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INTERNATIONALIZATION STRATEGIES OF JAPANESE ELECTRONICS COMPANIES: IMPLICATIONS FOR ASIAN NEWLY INDUSTRIALIZING ECONOMIES (NIEs)

by

Bundo Yamada

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by Bundo Yamada, Head of Project: Dieter Ernst,
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RÉSUMÉ

La stratégie des entreprises japonaises d'électronique a de grandes répercussions dans l'industrie électronique des nouvelles économies industrielles (NEI) de l'Asie de l'Est, ainsi que dans celle des Etats de l'ANASE (Association des Nations de l'Asie du Sud-Est). L'électronique japonaise a subi, au cours des dernières années, une restructuration sévère, largement accélérée par la forte réévaluation du yen. Son évolution l'a faite passer d'une électronique grand-public à une électronique industrielle et aux composants (en particulier, à la fabrication de semiconducteurs). En même temps, au sein de l'industrie grand-public, les entreprises ont misé sur les secteurs à haute valeur ajoutée pour leurs productions destinées au marché intérieur. Toutes les opérations et tous les produits caractérisés par l'utilisation intensive de main-d'oeuvre ont été transférés dans les pays de l'ANASE à bas salaires, à l'exception de ceux qui requièrent une qualité ou des performances spéciales.

Une division régionale du travail est en train de prendre forme. Partout en Asie, des filiales d'entreprises japonaises dépendent de leurs importations en provenance du Japon pour les pièces, les composants et l' outillage. Les conséquences négatives que cette politique a entraînées sur la balance commerciale de ces pays à l'égard du Japon ont conduit les industries japonaises à s'efforcer de s'approvisionner davantage dans la zone de l'ANASE ou parmi les NEI de la "première génération". De nombreux fournisseurs japonais de pièces et de composants ont suivi leurs principaux clients en investissant dans l'Asie du Sud-Est. Le développement d'une production de biens périphériques ou de médiocre qualité commence même à apparaître hors du Japon : calculatrices, la plupart des productions audio, téléviseurs moyens et petits écrans et appareils ménagers figurent parmi ces productions. Les entreprises japonaises se sont adressées à la Corée du Sud pour la fourniture de la plupart des biens électroniques grand public produits par les fabricants d'équipements originaux (original equipment manufacturer, OEM). Dans l'avenir, des accords de ce type se multiplieront avec d'autres pays asiatiques. Dans les prochaines années, les échanges régionaux de composants électroniques et d'équipement devraient s'amplifier rapidement, au même titre que la division régionale du travail à l'intérieur des entreprises, sous l'influence de ces accords. Reste à savoir si les nouvelles économies industrielles d'Asie -- de "première et deuxième" générations -- réussiront à mettre sur pied des industries compétitives de pièces et de composants originaux qui leur permettraient de fournir des produits différenciés par leur conception et leur ingénierie inspirées de celles des entreprises électroniques de pointe du Japon et des autres pays de l'OCDE.

SUMMARY

The strategies of Japanese electronics firms have major implications for the electronics industries of the East Asian NIEs as well as the ASEAN (Association of Southeast Asian Nations) member countries. Japan's electronics industry has been undergoing a drastic restructuring in recent years, precipitated to a large extent by the strong revaluation of the yen. A marked shift is occurring away from consumer electronics to industrial electronics and electronic components (in particular, semiconductors). At the same time, within the consumer electronics industry, firms have focused their domestic production on the highest value-added segments of the

market. Labor-intensive production processes and products which are not sharply differentiated by quality or special performance features are being shifted to the low wage ASEAN countries.

An elaborate intra-regional division of labor is taking shape. Subsidiaries of Japanese firms established elsewhere in Asia still rely heavily on parts, components, and tooling imported from Japan. The negative effect this has on those countries' trade balances with Japan has caused Japanese firms to make a stronger effort to source within the ASEAN region or from the first-tier NIEs. Many Japanese parts and components suppliers have followed their major customers in investing in Southeast Asia. Even some product development for peripheral or low-end products is beginning to be performed outside Japan. Electronics products which have been almost entirely shifted out of Japan include calculators, most audio products, medium- and small-screen TVs; and household appliances. Japanese firms have gone to South Korea for OEM (original equipment manufacturer) supplies of most consumer electronics goods. Such OEM arrangements with other Asian countries can be expected to increase in the future. As a result of such arrangements, as well as the growing intra-firm regional divison of labor, intra-regional trade in electronics components and equipment should grow rapidly in coming years. Whether the first - and second - tier Asian NIEs can build up competitive parts and components industries of their own will shape their ability to supply products differentiated by design and engineering from those of the leading Japanese and other OECD electronics firms.

PREFACE

This paper by Bundo Yamada is one of the few attempts so far to provide a detailed and systematic treatment of the process of regional integration occurring in East Asia, driven to a significant degree by the internationalisation strategies of major Japanese firms. The focus is the electronics industry, but the processes described are occurring in the automotive and other industries as well. Yamada argues that the division of labor taking shape in East and Southeast Asia differs in important ways from the historic one based principally on the need to tap reserves of cheap labor. As the region continues to grow more rapidly than the rest of the world, the regional market is weighing more heavily in Japanese firms' investment strategies. Moreover, technology tie-ups between Japanese firms and major NIE electronics firms are becoming more common. While much of the Japanese investment in the ASEAN countries continues to be subordinated to headquarters' centralised control; the sophistication of the products and activities being located in those countries is increasing as their technological capabilities increase. Local sourcing of components is becoming a more compelling concern of Japanese electronics firms; both because the high value of the yen makes reliance on imported components costly in economic terms, and because the negative effect of such imports on the ASEAN countries' trade balances with Japan is politically costly.

This paper deserves an early distribution to the relevant research community because it raises a number of important issues for consideration and further research. It points out the fact that the continued reliance of NIE electronics firms on Japan for critical components limits their ability to differentiate their products in the market. It also underlines the relative weakness of local supplier networks, especially in the seond-tier Asian NIES. A critical question is how those networks can be strengthened, given the strong tendency for many Japanese firms to bring their own suppliers with them from Japan rather than cultivate local suppliers. Finally, another issue is to what extent the Japanese market will in the future become a major outlet for the electronics products manufactured in the Asian NIEs.

Louis Emmerij
President of the OECD Development Centre
October 1990

I. INTRODUCTION*

Electronics is expected to be a leading industry in the 21st century because of its enormous potential for growth; revolutionary technology; and impact on other industries and markets. The electronics industry is closely involved in changes taking place in domestic industrial structure. Through trade, direct overseas investment, and technology transfer, it has international significance as well.

This report will trace the development of Japan's electronics industry and describe the general domestic and overseas strategies of Japanese companies amid the current restructuring. Against this background, it will then discuss the future, focusing in particular on relations with the Asian NIEs (Newly Industrializing Economies) and ASEAN countries.

