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# U.S. and Japanese Electronics Industries in Malaysia: A Comparative Analysis

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## Introduction

In the last decade Malaysia has experienced rapid and sustained growth in manufacturing. Though this growth has occurred in many industrial sectors, the most striking developments have been in the electrical and electronics-related (from now on, electronics) industrial branches. Malaysia is now among the largest exporters of air conditioners, semiconductors (semiconductors is used interchangeably with integrated circuits or ICs) and televisions in the world. In contrast to Korea and Taiwan, the Malaysian electronics industry is almost entirely dependent upon foreign direct investment. The two most significant sources of investment in the Malaysian electronics industry are U.S. and Japanese multinational corporations (MNCs).

The debate about MNCs operating in developing countries has a long history that can be traced back to writings on imperialism by Hobson and Lenin.<sup>1</sup> In post World War Two period these debates continued with other protagonists. Two of the most influential were Vernon and Akamatsu who separately formulated variants of product cycle theory.<sup>2</sup>

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1 J. Hobson, *Imperialism: A Study*, (London: G. Allen and Unwin Ltd., 1938). V. Lenin, *Imperialism: The Highest Stage of Capitalism* (Moscow: Progress Publishers, 1942).

2 R. Vernon, "International Investment and International Trade", *Quarterly Journal of Economics*, Vol.80, No.2, (May 1966), pp.190-07. K. Akamatsu, "A Theory of Unbalanced Growth in the World Economy", *Weltwirtschaftliches Archiv*, Heft 2.

They argued that as products matured and became more commodity-like their manufacture would be transferred to developing countries, while developed country production shifted to higher-value added products.

The Dependency School which was critical of the activities of MNCs also emerged in the postwar period. The Dependency theoreticians held that the activities of MNCs resulted in a transfer of value from the developing nations to the developed nations.<sup>3</sup> The general conclusion among the Dependency adherents was that industrial development was impossible or could at best only be "dependent development."<sup>4</sup> In the late 1970s Frobel et al. revised the dependency argument observing that a New International Division of Labor (NIDL) had formed that transformed the developing countries into cheap labor sources for MNCs.<sup>5</sup> This was the result of a new division of manufacturing into many intermediate steps requiring different capital and labor skill mixes. On the basis of garment industry studies, they concluded that developing countries would remain confined to low wage production for export. This approach did not foresee that initial operations based on inexpensive labor could evolve into more sophisticated types of production activities.

By the mid-1980s the success of the East Asian NIEs especially Korea, Taiwan, and Singapore weakened the arguments of the NIDL theorists. In response to East Asian NIEs success the world-systems theorists such as Wallerstein and Hopkins shifted the object of study toward the mechanisms by which capitalist firms and industries develop global divisions of manufacturing.<sup>6</sup> This found an echo in Michael Porter who argued that an improved understanding of corporate behavior could come from the examination of a product's "value chain."<sup>7</sup> This shifted the academic focus from simplified macroeconomic indicators and grand theory to more rigorous empirical studies of firms and industries and the organization of networks of firms and factories into production chains.

Malaysian economic success provides an interesting case study of the manner by which production networks become rooted in a particular nation. As we shall see,

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3 F. Cardoso and E. Faletto, *Dependency and Development in Latin America*, (Berkeley: University of California Press, 1979). A. Frank, *Capitalism and Underdevelopment in Latin America*, (New York: Monthly Review Press, 1967).

4 P. Evans, *Dependent Development: The Alliance of Multinational, State and Local Capital in Brazil* (Princeton: Princeton University Press 1979).

5 V. Frobel, J. Heinrichs and O. Kreye, *The New International Division of Labor* (Cambridge: Cambridge University Press, 1980).

6 I. Wallerstein and T. Hopkink, *World Systems Analysis* (Beverly Hills: Sage Publications, 1982).

7 M. Porter, *The Competitive Advantage of Nations* (New York: Free Press, 1990).

Malaysia is a node of and an intersection for Japanese and U.S. electronics industry production chains. Malaysian success in electronics is the result of the development of two quite narrow U.S. global production chains in Malaysia and a very broad Japanese movement into Malaysia. Each chain has its own historical root and trajectory.

