

Japan's Role in Technology Transfer in Philippines (A preliminary Study on Japanese Technology Transfer to The Philippines)*

*Jose Antonio R. Tan***

I. INTRODUCTION

As in any other economy, technology plays a key role in the development of the Philippine economy. Technology can be sourced from within borders through the development of indigenous technology, or from across borders through international technology transfer. Kakazu (1990) pointed out that Asian developing countries have heavily depended on transferred technologies.

The role of international technology transfer in economic development has been gaining much attention in the recent years. The adoption and adaptation of appropriate technologies have been recognized as a solution to the continued underdevelopment of developing economies. Today, the need for technology transfer is further emphasized with the increasing integration of the global economy. The move toward freer trade and stronger market linkages has introduced more competition in international markets. Hence, in order to remain competitive in the global market, it becomes imperative for an economy to develop or acquire new and appropriate technologies.

Relevant to international technology transfer is technology sourcing and compatibility. Technology is highly dependent on locational and economic conditions. Its most common sources are the industrialized countries. Of these, Japan may be of great interest to the

* Commented by Dr. Wisarn Pupphavesa, Director, Asia-Pacific Economic Relations Project TDRI.

** Institute for Development Studies (PIDS), Philippines.

developing Asian nations, such as the Philippines, since the economic activity is now moving toward the Pacific Rim, where Japan is the hub. Moreover, Japanese technology may be more compatible with the industries of Asian countries.

The literature on technology transfer to the Philippines is not extensive. Much of the research done on it has been subsumed under researches on foreign investment on the grounds that the inflow of foreign investment automatically leads to the inflow of technology. Questions on the quality of technology have more often been left unanswered, if not totally ignored. And while technology transfer has been included in researches on Philippine development, the discussion has been confined to its periphery only.

If the literature on technology transfer to the Philippines is wanting, the research done on Japanese technology transfer to the Philippines is almost nil. The same is generally true for the transfer of technology by other nationalities.

This paper is an exploratory study of Japanese technology transfer to the Philippines. Hence, the conclusions reached may be limited and are expected to be improved by further studies. The second section of this paper deals with the theoretical aspects of technology transfer. The third section discusses technology development in the Philippines as well as the policy environment for technology transfer. The fourth section looks into Japan's role in technology transfer into the Philippines. The last section presents the conclusions.

II. THEORETICAL ASPECTS OF TECHNOLOGY TRANSFER

A. The Concept of Technology and Technology Transfer

There are several definitions of technology. The 1991 World Development Report describes technology as the knowledge that leads to improved machinery, products and

processes. Merrill (1968) defines it as all the skills, knowledge and procedures for making, using and doing useful things. Stewart (1979) defines it as the knowledge of how to do and make useful things. Kakazu (1990) refers to technology as a collection of production techniques, know-how and skills which transform inputs into outputs.

A concise conceptualization of technology will have two components: hardware and software. Hardware refers to the capital goods and production processes and designs needed to produce marketable products. Software pertains to the capacity to properly use the hardware. This includes the knowledge of how to run the hardware and the managerial skills in handling the entire operations.

There are two sources of technology. The first source is the indigenous technologies that are developed from the research and development activities of a country's government or domestic private sector. The other source originates from outside the borders; i.e., imported or transferred technologies.

Technology transfer would then mean the transmission of technology to suit local conditions, with effective absorption, adaptation and diffusion from one country to another (Kaynak 1985). Lindsey (1985) points out that there is a difference between transport and transfer of technology. Transport of technology pertains to the movement across borders, while transfer, in addition, implies control over the technology.

B. Channels of Technology Transfer

Trade in technology is similar to trade in commodities--there exist a seller and a buyer. In technology transfer, the seller is called the sender and the buyer, the receiver. There are no limitations to the type of agents; they may come from either the government sector or the

private sector.

The channels or vehicles for technology transfer can be dichotomized according to the sender's equity participation; namely, (1) channels with equity participation; and (2) channels without equity participation. Channels with the sender's equity participation are in the form of direct foreign investments or joint ventures.

Direct foreign investment means the establishment of a wholly-owned or majority-owned corporation in the receiving country. One of its distinct features is that it involves not only a transfer of resources but acquisition of control as well (Krugman and Obstfeld 1988). Joint ventures, on the other hand, refer to arrangements wherein foreign entities form partnerships with domestic entities. They are engaged in either a private-to-private, government-to-government or government-to-private agreement.

Technology is transferred through these channels when the parent/investor corporation provides the subsidiary/affiliate or joint venture with their production design. The presence in the production process of technical experts from parent/investor companies can facilitate the process. Technology can also be transferred through the purchase of imported equipment in supply arrangements with parent/investor corporations, or through training programs conducted by the sender either in the host-country or in the sender's home country.

Research and development activities conducted by the subsidiaries/affiliates or joint ventures with assistance from their principals is another form of technology transfer. In some cases, subsidiaries/affiliates or joint ventures enter into licensing agreements with their parent corporations or foreign principals.

It is only in extraordinary circumstances that technology is freely available. In channels

with equity participation, payment for the technology usually comes in the form of profit remittances from the subsidiary/affiliate or partner in the joint venture to the parent or investing foreign entity.

Technology transfer may also be effected without any equity participation from the sender. As in any commodity, technology can be sold either directly or indirectly. Direct technology sales would be in the form of technology licensing agreements, technical collaboration agreements, process patents, management contracts and franchising. In contrast, indirect technology sales are agreements on the licensing of a specific technology's output thus giving the licensee control over such technology. This way of control comes in the form of product patents, trademarks and marketing agreements. Payments for the access to technology include technology fees, licensing fees and royalties.

C. Technology Packaging

Technology packaging is the manner by which the sender puts together the transferred knowledge. The most packaged form of technologies are those associated with direct foreign investment, while the least packaged form is the purchase of capital goods and other inputs. Technologies associated with joint ventures and licensing agreements are considered intermediate forms (Stewart 1979).

The packaging depends on the degree of the transferred technology relative to the technological capability of the host country. The entry of sophisticated (high) technology into developing countries entails a high degree of packaging since the technological capability of these countries is likely to be low.

D. Determinants of Choice of Transferred Technologies

Since the transfer of technology involves a sender and a receiver, the choice of technology would depend on: (1) the absorptive capacity of the receiver; (2) the willingness of the sender to transfer technology; (3) the destination of the production output; and (4) the policy environment in the host country.

The absorptive capacity of the receiver refers to his ability to assimilate the transferred technology. There are two factors in determining the absorptive capacity. First is the science and technology potential of the receiving country; that is, how prepared it is to accept the technology. Second is the receptiveness of the receiver to the newly transferred technology. Here, cultural considerations and work ethic come into play.

As for the sender's behavior, one has to consider the degree of control that the sender is willing to surrender to the receiver upon transfer of the technology. After all, the application of new technology, indigenous or transferred, often leads to a positive economic rent that, in the case of technologies transferred, has to be allocated between the sender and the receiver. Naturally, each party will want the larger share of the rent.