The electronics industries in Japan, the Asian NIEs, and the ASEAN countries have evolved under differing conditions at different periiods. However, international specialization, that is relations of mutual interdependence, broadly based on multiple levels, are developing between Japan and the Asian NIEs, between the Asian NIEs and ASEAN countries, and between the ASEAN countries and Japan.

Needless to say, by virtue of its large market for Asian products, the United States, has had a significant impact on Asian economic development and the structure of its industries. The growing European market is also important for Asian industries. However, the focus here will be on Japan, its electronics industry and the evolving relationships with its leading Asian economic partners, their policies and industrial strategies.

Section 2 of this report discusses the growth and restructuring of the Japanese electronics industry. Since 1985, the industry has been shifting from its traditional orientation toward exports of consumer equipment to a new structure stressing computers and high-technology parts. The immediate causes of this restructuring have been trade friction and the rapid appreciation of the yen. It is explained how the Japanese electronics industry has met these challenges and modified its overseas strategies. Current issues facing the industry will also be mentioned.

Section 3 deals with trade, direct investment, and technology transfer between Japan and the Asian NIEs. A major change in the Japanese electronics industry is that it is exporting less consumer equipment, which was its former leading export item, and more industrial equipment and electronic parts. Furthermore, since recovering from the from the slump in semiconductors in 1986, Japanese firms have been rapidly stepping up their overseas operations, prompted by the rising value of the yen. Direct investments are being redirected from the Asian NIEs to the ASEAN countries.

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Changes are also under way in the form of specialization. Originally, certain production processes were transferred overseas to reduce the cost of production. Now, specialization is associated with the transfer of all phases of production and original equipment manufacturer (OEM)-based production. These changes will change the shape of economic relations between Japan, the Asian NIEs, and the ASEAN countries.

Section 4 discusses international specialization and strategies of Japanese companies which entered the world market after American and European firms. Until relatively recently, Japanese companies essentially aimed at increasing productivity, developing domestic technology and expanding exports. Changes in the international situation, however, have forced Japanese companies to modify this strategy.

The new strategies that Japanese companies are beginning to adopt for international specialization will be examined by looking at the development of this phenomenon. Then, the possible future role of Japanese companies will be considered in relation to Asian NIEs and the ASEAN countries.

Section 5 will establish a model for the related development of the electronics industry based on the technological innovation, in the development record of Japan, the NIEs and the ASEAN countries. This model, will serve as a framework for reviewing the dynamics of Asian economic growth through the international specialization of production and expansion of markets.

Section 6 presents some conclusions.

II. DEVELOPMENT AND RESTRUCTURING OF THE JAPANESE ELECTRONICS INDUSTRY

Electronics is establishing itself as one of Japan's leading industries. In 1988 it accounted for 30.6 per cent of the value of production and 34.5 per cent of the country's manufactured industrial exports.

The production of Japan's electronics industry was worth $165 billion in 1988, which was seven-tenths of the output of the United States, 1.1 times that of Europe, and 3.9 times that of the Asian newly industrializing economies (NIEs). From 1985 to 1988, the value of its production in dollars increased by a factor of 2.2, as compared with 1.2 for the United States, 1.7 for Europe, and 1.6 for the Asian NIEs. However, the yen appreciated 47 per cent during the same interval.

The report of a MITI-sponsored Conference on the Midrange Outlook for the Electronics Industry predicts continued growth for the Japanese electronics industry (excluding consumer equipment) as shown in Table 2.1. Average annual growth in the computer and semiconductor industries through the year 2000 is expected to exceed 10 per cent.

Table 2.1 Production of Electronics Industry through 2000 (billion $)

	1987	2000
Computers	34	150 (12%/year)
Telecommunications equipment	17	43
Semiconductors	12	96 (13%/year)
Electronic parts	22	50 (6%/year)

Within the Japanese electronics industry, the production value of industrial equipment and parts has risen steeply since about 1985 (Figure 2.1). For industrial equipment, this reflects a rise in computer production. For electronic parts, the increase has come in very large-scale integrated (VLSI) circuits and advanced components. The Japanese electronics industry is currently moving away from its traditional production for export of consumer equipment, to a new structure stressing computers and high-technology parts (Figure 2.2).

The export ratio of industrial equipment and electronic parts has been increasing steadily since the latter half of the 1970s. In 1986 it surpassed the export ratio of consumer equipment, which was undergoing a sharp decline. The consumer equipment export ratio has already dropped below 30 per cent and is still falling.

1. The Japanese Electronics Industry at Present

a. Consumer Electronics

Although targeted for development by the Temporary Act for Promoting Electronic Industries in 1957, the Japanese consumer electronics industry has received little R&D assistance from the government and few loans from governmental finance organizations. In the main, it has matured in an environment of intense, unrestricted competition. The 1964 Tokyo Olympics provided a particularly strong stimulus to demand.

Since the 1970s, demand for consumer electronics equipment has benefited from the economy's high rate of growth. Players in the consumer electronics market include major electrical appliance manufacturers such as Matsushita, Sony, Sanyo, and Sharp, and giant firms such as Hitachi, Toshiba, and Mitsubishi, who have staged a continuing race to develop new products (See Figure 2.3).

Until 1957 radios were the leading product of Japan's electronics industry, then from 1958 to 1967 black and white TVs became the front-runner. They were supplanted by color TVs from 1968 to 1972 and then audio equipment led for a decade. Video cassette recorders became the leading product in 1982 and since 1987 video camera recorders have made a strong showing.

Technological advances have stimulated consumer demand, even within the same product categories, by creating products differentiated by higher functionality or quality.

Growth in the consumer electronics industry is closely related to the competitive environment, in which a technological breakthrough is followed by development of a new product, creation of a new market, entry of rival firms into this market, and then differentiation of products through further technological advances.

In the early 1970s the consumer electronics industry began overseas production of electronic parts. In the 1980s, production of high-added-value products such as video cassette recorders has also been moving overseas to the United States, Britain, West Germany, South Korea, Taiwan and other countries. This shift toward overseas production of products with high-added value is expected to continue, as a means of avoiding trade frictions.

b. Computers

As indicated in Table 2.2, output of computers has grown steadily and in 1987, became the leading sector in the Japanese electronics industry, surpassing the production of consumer electronic equipment.

Table 2.2 Production of Computers and Related Devices (billion $)

1965	1970	1975	1980	1985	1986	1987	1988
0.1	0.9	1.8	5.2	14.1	23.2	34.7	45.6

The Japanese computer industry has a substantial share in the world market. In 1987 the top three Japanese makers of mainframe computers (including small business models) had a combined share of 30 per cent of the world market, of which Fujitsu had 12.3 per cent, NEC 11.5 per cent, and Hitachi 6.9 per cent.

In supercomputers, the domain of the most advanced technology, these three Japanese companies had 36 per cent of the world market of which Fujitsu had 22 per cent, Hitachi 8 per cent, and NEC 6 per cent. The Japanese computer industry has become a powerful international competitor, but now faces restructuring due to growing trade frictions with the United States and Europe.