This paper contains the following four sections. The first section briefly outlines the dimensions and history of the Malaysian electronics industry. The second section contains two subsections that describe U.S. electronics investment in Malaysia in the semiconductor and hard disk drive (HDD) industries. The third section examines Japanese investment and includes a subsection on Japanese investment in semiconductor production in Malaysia. The conclusion speculates on the future prospects for the Malaysian electronics industry.

### The Malaysian Electronics Industry

Before 1970 Malaysia had foreign electronics industry investment. The government's New Economic Policy promulgated in the 1970s emphasized the attraction of export-oriented FDI to create employment opportunities. A modification of the Investment Incentives Act of 1968 allowed Perlis, Kedah, and Johor Tenggara to join the earlier free trade zones such as Ulu Klang and Sungei Way as locations for industrial estates. If 90 percent of the production was exported, foreign investors received government incentives such as tax holidays and tariff exemptions on the imported parts and materials.<sup>8</sup>

The first significant electronics export-oriented investments were by U.S. merchant semiconductor firms requiring low cost labor for their semiconductor assembly and testing operations. The parts were imported from the U.S., assembled and tested, and then reexported to the U.S. Japanese firms made a nearly simultaneous set of investments by establishing import-substitution consumer electronics operations aimed at domestic demand. In the late 1970s a second wave of Japanese parts makers began to invest in Singapore and, to a lesser extent, in Malaysia. These parts makers were searching for inexpensive labor and they aimed to export parts to other NIEs and even to Japan.

The 1986 Plaza Accord agreement signaled the onset of a persistent upward yen revaluation against most major currencies. The earlier investments became the foundation

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8 R. Chaponniere, "The ASEAN Integrated Circuit: The electronics industry in ASEAN-issues and perspectives." *ASEAN Economic Bulletin* Vol.1 No.2, (1984), pp.136-151

for a much broader wave of investment by Japanese firms that would transform Malaysia into an electronics powerhouse. In a roughly contemporaneous, but unrelated, development U.S. merchant HDD firms began a massive transfer of production activities to Southeast Asia.

Over the last two decades the Malaysian electronics industry has diversified greatly. Nearly every major Japanese and U.S. electronics firm now has production facilities in Malaysia. In 1993 Malaysia exported approximately \$28 billion worth of manufactured goods, of these exports 58 percent or \$16 billion were electrical and electronic products. In 1987 the electronics industry employed 89,000 workers, by 1992 this had increased to 210,000.<sup>9</sup> Currently, electronics is Malaysia's largest employer of manufacturing workers. During the last decade export composition also shifted as consumer and industrial electronics have rapidly increased their share of Malaysian output. As a result, the total rate of growth of electronics exports since 1990 has been well in excess of 15 percent per year.

The growth of a Malaysian electronics industry is due to manufacturing investment by multinational corporations headquartered in Japan, the U.S., Europe, Singapore, Taiwan, and Korea. During the late 1960s and early 1970s firms established operations in Malaysia for two reasons: First, the U.S. companies relocated to secure inexpensive labor and receive significant tax holidays. Meanwhile, these operations have evolved into sophisticated operations producing high-quality goods for the world market. Second, many Japanese firms established operations initially to participate in import substitution industrialization. Later, some Japanese ISI plants switched to exportation.

Malaysia's success is partially due to a division of labor with Singapore, the Southeast Asian headquarters for many multinational firms. Malaysia and, especially, Penang was the beneficiary of investment by firms that found Singapore becoming too expensive. Recently, the rapid growth of investment has put enormous pressure on Malaysia's labor supply and wages have increased rapidly making highly labor intensive activities difficult to justify economically. But, rather than leave Malaysia, many MNCs are upgrading their factories with increased investment in automation and producing higher added-value items.

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9 Ministry of International Trade and Industry (Malaysia), *Malaysia: International Trade and Industry Report 1993* (Kuala Lumpur: MITI, 1993).

