussed. In section 9.2, the pattern of Japan's technology transfer in the region since the mid-1980s will be analyzed. The "push factors" for the expansion of Japanese FDI as well as other channels of technology transfer will also be discussed. Section 9.3 highlights recent trends in the role of Asian NIEs as new transmitters of technology in the region via the channel of direct investment. The factors pushing firms in NIEs to expand FDI will also be mentioned. Section 9.4 will discuss the nature of the Asian Pacific region as a market for technologies from Japan and NIEs. In other words, the "pull factors" accounting for the expansion of direct investment and other flows of technology will be analyzed. In section 9.5, the implications of new trends in technology transfer will be discussed in the dynamic context of the Asian Pacific economies. Finally, section 9.6 will summarize my major conclusions.

9.1 Channels of Technology Transfer

In this paper, *technology* is defined in a broad sense to include not only production technology (hardware of production or knowledge about machines and processes) but also management expertise, marketing skills, and other intangible corporate assets.

Technologies can be internationally transferred through many channels. Broadly speaking, these channels can be divided into two categories, public and private. In the first category, technologies can be considered as public goods, and the transfer is conducted by public organizations, such as governments of advanced countries and international agencies. Such technologies are seen in fields such as agriculture and government administration, where markets for technologies do not exist. The transfer is conducted as a part of the technical assistance or economic cooperation provided to developing countries. By contrast, private channels of transfer relate to technologies that are developed by private firms and transferred on a commercial basis. The owners or suppliers of technologies are usually, but not always, multinational corporations (MNCs). The scope of this paper is limited to private channels of technology transfer.

Technology transfer by MNCs or other private firms is conducted through the following channels: (foreign) direct investment (FDI), licensing arrangements, plant export, original equipment manufacturing (OEM), and others.[2] FDI involves the transfer of a package of managerial resources including production technology, management know-how, and marketing skills. Other channels of transfer do not involve such packaging and have drawn wide attention since the late 1970s as "new forms" of MNCs' involvement in developing countries (Oman 1984).

The importance of each channel varies, depending on the strategy of the MNC supplying the technologies, the characteristics of the technologies themselves, and the policies, absorptive capacity, and managerial resource endowments of the recipient countries.

The preference of MNCs for one channel or another depends on many factors. If the technologies are newly developed, MNCs prefer direct investment with majority ownership to an arm's length transaction because majority ownership allows them to control use of the technologies, preventing the leakage of technology to third parties. Another determinant of the channel used is the firm's perception of the environment in the recipient country. If the environment is considered risky, licensing arrangements may be chosen since, with this channel, the MNC's level of commitment in the market is much lower than in the case of direct investment. In the case of OEM, the technological levels of the recipient firms are crucial since the products made by the latter as a result of technology transfer will be sold under the brand name of the transferring MNC.

From the standpoint of developing recipients, FDI may be the most effective channel for the development of a new industry since developing countries tend to be poorly endowed with management and marketing skills. However, if the technology is standardized and product markets are stable, recipient countries may prefer other channels that do not involve control by foreign firms. When the preferences of MNCs and recipients do not coincide, their respective bargaining power will determine which channel of technology transfer is ultimately used.

Since the remainder of this paper will focus on FDI, it seems fitting to discuss here the relation between FDI and technology transfer and the various controversies surrounding this issue.

In Asia, there have been complaints that Japan is passive in transferring

2. Other channels of technology transfer not dealt with in this paper include turn key contract, franchising, and international subcontracting. For a more detailed discussion of channels of technology transfer and related issues, see, e.g., UNCTC (1987).

technology to the region's developing countries. The complaints can be divided into two types. In the first type, Japanese firms are said to be unwilling to transfer technology (the technologies that Asian countries want); that is, no technology is transferred under any channel. This is a complaint often heard in Korea regarding the passive attitude of Japanese firms toward the transfer of recent high-technology developments in Japan. It is true that Japanese firms prefer to keep new technologies at home and serve foreign markets by exporting products from Japan. But, when Japanese firms decide to provide or transfer the technology to foreign countries, they will choose one of the channels discussed above. FDI is one of those channels. It can thus be implicitly assumed that FDI represents technology transfer. This leads to the second type of complaint from Asia, namely, that, even when Japanese firms do undertake FDI, they do not really transfer technology. This complaint is often heard from Thailand, Malaysia, and other Southeast Asian countries.

More concretely, firms affiliated with Japan are said to be reluctant to train local employees, with the result that there is no smooth transfer of technology. Japanese companies allegedly staff their affiliates with too many Japanese managers, thus depriving local staff of the opportunity to acquire management skills.[3] However, these claims are often confused by the lack of a clear definition of concepts, and thus, in many cases, friction between Japan and other Asian countries results from a gap in perception. Let me provide a simple framework to understand this problem and summarize the evidence shown by a number of surveys, including my own.

We may divide technologies into three types: production technology, administration technology, and management skills (Ogawa 1976). Accordingly, we may divide technology transfer into three levels. Suppose that an MNC undertakes an FDI project in a developing country to produce a manufactured product. First, a factory is built. The factory is a form that embodies both production technology and administration technology. Production technology is the combination of equipment and the knowledge to operate that equipment. The transfer of this technology requires the transfer of both equipment and knowledge—and therefore the training of local operators.

In the production process, there are many forms of administration: inventory, quality control, schedule control, facility administration, and so on. The transfer of these administration technologies involves the training and education of engineers and managers at middle levels (section chief, department head, etc.).

The third type of technology is the management skills embodied in the head office. The head office is usually located in the capital of the host country and manages the operations of a factory or a number of factories, and it also directs all planning, marketing, finance, and other similar activities. High-level managers at the head office have to follow the trends in product markets, tech-

3. See, e.g., the papers written by Southeast Asian scholars in Sekiguchi (1983).

nological change, and other areas and devise strategies that can cope with new situations. The transfer of such management skills requires the training of high-level managers, who are gradually allowed to fill the top-class managerial posts initially held by staff from the MNC's home country.

The behavior of MNCs regarding the transfer of the three types of technology discussed above can be hypothesized as follows. Regarding production technology and administration technology, MNCs have two incentives to transfer to the host country. First, since the employees and staff at these stages are large in number, most of them must be recruited from the local labor market; only a few, if any, are sent from the MNC's home country, except during the initial stage of the operations. Second, in order to run affiliated firms efficiently, MNCs have to train employees and middle managers so that they can operate or manage the factory smoothly.

Transferring management skills is more complicated. The persons in charge of planning or conducting financial and marketing strategies must have high levels of managerial knowledge and sometimes must be aware not only of the situation of the affiliated firm but also of the global strategy of the MNC as a whole. These persons therefore are frequently in contact with headquarters, and it is essential that they be able to communicate effectively with the headquarters. If these conditions are not met, MNCs have the incentive to send staff from the parent headquarters to fill the top managerial posts of the affiliates.

The evidence so far has confirmed the point that there is a relatively large number of Japanese expatriates in the joint ventures or subsidiaries of Japanese firms. However, this does not necessarily mean that there is a lack of technology transfer. In many cases, it may mean the reverse, particularly in the initial stage of the investment project. The important problem here is whether the number of Japanese staff has declined steadily over time as a result of the transfer of technology to local staff.

The results of my field surveys (Tran 1992) on the operation of Japanese affiliates in the synthetic fiber industry in Korea, Taiwan, Thailand, and Indonesia can be summarized as follows. First, in the case of production and administration technologies, Japanese firms have been active in training local employees, for example, by sending middle managers to Japan for training courses, by conducting on-the-job training, and by other activities. With these efforts, the transfer has been quite smooth. The number of Japanese staff at various managerial levels in the factory has been reduced steadily without interruption or major trouble in the operations. Second, there has, however, been no significant progress evinced in the transfer of management skills. This is particularly true for Thailand and Indonesia.