Some of the factors in the development of Japan's computer industry have been the following:

1. Government policies to foster computer industry growth

a) In the 1950s and 1960s, when there was still a wide technological gap between domestic and overseas manufacturers, protective policies such as import quotas and tariffs and restrictions on foreign capital enabled the domestic manufacturers to get started. Between 1961 and 1964, except for Fujitsu which followed a course of independent development, leading Japanese companies formed technological alliances with American manufacturers other than IBM;

b) Various measures were taken to narrow the technological gaps created by the IBM 360 series of IC-based third-generation computers and the IBM 370 series of large-scaled integrated (LSI) chip-based 3.5-generation computers. These included government-industry joint research projects, special financing arrangements, tax incentives, and rental financing assistance through the Japan Electronic Computer Company (JECC). From 1972 to 1976, with government assistance, the domestic manufacturers were paired into three groups (Fujitsu-Hitachi, Mitsubishi-Oki, NEC-Toshiba) to develop domestic machines to compete with the IBM 370;

c) Under government guidance, a joint R&D organization was set up for basic computer technology, but the participating companies competed freely in developing and marketing of products based on the results;

d) Deregulation of computer-related trade and capital was completed in 1976. The law on which policies for promoting the electronics industry had been based since 1957, expired in 1985. The focus of government promotional efforts have now shifted from hardware technology to software technology.

2. Unique features of the Japanese computer industry

a) In the general purpose Japanese computer market, sharp competition in both technology development and marketing among the six domestic manufacturers and foreign firms such as IBM has stimulated the development of the Japanese computer industry;

b) The consumer electronics industry is highly developed, with great depth and breadth in semiconductors, integrated circuits, and other computer-related electronics technology;

c) The major manufacturers of electrical and telecommunications equipment have entered the computer industry. Their well-rounded engineering development capabilities and ample financial resources have enabled them to keep up with the rapid pace of computer technology;

d) Japanese computer manufacturers are also leading semiconductor manufacturers, capable of linking the development of new LSI and very large-scale integrated (VLSI) chips with that of new computers. This capability is what distinguishes Japanese computer manufacturers from US computer manufacturers.

3. Expansion of computer demand accompanying industrial development

a) Computers are used by 96 per cent of large Japanese firms and by 41 per cent of smaller firms.

Computer shipments climbed from 51 thousand units in 1980 to 168 thousand units in 1985 (Figure 2.4). The small and mini categories experienced especially large growth. One reason was the development of Japanese-language information processing technology, starting around 1980. The ability to employ some seven thousand *kana* and *kanji* characters in addition to alphanumerics widened the user appeal of computers.

Japanese-language word processing is the primary force driving office automation, with performance of personal computers (and word processors) rising and costs falling.

Owing to the spread of office and factory automation, the introduction of computer-integrated manufacturing (CIM), and the growth of value-added networks, 1990 shipments are expected to top 380 000 units, 2.3 times the total in 1985.

b) Numerically controlled machine tools and robots were introduced around 1975. Increasingly, factory automation equipment will be networked for efficient, diversified, small-lot production, creating high value-added products for a diversified consumer marketplace (Figure 2.5);

c) Point of sale (POS) systems, first introduced in 1972, have recently become widespread. Their penetration of department stores, supermarkets, and gasoline stations already exceeds 50 per cent;

d) It appears that the stable growth of the Japanese economy will continue in the years ahead, so an average annual growth of 12 per cent is expected for the computer industry through the year 2000.

***C**. Telecommunication Equipment*

Until the deregulation of telecommunications in 1985, the telecommunications equipment industry was under government control. The domestic market was parceled out to the major Japanese manufacturers, including Fujitsu, NEC, and Oki, along lines dictated by the telecommunication infrastructure plans of the Nippon Telegraph and Telephone monopoly (NTT). There was an atmosphere of cooperation and mild competition.

With deregulation, NTT became a private corporation and fifteen new common carriers (NCCs) appeared on the scene. Another 660 firms entered the value added network (VAN) business, earning revenues of more than $6 billion in fiscal 1987.

Production of telecommunications equipment has accelerated as shown in Table 2.3, growing by a factor of 3.9 in the ten years from 1975 to 1985, then by a factor of 2.6 in the three years from 1985 to 1988.

Table 2.3 Telecommunications Equipment Production (billion $)

1965	1970	1975	1980	1985	1986	1987	1988
0.5	1.1	2.1	4.3	8.2	11.8	15.8	21.5

The Integrated Service Digital Network (ISDN) was introduced in Japan in 1988, and is scheduled to cover 130 cities by 1990. Switching systems were 26 per cent digital in March 1988, a figure expected to rise to 40 per cent by 1990 and 100 per cent by 2000.

The major telecommunications equipment manufacturers are also computer manufacturers (see Figure 2.6). The Japanese electronics industry is therefore well positioned to create information processing systems and networks that require both communication and computer technology.

d. Electronic Parts

Production of integrated circuit chips began to grow in the latter half of the 1960s, mainly for consumer equipment such as calculators, audio equipment, and watches. The market has expanded since the 1970s with the growth of color television.

Competition to make consumer products smaller and higher in performance has contributed to progress in IC chip production technology.

A system of grants to promote development of VLSI chips for fourth-generation computers was established in 1976. For this purpose, domestic manufacturers were divided into two groups (Fujitsu-Hitachi-Mitsubishi and NEC-Toshiba), with the Agency of Industrial Science and Technology and NTT playing cooperative roles. Under this system the groups vied with each other and succeeded in developing a large number of VLSI chip techniques (over 1 000 patents).

Specialized parts manufacturers account for only a small percentage of the development and production of integrated circuits in Japan. Most of the work takes place at the computer and telecommunications firms, consumer electronics firms, and integrated electrical firms. There is also substantial production by automobile, audio, and watch manufacturers.

Japan's IC technology is outstanding in both integration and production. In the heyday of the 64K dynamic random access memory (DRAM) chips, Japan had more than 70 per cent of the world market. Since 1977, to reduce trade friction Japanese firms have begun local production in the United States: NEC and Hitachi in 1978, Fujitsu in 1979, Toshiba in 1980, and Mitsubishi in 1983.

The effects of the semiconductor slump of 1985 continued until 1987, but 1988 saw recovery with more than 30 per cent growth over the preceding year (Figure 2.7). While still increasing their output of 1M DRAMs, the growth of micro fabrication technology and process technology has made larger capacities and higher processing speeds possible, and the semiconductor manufacturers are now gearing up to produce 4M DRAMs.

The 1985 slump was the turning point for semiconductor manufacturers. Since then, the production of application specific integrated circuits (ASICs) has been increasing. ASICs are custom ICs for specific applications or users and they offer a number of advantages.