## U.S. Electronics Investment in Malaysia

The following product groups: semiconductors, HDD and HDD parts and, most recently, personal computer assembly for the Asian region receive the bulk of U.S. electronics investment. These three products share certain similarities as all are "high technology" and many key companies have their headquarters in Silicon Valley. In 1995 there were, at least, 29 U.S. electronics plants scattered throughout Malaysia. The location of the largest number, eighteen, is Penang and seven more are in the Kuala Lumpur/Petaling Jaya area. The Malaysian-American Electronics Association consisting of the 16 largest U.S. electronics firms reports that its member firms employ over 45,000 Malaysians.<sup>10</sup>

U.S. firms comprise a significant portion of the Malaysian economy. According to the MAEA its members produced nearly 12 percent of the total value of the Malaysian manufacturing sector and 3.5 percent of Malaysia's gross domestic product. Moreover, U.S. companies purchased over \$350 million in parts and services in Malaysia. These investments have steadily deepened and recently, U.S. firms have begun hiring greater numbers of engineers to reinforce their Malaysian production process development.

## Integrated Circuits

The merchant semiconductor and HDD industries concentrated production in Southeast Asia because Fairchild Semiconductor Inc., the original Silicon Valley semiconductor firm, established Asian assembly facilities to decrease the high costs of the labor-intensive semiconductor assembly process. Fairchild was a unique company in that almost from its inception it had many spinoffs that also became successful companies. As with Fairchild, the spinoffs such as Intel, AMD, and others also decided to assemble semiconductors in Southeast Asia and particularly, Penang, Malaysia.

In the early 1970s semiconductor firms (such as Texas Instruments, Intel, Motorola and National Semiconductor) made investments in Southeast Asia aimed at lowering the cost of semiconductor assembly.<sup>11</sup> Rapidly, Southeast Asia and, especially, Malaysia became the focus of offshore assembly. U.S. firms operating in Malaysia air freighted in un-

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10 Malaysian American Electronics Industry (MAEA), "Report and Forecast, 1992/93." (Kuala Lumpur: MAEA, August, 1993).

11 R. Langlois, T. Pugel, C. Haklisch, R. Nelson, W. Egelhoff, *Microelectronics: An Industry in Transition* (Boston: Unwin Hyman, 1988) and A. Scott, "The Semiconductor Industry in South-east [sic] Asia: Organization, Location and the International Division of Labor," Working Paper 101, (Los Angeles: Institute of Industrial Relations, University of California, Los Angeles, 1985)

finished semiconductors, packaged them, and then reexported nearly their entire production to the U.S. An indication of the attractiveness of offshore assembly is the fact that Intel established its Malaysian assembly plant only four years after its spinoff from Fairchild in 1968.

In the intervening two decades the semiconductors and the assembly techniques used in the plants have changed dramatically. In the 1970s these plants were extremely labor-intensive using hundreds and even thousands of women to manually assemble the ICs. This labor-intensity and the enormous pressure for less expensive production led to frequent critiques of these plants as exploitative of women and generally undesirable.

By the late 1980s these assembly operations had become quite automated. However, contrary to the predictions of some, even after automation, assembly and test operations did not return to the U.S. This is because Malaysian operators, technician and engineers are inexpensive compared to the U.S. There is also a widespread belief that Malaysian workers have more commitment and diligence than American workers. Moreover, these factories have accumulated high skill levels. Some U.S. firms depend on Malaysian engineers and technicians to assist in designing new chips for efficient assembly. Thus, even with labor costs increasing, the greater capital intensity of assembly and the capabilities of employees convinced U.S. semiconductor companies to retain production in Malaysia.

The largest number (13 out of a total of 29) of U.S. firms operating in Malaysia are in the IC assembly and test fields or are suppliers to these functions.<sup>12</sup> Because much of the global semiconductor assembly is in Malaysia, the country has become an enormous importer and exporter of semiconductors. For example, in 1988 semiconductor imports were \$2.7 billion and exports were \$3.4 billion. By 1992 Malaysia imports increased to \$5.2 billion and exports were \$5.2 billion (MIDA 1994).<sup>13</sup> The U.S. firms and their Japanese and European counterparts made Malaysia the third largest IC exporter in the world (after Japan and the U.S.). Trade volume statistics expose a key fact about Malaysia -- generally it has not been the source of the ICs, it is a stop on the global assembly line.