Since international technology transfer will necessarily entail technological dependence, the allocation will largely depend on the degree of such dependence. The more technologically dependent is the receiver, the larger will be the portion that accrues to the sender. There is then an incentive for the sender to retain proprietary rights over his technology and limit its transfer to the receiver.

On the other hand, the receiver or the host government will want substantial control over the technology not only to have a greater share of the economic rent but to allow innovation,

mastery and diffusion of the technology as well. In the long run, it is always desirable for the host country to be technologically independent. The level at which the degree of control will balance itself depend on the bargaining power of the players of the transaction.

The type of technologies that will be transferred largely depend on the destination or target market of the output. Specifically, the maturity of the technology used is positively related to the income level of the target market. Output destined for developed economies will use fairly new technologies, while output intended for internal markets of developing economies (usually for import-substitution) will apply mature technologies.

This sender-receiver relationship in technology transfer is contingent on the host country's economic as well as science and technology policies. The prioritization and coordination among these policies determine the most appropriate technology that will flow into the host country. These policies also reflect the host country's commitment to support the development of these technologies.

E. Assessing Technology Transfer

Since technology is a qualitative variable, a quantitative analysis of its transfer is helpful but insufficient. While such type of analysis provides information on the destination, source and the prevalent mode of transmission of technology, it cannot adequately assess the technology's welfare-improving effects. For quantitative analysis to achieve the last goal, it is necessary for the researcher to know the productivity of each specific sector where technology flows in and impute the welfare effects. However, this is again difficult and can be unreliable. Hence, a qualitative analysis of the transferred technology is more effective.

Based on the research of Stewart (1979) and Lindsey (1985), the quality of technology

transfer can be assessed through the evaluation of four properties, namely: (1) completeness; (2) appropriateness; (3) diffusion; and (4) mastery.

Completeness pertains to the extent of transfer of the technology to the receiver. Given that T is the technology to be transferred, T^* is the knowledge of the sender regarding T , T^A is the knowledge of the receiver of T after the transfer, and t is the transfer period, the transfer is said to be complete if at the end of t , $T^* = T^A$. This implies that technology transfer is only complete if there is no disparity between the receiver and the sender on the use of the technology; if the receiver can use it without ongoing assistance from the sender. An indicator for completeness will be the degree of control that the receiver has over the technology.

It is important to recognize that "completeness" must always be evaluated relative to the kind of technology that must be transferred. Take for example, the transferred technology that involves the assembly of motorcycles, excluding the production of motor and train drives. If the activity is undertaken entirely by the host country nationals, then the transfer is complete. However, if the relevant technology is motorcycle manufacturing, the transfer is still incomplete (Lindsey 1985).

However, transferred technologies that may be complete do not always guarantee welfare improvement for the host country. The property of appropriateness is important since it deals with the suitability and adaptability of the said technologies with the state of the economy. Stewart (1977) defines appropriate technology as "the set of techniques which make use of available resources in a given environment."

It has been pointed out many times that technology is location specific. Technology which thrives in certain places may fail to in other areas. The application of inappropriate

technologies is detrimental, especially in the long-run. An important consideration here is the input requirements of the technology, i.e., whether it will make use of indigenous inputs; whether it is labor-saving or labor-absorptive; whether the output will suit the markets they are intended for.

Appropriateness pertains not only to technological suitability but also to affordability. The cost of a technology depends on its packaging. The higher the degree of packaging, the higher will the cost of a technology be.

The benefits of any transfer across borders will be maximized if these technologies are diffused within the economy. A higher degree of technological diffusion is always preferred. The extent of such diffusion, however, depends on two factors; namely, (1) degree of packaging; and (2) labor mobility across firms and industries.

Diffusion of the hardware is highly dependent on the sender's control over the technology through the restrictive clauses in licensing agreements or the sender's equity holding. The higher the degree of control of the sender, the less likely will the hardware be diffused. The diffusion of software, on the other hand, depends on the movement of labor across firms or industries. Disincentives for movement of labor mean minimal diffusion of software.

The last property that must be examined is technological mastery. This pertains to the capacity of the receiver to adapt and further develop the acquired technology, and from this, create a new one. It includes reverse engineering, wherein the technology would be disassembled, studied, and imitated. The acquisition of transferred technology must not lead to de-skilling, unless the skills to be unlearned are totally obsolete.

III. TECHNOLOGY AND POLICY ENVIRONMENT

A. The Philippine Manufacturing Sector

The total productivity of the Philippine manufacturing sector has been declining for decades. Estimates show that the total factor productivity growth in manufacturing averaged -0.7 percent during the period 1956-1970, -2.2 percent from 1971 to 1980, and around -2.5 percent to -3.0 percent in the period 1980-1983 (Hooley 1985). While there are indications that productivity improved during the period 1984-1989, such increase nonetheless, is tempered by its substantial decline from 1980 to 1983 so that overall productivity declined during the 1980s.

The sector's productivity performance of the Philippine manufacturing sector contrasts sharply with the steady productivity growth in the ASEAN and East Asian countries, contributing in part to the loss of international competitiveness of Philippine manufacturing products. The sector's poor productivity growth also explains its historical fragility and vulnerability to shocks as well as its very low labor absorption capacity.

A striking feature of the Philippine manufacturing sector, which is also a key reason for the sector's low and declining productivity, is its factor intensity. The Philippines is a labor-abundant country; hence, the appropriate technology and industrialization strategy is labor absorptive. Compared with its Southeast Asian neighbors--Thailand, Indonesia and Malaysia--the Philippines has been pursuing a more labor-saving industrialization, however. The share of labor absorbed by its manufacturing sector exhibits a declining trend although the sector's share in Gross Domestic Product (GDP) is increasing (see Figure 1). Moreover, the slow increase in the share of manufacturing indicates that the labor-saving technology and industrialization strategy adopted has failed to substantially develop the sector.

B. Gaps in Technological Capability

The Philippines has a high science and technology (S&T) potential (De Dios 1992). Table 1 shows that the Philippines has the highest latent number of scientific and technical personnel in the ASEAN, the newly industrializing economies (NIEs) and South Asia, except for India. In terms of such type of personnel per 1,000 of population, the Philippines has the highest ratio in the Southeast Asian region. However, this potential has not been tapped to benefit the S&T sector (see Table 2). The research and development (R&D) effort has been very lukewarm. R&D expenditures as a percent of GNP has declined from 0.26 percent in 1980 to 0.11 percent of GNP in 1990. Table 2 further shows that the personnel engaged in R&D declined from 17,992 in 1982 to 6,876 in 1987. The stunted growth of technology in the Philippines is further substantiated by statistics which show that the share of patents granted to local inventors has an inverted-U trend since 1977 (see Table 3). The share of local inventors increased from 41.9 percent in 1977 to 50.1 percent in 1980, but declined by more than half to 23.5 percent in 1990.

R&D efforts in the Philippines has been concentrated on government R&D. De Dios (1992) observed that the private sector accounted for an average of 10 percent of total R&D expenditures only from 1987 to 1990. Given the public sector's tight budgetary constraints in the near future, the tendency to rely heavily on government for R&D may slow down S&T development in the country.