2. Plant and Facilities Investment and R&D Investment in the Japanese Electronics Industry

a. R&D Investment

The international competitive strength of the Japanese electronics industry derives from investment of vast funds in research to strengthen its technological capabilities. In 1986, the telecommunications, electronics, and electrical instrument industry spent 8.1 per cent of its revenues on R&D, which compares with 5.9 per cent for the automobile industry, 5.8 per cent for the chemical industry, and the average of 2.7 per cent for all manufacturing industries (Figure 2.8).

R&D spending by the Japanese electronics industry has grown spectacularly in recent years. The increasing sophistication of technology requires increasingly large R&D outlays.

b. Government Spending on Research

Government research and development assistance has also played a significant role in Japan's industrial development. The ratio of government expenditures to total R&D expenditures has not exceeded 30 per cent, however, and has been decreasing in the 1980s, recently falling below 20 per cent (Figure 29).

Government research policy is guided by the following three principles: (1) It is intended to promote the development of new technology by industry; (2) Grants are awarded to companies or groups of companies on a competitive basis; and (3) New technology developed with government assistance is made available to the industry as a whole.

c. Trends in Plant and Facilities Investment

New technology quickly becomes obsolete, so the investment in research and development needs to be recovered as quickly as possible. The cycle of developing new technology and investment in facilities to manufacture products embodying the new technology is relatively brief.

The performance and quality of hardware products depends on the performance of their electronic components. Thus manufacturers of both consumer electronics products and computers increasingly tend to concentrate their investments in the area of electronic parts. The growth of this investment has been especially large since the development of VLSI in the late 1970s (Figure 2.10).

3. Restructuring and Future Problems

Among the causes of a major restructuring of the electronics industry were the appreciation of the yen following the 1985 Plaza monetary agreement and persisting frictions with Japan's main trading partners.

Japanese enterprises have dealt with the appreciation of the yen in four ways. First, they have reduced labor costs by moving labor-intensive manufacturing processes offshore into Asia. Second, they have reduced production costs by developing technology that dramatically increases productivity. Third, they have created new markets by developing new products. Fourth, they have reduced the size of their unprofitable divisions.

These measures have been successful, but have also aggravated trade frictions. Japan's industry now faces a need for further restructuring.

Current structural readjustments of Japanese industry are changing the pattern of overseas operations, the aim of which is shifting from cost reduction to the avoidance of trade frictions by creating subsidiaries in advanced countries. The center of gravity of overseas operations by Japanese companies has recently been shifting from Asia toward the United States and Europe. These new overseas operations of Japanese companies include transfer of high value-added production processes, transfer of R&D divisions and relinquishing of managerial authority. To reduce trade

friction with Europe, almost all Japanese VCR manufacturers have begun production in Europe: Japan Victor and Sony in 1982; Mitsubishi, and Hitachi in 1983; Matsushita, Sanyo, Toshiba in 1984 and Sharp in 1985. The percentage of overseas production has risen annually, reaching 12 per cent in 1987.

A new aspect of Asian operations is an international division of production in which local production is for Asian markets. Hitachi has begun a joint semiconductor venture with Gold Star of the Republic of Korea, for example. Hitachi is providing its 1M DRAM technology, and Gold Star plans to begin volume production in 1990. In recognition of the technological capabilities of the newly industrializing regions, a sharing of research and development work has also begun.

The report of the Conference on the Midrange Outlook for the Electronics Industry calls for increased technological cooperation with the developing countries by promoting computer literacy, the development of standards and industrialization of software production, inviting researchers to visit Japan, and sending more educational personnel overseas. Starting in 1990, MITI plans to make development assistance available to computer software engineering trainees from other countries in Asia.

Among the problems facing the Japanese electronics industry at home are a need for more investment in research and development, and learning how to manage risks involving large amounts of capital investment. Moreover, relative to its progress in hardware, the Japanese electronics industry lags behind in software technology. Urgent measures are needed to deal with a rapidly growing demand for software, whose development is falling short of the need, due to a lack of software engineers and low productivity in software development. A shortage of 1 million software engineers is predicted by the year 2000. Government and industry are cooperating to (1) improve software productivity; (2) train personnel; and (3) promote the development of general-purpose software packages.

International issues include establishing international standards, protecting intellectual property rights and preventing trade protectionism. These problems are common to all countries and must be solved through cooperation.

To maintain its leading position, the Japanese electronics industry is expanding direct investment abroad, transferring technology to other countries and broadening access to its domestic market. It also sees an appropriate international division of labor as an effective way to expand markets.

III. ASIAN NIES AND JAPAN

TRADE, DIRECT INVESTMENT, AND TECHNOLOGY TRANSFER

1. Electronics Imports and Exports

a. Export Trends in Japan's Electronics Industry

Until the early 1980s, Japanese exports of consumer electronics products were an important factor behind the growth of the electronics industry. However, since 1985 there have been major changes in the industry's pattern of exports.

Calculated in yen, Japanese electronics exports have actually declined: the 1988 level was only 94 per cent of the 1985 level. Calculated in dollars, exports continued to rise after 1985, but the export ratio (exports/production) peaked at 53 per cent in 1984 and has been falling ever since, reaching 42.8 per cent in 1988. See Table 3.1.

Table 3.1 Japanese Electronics Production, Exports, and Imports ($ billion)

	1965	1970	1975	1980	1985	1986	1987	1988
Production	2.4	9.4	14.6	39.7	77.8	108.4	129.8	165.3
Exports	0.6	2.4	6.4	20.1	40.6	50.9	59.3	70.9
Imports	0.1	0.6	1.1	3.1	4.3	5.1	7.1	9.8

Export growth from 1985 to 1988 was a nearly flat 9 per cent in consumer equipment (-42 per cent in yen), 91 per cent in industrial equipment (2 per cent in yen) and 142 per cent in electronic parts (31 per cent in yen). Table 3.1 lists a breakdown of export values in these categories. The percentages have undergone major changes: from 45 per cent for consumer equipment; 23 per cent for industrial equipment; and 32 per cent for electronic parts in 1980, to 24 per cent for consumer equipment; 33 per cent for industrial equipment; and 43 per cent for electronic parts in 1988.

Table 3.2 indicates a fundamental change in export structure. Consumer equipment, the former leader, is giving way to industrial equipment and electronic parts.

Table 3.2 Exports of Japanese Electronics Industry (billion $)

	1965	1970	1975	1980	1985	1986	1987	1988
Consumer equipment	0.4	1.6	3.7	9.0	15.9	17.5	16.0	17.3
Industrial equipment	0.1	0.4	1.2	4.6	12.2	16.2	19.8	23.3
Electronic parts	0.1	0.4	1.2	4.6	12.2	16.2	19.8	23.3
Total	0.6	2.4	6.4	20.1	40.6	50.9	59.3	70.9

One reason for the declining share of consumer equipment in exports is a shift of production toward the domestic market, prompted by reduced cost competitiveness. Tape recorders are an example: exports declined by 3 per cent in 1986, 28 per cent in 1987, and 51 per cent in 1988 in terms of units shipped. Another factor is overseas production to avoid trade friction. For example, offshore production of video cassette recorders increased from 7 per cent in 1985 to 12 per cent in 1987.