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12 MAEA, *op. cit.*

13 Malaysian Industrial Development Authority (MIDA). "The Electronics Industry," Unpublished manuscript (1994).

The U.S. semiconductor industry operates only assembly and test facilities in Malaysia. The value-added from these assembly and test processes ranges from less than 15 percent to approximately 50 percent of the total value. In the most sophisticated and expensive IC assembly and test adds proportionally less value to the final price. In contrast, for lower-cost, less-sophisticated ICs, assembly and test adds greater value, i.e., the assembly costs are roughly similar whatever the value of the IC. Finally, the U.S. or Japan are the sources of nearly all the valuable components.

The changes in IC exports and imports between 1988 and 1992 highlights an important change in Malaysian semiconductor trade patterns. Japanese firms are importing ever larger numbers of integrated circuits as components in consumer and industrial electronics products to be exported. The permanence of this pattern is difficult to predict as Japanese firms are building integrated circuit fabrication facilities in Malaysia that may again shift the balance.

For ICs there are few opportunities for backward linkages to the Malaysian economy. A few Malaysian firms have developed their own technology and supply inputs to IC assembly and testing industry. Still, this remains limited, though a few Malaysian suppliers are now exporting equipment.<sup>14</sup> Finally, many Japanese and U.S. firms have established subsidiaries in Malaysia to provide parts and components to the IC industry.

The IC commodity chain has only two important nodes, assembly and test and wafer fabrication. Though Malaysia already fabricates some standard transistors, the step to world class fabrication is a large one. U.S. firms, largely intent on exporting, have no reason to transfer fabrication to Malaysia. This may change in the future as Malaysian production of computers and other high technology electronics rises, but at present this remains the case.

### **The Winchester Rigid (Hard) Disk Drive Industry**

The second wave of U.S. investment in Malaysia occurred in the 1980s as the newly formed merchant computer HDD manufacturers (such as Seagate and Conner Peripherals and Western Digital Corporation) relocated more labor-intensive manufacturing operations from Singapore. In HDDs nearly the entire manufacturing process occurs in South-

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14 R. Rasiyah, "Changing Organization of Work in Malaysia's Electronics Industry," (1994) Unpublished mimeo.

east Asia, though not wholly in Malaysia. Southeast Asia is now the site for the manufacture the vast majority of the world's HDDs. Though some important production activities are in Malaysia and, especially, Penang, Thailand received more of the HDD manufacturing being relocated from Singapore than did Malaysia.<sup>15</sup>

The HDD industry resembles the IC business in certain superficial ways. First, HDDs are experiencing rapid technological change with areal density (i.e., the amount of information stored per square inch) increasing at 50 percent per annum. The global market for HDDs is nearly 50 million per year and growing due to the rising demand for personal computers. Similarly, the product life-cycles are approximately 18 months in duration, which means that quick transfer of a newly designed product from research and development to full-scale production is necessary. In contrast to ICs, HDDs are electromechanical products assembled from many parts including: magnetic heads, disks, various mechanical components, a completed printed circuit board and components, plastic injection molded and stamped metal parts.<sup>16</sup> The larger number of parts means that the supplier chain is more important than for semiconductors.

The early establishment of HDD manufacturing in Southeast Asia is also connected to Fairchild Semiconductor. Specifically, the president and co-founder of Seagate Technology Inc., the first major independent merchant HDD producer, previously had managed Fairchild factories in Singapore and Thailand. HDD production began in Southeast Asia in 1982 when Seagate Technology Inc. opened plants in Singapore and Thailand. From the beginning Seagate established a division of labor between the two plants: Thailand undertook subassembly and Singapore did the final assembly. Seagate invested in Southeast Asia because it recognized that HDDs would become a commodity business in which price would be a crucial factor.

Seagate's success in overseas manufacturing forced its U.S. competitors to also relocate to Southeast Asia. Rapidly, Southeast Asia, particularly Singapore, became the production location of choice. The concentration of HDD manufacturers has drawn most of the major parts suppliers to Southeast Asia. Currently, manufacture of nearly all the components of an HDD is in Southeast Asia. This relocation of parts suppliers is creating

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15 D. Ernst and D. O'Connor, *Competing in the Electronics Industry: The Experience of Newly Industrializing Economies* (Paris: OECD, 1992).