It is apparent from the preceding discussion that the Philippines has been underutilizing its high S&T potential. Because of the weak productivity and growth performance of the industrial sector and sluggish development of indigenous technology, there is a need to rely more on technology transfer into the country through the private sector.

C. Experience in Technology Transfer

Much of the research on technology transfer to the Philippines does not make any distinction according to source country. Nonetheless, these studies may still provide some insights on the possible impact or non-impact of Japanese technology transfer.

Lindsey (1981), in a survey of the literature on foreign investments, looks into technology transfer practices of transnational corporations (TNCs). His major findings are: (1) most of the equipment brought in by investors are already in use in the Philippines; (2) R&D activities are limited mostly to quality control instead of basic research; (3) there is minimal diffusion of technology to local firms; and (4) the processes used are very simple leaving little room for skills development. From these findings, Lindsey concludes that there was little technology transfer by the TNCs to the Philippines.

De Dios (1992) conducted a study of technology transfer by TNCs in export processing zones (EPZs) and science parks. In his study he finds that the prevalent vehicles for transfer were direct foreign investment and subcontracting arrangements. The equipment used by the firms in the EPZs were relatively new. He attributes this to the firms' export-oriented products. However, he adds that the newness of the equipment does not necessarily mean that the machines are sophisticated. TNCs can break down their high technology industries into smaller processes which may require low technology; these low technology processes require minimal skill. He further notes the low proportion of technical personnel to total employment in the EPZs and the low R&D effort of the TNCs within the special zones. De Dios concludes that "except for a few exceptions, the magnitude of technology actually transferred and mastered is quite limited."

D. Policy Environment

The policy environment plays a crucial role in determining the appropriateness of international technology transfer. Theoretically, the technologies flowing into an undistorted economy are appropriate. The absence of distortions in both good and factor markets makes the transmission of correct signals to the international carriers of technology possible.

Market forces screen the inflow of technology. If market forces are functioning efficiently, the technology brought in by investment inflows are likely to be appropriate. Hence, the first best approach to attracting appropriate technology is to adopt a vigorous investment promotion policy combined with policies that will remove potential market distortions.

The Philippine government has taken positive steps to make the economy more conducive to the transfer of appropriate technologies. With the enactment of the Foreign Investment Act of 1991, the system of identifying areas where foreign investments are allowed was drastically changed. Previously, foreigners can only invest in areas identified by the government. Now, all areas, except for the few listed in the negative list, are opened to foreign ownership. This virtually opens the country to foreign investors.

The Omnibus Investment Code of 1987 (OIC) grants incentives in the form of duty free importation, tax credits and tax exemptions to investments in areas identified as preferred areas of investment. Furthermore, the government has taken steps to improve the physical infrastructure, which has long been considered by foreign investors as inadequate, by adopting the Build-Operate-and-Transfer (BOT) Law. Since the development of infrastructure is hampered by the government's budgetary constraints, the BOT allows the private sector to build public infrastructures and operate them for profit, with the condition that the facilities shall

eventually be transferred to the government.

Together with these vigorous efforts to attract more investments, the government has moved to eliminate market distortions. Import liberalization and tariff reforms were effected to restructure and rationalize the industrial sector. It is expected that with the full implementation of these programs, the distortions in the allocation of factors for production among industries will be minimized.

Foreign exchange deregulation is also in progress, and with it, the distortions arising from artificially maintained exchange rates will disappear. Only then will the international competitiveness of Philippine products be truly reflected.

Aside from its attempts to achieve an open and less distorted economy, the Philippine government has taken an active role in technology transfer. It now realizes the need to develop the S&T sector (De Dios 1992). In 1989, the Cabinet adopted a science and technology master plan (STMP). One of the strategies in the Plan is to modernize production through technology transfer by diffusing mature technologies developed by the public sector. Also to improve the S&T potential, the STMP calls for the development of high-quality S&T manpower by improving the curricula of the engineering and science courses and strengthening their institutions. Since the STMP efforts are financed mostly by the treasury, the full and efficient implementation of these strategies is limited by the government's budgetary constraints. Thus, to induce the private sector to engage in S&T activities, investors in S&T development are granted incentives under the Omnibus Investment Code (OIC).

However, it is worth noting that since all these policy adjustments have been implemented only recently, their full impact is yet to be felt.

The Philippines is yet to see a selective technology transfer policy that will ensure a complete, diffused and mastered technology transfer, especially in strategic areas. To date, technology transfer is regulated by the Bureau of Patents, Trademarks and Technology Transfer (BPTTT) of the Philippine Trade and Industry Ministry. The bureau evaluates the technology transfer agreements transacted in the country. Under its rules and regulations, clauses in the contract that restrict the transfer of technology and encourage technological dependence are prohibited. However, the power of the BPTTT is only limited in cases where a contract exists. The transfer of technology between firms may take place without the necessity of a technology contract. Therefore, under such cases, the powers of the bureau do not apply. The technology that is transferred may, instead of being benefiting the receiver, lead to welfare loss (e.g., technological dependence).

IV. JAPAN AS THE SOURCE OF TECHNOLOGY

The development of technological linkages of Southeast Asian countries with Japan must not be overlooked. There are several reasons for this, foremost of which is that the Japanese, in their initial stages of development, adopted labor-absorptive and energy-saving technologies. This pattern of development is suitable for the developing Southeast Asian countries. In addition, the geographic and cultural proximity (at least for some SEA countries) is a built-in advantage. As Hieneman *et al.* (1985) stated, Japan is the "natural source" of technology for the SEA region.

A. The Philippines in Japan's Investment Sphere

Toward the end of the eighties, Japan has become the main source of the Philippines'

investment inflows. In terms of annual investment flows, Japan has already overtaken the U.S. as the top investor, although the stock of U.S. investment, much of which entered the country in previous decades, is almost thrice that of Japan. The share of Japanese investments to total investments has been increasing, from 5.9 percent in 1983 to 45.4 percent in September 1991. On the other hand, the share of the U.S. investments has declined secularly from 71.2 percent in 1983 to 19.9 percent in September 1991 (see Table 4).

Although Japanese capital flow to the Philippines has been increasing, the Philippine effort to attract Japanese investment *vis-à-vis* the ASEAN countries is lackluster. Lim (1988) reports that among ASEAN nations, the Philippines received the smallest share of Japanese investments. This statement remains true today. Table 5 shows that the Philippines ranks last among the ASEAN-4 countries since 1982. The 1951-1989 cumulative Japanese investments tells the same story. In a 1986 survey on Japanese direct investment conducted by the ASEAN Promotion Centre of Trade, Investment and Tourism, the Philippines was the least preferred among the ASEAN members.

With regard to the pattern of Japanese investments in the Philippines, Table 6 indicates that most Japanese corporations prefer less equity participation in their investments in the Philippines. During the period 1986-1991, 167 Japanese investments were in the form of joint ventures with Filipinos; 98, in subsidiaries; and 21, in wholly-owned corporations.