A survey by MITI (1989a, 21–22) also shows that, in the Japanese-affiliated firms in Asia, a substantial reduction in the number of Japanese staff was recorded at middle-management levels but not at higher levels.

What are the reasons for the differential transfer rates between the factory (the transfer of production and administrative technologies) and the head office (the transfer of management skills)? The quick transfer of production and administrative technologies can be explained by the cost and efficiency considerations of MNCs, as discussed earlier. The slow transfer of managerial posts may be attributed to the following four factors.

First, as noted earlier, communication between affiliated firms and the parent headquarters must be conducted smoothly. Because of language barriers, Japanese firms are reluctant to give high-level managerial posts to local staff.

Second, one of the major features of the Japanese management style is to grant managerial posts only to those employees who, after entering the company as university graduates, have worked their way up through the ranks, serving in various positions within the company for many years. Under such a system of intrafirm training and promotion, it takes about twenty years or more for an employee to reach a high managerial post.

Third, in the case where Japanese firms modify their management style and are willing to recruit qualified persons from the local labor market, it is essential that the supply side of that market meet the demand. However, in many developing countries, the shortage of qualified high-level managers is still a serious problem.

Fourth, in some Asian countries, the efforts of local partners to catch up (using local replacements for foreign managerial resources) have been weak. In many cases, local shareholders simply prefer to maximize the dividends from the joint ventures and thus discourage the localization of management since local managers are usually thought to be less efficient than Japanese ones.

In the case of Korea and Taiwan, the third and fourth factors have been small; that is, the local supply of human resources has expanded over time, and local efforts to catch up by replacing foreign managerial resources have been strong (Tran 1988). In addition, owning to historical factors, linguistic similarity, and educational access, Koreans and Taiwanese have an advantage in studying and learning the Japanese language. This point, together with many common cultural values in Far East Asia, has lowered the communication barriers between Japan and the two Asian NIEs. For these reasons, so long as FDI is undertaken, the transfer of management skills from Japan to Korea and Taiwan has been considerable. It is interesting to note that the claims that Japanese firms undertake FDI but do not transfer technology (management skills) have been heard from Southeast Asian countries but almost never from Asian NIEs.

Given the scope of this paper, I shall go no further on this point. I simply need to confirm here that FDI is a channel of technology transfer. When FDI is undertaken, it involves technology transfer, at least at the factory level.[4] As

4. According to MITI (1986, 591), in 1983 about 95 percent of production technologies used in Japanese affiliates in Asia were supplied by Japan. For affiliates in electronics and other machinery-related industries, such figures were in the range of 97–99 percent.

far as management skills are concerned, even when FDI does not involve a localization of such technology, management operations must nevertheless be moved from the MNC's home country to the host country. Therefore, FDI results in an increase in the production capacity in host countries, changes in the location of industrial activities, and, consequently, a change in the division of labor among home and host countries of MNCs.

9.2 Trends in Japan's Technology Transfer in Asia: Pattern and Factors

9.2.1 Foreign Direct Investment

Since late 1985, when the value of the yen began to increase sharply, Japan's FDI has rapidly expanded. Japanese manufacturing firms have ventured overseas at high speed. On a reported (to the Ministry of Finance) basis, Japanese FDI in world manufacturing industries reached U.S. $3.8 billion in fiscal 1986 (an expansion of 62 percent over the previous fiscal year), U.S. $7.8 billion in 1987 (an expansion of 106 percent), U.S. $13.8 billion in 1988, and U.S. $16.3 billion in 1989.

Along with these general trends, investment in Asia has also shown a high rate of expansion since 1986. For all manufacturing industries as a whole, the cumulative investment in the most recent four years exceeded the cumulative investment from 1951 to 1985 (see Table 9.1). The rapid appreciation of the yen has significantly changed the structure of Japan's international competitiveness. Wages and other factor costs in Japan, in dollar terms, rose rapidly owing to the drastic change in the value of the yen. In 1986, Japanese wages, for instance, were about four times higher than the average level in Asian NIEs and about thirteen times higher than in ASEAN countries (MITI 1988, 13). Given the still higher value of the yen in subsequent years, factor costs in Japan in the late 1980s should have been much higher than in 1986. As a result, many industries have had to venture overseas in order to achieve lower production costs. Until mid-1986, Asian NIEs, particularly Taiwan and South Korea, were the major markets absorbing these new direct investments. Since mid-1986, the waves have spread to ASEAN, especially Thailand and Malaysia. Since 1987, Japanese direct investment in Indonesia has also risen substantially. These investments include not only the establishment of new wholly owned subsidiaries or joint ventures but also the expansion of production (including the addition of new product lines) by existing ventures.

Three features of the Japanese manufacturing sector's direct investment in Asia since the mid-1980s may be noted. First, the industrial structure of Japanese FDI in the region has been significantly upgraded in the sense that the weight of more technologically sophisticated industries has risen considerably. This is partially reflected in the increasingly strong presence of the electrical and electronics industries. In the most recent four years, those industries accounted for more than 30 percent of the total Japanese manufacturing direct

Table 9.1 **Japanese Manufacturing Direct Investment in Asia (million U.S. dollars)**

	Asia		ASEAN-4		Asian NIEs	
	1951–85	1986–89	1951–86	1987–89	1951–86	1987–89
All manufacturing	7,517	8,074	4,207	3,618	3,891	3,001
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
Foodstuffs	256	795	165	136	90	595
	(3.4)	(9.8)	(3.9)	(3.8)	(2.3)	(19.8)
Textiles	1,182	387	825	176	366	67
	(15.7)	(4.8)	(19.6)	(4.9)	(9.4)	(2.2)
Pulp and paper	191	260	163	223	31	21
	(2.5)	(3.2)	(3.9)	(6.2)	(0.8)	(.7)
Chemicals	1,292	786	438	276	876	432
	(17.2)	(9.7)	(10.4)	(7.6)	(22.5)	(14.4)
Steel and nonferrous	1,697	881	1,494	579	231	220
metals	(22.6)	(10.9)	(35.5)	(16.0)	(5.9)	(7.3)
General machinery	580	806	133	409	585	242
	(7.7)	(10.0)	(3.2)	(11.3)	(15.0)	(8.1)
Electrical machinery	833	2,515	245	1,200	829	807
	(11.1)	(31.1)	(5.8)	(33.2)	(21.3)	(26.9)
Transport equipment	692	633	392	230	386	239
	(9.2)	(7.8)	(9.3)	(6.4)	(9.9)	(8.0)
Others	796	1,010	352	387	548	381
	(10.6)	(12.5)	(8.4)	(10.7)	(14.1)	(12.7)

Source: Calculated from data released by the Ministry of Finance (Japan).

Note: Attention should be paid to the differences in the periods covered under "Asia" compared with those covered under "ASEAN-4" and "Asian NIEs," differences due to data availability. Figures in parentheses are share of each industry in all manufacturing.

investment in Asia, compared with 11 percent for the preceding period (table 9.1). In contrast, labor-intensive industries, typically textiles, and resource-intensive industries, such as chemicals and steel and nonferrous metals, have shown a sharp decline in their share of Japanese FDI. The exceptional case is foodstuffs, an industry that is considered labor intensive. Its share rose sharply in the second period. This was due, however, to the merger and acquisition of a large firm in Singapore by a Japanese manufacturer of alcoholic beverages in 1989. In terms of statistical data, this case has biased the structure of the Japanese manufacturing sector's direct investment in Asian NIEs (table 9.1).