16 J. Porter, (President, Disk/Trend Inc.) Telephone interview, September 3, 1994, 2:30-3:13 pm, Mountain View, CA.

powerful synergies and is contributing to the decision by captive HDD divisions of companies such as NEC and IBM to also relocate to Southeast Asia.

It was only in the late 1980s that HDD manufacturers and suppliers began to establish significant plants in Malaysia. However, HDD-related U.S. firms are rapidly overtaking the U.S. IC assemblers in importance to the Malaysian economy. Currently, seven U.S. merchant HDD firms operate factories in Malaysia. These investments involve quite high technology levels and significant capital investment. For example, Conner Peripherals, one of the largest HDD producers in the world, employs 3,300 person in its \$100 million Penang facility. In Penang Seagate Technology recently opened an advanced recording head facility employing 7,000 Malaysians.<sup>17</sup>

Malaysia has developed an infrastructure that will prove attractive for segments of the HDD production chain requiring a skilled work force, good infrastructure and trained technicians and engineers. For example, in 1993 the U.S. firm, Komag, opened a sputtering facility for magnetic disks in Penang. Currently, sputtering for HDD disks is only done in three countries: the U.S., Japan, and Malaysia. Also, many HDD Japanese suppliers such as Nippon Densan, a maker of HDD motors, have established factories in Malaysia to supply their customers. The combination of HDD operations in Malaysia, Singapore, and Thailand creates an integrated global-class manufacturing and service infrastructure in Southeast Asia. As a result, Silicon Valley's role in the HDD industry is increasingly the headquarters, marketing, and research and development function.<sup>18</sup>

HDDs require more parts than do ICs; however most are extremely technology-intensive and only produced by U.S. and Japanese firms. The most important component provided by indigenous firms is assembled printed circuit boards (PCBs). However, the value of PCBs largely consists of the components mounted on the board, not the board assembly process. In other words, in the HDD industry the opportunities for backward linkages to indigenous firms are more limited than immediately apparent.

### Japanese Electronics Investment in Malaysia

Japanese electronics investment in Malaysia is far more diverse than that of the U.S.

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17 For Seagate, see *Electronics Business Asia*, "Company Notes." *EBA* (July, 1994) p.23. For Conner Peripherals, see Malaysia Industrial Digest, "Conner Malaysia's Production to Hit 1.3 Million Drives in 2nd Quarter," Malaysia Industrial Digest (April-June), p.4.

18 M. Porter, *op. cit.*

The sheer number of Japanese investments means that networks of assemblers and suppliers having some resemblance to those in Japan are emerging in Malaysia. When considered from a production chain perspective, ever more links of the chain are now in Malaysia. The other aspect is that Japanese firms are building an integrated production structure in Malaysia that eventually should have high local content, though the provision of most local content is through the local subsidiaries of Japanese suppliers.

Understanding Japanese investment is only possible in the context of some general trends in the global economy. Perhaps, the most important single factor has been the continuing rise in the value of the yen. In the process the yen has gone from a drastically undervalued currency to an overvalued one. Simultaneously, most of the ASEAN countries continue to base their currencies on the dollar making them inexpensive production locations for Japanese firms.

From a historical perspective there are two types of Japanese electronics FDI: The first type is investment in the manufacturing of consumer electronics products for the domestic market (import substitution industrialization). The second type of investment is for the export of consumer electronics and components to the U.S., Europe, the Middle East, Asia, Oceania and Japan. Products manufactured for the domestic market include: rice cookers, refrigerators, irons, vacuum cleaners, air conditioners, etc. Although the variety produced for the domestic market is large, the actual volume for each product is small. This contrasts markedly with efficient export production that must be on a very large scale and employ the latest manufacturing equipment and techniques.

From independence in 1957 the Malaysian government pursued an import substitution industrialization (ISI) policy to promote industrialization. The motives of the Japanese companies that established ISI factories in the late 1960s and early 1970s was to circumvent trade barriers. In 1965 Matsushita established its first ISI production facility to assemble TVs and radios for the domestic market. Following Matsushita were the other major consumer electronics manufacturers, such as Toshiba and Sanyo. Japanese consumer electronics firms established six factories between 1970 and 1974 and five more between 1975 and 1979.

Initially, most inputs were imported, but some assemblers also initiated internal production of parts such as transformers, resistors, and batteries. The decisions by parts suppliers to relocate production from Japan are quite complicated and vary by the firm.