Domestic demand in Japan is always saturated, so new demand can only be created by developing new products. The need to modify production lines for new products provides another incentive for moving production of existing products overseas.

Table 3.3 provides examples of the steep decline in the export ratio of consumer equipment. As new products are developed their export ratios may be initially high, but they too can be expected to follow the same pattern.

Computers accounted for 16 per cent by value of 1988 exports and telecommunications equipment for 9 per cent. About 80 per cent of the computer exports were OEM exports to the United States and Europe. About 40 per cent of the telecommunications exports were facsimile equipment, a product group whose exports have recently risen sharply.

Exports of electronic parts have also increased since 1985, accounting for 43 per cent of electronics exports by value in 1988, as compared to 31 per cent in 1985.

Parts supplied to overseas production plants account for most of the increase. A related factor is the low local procurement ratio of approximately 20 per cent.

Table 3.3 Export Ratios of Consumer Equipment (value base)
(percentages)

	1985	1988
Tape recorders	85.8	49.2
Color TVs	67.7	21.6
VCRs	82.9	64.8

Exports of integrated circuits were slowed by the recession of 1985, but increased in 1987. In 1988 IC exports accounted for 22 per cent of the value of electronic parts exports. The IC export ratio is held down, however, by the requirements of consumer equipment, computers, and telecommunications equipment made for the domestic market, coupled with a strong demand from other sectors such as the automobile industry. (The IC export ratio was 29 per cent in 1986, 31 per cent in 1987, and 34 per cent in 1988.)

Table 3.4 provides a geographical breakdown of Japan's electronics exports. The United States was the principal destination, accounting for 40 per cent of consumer equipment, industrial equipment, and parts exports, as a whole. Exports to Asia, however, have been increasing at a rate well above the average; the 1987/1986 ratio was 129 per cent and the 1988/1987 ratio was 128 per cent (in dollars).

Table 3.4 1988 Exports by Region (billion dollars)

	Asia	Europe	N. America	Others	Total
Consumer equipment	3.3	5.7	7.2	1.1	17.3
Industrial equipment	3.5	7.7	10.7	1.4	23.3
Electronic parts	11.7	7.0	10.2	1.4	30.3
Total	18.5	20.4	28.1	3.9	70.9

Electronic parts form a high percentage of the exports to Asia. Integrated circuits and semiconductor devices are particularly significant in Asia-bound exports, comprising 51 per cent, as compared with 31 per cent of exports to the United States and 15 per cent of those to Europe. This trend is related to the growing production of consumer electronic equipment in Asia.

The shift of production from Japan to the Asian NIEs and the ASEAN countries is near completion for almost all audio equipment, including radio cassette recorders and headphone stereo sets, for compact TV sets and calculators, and for appliances such as refrigerators, washing machines, and fans. High-quality electronic parts, however, are still supplied from Japan.

Another recent trend is the rise of exports of semi-finished IC products. Japan is now playing the role of a parts supplier to the electronics assembly industry in the Asian NIEs.

b. Trends in Imports from Asia

Japan's electronics imports are increasing annually. The 1988 figure of $9.8 billion was 126 per cent of imports the previous year. But imports still remain small by comparison with domestic production of $165.3 billion and exports of $70.9 billion.

Table 3.5 shows the trend in imports since 1965.

Table 3.5 Imports of Electronic Products (billion $)

	1965	1970	1975	1980	1985	1986	1987	1988
Consumer equipment	0.01	0.01	0.06	0.17	0.10	0.19	0.42	0.75
Industrial equipment	0.11	0.34	0.58	1.31	1.67	1.93	2.43	3.40
Electronic parts	0.04	0.21	0.45	1.62	2.57	2.95	4.30	5.66
Total	0.16	0.56	1.09	3.10	4.34	5.07	7.15	9.81

In 1988 the United States supplied 58 per cent of imports, followed by Asia with 31 per cent. (See Table 3.6.)

Table 3.6 1988 Imports by Origin (billion $)

	Asia	Europe	N. America	Others	Total
Consumer equipment	0.64	0.04	0.07	--	0.75
Industrial equipment	0.36	0.40	2.52	0.12	3.40
Electronic parts	2.00	0.53	3.09	0.04	5.66
Total	3.00	0.97	5.68	0.16	9.81

Imports from Asia have been rising sharply; the 1987/1986 ratio was 139 per cent and the 1988/1987 ratio was 157 per cent. Most of the imports are electronic parts. Of these, 70 per cent are items such as resistors and capacitors. Only a small proportion are integrated circuits. Imports of consumer equipment were approximately $600 million in 1988, but recent growth has been large in percentage terms. The 1987/1986 ratio was 145 per cent and the 1988/1987 ratio was 184 per cent. Approximately 80 per cent of these consumer equipment imports come from Asia, most of them on an OEM basis. Table 3.7 shows the increasing share of imports in the Japanese market for two major consumer products: video cassette recorders and color TV sets.

Table 3.7 Imports of Consumer Equipment:
thousands of units (import share in parentheses)

	1986	1987	1988
VCRs	14 (0.2%)	128 (1.6%)	367 (3.7%)
Colour TVs	23 (1.0%)	35 (4.0%)	74 (7.9%)

There is some doubt, however, that this high growth of exports to Japan can be maintained, despite the comparative advantage enjoyed by the Asian NIEs due to their lower costs and the strong yen. The reasons are the following:

(1) The Japanese market for consumer electronic products is already highly saturated. (In 1988, 64 per cent of all Japanese homes had VCRs, and 99 per cent had color TVs.)

(2) The production costs of high quality, advanced-function products which consumers now want has been greatly reduced, nearly completely compensating for the appreciation of the yen.

(3) Competition among Japanese firms is becoming more intense as they turn toward the domestic market.

Therefore, although exports from the Asian NIEs to Japan may continue to grow, they are unlikely to be able to capture a large share of the market.

2. Overseas Operations and Direct Investment by Japanese Companies

a. The Driving Forces: Trade Friction and a Strong Yen

There have been two periods of greatly increased overseas activity by Japanese companies. The first was in 1973 to 1974. The second began in 1987 and is still continuing.

The first peak was a response to the dollar shock of 1971, which sent the yen floating up against the dollar, while the second peak has been associated with the further rise in the yen's value following the G5 Plaza agreement in 1985, the crash of the New York stock exchange in October 1987, the worsening friction over America's continuing trade deficit with Japan and a need for local production facilities in the European Community in preparation for European integration in 1992. Overseas Asian operations by Japanese firms were slowed by the second oil crisis of 1977, but since the recovery from the semiconductor slump in 1986 they have been increasing rapidly, influenced by the rising value of the yen (Figure 3.1).

Direct Japanese investment overseas totalled $12.2 billion in 1985. By 1988, this figure had risen to $47 billion and new investments in that year were 41 per cent greater than in 1987.