The steady expansion of direct investment by Japan's electrical/electronics industry has been increasingly accompanied by the transfer of high technology. Until the early 1980s, firms tended to transfer standardized or low-level technologies such as those relating to the assembly of black-and-white television sets or to simple electronics parts. In recent years, however, Japanese firms have increased the transfer of technologies relating to sophisticated electronic parts, the production of color televisions, videocassette recorders, and other areas.

FDI from other industries has also been characterized by the transfer of high technology. In the case of Japanese direct investment in Korea's chemical industry, for example, the number of such high-tech projects as biotechnology and pharmaceuticals has increased (JETRO 1991, 146). Somsak (1991) also documented the fact that Japanese direct investment in Thailand has markedly increased in the fields of capital goods and intermediate electronic and electrical products.

The second feature of Japan's manufacturing sector's direct investment in Asia in recent years has been the increasing export orientation of investment projects. The rapid appreciation of the yen has forced Japanese firms to locate their manufacturing production activities overseas as a substitute for exports, on the one hand, and for sourcing cheaper products to serve their domestic markets, on the other. According to a MITI survey (1989a) of the markets for the products of Japanese manufacturing subsidiaries in Asia, 15.8 percent of the sales of those firms were shipped back to the Japanese market in 1986, compared to 10.8 percent in 1983; furthermore, 29.5 percent were exported to third countries, compared to 22.3 percent in 1983. For electrical and electronic products, third-country markets have been much more important than for manufacturing industries as a whole. According to another survey by MITI (1987, 269) on the purposes of direct investment projects undertaken after 1985 in Asian NIEs by Japan's electrical/electronics industry, 14.8 percent of the outputs were shipped back to the Japanese market, another 41.6 percent were exported to third countries, and only 43.6 percent were sold in local markets. Data from recipient countries such as Thailand (Somsak 1991) and Indonesia (Thee 1990) also show the same trends.

The third feature is the increasing presence of small and medium-sized firms (SMSFs). As shown in table 9.2, SMSFs accounted for more than half the FDI projects undertaken by Japanese firms in recent years. The table also shows that about two-thirds of manufacturing FDI projects undertaken by SMSFs have been concentrated in Asia. In particular, the concentration of investment in Asia by four manufacturing sectors, namely, machinery, textiles, metals, and miscellaneous goods, is prominent (Adachi 1991). Because of the rapid appreciation of the value of the yen, many SMSFs have sought low-cost production sites in Asia. Some of them are subcontractors of large firms in Japan and have undertaken FDI at the request of their parent firms, which want to ensure the supply of parts and components in the latter's Asian assembly plants.

Since the technological gap between developing countries and SMSFs of advanced countries can be hypothesized to be smaller than that between developing countries and larger firms, the technologies of Japanese SMSFs can be easily transferred to and diffused throughout Asia. This point will be discussed in more detail in section 9.5 below.

Table 9.2 Trends in Japanese FDI by SMSFs (%)

	1980	1985	1988	1989
Share of SMSFs in all Japanese FDI projects	41.3	31.1	59.6	53.8
Share of manufacturing investment in all FDI projects by SMSFs	30.4	43.1	44.5	38.2
Share of Asia in all manufacturing FDI by SMSFs:	57.6	63.5	65.6	64.7
Of which:				
NIEs-3[a]	36.4	30.7	26.8	20.4
China	21.2	21.1	8.1	7.9
Other Asia		11.7	30.7	36.4

Source: Small and Medium Enterprises Agency, *White Paper on Small and Medium Enterprises* (Tokyo: Ministry of Finance, various years).

[a]Korea, Taiwan, and Hong Kong.

9.2.2 Other Channels of Technology Transfer from Japan

Direct investment has not been the only channel of technology transfer from Japan. Since the mid-1980s, other channels have been adopted, including licensing arrangements, production cooperation, and OEM. Japanese firms seem to adopt different channels of technology transfer depending on the general technological level as well as the degree of political or economic risk in host countries. Table 9.3 provides some evidence for this point. The table summarizes the forms (channels) of technology transfer by Japanese firms during the first two and a half years since the value of the yen started its sharp rise. The table suggests that direct investment is important in Asian NIEs and ASEAN countries while licensing arrangements and production cooperation have been chosen mainly for the Chinese market. OEM has so far appeared only in Asian NIEs. This may be explained by the relatively high technological levels of firms in NIEs, compared to those in other Asian developing countries. Along with the accumulation of managerial resources, many firms in NIEs have preferred OEM-type technology transfers over FDI, which results in management control by MNCs.[5] In terms of the cost of buying technology, OEM is also much cheaper than licensing arrangements are. From the point of view of Japanese firms, the attainment of a high technological level by firms in NIEs is a precondition for transfer through the OEM channel because of the need to ensure product quality, as mentioned in section 9.1 above. The reason why licensing arrangements have been the most important channel of technology transfer for China may be that China is considered by Japanese firms to be much riskier than NIEs or ASEAN countries because of the possi-

5. About 30 of the firms surveyed by MITI (1989a, 122–23) have conducted OEM in Asia and other regions. The most important reason for choosing this channel of technology transfer is said to have been "requests" from recipient firms.

Table 9.3 **Forms of Technology Transfer to Asia by Japanese Firms, 1986–June 1988 (no. of cases)**

	Local Production (direct investment)	Licensing Arrangement	Production Cooperation	OEM
Korea	127	98	44	9
Taiwan	209	51	43	8
Hong Kong	39	5	9	1
Singapore	113	3	4	0
Asian NIEs (A)	488	158	100	18
Thailand	129	21	6	0
Malaysia	62	5	2	0
Philippines	28	5	2	0
Indonesia	45	16	8	0
ASEAN-4 (B)	264	47	18	0
China (C)	85	107	38	1
Asian Pacific (A + B + C)	837	312	156	19

Source: Compiled from NEEDS system of the *Japan Economic Journal* (*Nihon Keizai Shinbun*).

Table 9.4 **Channels of Technology Transfer from Japan to Asia**

	N	%
Total projects surveyed	856	100.0
FDI	477	55.7
Licensing arrangements	347	40.5
Other channels	32	3.7

Source: Survey by Nikkei Research Institute of Industry and Markets, Tokyo, October 1990.
Note: The survey covered only four machinery-related industries: general machinery, electrical/electronic products, automobiles, and precision machinery.

bility of changes in foreign and domestic economic policies as a result of changes in the political situation.

Table 9.4 gives the results of a survey of 474 Japanese manufacturers in four machinery-related industries (general machinery, electrical/electronics, transport equipment, and precision machinery). According to the survey, 342 firms had conducted a total of 856 projects involving technology transfer in Asian countries (including NIEs, ASEAN, China, India, and Pakistan) by October 1990. Even though India and Pakistan were included in the survey, these two countries together accounted for only 10 percent of the total number of technology transfer projects. Table 9.4 shows that both FDI and licensing arrangements have been important channels of technology transfer by Japanese machinery-related producers to Asian countries. Most projects involving "other" channels have probably been conducted in recent years. Table 9.5 breaks down all projects according to transferee and timing of the transfer.