For example, some companies such as wire harness makers and small motor producers moved offshore quite early due to their need for low-wage workers. These investments were not coordinated with the assemblers. Other suppliers such as plastic injection molded and metal stamped parts firms are often highly correlated with decision by major assemblers to relocate production offshore. This is because the shipment of finished large plastic or metal parts is inefficient and expensive, so if assemblers anticipate sufficient production volume they encourage these suppliers to accompany them. An important reason for this is that local suppliers often do not have the skills necessary to produce a consistently high quality part acceptable in the global market. Many of these parts are cosmetic parts very important for appearance of the finished good. General parts suppliers used in a variety of electronics products relocated more gradually. As the market grew in Malaysia and the cost of imports from Japan increased due to the increasing value of the yen, nearly all the parts suppliers relocated activities to Southeast Asia and, especially, Malaysia and Singapore.

After the 1986 Plaza Accord the increase in the yen's value made audiovisual exports from Japan increasingly uncompetitive in the international market. Korean consumer electronic firms were major beneficiaries of this exchange-related lack of competitiveness and Japanese firms lost market share in the global consumer electronics industry. Japanese firms responded by transferring even more production offshore.<sup>19</sup> Also, the Malaysian government intensified its efforts to attract FDI by introducing the Promotion of Investment Act in 1986 that provided even more lucrative incentives.

Between 1985 and 1993 Japanese consumer electronics firms established 39 new manufacturing facilities. The new arrivals included companies such as Sony, Aiwa, JVC, Pioneer. The companies already producing in Malaysia expanded existing facilities and built new ones to manufacture consumer and other electronics goods such as CD players, stereos, VCRs, televisions and air conditioners for export.

The importance of Malaysia for Japanese electronics firms is evident. For example, Malaysia is the center of Matsushita's Asian production network. Matsushita's sixteen plants accounted for between 3 and 4 percent of Malaysia's total exports.<sup>20</sup> For the Japanese electronics industry Malaysia is the largest concentration of investment in Asia.

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19 Y. Ajima, "Electronics Makers Move Offshore." *Economic Eye* (December, 1986): 21-24.

20 J. Abegglen, *Sea Change* (New York: Free Press, 1994), p.38.

Due to this heavy investment Malaysia is the one of the world's largest producers of audiovisual products, such as televisions, VCRs, and compact disk players. In 1994 Malaysian television production exceeded that of Japan (in 1993 Malaysia produced 9.5 million television sets). In 1993 Japanese televisions assembled in Malaysia accounted for 18.6 percent of the total global production by Japanese firms. For VCRs Malaysia accounted for 18.9 percent of total Japanese global production.

Following the large assemblers Japanese part suppliers, large and small, established factories to produce electronic and electric components. Between 1985 and 1993 electronics parts and components firms established 91 factories in Malaysia.<sup>21</sup> In the 1990s this investment activity resulted in double digit growth rates in electronic parts and components production. Malaysia is the largest or second largest Southeast Asian producer of parts such as condensers, transformers, resistors, small motors, and switches and an important source for parts and components for Japanese assemblers throughout Asia. Moreover, many Malaysian-made parts and components will be exported to Japan. For some products, Malaysia is becoming an exporter of parts and component kits for assembly in third countries.

This massive wave of investment created an electronics production complex that is quite sophisticated in its manufacturing capability. In the future this complex will continue to deepen providing Malaysia with a base to continue upgrading its industry as labor costs increase. Finally, there is an increasing tendency for Japanese parts and component suppliers in Malaysia to serve new customers such as U.S. and European firms operating in Southeast Asia.

### Semiconductors

Japanese semiconductor firms are also operating plants in Malaysia. Japanese semiconductor assembly and testing in Malaysia began roughly contemporaneously with the U.S. firms, as both moved to take advantage of the preferential policies of the Malaysian government toward foreign investment. In the early 1970s Japanese semiconductor manufacturers, such as Hitachi, Toshiba, NEC, and Naito Electronics made their initial investments in the Free Trade Zones. In the late 1980s companies such as Fujitsu and Rohm

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21 Nihon Denshikikai Kogyokai. *93 Kaigai Denshikogyo no Doko Chosadan Hokokusho* (Tokyo: Nihon Denshikikai Kogyokai, 1993).

also opened fabrication facilities in Malaysia. Suppliers of silicon wafers are Shinetsu Handotai and the European firm, MEMC are also producing in Malaysia. Currently, Malaysia's wafer output accounts for about 15 percent of the global semiconductor wafer production. These two companies produce wafers not only for Japanese, American, and European semiconductor manufacturers in Malaysia but also for customers in the other Asian countries such as Korea, Taiwan, and Singapore.