Direct foreign investment was formerly concentrated in non-manufacturing areas such as finance, distribution, and real estate. However, direct investment in manufacturing has recently increased rapidly, as local production is used to offset the effects of the strong yen. In 1988, direct investment in manufacturing was $16.9 billion, an increase of 76 per cent over the previous year, a much greater increase than in non-manufacturing industries. Cumulative investment in manufacturing industries had reached $43.5 billion by the end of September 1988, so the 1988 investment figure was approximately 30 per cent of the total. Growth was high in the electrical equipment ($3 billion), general manufacturing ($1.4 billion), and chemicals industries ($1.3 billion).

A geographical breakdown shows that North America remains the major investment recipient, getting $22.3 billion (145 per cent of the amount in 1987) as opposed to $9.1 billion for Europe (189 per cent) and $5.6 billion for Asia (114 per cent). In addition to the construction of automobile, chemicals, and manufacturing plants in North America to avoid trade friction, there has been a growing number of large-scale mergers and acquisitions.

Toyota's operations in the United Kingdom are an example of the investments being made to gain a firmer foothold in Europe before EC integration in 1993. The electronics industry in particular has extensive plans for locating integrated production

facilities in Europe. In 1991 Fujitsu will begin operating an integrated fabrication plant for 1M and 4M DRAMs in Northern England; Hitachi, an integrated fabrication plant for 4M DRAMs in Munich; and Shinetsu Handotai, a 1M DRAM wafer plant in Livingston, Scotland. Investment will continue to increase as production for the European market shifts to European locations.

Direct investment in Asia totalled $700 million from 1961 to 1970, $9.1 billion from 1971 to 1980, $12 billion in the five-year period from 1981 to 1986, $4.9 billion in 1987, and $5.6 billion in 1988. Although Korea, Taiwan, Singapore, and Hong Kong have been the traditional investment targets in Asia, companies are now shifting their sights to the ASEAN countries, especially Thailand and Malaysia. Investment in Malaysia in particular has picked up sharply in recent years.

The reason for this shift is the rising wage levels in the Asian NIEs and the appreciation of their currencies against the dollar, which makes them less attractive to export-oriented investments. The current trend is to locate technology-intensive plants in the NIEs, due to their higher level of economic development, and labor-intensive plants in the ASEAN countries.

The sudden rise in investments in Malaysia is due to a combination of conditions that make it advantageous to start operations quickly while the yen is strong. These include (1) a relaxation of foreign investment regulations and streamlining of investment procedures, which has opened the door to foreign investment; (2) an availability of high-quality, inexpensive labor; and (3) a developed infrastructure of roads, harbors, airports, and telecommunications that Malaysia built with oil income in the early 1980s.

In a poll conducted in September 1989 by the Nihon Keizai Shimbun, a major Japanese economics newspaper, 75 per cent of the businessmen queried said that they intended to expand their investments in Asia by the year 2000. The leading candidate for investment was Thailand (26 per cent), followed by China (17 per cent), Indonesia (12 per cent), Taiwan (9 per cent), and Malaysia (7 per cent).

Asia used to be regarded as a place to manufacture products for export elsewhere, but now operations are increasingly being undertaken to win a share of expanding markets in Asian countries where steady, high economic growth is expected.

b. Changing Trade Structure

In 1980 Japanese manufacturers carried out 2.9 per cent of their production overseas, and in 1985 the figure was 3 per cent. Since then, however, increased overseas investment has resulted in a steadily rising overseas production ratio, reaching 4.8 per cent ($130 billion) in 1988.

In terms of sales, 45 per cent of overseas production is sold in the United States; 31 per cent in Asia; and 15 per cent in Europe, with 79 per cent of the output sold locally, 9 per cent exported to Japan, and 12 per cent exported to third countries.

Japan's overseas subsidiaries in the Asian NIEs and ASEAN countries are planning to minimize the number of parts they procure from Japan as much as possible. In Taiwan and Singapore, Japanese subsidiaries obtain 70 to 80 per cent of components for color TVs and 80 to 100 per cent of audio parts locally.

Table 3.8 Local Procurement by Japanese Subsidiaries in Asia
(processing and assembly)

	1981	1986	1991
Local procurement	42%	51%	66%
Procurement from Japan	53%	44%	28%
Procurement from 3rd-party countries	5%	5%	6%

Source: MITI, "Research on Corporate Internationalization"

By the year 2000, production of computer peripheral equipment by overseas subsidiaries of Japanese electronics companies is projected to rise to 15 per cent (from 2 per cent in 1987), of semiconductors to 15 per cent (from 5 per cent in 1987), and of electronic parts to 40 per cent (from 20 per cent in 1987).

Moreover, an increasing percentage of Japan's imports are coming from Southeast Asia, as shown in Table 3.9.

Table 3.9 Geographical Breakdown of Japanese Imports

	Total value	Regional percentage				
		US	EC	SE Asia	China	Others
1985	$40.2 billion	35.5	18.6	19.1	4.4	22.4
1988	$91.8 billion	25.6	22.6	25.1	5.1	21.6

Source: JETRO.

The rising wave of imports from Southeast Asia is explained by the growing penetration of the Asian NIEs' products into Japanese markets and the shift of production to Southeast Asia because of the appreciation of the yen.

The Asian NIEs are using export-oriented industrialization to promote economic growth as they move toward an advanced industrial structure. Formerly the Asian

NIEs relied on exports to the United States, but the growth of their internal markets and exports to Japan are altering their trade patterns. As Table 3.10 shows, the percentage of their exports to the United States is falling while the percentage to Japan is rising. The Asian NIEs are also starting to import more from the United States and less from Japan. This trend is slowly correcting the imbalances in their trade, favorable with the United States and unfavorable with Japan.

Table 3.10 Changing Trade Structure of Asian NIEs

	Exports				Imports			
	To United States		To Japan		From United States		From Japan	
	1987-1988		1987-1988		1987-1988		1987-1988	
South Korea	39%	36%	17%	20%	22%	24%	34%	31%
Taiwan	45	39	12	14	21	28	35	29
Hong Kong	38	33	5	5	8	9	20	19
Singapore	24	24	9	9	15	15	21	22

Source: Institute of Developing Economies

3. Technology Transfer

The shift of production from Japan to other Asian countries began with the transfer of labor-intensive processes to compensate for the loss of competitiveness that followed the appreciation of the yen. At the beginning of this process, the electronics industry mainly exported consumer equipment, so the transfer of production started with consumer electronic products such as tape recorders, stereo sets, and color TVs.

Parts or semi-finished products were supplied from Japan for simple processing and final assembly; then the products were exported to third countries, mainly the United States. Japan was using the rest of Asia as an assembly plant for its exports. However, this was welcomed by the Asian countries which were seeking to create an export-oriented industrial base.