Japanese investment in the Philippines is highly concentrated in metals and engineering, construction and electronics and telecommunications during the period 1986-1991. Investments in metals and engineering amounted to ₱4.9 billion and much of it (₱4.0 billion) was in the automotive subsector. Investment in electronics and telecommunications was valued at ₱3.2

billion, with computer software, hardware and services taking ₱2.4 billion. Construction had ₱2.3 billion invested in it, with ₱1.7 billion going to glass and ceramic products. A closer look at the data indicates that the Japanese tend to prefer more equity control in their large investments. The modality of the investments in automotive, and glass and ceramic products is in the form of majority-owned corporations while the modality of investments in computer software, hardware and services is in wholly-owned corporations.

B. Characteristics, Patterns and Suitability

Japanese technologies are known to maximize the use of capital goods (machinery and equipment) and savings of raw materials. In Japan, a three-workshift system is commonly used and there is constant R&D to improve the utilization of equipment. With the high cost of imported raw materials, Japanese technologies are geared toward cutting production costs while improving product quality.

The Japanese manufacturing sector is characterized by small and medium enterprises (SMEs), constituting 90 percent of the enterprises in the sector and employing 80 percent of the sector's total employment (Phongpaichit 1988). It is also the practice of large Japanese conglomerates to subcontract production to these SMEs. It is worth noting that the SME-based structure of production is highly compatible with that of developing Southeast Asian nations.

A cumulative direct investment of Japanese companies of 39.4 percent during the period 1951-1989 went to areas outside the developed regions, North America and Europe (Aoki and Bando 1991). Ozawa (1985) pointed out that the majority of Japanese manufacturing investments is concentrated on low technology standardized products. Hence, the technologies transferred to developing countries are the labor-intensive intermediate type. These technologies

might be considered obsolete in Japan but still appropriate for developing countries.

Japanese capital prefer entering into joint ventures with domestic entities in developing countries, and in fact, they even accept minority ownership. Around half of Japanese manufacturing ventures in Asia are participated by SMEs. Being small, SMEs prefer joint ventures to limit their exposure to the political risks in developing countries.

Such preference for joint ventures is true for Southeast Asia (Hieneman *et al.* 1985; Lindsey 1985; Ng *et al.* 1986). Since technologies brought by the Japanese investments in the Southeast Asian region are labor-intensive, the transfer requires personnel training, the extensiveness of which depends on the level of sophistication of the technology. It has been pointed out that the language barrier made Japanese corporations favor the "learning-by-doing" approach in transferring technical skills (Hieneman *et al.* 1985).

In terms of cost, Santikarn (1980) reported that the technology brought by the Japanese in Thailand were less costly than those brought by other sender nations.

All these indicate that the Japanese technologies are suitable for the Southeast Asian region. The question now is whether the Philippines is an exception or not.

C. Reasons behind Japanese Technology Outflows

Japan's attempt in technology and investment export is relatively new compared to the U.S. and Western Europe. In fact, Japan was still at the receiving end of technology transfer during the early post-war period.

The factors affecting Japan's technology outflows can be attributed to both macroeconomic pressures and its government's policy. Its fast economic development led to labor shortages and rising wages. In addition, the yen appreciated *vis-à-vis* the U.S. dollar.

Japanese corporations had to find labor to operate their plants and cut their costs. Relocating plant operations was, however, a more profitable option than importing labor. When the yen strengthened, it affected the export performance of Japanese manufacturers by making Japanese goods unattractive to international markets. Hence, relocation in economies with weak currencies gained ground. Also, when protectionism against Japanese products increased, especially in developed countries, Japanese producers had to relocate inside their target markets to circumvent the countries' protectionist policies.

Aside from the macroeconomic factors, Japanese government policies also encouraged technology exports by providing/encouraging technology export financing, export insurance on technology exports and tax credits on income from technology exports (Hieneman *et al.* 1985).

D. Japanese Technology Flows to the Philippines

1. Vehicles of Technology Transfer

The Japanese preference for less equity participation on their investments necessitates the use of technology contracts in transactions involving technology transfer. This guarantees remuneration for the technology transferred into the country.

Statistics on technology transfer agreements from the BPTTT show that the Philippines is still highly dependent on the U.S. for technology. Japan was its number two source of technology. As of 1990, the number of technology transfer agreements with the U.S. was 2.6 times that with Japan. Moreover, the number of technology transfer agreements during the period 1986-1990 with the U.S. was 2.8 times that with Japan (see Table 7). Considering that Japan has emerged as the lead investor in the Philippines in the late eighties, more Japanese technology may be expected to enter the Philippines.

The data also shows that the Japanese use joint ventures as a major mode of technology transfer (see Table 8). Contrary to the results of studies on Japanese technology transfer to the SEA region, the BPTTT figures prove that the Japanese also prefer licensing agreements in the Philippines, and is, in fact, slightly more prevalent than joint ventures. Such preference for licensing agreements may be indicative of their hesitancy to invest in the Philippines *vis-à-vis* other Southeast Asian nations. Nevertheless, joint ventures and licensing agreements are advantageous for the receiver of technology transfer since they allow more participation on the part of host country nationals.

The use of joint ventures and licensing agreements has two implications. First, Filipinos, as receivers, may have realized that they have the capacity to use, adapt or further develop the technology. Second, the sender's willingness to relinquish any control over certain technologies indicate that such technologies transferred are obsolete in Japan. There is, however, nothing wrong with this last implication as long as the technologies are still appropriate for the Philippines. Finally, the prevalence of technology transfer agreements without any Japanese equity participation implies that the Japanese are carrying on their practice of subcontracting.

However, the use of data on technology transfer agreements has its limitations. The smaller number of contracts with wholly- and majority-owned firms does not imply that there is less technology transferred through these vehicles. The transacting parties might simply have found no need for technology contract between a parent company and subsidiary/affiliate since the former already possesses substantial control over the latter.

2. Distribution of Technologies

Where are transferred Japanese technologies in the Philippines directed? There are two

possible sources that indicate destinations of Japanese technology, namely, the distribution of technology transfer agreements (Table 9) and the distribution of Japanese investments (Table 6). Japanese technology transfer agreements are largely concentrated in the metal-based (e.g., automotive, electrical machinery and appliances) and chemical-based industries. This is supported by the investments data which show that these two industries are among the Japanese's preferred investment areas. From 1986 to 1990, 38 and 14 agreements were closed in the metal-based and chemical-based industries, respectively. The bulk of the agreements in the metal-based industry are on the manufacture of motor vehicles, numbering 12 from 1986 to 1990. This is not surprising since Japanese vehicles visibly dominate the car and truck markets in the Philippines. A number of technology transfer agreements were also reached in the manufacture of electrical machinery and appliances.