Table 9.5 Technology Transfer from Japan to Asia

	Total No. of Projects	Before 1970	1971–80	1981–85	1986–Oct. 1990
Korea	195	9	44	53	87
	(100.0)	(4.6)	(22.6)	(27.2)	(44.6)
Taiwan	155	25	28	40	59
	(100.0)	(16.1)	(18.1)	(25.8)	(38.1)
Hong Kong	14	4	3	2	5
	(100.0)	(28.6)	(21.4)	(14.3)	(35.7)
Singapore	47	0	28	9	10
	(100.0)	(.0)	(59.6)	(19.1)	(21.3)
Thailand	109	11	21	8	63
	(100.0)	(10.1)	(19.3)	(7.3)	(57.8)
Malaysia	89	3	21	17	43
	(100.0)	(3.4)	(23.6)	(19.1)	(48.3)
Indonesia	63	3	21	19	18
	(100.0)	(4.8)	(33.3)	(30.2)	(28.6)
Philippines	31	2	10	6	11
	(100.0)	(6.5)	(32.3)	(19.4)	(35.5)
China	68	0	2	36	29
	(100.0)	(.0)	(2.9)	(52.9)	(42.6)
Asia total	856	59	187	229	357
	(100.0)	(6.9)	(21.8)	(26.8)	(41.7)

Source: See table 9.4.

Note: "Asia total" includes India and Pakistan, which do not appear in this table. "Total no. of projects" includes some that were to be conducted in 1991 and some for which the time of transfer was unknown. Figures in parentheses show percentage share in total number of projects. See also table 9.4.

Three points emerge from this table. First, Korea, Taiwan, Thailand, and Malaysia have been the major markets for Japan's machinery-related technologies, followed by China and Indonesia. Second, for most countries, about 40 percent or more of the projects were conducted during the latest five-year period. This, again, confirms the aggressive behavior of Japanese firms regarding technology transfer to Asia following the sharp rise in the value of the yen. Third, the concentration of technology transfer in that period was more pronounced in ASEAN countries like Thailand and Malaysia than in NIEs such as Taiwan and Korea. Since machinery-related technologies can be considered to be more sophisticated than those found in other industries such as textiles and foodstuffs, this suggests that Japanese firms have an increasingly strong interest in exporting high technologies to ASEAN's growing economies.

In sum, since the latter half of the 1980s, technology transfer by Japanese firms of all sizes to the Asian Pacific region has been actively conducted through various channels. Among the technologies transferred, sophisticated technologies such as those relating to electrical and electronic products have played an increasingly important role.

9.3 Asian NIEs as the New Transmitters of Technology: Pattern and Factors

Along with the intensive movement of technologies from Japan, the Asian Pacific economy has also been characterized by the active transfer of managerial resources from Asian NIEs since the second half of the 1980s. To provide a simple picture of that phenomenon, this section will review the pattern of direct investment (the major channel of technology transfer) from Taiwan and Korea to ASEAN countries.[6]

9.3.1 The Pattern of Taiwan's Direct Investment in ASEAN

Taiwan started FDI as early as 1959, but until around 1980 the annual FDI level was very small. Substantial FDI occurred in the early 1980s, and annual direct investment abroad expanded rapidly after the middle of the decade. The cumulative FDI for the two decades between 1959 and 1980 was only U.S. $100 million, while the same figure for the period 1981–85 was U.S. $114 million. The sum of FDI conducted during the two subsequent years, 1986 and 1987, was an even higher U.S. $160 million. At the end of the decade, annual FDI from Taiwan experienced continuing jumps: from U.S. $219 million in 1988, to U.S. $931 million in 1989, to U.S. $1.6 billion in 1990.[7]

A number of factors have pushed Taiwanese firms to expand investment abroad in recent years. These include the rapid rise in wages and other factor costs in Taiwan, the increase in the value of the new Taiwan dollar, and trade friction with the United States. For these reasons, Taiwanese FDI has so far been conducted mainly by manufacturing firms and in the manufacturing sector of the recipient countries. In terms of capital stock at the end of 1990, about two-thirds of Taiwanese FDI was accounted for by manufacturing industries.

Since the 1980s, more than half of Taiwanese direct investment abroad has been concentrated in the United States. However, by 1987, the United States has been particularly important for Taiwan's electrical and electronics industry. In the area of light manufacturing (labor-intensive industries), for ex-

6. For a short review of other channels of technology transfer from Asian NIEs, see, e.g., Chen (1985). This reflects, however, only the situation until the early 1980s.

7. FDI data released by Taiwanese authorities have usually been underestimated. This has been due in part to the fact that some investments were not submitted to the government for approval. The government's review process is usually time consuming, so, in order to avoid possible delays in their investment schedules, firms may have bypassed government regulations whenever possible. This data problem, however, does not significantly affect the analysis here unless the unreported FDI has had a pattern quite different from that described in the paper. In fact, so long as the magnitude or the amount of FDI is concerned, the underestimation of the data tends to strengthen my argument.

ample, textiles, apparel, wood products, foodstuffs, and beverages, ASEAN countries have been much more important. As shown in table 9.6, light-manufacturing industries accounted for about half of Taiwanese direct investment in ASEAN, and the investment stock in this region has far exceeded that in the United States. In particular, Taiwan's direct investment in labor-intensive industries in Thailand, Malaysia, and the Philippines has shown a high rate of expansion. In the most recent period, from 1988 to 1990, Taiwanese electrical and electronics firms have also conducted substantial direct investment in ASEAN countries (table 9.7). However, Taiwanese electronics firms' direct investment in Thailand and other ASEAN countries seemed to be involved primarily in the production of highly standardized products such as lamps, transformers, and washing-machine motors (Ramstetter 1988, 118; JETRO 1991, 159). This is quite different from FDI by Japanese electronics firms.

Recently, Taiwanese light manufacturers have also been active in direct investment in Vietnam, which promulgated a new foreign investment law in January 1988.[8]

As a result of active direct investment since the latter half of the 1980s, Taiwanese capital and technology have now gained a significant position in most ASEAN countries. Until the mid-1980s, in terms of FDI, the position of Taiwan as a capital supplier was negligible in most ASEAN countries, except for Thailand. However, the cumulative investment in recent years shows that Taiwan has become the largest supplier of managerial resources in Malaysia, the second (but close to first) largest supplier in Indonesia, and the third (but close to second) largest supplier in Thailand (see table 9.8).[9]

Since FDI involves the transfer of a package of production technologies, management skills, and marketing skills, the growth and the industry composition of the Taiwanese direct investment in ASEAN has many implications for the pattern of technology transfer to Southeast Asian countries. I shall return to this point in section 9.5 below.

9.3.2 The Pattern of Korea's Direct Investment in ASEAN

South Korea began direct investment abroad in 1968 when it undertook a project to procure lumber in Indonesia. Until 1985, however, the levels of

8. Direct investment in Vietnam from Asian NIEs and other sources is analyzed in Tran (1991a).

9. In the case of the Philippines, data in table 9.8 unfortunately do not show investments from Taiwan. According to the data from JETRO (1992, 216), however, out of 50.8 billion pesos of cumulative FDI (on an approval basis) from 1988 to 1990, Taiwan ranked second, with 17.4 percent of the total, preceded by Japan (25.3 percent) and followed by the United States (14.8 percent).

In the data for Indonesia, FDI in the mining sector is not included. The result is that the shares of Taiwan and Korea in table 9.8 tend to be overestimated since they have undertaken almost no direct investment in the oil exploration and other mining industries in Indonesia. I owe this point to Hal Hill. For details, see Hill (1988).