Most Japanese semiconductor production has been limited to the assembly and test area and low-value device production. In contrast to U.S. firms that reexported the bulk of the chips they assembled to the U.S., Japanese producers targeted the non-Japanese Asian device market. From the late 1970s Asian demand for semiconductors steadily grew and Japanese electronic manufacturers expanded production in countries like Malaysia. As a result, the semiconductors produced in Malaysia constantly changed in response to the rapidly changing demand for inputs for manufacturing various consumer and office automation products. Thus, much of the production by Japanese firms in Malaysia is diodes, transistors, and other parts for consumer electronics.

As late as 1991 Japanese firms believed relocation of IC fabrication to Malaysia would require a major upgrading of the infrastructure. However, in 1994 Japanese manufacturers announced the construction of Malaysian fabrication facilities to produce both 4M and 16M DRAMs in 1996. Fujitsu's Malaysian facility is three to four years behind the leading-edge of the semiconductor industry, but still it will drastically upgrade Malaysia's semiconductor fabrication operations. Also, Toshiba is planning to build another IC fabrication facility in Malaysia. The Japanese firms are relocating sophisticated fabrication facilities to Malaysia because the rising yen makes it difficult to supply the new consumer electronics facilities and the rapidly expanding U.S. personal computer production facilities in Southeast Asia.<sup>22</sup>

## Discussion

Over the last twenty years the Malaysian electronics industry has displayed impressive growth. It now is a major node in the global strategies of both U.S. and Japanese electronics MNCs. Though the rate of growth is slowing, the infrastructure of assemblers and suppliers makes Malaysia a prime location for higher value-added production activi-

22 C. Yoshida, "Chip Makers Quickly Shifting to Asian Plants," *Nikkei Weekly* (September 12, 1994) p.22.

ties that require higher levels of technical and engineering skills. The less positive aspect of this electronics investment is that firms owned and operated by Malaysians provide few inputs for the MNCs.

The composition of Malaysian electronics production is evolving from low-value products such as radio cassette players to higher-value ones such as CD players. Besides audiovisual products, production of other electronic and electrical goods has increased rapidly. For example, the production by Japanese firms of PC peripherals such as floppy disk drives (FDD) has also increased dramatically. In 1993 the volume of FDD outputs increased to 15.8 million units from only one million in 1990.

The expanding Malaysian domestic market fueled demand growth and that encouraged Japanese plants to increase output of other home appliances. In the process, products originally produced solely for the domestic market such as refrigerators are now major exports. Effectively, Malaysia has developed a dynamic cluster of Japanese assemblers and suppliers that is operating synergistically to attract other assemblers and suppliers -- both broadening and deepening its electronics production activities.

Most of the products produced by Japanese assemblers are exported to third countries such as U.S., Europe, and the Middle East. However, as manufacturing of many products shifts entirely to Malaysia from Japan, finished goods such as small TVs, certain types and sizes of air conditioners and fans are now being exported to Japan. Moreover, large assemblers such as Matsushita, Hitachi, and Toshiba recently began relocation of development and process engineering functions for certain products such as televisions and air conditioners to Malaysia. This transfer will likely continue throughout the 1990s and should add further to Malaysia's increase in value-added production.

The growth of the Malaysian electronics industry is still dependent upon MNC investment, both Japanese and American. This contrasts markedly with Korea and Taiwan that have developed strong indigenous industries. The implications of this lack of indigenous involvement in the Malaysian electronics industry are difficult to assess. This may create problems in the future. And yet, by not depending on investment from any single country or a single sector, Malaysia has a diversified production base that should be quite resilient. For the foreseeable future the outlook continues to be positive, though the growth of indigenous firms still remains limited.