The concentration of Japanese technology in the metal-based and chemical-based industries may not be favorable to the Philippines for two reasons. First, these industries, especially the metal-based industries, tend to be import substituting industries. Import substituting industries are highly protected industries whose products are for domestic consumption. It can be observed that the output of the Japanese preferred industries are generally intended for the domestic market, e.g., automobiles and chemical-based products. At the same time, the protection accorded to these industries are relatively high. Sumulong (forthcoming) estimates a 400 percent effective protection rate (EPR) for transport equipment, 206 percent EPR for electrical machinery, 168 percent EPR for metal fabrication and 104 percent EPR for chemical and chemical products. Second, these industries are highly dependent on imported inputs; hence, the local value added is likely to be low. The industries' import

dependence also makes the production of their output costlier which reduces the comparative advantage in these products. It may turn out cheaper for the Philippines to import these commodities than have them locally produced.

3. Inflow of Japanese Capital Goods

Capital goods are embodied technologies; hence, the import of capital goods is a form of technology transfer. In fact, capital goods purchase is considered to bear a low degree of packaging. The Philippines' major sources of capital goods are the U.S. and Japan (see Table 10).

During the period 1975-1985, the U.S. and Japan alternated as the Philippines' lead supplier. Starting 1986, however, Japan has consistently been the leading source of major capital good imports such as non-electrical machinery and equipment, and road and transport equipment. The third major category, telecommunications and electrical machinery were primarily sourced from the U.S. until 1989. In 1989, Japan became the major source in all the three categories of capital goods.

4. Quality of Transferred Technologies

A survey was conducted to have an idea of the quality of Japanese technology transfer to the Philippines.¹ The respondents were chosen from industries where Japanese investments are heavily concentrated, namely: automotive, motorcycle, electronics, basic chemicals, chemical-based and basic metals.

¹The survey conducted is only exploratory. The survey consists of an interview with the President of the Philippine Automotive Federation, Inc. (PAFI) and questionnaires responded by the leading Japanese-participated corporation in each of the selected industries. Better results may be obtained with a more extensive survey.

It appears that the labor-intensity of the technology is industry-dependent. Respondent firms from the electronics, basic metals, basic chemicals and chemical-based industries indicate that their production processes are less labor-intensive. On the other hand, the respondents from the automotive and motorcycle industries contend that their processes are labor-intensive for the reason that the current volume of production do not require more sophisticated labor-saving technology, e.g., robotics.

With respect to the newness of the machineries, all respondent firms pointed out that their machineries were fairly new. They stated that the machinery and equipment used are comparable with that of the other Southeast Asian countries, and some are even comparable with those in use in Japan. The production processes used are skills-intensive; hence, they require extensive training.

In the survey, it appears that R&D efforts of the Japanese-participated firms need more emphasis. The respondent firms from the basic metals and basic chemicals reveal that the R&D activities are conducted in Japan by their parent companies. In the automotive industry, the car manufacturing firms engage in R&D but the participation of host nationals is very limited. Two reasons are cited. First is that the Filipino does not have the expertise to conduct R&D. Second is that Filipinos are more concerned about applied research, e.g., quality control, rather than product innovation. Only the respondent firms from the electronics and chemical-based industries responded that they are conducting R&D activity with substantial Filipino participation.

5. Skills Development

Skills can be classified into management and technical skills. Management skills are

those needed to efficiently run a corporate organization. These largely involve human relations, i.e., the handling of and interaction with personnel. These are skills which guarantee a harmonious working relationship within the corporation.

Technical skills, on the other hand, refer to the know-how necessary to operate the whole or a part of the production process. These skills range from the operation of simple processes such as handling bolts and nuts to complex processes such as designing automation systems. The simplicity or complexity of the processes determines the level of technical skills required, which in turn, determines the quality of the training program needed/adopted.

There are two important considerations in the transfer of know-how. The first is the quality of skill transferred to the receiver (i.e., is the skill welfare-improving?). The second is the potential for diffusion of the skill to local firms, assuming that the first consideration is satisfied.

The transfer of skills largely depends on the corporation's management policies. In a 1981 survey reported by Tomita (1985), it was found that a majority of Japanese-participated corporations in the Philippines transfer skills for corporate operations to Filipinos through in-house training. Of the corporations surveyed, 91.1 percent use in-house training for manpower development. In a later survey, Imaoka (1989) found that 89 percent of Japanese joint ventures in the Philippines apply On-the-Job Training (OJT). This pattern also prevails in the other ASEAN countries. It is worth noting that although personnel training in Japanese parent companies is the second most utilized form of training, the Japanese joint ventures in Philippines do not use this method as much as the other ASEAN countries do (see Table 11).

Table 11 shows that 15 percent of Japanese joint ventures in the Philippines use job

rotation, which is at par with the other ASEAN countries. This percentage is considerably lower than the 53 percent figure reported for Japanese parent companies. Also job rotation is the least preferred method of training among Japanese joint ventures in the Southeast Asian region. This implies that the knowledge of each personnel is thus limited to the area where he is initially assigned and opportunities for multiple skills creation is minimal. In the context of the transfer of know-how, this is less preferred. After all, it is always advantageous for the local personnel to gain a knowledge of the entire process. More knowledge leads to acquisition not only of multiple skills but of a more wholistic view of the operations as well.

With respect to the type of technical skill acquired, the results of previous studies and the survey conducted for this paper are conflicting. Lindsey (1981) found that Japanese firms often use simple processes that require minimal skill to operate; hence, there is little opportunity for development of technical skills. However, the respondent firms of the survey indicated that the technologies are complex and require extensive skills training.

Likewise, the previous studies and the survey show conflicting results for the transfer of management skills to host nationals. Lindsey (1985) reports that Japanese corporations allow Filipinos to occupy middle management positions; however, the Japanese usually occupy the key management positions. The primary reason advanced for such phenomenon is that Filipinos are not yet capable of managing the Japanese-patterned operations. Another reason is that a Japanese national is needed in the joint venture or subsidiary/affiliate to facilitate an effective communication between the affiliate/subsidiary or joint venture and the Japanese parent corporations.

The survey, contrary to the previous studies, finds that Filipinos are allowed to hold key

positions in all the firms surveyed except for those in the automotive industry. In fact, the respondent firms from the basic chemicals, chemical-based and motorcycle industries report that the number of Japanese nationals holding key management positions number to only two, at the most.

Skills are diffused to local corporations when personnel from Japanese-participated corporations transfer to local firms. A key management objective of Japanese corporations is to develop company loyalty among personnel. Management policies are usually framed to pursue this objective. Also, in the training of personnel, Japanese corporations make their personnel incompatible with other companies. The emphasis on teamwork counteracts the individualistic mentality of the personnel. Finally, an in-house promotion scheme is set in place to encourage personnel to stay longer with the corporation. Table 11 shows that 62 percent of Japanese joint ventures in the Philippines use in-house promotion.