Table 9.6 **Structure of Taiwan's FDI: Cumulative Investment from 1959 to 1987 (thousand U.S. dollars)**

	ASEAN	U.S.	Other Regions	Total
Primary industries	638	. . .	4,659	5,297
	(.7)		(8.4)	(1.4)
Manufacturing:				
Light industries	42,421	24,151	12,706	79,278
	(49.2)	(10.4)	(23.0)	(21.2)
Electrical and electronic prods.	9,738	116,406	6,293	132,432
	(11.3)	(49.9)	(11.4)	(35.4)
Other manufacturing	26,040	40,051	12,932	71,851
	(30.2)	(17.2)	(23.4)	(19.2)
Construction and tertiary industries	7,306	52,606	18,636	78,548
	(8.5)	(22.6)	(33.7)	(21.2)
Total	86,143	233,214	55,226	374,583
	(100.0)	(100.0)	(100.0)	(100.0)

Source: Compiled from Republic of China, Ministry of Foreign Affairs, Investment Commission, *Statistics on Overseas Chinese and Foreign Investment, Technical Cooperation, Outward Investment, Outward Technical Cooperation* (December 1988, 1989, 1990).

Note: Figures in parentheses are industry shares in total investment within each region. "ASEAN" excludes Brunei. "Light industries" includes food and beverages, textiles, garments and footwear, lumber and bamboo products, pulp and paper products, leather and fur products, and plastics and rubber products.

Table 9.7 **Structure of Taiwan's FDI: Cumulative Investment from 1988 to 1990 (thousand U.S. dollars)**

	ASEAN	U.S.	Other Regions	Total
Primary industries	5,738	0	300	6,038
	(0.6)	(.0)	(.0)	(.2)
All manufacturing	855,778	712,537	82,766	1,651,092
	(94.2)	(67.2)	(11.4)	(61.1)
Light industries	151,656	189,500	11,512	352,668
	(16.7)	(17.9)	(1.6)	(13.1)
Electrical and electronic products	356,150	173,067	56,031	585,259
	(39.2)	(16.3)	(7.7)	(21.7)
Other manufacturing	347,972	349,970	15,223	713,165
	(38.3)	(33.0)	(2.1)	(26.4)
Construction and tertiary industries	46,649	348,220	644,623	1,044,799
	(5.1)	(32.8)	(88.6)	(38.7)
Total	908,626	1,060,757	727,689	2,701,929
	(100.0)	(100.0)	(100.0)	(100.0)

Source: The same as table 9.6.

Note: See table 9.6.

Table 9.8 Major Suppliers of Direct Investment in Asian Countries (million U.S. dollars)

Recipient Countries	Suppliers: Total	Japan	U.S.	U.K.	Holland	West Germany	South Korea	Taiwan	Hong Kong	Singapore
Investment stock at the end of 1987:										
Thailand	11,536	2,773	1,910	651	422	19	9	675	445	351
	(100.0)	(24.0)	(16.6)	(5.6)	(3.7)	(.2)	(.1)	(5.9)	(3.9)	(3.0)
Malaysia	4,200	1,741	202	879	61	68	. . .	34	262	594
	(100.0)	(41.5)	(4.8)	(20.9)	(1.5)	(1.6)		(.8)	(6.2)	(14.1)
Indonesia	17,284	5,928	1,244	560	851	867	222	144	1,876	299
	(100.0)	(34.3)	(7.2)	(3.2)	(4.9)	(5.0)	(1.3)	(.9)	(10.9)	(1.7)
Philippines	2,830	377	1,620	102	130	. . .	. . .	. . .	. . .	. . .
	(100.0)	(13.3)	(57.2)	(3.6)	(4.6)					
Cumulative investment in recent years:										
Thailand (1988–89)	7,868	4,431	570	250	63	175	66	530	278	408
	(100.0)	(56.3)	(7.2)	(3.2)	(.8)	(2.2)	(.8)	(6.7)	(3.5)	(5.2)
Malaysia (1988–89/90)	3,690	967	179	207	. . .	57	49	1,314	138	231
	(100.0)	(26.2)	(4.8)	(5.6)		(1.6)	(1.3)	(35.6)	(3.7)	(6.3)
Indonesia (1988–89)	11,159	1,304	783	110	572	973	728	1,126	867	489
	(100.0)	(11.7)	(7.0)	(1.0)	(5.1)	(8.7)	(6.5)	(10.1)	(7.8)	(4.4)
Philippines (1988–89)	275	71	98	4	18	. . .	. . .	. . .	. . .	. . .
	(100.0)	(25.8)	(35.6)	(1.5)	(6.5)	. . .	. . .	. . .	. . .	. . .

Source: Calculated from JETRO data.

Note: Original data for Thailand and Malaysia are in local currencies. The following exchange rates have been used for conversion: U.S. $1.00 = 25.07 baht = 2.49 ringgit at the end of 1987; and U.S. $1.00 = 25.7 baht = 2.7 ringgit for 1989 (annual averages). For data on Indonesia, see n. 9 of the text. Ellipses points indicate marginal or zero.

Korean FDI were small, and investments tended to be concentrated in resource development and in commerce and other service sectors aimed at facilitating export activities.

Since the mid-1980s, Korean FDI has been characterized by rapid expansion and by the increasing participation of manufacturing industries. The cumulative FDI for the latest four years (1986–89) amounted to U.S. $968 million, which was twice the cumulative FDI from 1968 to 1985 (U.S. $476 million). The manufacturing sector accounted for only 17 percent of investment stock at the end of 1985, but this share rose to an average of 39 percent during the period 1987–89. As will be seen below, the share of the manufacturing sector has been even higher for Korean FDI in ASEAN countries.

The factors accounting for the expansion of Korean manufacturing FDI since the second half of the 1980s are almost the same as in the case of Taiwan: a sharp rise in real wages, a revaluation of the local currency against the U.S. dollar, and trade conflict with the most important export market, the United States.

Recent trends in Korean direct investment in ASEAN are summarized in tables 9.9 and 9.10. These data illustrate the following features. First, for most ASEAN countries, substantial Korean direct investment began in the most recent two years. In particular, Korea's investment in Thailand and Indonesia was marginal before 1987. Second, with the exception of Indonesia, almost all direct investment in ASEAN has been in manufacturing industries (table 9.9).

Third, within the manufacturing sector, Korean firms tend to invest either in labor-intensive industries, such as foodstuffs, textiles and apparel, footwear and leather, wood and furniture, and other miscellaneous products, or in resource-intensive products, such as chemicals, nonferrous products, and fabricated metals (table 9.10). The first group of industries accounts for about 54 percent of the investment in Thailand, 81 percent in Indonesia, and 60 percent in the Philippines. The share of the second group of industries is high in resource-rich Malaysia. None of the ASEAN countries have received substantial direct investment from Korea's electrical and electronics industry.

These observations suggest that the pattern of Korean FDI in ASEAN has been almost the same as that of Taiwan: expansion in recent years and concentration in labor-intensive and technologically standardized industries. In addition, the average size of investment projects undertaken in ASEAN by Taiwan, Korea, and other Asian NIEs has been much smaller than that of projects undertaken by Japan (Ramstetter 1988; Thee 1990).[10]

10. Some Korean and Taiwanese firms undertaking FDI in ASEAN countries may be Japanese affiliates in those two Asian NIEs. At the moment, however, I cannot confirm this point. However, whether they are Japanese affiliates or pure Korean and Taiwanese firms, my argument is not significantly affected. Even if these firms were Japanese affiliates, their technologies should have been adapted to fit the NIEs' factor endowments. In addition, the management style and other intangible assets of those affiliates may have been largely localized since Japanese ownership in joint ventures in Korea and Taiwan has generally been as a minority. For the case of Korea, see, e.g., Koo (1985, 186–88).