For products not sharply differentiated by quality or engineering, the transfer of production technology is now nearly complete. These include audio products (radio cassette recorders, headphone stereo sets, compact stereo systems), low-end color TVs, calculators, and home electrical appliances such as refrigerators, microwave ovens, washing machines, and vacuum cleaners.

Factors driving this transfer of the production of consumer products included the following:

(1) Mass production technology was already well established;

(2) Given a supply of parts, it was relatively easy to get started by transferring the assembly technology;

(3) There was an abundance of qualified labor;

(4) The technology was available for transfer because the weight of Japan's production structure was shifting toward industrial equipment.

What began as a transfer of individual production processes for consumer equipment has led to the transfer of all phases of production of low-cost, high-volume products. Production of electronic parts such as capacitors, resistors, and coils that are high in labor content and low in price was transferred during the first wave of overseas activity.

In integrated circuits, the transfer has taken the form of a division of labor. Wafers produced in Japan are being sent elsewhere in Asia for the manual finishing and assembly steps. However, there are recent indications that in integrated circuits, too, there is a shift from transferring certain steps of production to a transfer of the whole production process.

When Japanese firms began building facilities for producing integrated circuits in the United States and Europe, they were less concerned with cost reduction than reducing frictions arising from their exports of integrated circuit chips. However, there were other reasons for producing integrated circuits in the Asian NIEs.

Hitachi, for example, has formed an alliance with Gold Star of South Korea, under which Hitachi is providing its 1M DRAM technology. Gold Star was to start volume production in the first half of 1990. Later, Hitachi plans to import Gold Star's chips on an OEM basis. Hitachi's strategy in creating this partnership seems to be to transfer its 1M DRAM technology to South Korea so that it can concentrate its resources on the next generation of semiconductors.

Many Japanese semiconductor manufacturers are starting to open centers in other Asian countries for designing new integrated circuits. In South Korea, Taiyo Yuden has begun to design hybrid ICs, in Taiwan, Seiko Epson has begun to design ASICs, and in Taiwan and Singapore Fujitsu has begun to design ASICs.

A significant amount of high value added technology is being transferred. The following agreements between Japanese and South Korean firms for transferring technology were announced in the second half of 1988 and first half of 1989:

- Mitsubishi Electric ----- Goldstar Industry System
  CD player component production technology

- Sanyo Electric Co. ------ Samsung Electronics
  Plain-paper copier production technology

- FANUC Ltd. ---------- Daewoo Heavy Industry
  Welding robot technology

- Hitachi ---------- Daewoo Electronics
  Automotive audio production technology

- Toshiba ---------- Samsung Electronics
  Low-end VCR production technology

- Hitachi ---------- Gold Star
  1M DRAM production technology (mentioned in text).

Toshiba is transferring all prototyping, development, and production of low-end video cassette recorders to Samsung Electronics, apparently so that it can concentrate its resources on high-end models. This takes both firms a step closer to sharing product development.

Due to the appreciation of the won and the rising cost of labor, South Korea is trying to shift toward products with high value added. Japanese businessmen consider South Korea as not simply an overseas production site but as a growing consumer market, and are seeking, via the process of transferring technology, to develop partnerships that will extend to marketing.

In the past, there was a fear of the possible boomerang effects of transferring technology. Now that the Asian NIEs have become more industrialized and production is becoming increasingly international, however, the suppliers of technology are finding that they must transfer high technology for their own interests.

From now on, Japan will have to transfer existing high technology to overseas countries as much as possible, and it will also have to strive to develop technology with high value added.

IV. INTERNATIONAL SPECIALIZATION AND CORPORATE STRATEGIES

1. The "Glocalization" of Japanese Enterprises

Japan industrialized and established a presence in world markets later than the United States and Europe. Its companies have also adopted a somewhat different overseas strategy than their European and American counterparts.

In adapting to various national markets, European firms have recognized the independence of their overseas subsidiaries, while maintaining a loose control. American-owned multinationals develop strategies and establish programs with a global perspective, in which the headquarters exercise a considerable degree of control and require the overseas subsidiaries to carry out their programs.

Japanese enterprises, using Japan as their sole manufacturing base, have used the marketing networks of the large trading companies to deliver their products to world markets. Overseas manufacturing subsidiaries and joint ventures had to accommodate to that framework. Accordingly, Japanese firms have based their strategy upon three pillars: high productivity, domestically developed technology and expanding exports.

Another characteristic peculiar to Japanese corporations is their approach to the manufacturing process. In the United States, stopping the production line is considered absolutely unacceptable. Even when substandard goods are being produced, the line is not stopped. This is based on the idea that any substandard goods can be caught at the inspection stage and be reprocessed. In Japan, by contrast, the line is stopped immediately. A Japanese firm considers the loss resulting from stopping the line as less important than the loss that would result if a substandard product went out into the marketplace. Moreover, such an incident is expected to be a learning experience, assuring that a similar stoppage does not recur.

This method of effecting improvements by successive learning experiences, combined with the US system of quality control, produce outstanding results in the form of Japanese quality control.

In the course of their growth, Japanese firms were fortunate enough to have the equipment for creating flexible manufacturing systems for highly integrated semiconductor devices, small and economical computers and robots, telecommunications technology, precision mechanical engineering and so on.

However, a changing international situation has compelled Japanese enterprises to modify their three-pronged strategy. The competitive lead that was achieved under stable exchange rates was undermined by the appreciation of the yen, and it became necessary to develop a new strategy for regaining cost competitiveness.

The practice of using the technology of foreign firms as the basis for development of local technology became the cause of disputes involving intellectual property rights. What was needed was a new approach based on greater strength in

basic technology, transferring abroad the results of R&D activities, technological exchange with research scientists and engineers, and so on.

The strong export orientation of management -- investing the profits from exports in domestic and overseas production facilities to strengthen further export competitiveness -- resulted in a burgeoning excess of the balance of trade, which further exacerbated trade frictions.

These problems cannot be solved just by transferring production abroad. There is a trend toward stricter standards in other countries, with the result that "localization" is becoming more and more inevitable. This is why Japanese firms have recently begun to follow a policy that has been dubbed "glocalization", that is to say basic management strategy is determined on a global basis, but full attention is paid to localization -- assuring that the enterprise in the host nation contributes to the growth of the local economy. Localization thus includes such things as transferring technology, cooperating in the development of local suppliers of parts, strengthening local design and development activities, and working harmoniously with local firms and the community.

Corporate strategy could, for example, divide the world into four regions, the United States, Europe, Asia and Japan, in which product development, production, sales and administrative activities could be carried out in a coordinated manner for each region, or establishing regional management subsidiaries and devolving to them some of the functions of the head office.

Most of the overseas subsidiaries established by Japanese firms in Asia generally rely on purchases from Japan for parts, raw materials, dies and other manufacturing equipment because of insufficiently developed local industries, a situation which adds to an unfavorable balance of payments with Japan. However, these off-shore enterprises are reaching the point where they have the ability to supply world markets with low-cost parts, subassemblies and low-end products.