In a comparison of the tenure of local middle managers in Japanese-participated firms across ASEAN, Tomita (1985) finds that the Filipino middle managers stays the shortest. However, compared to Filipino middle managers employed in non-Japanese foreign-participated corporations, the tenure of Filipino middle managers connected with Japanese-participated corporations is longer. Imaoka (1989) reports that the employment termination rate for Japanese joint ventures in the Philippines is relatively low compared with those of corporations in Japan (see Table 12). A major factor that influences this is the wages paid by Japanese-participated corporations *vis-à-vis* those of domestic firms. Lindsey (1989) states that, in general, transnational corporations in the Philippines pay higher wage rates than anyone else in the economy. Hence, the movement of labor toward local firms is limited, and if there is any

outward movement of labor from transnational corporations, it will be a transfer to other transnationals or to companies outside the Philippines.

This implies that the stable employment within the Japanese-participated corporations in the Philippines hinders the diffusion of skills to local corporations. Unless local corporations can offer better employment opportunities for Filipinos who are hired by Japanese-participated corporations, the diffusion of skills will remain limited.

V. CONCLUDING REMARKS

As a receiver, the Philippines has enough capacity to use, absorb and adapt technologies as shown by its high S&T potential. This is further augmented by the government's policy thrusts for the development of the S&T sector. Yet, such potential is still underutilized.

The implications that can be derived from data on Japanese technology transfer are varied. It is beyond doubt that there has been transfer of technology from Japan to the Philippines in the recent years. The vehicles used by Japanese to transfer technology to the Philippines is favorable to the receiver. The Japanese's preference for less equity participation gives Filipinos more control over the technology. The senders (Japanese firms) also conduct training programs for their personnel. The Japanese preference for OJT maximizes the "learning-by-doing" effect.

The transfer of technology by Japan, however, has weak points. First, the destination of the technologies infused into the Philippine economy cannot be considered as "welfare-improving" for its receivers. Japanese investments and technology transfer agreements are concentrated in import substituting industries where there is less comparative advantage in production. These preferred sectors tend to depend largely on imported inputs; hence, the local

value added for these products may be small.

Secondly, one has to consider the skill level required to operate the Japanese technologies used in the Philippines. If the skills required are very simple—e.g., screwing, painting, welding or bolting, the skills that will be transferred is minimal. The results of the survey and the previous studies are conflicting. There is a need to resolve these with a more extensive and updated survey.

Lastly, even if the skills learned by Filipinos in Japanese-participated corporations are substantial, it appears that the diffusion of these skills toward local firms is limited.

The mixed effects of Japanese technology transfer may be attributed to the policy environment prevailing in the Philippines during those times. The challenge to policymakers then is how to optimize Japan's technology transfer to the Philippines. The shift of Philippine policies toward an open market with the least distortions is certainly a step toward the right direction. If these policy adjustments are properly and efficiently implemented, the prospect for the transfer of appropriate technologies is bright.

However, appropriateness is not the only factor which determines the quality of a transferred technology. It must also be complete, diffused and mastered. Hence, some policy adjustments may still be needed; namely, (1) incentives for R&D activities of enterprises engaged in production or manufacturing; (2) measures to induce more subcontracting arrangements between Japanese and Filipino corporations; (3) measures to encourage the Japanese to enter into more joint ventures rather than forming wholly-owned corporations; and (4) selective technology transfer policy for strategic industries.

There is a need to distinguish between an enterprise organized for the purpose of

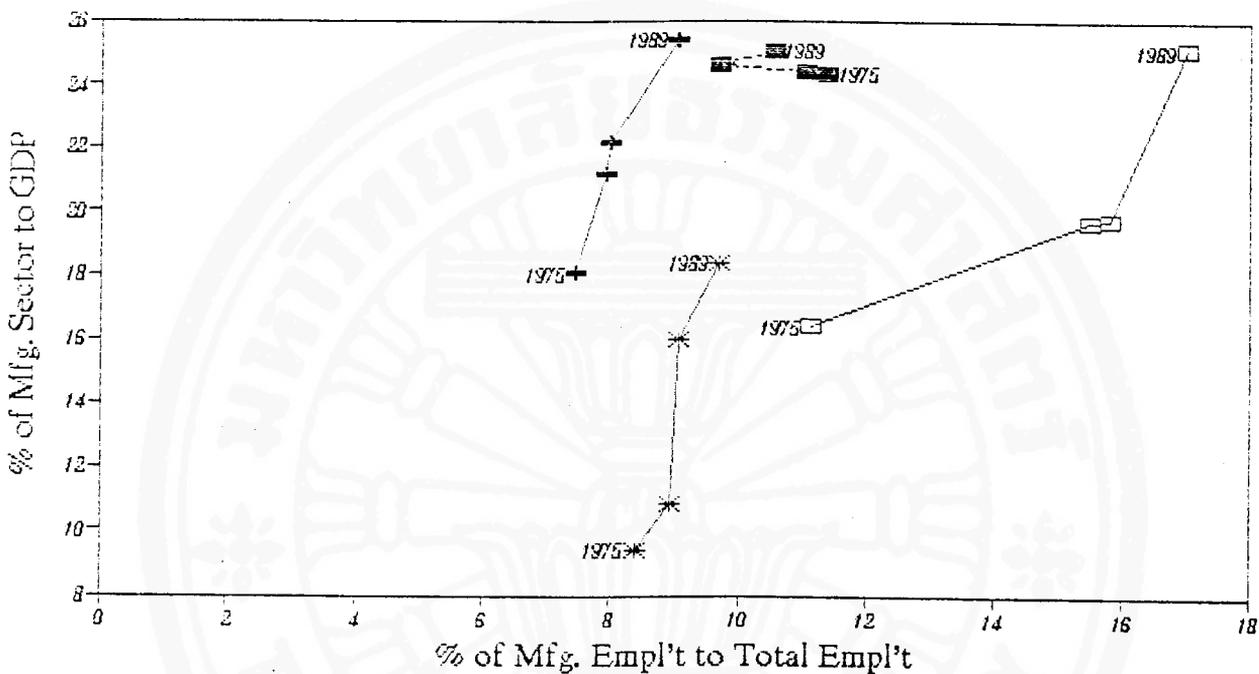
S&T/R&D activities and an enterprise which uses R&D to support its operations. To date, incentives are only given to the former. Technology transfer to the Philippines thus may be hastened if foreign production or manufacturing enterprises conduct their R&D activities within the country. Hence, granting incentives to these enterprises is advisable.

Subcontracting arrangements between Japanese and Filipino corporations will hasten the transfer of technology. By subcontracting, Filipinos gain complete control over the technology; hence technological mastery is possible. Also, direct diffusion of technology from a Japanese corporation to a local corporation is expected.

Joint ventures further increases the probability for diffusion and mastery. Meanwhile, since the Japanese has equity participation, the transferred technology is likely to be less mature compared to technologies transferred under licensing agreements, i.e., with no Japanese equity participation.

Lastly, there is a need for a selective technology transfer policy to ensure that Japanese technologies are diffused to, and mastered by host nationals, in strategic industries. The strategic industries are those wherein the economy has comparative advantage and the extractable economic rent in these industries is sizable. These industries are the pillars of the economy and any "mistransfer" of technology to these industries can make the receiver's economy dependent on the sender. By gaining control over the strategic industries, the sender can extract economic rent at the expense of the host economy.