Table 9.9 **Korea's Manufacturing Direct Investment in ASEAN (thousand U.S. dollars)**

	Thailand	Indonesia	Malaysia	Philippines
1973–85	1,871	11,993	26,488	2,009
1986	45	. . .	588	. . .
1987	997	2,349	240	2,062
1988	16,098	23,744	3,301	4,529
1989	13,363	76,383	33,858	8,758
1973–89	32,374	114,469	64,475	17,358
% of total	99.1	33.0	97.1	98.8

Source: Compiled from data in Rhee (1990). Original data were released by the Bank of Korea.
Note: "% of total" means share of manufacturing in total direct investment in all industries.

Table 9.10 **Industry Composition of Korea's Manufacturing Investment in ASEAN (outstanding investment stock as of the end of 1989) (thousand U.S. dollars)**

	Thailand	Indonesia	Malaysia	Philippines
Foodstuffs	. . .	25,685	. . .	. . .
Textiles and apparel	2,903	22,432	. . .	6,723
Footwear and leather	3,684	22,840	. . .	2,809
Wood and furniture	. . .	8,120	2,754	. . .
Paper	. . .	1,520	. . .	. . .
Chemicals	2,118	10,190	10,383	. . .
Nonferrous products	. . .	. . .	25,062	1,000
Primary metals	45	1,278	565	. . .
Fabricated metals	12,770	8,852	25,145	5,894
Other	10,854	13,552	566	932
Total	32,374	114,469	64,475	17,358

Source: See table 9.9.

9.4 The Asian Pacific Region as a Market for New Flows of Technologies: The Pull Factors

The analysis in preceding sections showed that, since the latter half of the 1980s, the Asian Pacific countries have seen intensive flows of production technologies, management skills, and marketing skills. These flows of technologies have been due not only to push factors, such as rising factor costs and rapid appreciation of currencies in the home countries of suppliers (as mentioned in secs. 9.2 and 9.3 above), but also to pull factors in the host countries. In other words, the reasons why Japanese and NIE firms have chosen the Asian Pacific region as a market for their managerial resources are also important. The pull factors in this region can be summarized as follows.

First, the absorptive capacity in Asia has increased considerably. The capacity for technology absorption may be defined as a synthesis of the educational and skill levels of the labor force, the availability of local entrepreneurship, and the government's ability to maintain a stable political and macroeconomic environment.[11]

Table 9.11 suggests a steady improvement in the educational levels of most Asian Pacific countries. It is noteworthy that Korea has by now achieved the same educational level as Japan in terms of both high school and postsecondary enrollment ratios. And, by the mid-1980s, the high school enrollment ratios of most ASEAN countries reached the levels attained by Asian NIEs in the early 1970s. These achievements in education have undoubtedly boosted the capacity of Asian developing countries to absorb foreign technologies. As Rosenberg (1982, 247–49) argued, historically, the countries that were most successful at borrowing technology were those that had well-educated populations.[12]

For other indicators of absorptive capacity, no direct and objective evidence can be shown. However, the perception of technology suppliers itself can suggest to some extent the absorptive capacity of host countries. For example, the positive response of Japanese firms in providing technologies through the OEM channel to Asian NIEs shows their recognition of the technological and management levels of firms in those countries. Regarding the policies of host countries, the capacity continuously to provide a politically and economically stable market environment is critical since this ensures the firms that they are not operating in a risky market; thus, they are more willing to make long-term investments, including human resource development. This relates to the second pull factor.

Second, the investment climate in the Asian Pacific region has been much more attractive, in terms of political and economic stability, than that in other developing parts of the world. In addition, the environment of the region as a whole has been further improved since the mid-1980s, in the sense that the favorable market conditions for foreign investment have spread from one

11. The increase in absorptive capacity by grading up the educational and technological level of the labor force is emphasized by Sekiguchi (1986), among others. Tran (1988) analyzed how Korea's synthetic fiber firms have increased their absorptive capacity and gradually substituted their own capital and technology for foreign resources. At the firm and government levels, the statement made by Vernon (1989, 36–37) is suggestive: "Some of the most critical factors in the successful transfer and application of technology are internal to the receiver of the technology: Internal to the country in terms of the economic and regulatory environment, internal to the firms in terms of the capacities, incentives, and attitudes of managers and technicians, and internal to the industrial structure of the country."

12. In its issue of 27 March 1991, the *Japan Economic Journal* (*Nihon keizai shinbun*) conducted a survey on the perception of top management of Japanese, American, and European firms. According to the results of the survey, the Asian Pacific countries will be considered as a promising investment region in the future, owing mainly to the high quality of the labor force.

Table 9.11 **Educational Level of Asian Countries**

	1965	1970	1975	1980	1984	1986
Japan:						
A	86	91	91	93	95	96
B	12.9	17.0	24.6	30.5	29.6	28.8
Korea:						
A	34	41	56	76	91	95
B	6.2	7.9	9.6	15.0	29.4	32.9
Hong Kong:						
A	34	41	49	64	69	. . .
B	5.4	7.4	10.1	10.5	12.8	. . .
Singapore:						
A	49	46	52	58	71	. . .
B	9.9	6.8	9.0	7.8	11.8[a]	. . .
Thailand:						
A	11	16	26	29	31	29
B	1.5	2.7	3.4	13.1	22.5[a]	19.6[b]
Philippines:						
A	41	49	54	65	68	68
B	18.8	19.8	18.4	27.7	34.1	38[b]
Malaysia:						
A	27	34	44	48	53	54
B	1.9	1.6	2.8	4.3	6.1	6.0[b]
Indonesia:						
A	12	12	20	29	39	41
B	1.5	2.8	2.4	3.9[c]	6.5	. . .
China:						
A	. . .	. . .	46	46	37	42
B	. . .	.1	.6	1.3	1.4	1.7

Source: Compiled from Unesco, *Statistical Yearbook.*

Note: A: high school enrollment ratio; B: postsecondary enrollment ratio. Ellipses points indicate that figures are not available.

[a]1983.

[b]1985.

[c]1981.

country to another and the area with a favorable investment climate has been expanded. In the region under review, we have witnessed that this area has expanded from the NIEs to Thailand in the mid-1980s (Chee 1988) to Indonesia (Thee 1990), and to Vietnam toward the end of the decade (Tran 1991a).

Government efforts to improve the investment climate may stem from a type of demonstration effect in the Asian Pacific region. The successful introduction of foreign managerial resources in a country may encourage neighboring countries to adopt similar policies to improve market conditions. The changes in external economic policies in Indonesia and Vietnam in the late 1980s, for example, may in part be explained by the demonstration effect from NIEs and Thailand.

Third, the Asian Pacific economy has experienced a rapid growth in the past three decades, and, given its current political stability and economic potential, the region has been considered as a growth center of the world. This has generated strong expectations among investors about the opportunities the region will provide. In addition, research on and international conferences about the region's economy have been intensively conducted. These activities contribute to the diffusion of knowledge and information about the economic situation and potential of the region and thus reduce the uncertainties of investment.

Fourth, the cost of the transfer of technology among the countries in the Asian Pacific region can be considered as small. The cost of transfer is not the cost of technology (the licensing fee) itself but a cost generated in the process of transferring a technology from one country to another. This includes communication (telephone, telex, etc.) costs, travel costs (for personnel in charge of the transfer project), and wages paid to the engineers and experts who help the transferees until the project begins its operations. According to Teece (1977), such transfer costs amount to 19 percent of the total cost (including the licensing fee) of the project.

Owing to geographic proximity and cultural affinities, the transfer cost of technologies provided by Japanese and NIE firms to other countries in the region can be considered as small, when compared to transferring technologies to other regions. In addition, for Japanese firms such costs may have declined over time owing to the learning effects of their previous FDI and other technology transfers in the region. For Taiwanese investors, the overseas Chinese networks in Southeast Asia enable them to reduce transfer costs.

Among these pull factors, the most important may be the second one. Political and economic stability is a precondition for firms to undertake FDI. Other factors promote and accelerate such investment. That is why after the Tien-an-men Square incident (June 1989), FDI in China has declined.

To be sure, the United States and some Western European countries have also become major markets for Japanese and NIE direct investment. These countries have indeed provided many pull factors, attracting FDI from East Asia. However, the Asian Pacific region is the single developing area of the world that has absorbed intensive flows of technology and other managerial resources from Japan and the NIEs. What implications will this fact hold for future economic development in the region?

9.5 Technology Transfer and Asian Pacific Dynamism: Implications of Recent Trends

The analysis in preceding sections suggests that, since the latter half of the 1980s, the Asian Pacific countries have seen intensive flows of production technologies, management skills, and marketing skills. Not only has the amount of managerial resources increased substantially, but the types of these resources have also been highly diverse. They include high technologies from Japan's electrical/electronics and other machinery-related industries, managerial resources from Japanese SMSFs, and labor-intensive technologies from Asian NIEs. The NIEs have increasingly played the role of both suppliers (of labor-intensive and standardized technologies) and recipients (of relatively sophisticated technologies from Japan), while ASEAN countries have been in a position to absorb various types of managerial resources.

From the economic development perspective of the Asian Pacific region, we may draw two implications from the trends in technology transfer since the second half of the 1980s. The first implication relates to the quantity or the amount of the flows of technologies, and the second one relates to the content or the structure of those flows.

9.5.1 Promotion of Industrialization by Intensive Flows of Technologies

The industrialization or economic development of a country is the result of many efforts, efforts that are not only economic but also political and social. Considering only the economic aspects, we can identify many indicators that determine the rate of economic growth. Saving and investment may be the most direct and important factors, as the Harrod-Domer model suggests. Industrial and trade policies are other areas that determine the success or failure of economic development. However, the experience of Japan, as well as that of Korea and Taiwan, also suggests the important role of foreign technologies in the industrialization process, even though, depending on policies and general technological levels in each country, the extent of that role and the channels utilized have been different.

The scope of this paper does not allow a detailed analysis of this point. I simply argue as follows. The importation of foreign technologies contributes to the process and the product innovations of recipient countries. The innovations have the following effects on economic development. On the macro level, the innovations result in an upward shift of the production function, which increases the rate of growth more than that of production factors. Moreover, some studies of the Japanese experience showed that the importation of technologies has enhanced domestic investment. This relates to the microeconomic effect of innovations. The availability of technologies enables the start of new industries. The importation of management skills or new organizational methods contributes to improvements in the operation of existing industries.

With these qualifications, we may say that the technology transfers from abroad cannot be a starter, but they can be promoters of industrialization in a country. Therefore, given the increasing absorptive capacity of Asian Pacific countries, the intensive flows of technologies since the mid-1980s may further enhance industrialization in the region. In addition, given the new features of Japanese FDI discussed in section 9.2 above, two related implications can be drawn here. First, since most new Japanese FDI projects have been export oriented, the implication is that new direct investment from Japan will contribute to the development of internationally competitive industries for Asian countries.

Second, since the mid-1980s, Japanese firms have invested in a wide range of industries. In particular, capital goods, intermediate goods, and parts-producing investment projects have increased substantially. This new feature is expected to upgrade, deepen, and broaden the industrial structure of Asian Pacific countries. Their industrial structure is expected to be much more sophisticated, and further industrialization in the region will be facilitated by new investments from Japan.

9.5.2 Facilitation of Asia's Further Industrialization by Increasing Availability of Various Levels of Technologies

Trends since the latter half of the 1980s also suggest that a wide range of different technologies is increasingly available in the Asian Pacific region. In particular, for ASEAN countries and other latecomers to industrialization in the region, many options for technology transfer have been provided, in terms of both supply sources of technology and channels of transfer. In this context, the increasingly strong presence of SMSFs and Asian NIEs as new sources of technologies is particularly noteworthy. This point reminds us of the argument regarding South-South technology transfer in the context of "appropriate technology" or the concept of an "optimal technological gap" stressed by Chen (1985).

The South-South technology transfer hypothesis suggests that the technologies transferred—usually from advanced southern countries to less developed southern countries—are more appropriate since the gap in factor endowments among southern countries is much smaller than that between North and South. The technologies developed and transferred by northern SMSFs also have the same characteristics. Those technologies are usually labor intensive, standardized, and used in small-scale operations. Thus, technologies transferred from SMSFs tend to fit the factor endowments of recipient southern countries.

The concept of an optimal technological gap is a modification of the concept *technological gap* suggested by Gerschenkron (1962)'s "advantages of backwardness" hypothesis. According to the technological gap argument, the greater the relative disparity in development level between a less developed country and more advanced countries, the faster the rate at which the former can catch up. In other words, the rate of technical progress in a relatively backward country is an increasing function of the gap between its own level of technology and that of the advanced countries. However, if the gap is too large, catching up may be impossible since the difference in technological capability is so great that the backward country cannot possibly apply or diffuse the advanced technology. For this reason, Chen (1985) suggested the concept of an *optimal technological gap*. If the gap is within a certain appropriate range, the rate of technical change in the backward region tends to rise rapidly, but the rate will decline along with further expansion of the gap. The level at which the rate of catching up is maximized is the optimal level.

In explaining the continuous spread of industrialization in the Asian Pacific region in the past twenty-five years or so, Kosai (1990, 6–7) pointed to three factors, of which the second is, interestingly, similar to the "optimal technological gap" argument: "(1) The demonstration effect of one country's continuous and easy-to-follow development patterns contributed to that of neighboring countries. (2) *Reasonably varying degree of differences in economic levels* among countries in the region meant each country can easily set a goal, and that the chances of catching-up, and the benefits to be expected from catching up were high. (3) The countries being chased took the development of the late comers as a challenge, and the competition spurred them on to further their own development" (my italics).

From the above discussion, we may hypothesize that the increasing role of SMSFs and Asian NIEs as suppliers of technologies will facilitate further industrialization in the region. In particular, intensive transfer of such tech nologies will help the development of the wide range of small-scale, labor-intensive industries (parts, peripheral products, and other supporting industries) that support the development of large-scale, capital intensive, and technologically sophisticated industries. The promotion of the development of such supporting industries will strengthen the industrial foundation of ASEAN countries and other latecomers in the region.

At the microeconomic level, not all firms within a single country, particularly a relatively large economy that has reached some level of industrialization, have the same level of technology. Most of the members of ASEAN are now countries of this type. In these countries, some relatively large firms, which have accumulated substantial managerial resources, including a large, highly qualified labor force, can efficiently absorb high technologies transferred from large Japanese firms.

In a word, the Asian Pacific region now has access to various sources of technologies. Combined with the increasing absorptive capacity of the countries in the region, the new trends in technology transfer since the latter half of the 1980s are likely to facilitate and promote further industrialization in this region.

9.6 Concluding Remarks

This paper has not touched on some other important aspects of technology transfer in the Asian Pacific region, such as transfer from the United States and other non-Japanese advanced sources, licensing arrangements, plant export, and other non-FDI channels of technology transfer from Asian NIEs. The technology transfer from Japan and the NIEs to China has also not been dealt with in detail. However, the paper has highlighted some important new trends relating to the issues under review. These include the intensive flows of technology through various channels from Japan and more recently from Asian NIEs and the multilayered structure of technological flows involving Japan's technology-intensive industries, small-scale projects by Japanese SMSFs, and labor-intensive industries from Asian NIEs. Combined with the increasing absorptive capacity of recipient countries, the new trends in technology transfer serve to facilitate further industrialization in the Asian Pacific region.