FIGURE 1 LABOR ABSORPTION BY THE ASEAN-4 (1975, 1980, 1985, 1989)



--■-- PHILIPPINES + THAILAND * INDONESIA □ MALAYSIA

สำนักหอสมุด

Table 1
LATENT RESOURCES OF SCIENTIFIC AND TECHNICAL
PERSONNEL IN ASIAN COUNTRIES, 1988

	Latent number of scientific and technical personnel	Number per 1,000 of population
South Asia		
Bangladesh	23,500	0.2
India	25,608,000	3.2
Pakistan	100,500	1.0
Sri Lanka	7,457	0.4
ASEAN		
Indonesia	193,262	1.1
Malaysia	26,000	1.5
Philippines	1,758,614	29.9
Thailand	20,288	0.4
NIES		
Hong Kong	145,523	25.6
South Korea	94,171	22.4
Taiwan	NA	NA
Singapore	38,259	14.4
Others		
China	7,466,000	6.8
Vietnam	NA	NA
Japan	7,046,000	57.5

Source: Aoki and Bando (1991).

Table 2
RESEARCH AND DEVELOPMENT (R&D) INDICATORS

PHILIPPINE R & D EXPENDITURES
(In Million Pesos)

Year	R&D Expenditures	As Percent of Current GNP
1980	688	0.26
1981	528	0.17
1982	634	0.19
1983	514	0.14
1984	613	0.12
1985	606	0.10
1986	620	0.10
1987	722	0.10
1988	807	0.10
1989	972	0.11
1990	1132	0.11

PERSONNEL ENGAGED IN R & D

Year	Total R&D Personnel	Total Population (in millions)	Personnel per Million Population
1980	11,053	48.098	229
1981	17,183	49.536	347
1982	17,992	51.283	354
1983	9,949	52.055	191
1984	10,185	53.531	191
1985	8,425	54.668	154
1986	7,834	56.004	140
1987	6,876	57.356	120

Source: De Dios (1992).

Table 3
PATENTS GRANTED TO LOCAL INVENTORS

Year	Percent Granted to Local Inventors
1977	41.9
1978	49.1
1979	47.1
1980	50.1
1981	47.9
1982	45.1
1983	25.7
1984	24.2
1985	22.9
1986	24.9
1987	26.6
1988	47.8
1989	24.3
1990	23.5

Source: Jurado (1992).

Table 4
CUMULATIVE INVESTMENTS AND PERCENTAGE SHARE OF
INVESTMENT FROM THE US AND JAPAN

Year	U.S.A.	Japan
Percentage Distribution of Investment:		
1980	52.5	12.7
1981	50.9	6.2
1982	47.9	17.7
1983	71.2	5.9
1984	61.1	13.2
1985	62.7	12.6
1986	69.5	7.6
1987	69.6	5.8
1988	40.5	25.9
1989	33.9	25.6
1990	26.6	27.0
September 1991	19.9	45.4
Cumulative Investments: February 1970 to September 1991 (in million US\$)	1,835.7	650.0

Source: Central Bank of the Philippines.

Table 5
 JAPANESE DIRECT INVESTMENTS IN SELECTED
 SOUTHEAST ASIAN COUNTRIES
 (In Million US\$)

Year	Thailand	Malaysia	Indonesia	Philippines
1978	32	48	610	53
1979	55	33	150	102
1980	33	146	529	78
1981	31	31	2,434	72
1982	94	83	410	34
1983	72	140	374	65
1984	119	142	374	46
1985	48	79	408	61
1986	124	158	250	21
1985	250	163	545	72
1988	859	387	586	134
1989	1,276	673	631	202
Cumulative Total (1951-89)	3,268	2,507	10,435	1,322

Source: Aoki and Bando (1991).

Table 6
 DISTRIBUTION OF JAPANESE INVESTMENTS BY SECTOR
 AND BY EQUITY PARTICIPATION, 1986-1991
 (In Million Pesos)

	Wholly-owned (100%)		Majority-owned (51%-91%)		Joint Venture (less than 50%)		Total		% Share to total
	Number	Value	Number	Value	Number	Value	Number	Value	
Agro-based Industries	3	38	4	24	20	72	27	134	0.9
Forest-based Industries	0	0	5	15	6	14	11	28	0.2
Minig and Metallurgical Industries	2	54	1	24	14	367	17	445	3.1
Metals and Engineering	3	346	22	4,028	26	570	51	4,944	34.8
Automotive	1	20	8	3,428	14	544	23	3,992	28.1
Construction	1	12	4	1,780	10	476	15	2,268	16.0
Glass and Ceramic Products	0	0	2	1,718	0	0	2	1,718	12.1
Toys, Gifts, Furnitures and Housewares	0	0	8	28	12	16	20	44	0.3
Service Industries	0	0	2	1,196	17	217	19	1,412	9.9
Electronics and Telecommunications	6	1,874	32	1,121	15	219	53	3,214	22.6
Computer Software, Hardware and Services	3	1,649	9	723	4	10	16	2,381	16.8
Chemical-based Industries	3	380	11	557	26	601	40	1,539	10.8
Wearables	3	61	9	37	21	76	33	174	1.2
Total	21	2,765	98	8,810	167	2,627	286	14,202	100.0

Note: Value = Equity Participation x Project Cost

Source: Board of Investments.

Table 7
 NUMBER OF TECHNOLOGY TRANSFER AGREEMENTS
 WITH US AND JAPAN

	1986	1987	1988	1989	1990	1986-90 As of 1990
U.S.A.	46	31	32	58	40	207
Japan	5	9	15	23	23	75
						495
						194

Source: Bureau of Patents, Trademarks and Technology Transfer.

Table 8
 DISTRIBUTION OF TECHNOLOGY TRANSFER AGREEMENTS
 BY EQUITY PARTICIPATION OF JAPANESE LICENSOR

	1986	1988	1989 As of 1989
90-100%	0	1	6
51-89%	0	2	3
50% or less	4	9	7
0	2	2	8

Note: 1987 figures are unavailable; 1990 figures are incorrectly tabulated.

Source: Bureau of Patents, Trademarks and Technology Transfer.

Table 9

 DISTRIBUTION OF JAPANESE TECHNOLOGY TRANSFER
 AGREEMENTS BY SECTOR

	1986	1987	1988	1989	1990	1986-90
Fishing				1		1
Mining				1		1
Manufacture of food, beverage and tobacco				1		1
Manufacture of paper products		2	1	1		4
Manufacture of chemicals and of chemical, plastic, coal, rubber and petroleum products				1		1
Manufacture of Pottery and Clay Products	2	2	2	3	5	14
Iron, steel and metal basic industries	1	1	3	1		6
Manufacture of metal products, machinery and equipment	1	4	8	14	11	38
Of which:						
Electrical industrial machinery and apparatus	1			1	3	5
Electrical appliance and houseware		1				1
Motor vehicles		1	3	7	1	12
Motorcycles		2	1			3
Radio, TV and communication equipment and apparatus			2	2		4
Electrical apparatus and supplies n.e.c.			2	1	1	4
Fabricated metal products except machinery and equipment n.e.c.			2	1	1	4
Engine and turbine				1	1	2
Shipbuilding and repairing				1	1	2
Special industrial machinery and equipment except metal- and wood-working machineries				1	1	2
Professional and scientific machinery and controllers n.e.c.				1		1
Manufacturing industries n.e.c.	1				1	1
Wholesale trade				1	3	5
Advertising and research services				1	2	3
				1		1

Source: Bureau of Patents, Trademarks and Technology Transfer.

Table 10
IMPORT OF CAPITAL GOODS

VALUE OF CAPITAL GOOD IMPORTS
(In Thousand US\$)

	1975	1980	1985	1986	1987	1988	1989
Machinery and Parts other than Electric (A)							
Japan	220,112	288,422	122,036	149,384	173,147	199,646	381,930
US	198,316	292,799	132,935	99,953	131,205	170,510	232,736
Telecommunications and Electrical Machinery (B)							
Japan	57,877	87,363	77,301	85,198	115,046	157,711	260,066
US	55,984	103,089	130,995	139,165	189,893	205,945	226,834
Road Vehicles and other Transport Equipment (C)							
Japan	143,393	256,685	36,059	44,283	100,708	207,479	406,171
US	71,309	143,384	15,236	14,684	14,493	26,361	119,876
Import of Capital Goods (A) + (B) + (C)							
Japan	421,382	632,470	235,396	278,865	388,901	564,836	1,048,167
US	325,609	539,272	279,166	253,802	335,591	402,816	579,446

PERCENTAGE DISTRIBUTION OF CAPITAL GOODS

	1975	1980	1985	1986	1987	1988	1989
Machinery and Parts other than Electric							
Japan	33.61	28.41	33.38	37.84	32.23	28.20	35.00
US	30.28	28.84	36.36	25.32	24.43	24.08	21.33
Telecommunications and Electrical Machinery							
Japan	36.88	27.99	26.11	25.55	25.47	27.25	33.60
US	35.67	33.03	44.25	41.73	42.03	35.58	29.31
Road Vehicles and other Transport Equipment							
Japan	46.92	48.12	53.39	56.79	67.84	58.14	60.52
US	23.33	26.88	22.56	18.83	9.76	7.39	17.86
Import of Capital Goods							
Japan	37.71	33.99	32.28	34.59	34.19	34.36	41.33
US	29.14	28.98	38.28	31.48	29.51	24.51	22.85

Source: Central Bank Statistical Bulletin (1984, 1989).

Table 11
 PERSONNEL ACQUISITION AND TRAINING SYSTEMS OF JAPANESE
 PARENT CORPORATIONS AND JAPANESE JOINT VENTURES, 1984

	Japan	Philippines	Thailand	Malaysia	Indonesia	Singapore
Methods of Personnel Training						
On-the-job training	86	89	88	98	93	87
In-company training	72	24	10	25	21	28
Job rotation	53	15	16	17	16	32
In-company training in Japan		48	72	58	69	70
Training overseas	42					
Others		9	2	4	9	11
Personnel Acquisition						
External hiring	0	0	2	2	0	4
Internal promotion	80	62	71	46	76	51
Use both	20	38	27	52	24	45

Source: Imaoka (1989).

Table 12
RATE OF TERMINATION IN JAPANESE PARENT CORPORATIONS
AND JAPANESE JOINT VENTURES, 1984

	Rate of Termination
Japanese parent corporations	3.7
Japanese joint ventures in:	
Philippines	1.5
Thailand	0.8
Malaysia	3.1
Indonesia	1.5
Singapore	4.9

Source: Imaoka (1989).

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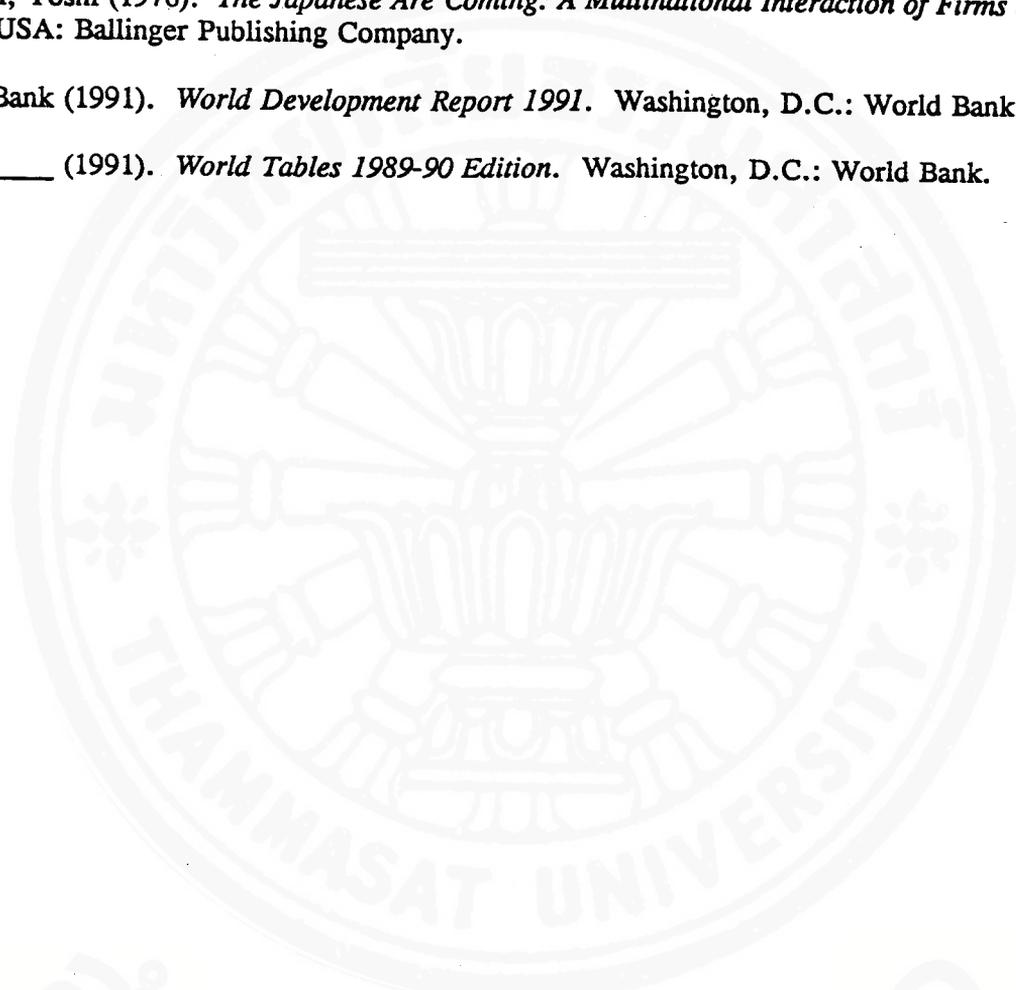
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