Economic development in the Asian Pacific region in the past twenty-five years or so can be viewed as a catching-up process by latecomers to industrialization. Korea, Taiwan, and other NIEs have attempted to catch up with Japan since the 1960s, starting with labor-intensive industries and then expanding to capital and technology-intensive industries. ASEAN countries and China have more recently joined this process by attempting to catch up with Asian NIEs in industries producing labor-intensive products. With the new trends in technology transfer discussed above, we may expect that such a multilayered pursuit process will be further promoted in the 1990s. Given the current economic reforms and open-door policy in Vietnam and the positive response of Asian NIEs to the country's new foreign investment law (Tran 1991a), it is very likely that Vietnam will join this multilayered pursuit process as part of the lower stratum of the region's industrialization.

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Comment Takatoshi Ito

Tran Van Tho's paper describes and analyzes technological transfers from Japan and from Korea and Taiwan to Asian countries. The paper serves four purposes. First, it describes "facts," namely, types of technological transfers (FDI, licensing arrangements, OEM), time series of FDI, destinations of FDI, FDI by industry, and size of firms. Second, the paper attempts to analyze reasons for those facts. Third, FDI from Korea and Taiwan to other Asian countries is documented. Fourth, the paper derives implications for economic growth from technological transfer. It is a nice paper, highlighting Japanese investment in Asia.

This paper documents FDI, licensing arrangements, and OEM, with an implicit assumption that they represent technological transfers. However, FDI etc. are only proxies of technological transfers and may not be necessary or sufficient for technological transfers in a rigorous sense: even if factories are built, the Japanese management may not be willing to train workers in a host nation (a frequently heard complaint); and, even if a factory is not built, technical assistance could be sent so that know-how may be provided. The reader should be reminded of this qualification.

Tran's paper invokes many interesting questions. I feel that the following issues deserve more attention in future research on Japanese foreign direct investment.

Obviously, there may be conflicts between Japanese firms and host countries. Japanese firms may want to limit technological transfers by not training managers or by refusing to reveal contents of key components. Japanese firms may also restrict the sales of assembled goods, preventing them from coming back to the Japanese market to harm the parent company. (An example is that a Japanese electronics company put restrictions on sales to the U.S. market when it provided technology for videocassette recorders.) On the other hand, recipient countries would want to maximize transfers by restricting the type of FDI. They may allow joint ventures, barring 100 percent subsidiaries; they may insist on a licensing agreement.

In other words, Japanese (or Korean and Taiwanese) parent firms maximize their profits by FDI (limiting the amount of transfers), while the recipient countries maximize their profits by learning (sometimes copying or stealing) technologies. Hence, technological transfers have to be placed in the context of a trade-off between these two possibly conflicting maximizing agents. How are these conflicts resolved in the actual cases of East Asian countries?

Reasons why FDI to Asia increased rapidly should be discussed in a separate section, carefully differentiating "pull factors" and "push factors": (i) looking for cheap and abundant labor; (ii) exchange rates; (iii) political stability; (iv) economic stability; (v) educational level; and (vi) changes in

Takatoshi Ito is professor of economics at Hitotsubashi University and a research associate of the National Bureau of Economic Research.

regulations concerning capital controls. The reader should ponder which ones were most important. Note that some of the push and pull factors may have a multiplier effect. Technological transfers enhance economic progress, which in turn yields political progress. Note that Japanese FDI to the United States increased more than FDI to Asian countries.

As an implication of technological transfers, the paper points out that technological transfers propel industrialization. However, technological transfers are only one factor in industrialization. Saving and investment and monetary and fiscal policies may be more important. One important question in the theory of economic development is how great a difference technological transfers make. Would such transfers make growth faster, allowing foreign capital to come in (with, one hopes, technological transfers)? Or would it be better in the long run to nurture domestic infant industries (avoiding "rents" being siphoned out)? Korea's development seems to have more of the former element than Japan's did.

Comment Bih Jane Liu

Foreign direct investment and technology transfer have not been the focus of my research for the past several years. Thus, as the commentator on this very interesting and informative paper, I shall only mention several points that might need further clarification.

The first question is related to the relation between foreign direct investment and technology transfer. In this paper, the author uses the amount of foreign direct investment as the proxy for the amount of technology transfer that comes along with foreign direct investment. This usage might create inaccuracy problems because the extent of technology transfer that could be brought up with foreign direct investment also depends on other factors such as the attitude of investors toward technology transfer.

According to table 9.6, the accumulated amount of foreign direct investment from Taiwan to Southeast Asia is U.S. $86 million for the period 1959–87. But other data sources indicate that the investment in Thailand alone by Taiwan in 1987 had already reached U.S. $299 million. This wide difference might imply that the investment data used in this paper are seriously underestimated. This underestimation, I suspect, comes from the utilization of the investment data collected by the Investment Commission of the Ministry of Economic Affairs, and the Investment Commission's data are widely believed to be underestimated. This is because, unlike large Taiwanese investors, who tend to report their foreign investments to the Investment Commission in order to get assistance for their foreign endeavors, small Taiwanese investors

Bih Jane Liu is professor of economics at National Taiwan University.

are reluctant to report such investments since the review process is time consuming.

Tran argues that, according to the South-South technology transfer hypothesis and the theory of the optimal technological gap, increasing participation in foreign direct investment by small and medium-sized Asian firms is to the advantage of Asian developing countries in their pursuit of technology transfer and industrialization. However, on the contrary, it could also be argued that small and medium-sized firms, when compared with large firms, are often more conservative in transferring technology, which, in any case, may not embody the latest standards and designs that host countries seek. This means that the increasing participation of small and medium-sized firms in foreign direct investment might not be as helpful as the author expected in speeding technology transfer and thus the industrialization of Asian developing countries. As a matter of fact, the increasing participation of small and medium-sized firms in foreign direct investment was driven by their smaller profit margins, and investment abroad seems to be the direct solution to their increasing labor costs and the appreciation of their own currencies.

It seems to me that the author has been quite optimistic about the contribution of technology transfer to the industrialization of host countries. However, this contribution depends not only on the labor quality of the host countries, as the author has emphasized in this paper, but also on the backward and forward linkage effects and dynamic externalities such as learning by doing or learning by producing. Without these linkage effects and dynamic externalities, we might have the case proposed by McCulloch and Yellen (1982). That is, when one country enjoys clear technological superiority in one sector while in others its technology is the same as other countries, then capital mobility between these two countries can serve as a substitute for technology transfer. This implies that, as long as capital is perfectly mobile internationally, the extent of technology transfer has no effect on employment, income distribution, or national welfare. In such an extreme case, intensive inflows of technology are neither a necessary nor a sufficient condition for further industrialization, that is, not as the author has asserted.

Finally, one issue that has not been mentioned clearly in this paper is the resemblance of foreign investment patterns between Japan and other Asian newly industrialized economies (NIEs). It was observed that Taiwan and South Korea were basically following the earlier patterns of Japanese foreign investments. However, we do not know whether such resemblances in investment patterns between Japan and Asian NIEs still exist in the 1980s. Another interesting phenomenon left unexplained in this paper is that, according to table 9.2, the share of foreign direct investment by Asian NIEs in manufacturing industries is decreasing while the share of Japan is increasing.

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