Japanese electronics firms are now beginning to set up international capital financing centers in Singapore and Hong Kong for the purpose of procuring low-cost parts made in Asia and supplying them efficiently to their far-flung manufacturing operations worldwide. Besides this effort to increase international procurement of parts, there is an increasing trend toward international specialization by region, in which Japanese firms abroad export intermediate and finished goods to Japan as well as to third countries. It would appear that these trends will make a contribution to reducing current imbalances of payments.

The future of firms operating internationally will be determined by their global strategy. Thus leading firms are moving to strengthen their international distribution operations and establish international procurement networks.

Japan has come in for considerable criticism for its ability to make profits by taking advantage of US and European achievements in basic research to expand its international markets for being, in effect, a freeloader on basic research. The basic

research work on the transistor, which drove the development of the electronics industry, was done in the United States and Europe.

The worsening of trade frictions raises the specter of "technological nationalism". We have reached the point where Japan as a nation must become more actively involved in exchanging personnel and information with other countries, making available the results of fundamental research, establishing advanced research facilities of international stature and commissioning projects at research institutions overseas.

Firms that have expanded overseas by emphasizing sales and production since the 1970s, began around the mid-1980s to establish R&D facilities for product development. However, there are still very few overseas facilities engaged in basic research.

The following considerations contributed to the trend toward localization of product development:

(1) Products had to be developed rapidly to suit the needs of the local market;

(2) Products had to be designed to match the materials and parts available locally;

(3) There was the hope that localization of development work would provide incentives for local technical staff, improve retention of and assist in the acquisition of talented engineers.

At Sony, basic research is still done in Japan but an effort is being made to conduct peripheral R&D locally. In the case of TV, for example, basic engineering design is Japanese but the design and assembly of the sets themselves are done locally, based on local needs. There are overseas research centers in the United Kingdom and West Germany, and the company is recruiting engineers on a global scale.

Matsushita Electric has extended the four-region concept to the technical domain to promote regional autonomy and self-sufficiency. It has overseas research centers in North America and Taiwan. However, Japanese companies are only beginning to establish R&D centers in the Asian countries. Their necessity will grow as the degree of specialization in the Asian NIEs and the ASEAN countries increases. This will be an important strategic consideration in the "glocalization" of Japanese enterprises.

2. The Overseas Strategy of Japanese Business

a. Consumer Electronics

World demand for consumer electronics products was $71.1 billion in 1985 and $112.4 billion in 1987. According to estimates by the Electronic Industries Association of Japan (EIAJ), it will be $204.9 billion in 1995 and $247.3 billion in the year 2000. To maintain this high rate of growth, additional demand will have to be created in the largely saturated markets of Japan, the United States and Europe (by developing new

products and enhancing the quality and function of major existing lines) and market expansion should occur in the Asian NIEs, the ASEAN countries and the countries of the Eastern bloc.

As competition from the Asian NIEs intensifies, Japanese enterprises will probably increasingly specialize in products with high value added, and it is expected that the percentage manufactured overseas will rise to 20-35 per cent.

With an eye to unification of the European market in 1993, Sony is moving to achieve complete localization, with plans to build an integrated manufacturing facility for making IC devices, and to establish a developmental research center for telecommunications equipment and another research center for high-definition TV. This will mark further progress in the firm's strategy of global localization. However, it appears that Sony plans to keep its most advanced technology development work based in Japan.

The greatest proportion of advanced technological plants will remain in Japan, apparently because the firms consider the sophisticated domestic market necessary to test market new products. However, the readily available high quality labor available in Asia is expected to contribute to an acceleration of the transfer of production of low-end products, and that before long it will be feasible to delegate the manufacture of high-tech products to Korea, Taiwan and Singapore.

Aiwa was already manufacturing products in 1988 worth $270 million in Singapore, mainly headphone stereos and radio-cassette recorders, and it expected the output there to reach $370 million in 1989. Aiwa also plans to expand the activities of the R&D center opened in 1988 by developing new products such as a radio-cassette unit with compact disc player. With Singapore now accounting for more than 50 per cent of Aiwa's total production, and growing in importance as an export center to the home market, the company plans to establish an Asian regional management center there within a few years.

Asahi Glass has entered into a joint venture in Thailand with a local partner for the manufacture and export of glass for picture tubes, a major element in color TV production, with start-up scheduled for 1991. Over 50 per cent of the output will be exported to other countries, including Japan. Plans for similar operations are also being put forward by Toshiba and Mitsubishi Electric, in concert with local firms.

In Malaysia, Toray has plans to assemble electric components for VCRs and air conditioners, and to manufacture floppy disks, and, in addition to supplying the local operations of Japanese electrical manufacturers, intends to export to Japan itself.

These projects are only a sample of those announced since the beginning of 1989. What they have in common is that they all involve exports to Japan.

In consumer electronics, the industry has moved from an export orientation toward greater value added for the domestic market, and local manufacture for the

overseas market. In components, there has been a shift toward raising the percentage of local procurement and horizontal specialization for supplying the Japanese market.

b. Computers and Peripherals

In the field of computers, exports are inhibited by the necessity for providing software and maintenance support services, and by the fact that existing international standards make it impractical to sell general-purpose computers manufactured in Japan in the overseas market without making modifications.

As things stand, firms are selling, primarily in Asian markets, under their own brand names, but in Europe and the United States, they generally opt for OEM contracts with overseas manufacturers.

The main problems now facing domestic manufacturers are overseas development of software, and the establishment of equipment maintenance services.

At present, there are licensing agreements relating to general-purpose machines between Fujitsu and Amdahl Corp. of the United States, and between NEC and France's Bull and Honeywell of the United States. In this domain, licensing activity between Japanese and American firms is expected to increase in coming years. In workstations, Fujitsu, Toshiba and Oki Electric are buying OEM products from Sun Microsystems, and Hitachi has entered the fray with a licensing agreement with Hewlett-Packard. In supercomputers, Hitachi has a cross-licensing agreement with Cray Research.

Exports of mass-produced products like peripheral devices and personal computers are growing as quality improves and prices come down. Export growth based on fierce price competition leaves the industry vulnerable to charges of dumping. Thus it is now necessary to compete on the basis of quality rather than sheer volume.

The rapid appreciation of the yen has also applied pressure to move production of this equipment offshore. Thus an effort is being made to effect a change in the rationale for establishing an overseas presence from the traditional search for cost reductions or avoidance of friction to the optimum-point production argument, in which manufacture and marketing are located at the demand point. However, the establishment of offshore manufacturing gives rise to friction with local firms and underscores the problem of the low proportion of components that are procured locally. It is necessary to increase the degree of localization by providing local component manufacturers with technical guidance and by transferring technology to them, and by improving coordination between local firms and Japanese component manufacturers.

In peripheral devices and personal computers, the Asian NIEs are concentrating on low-priced products and are strongly cost-competitive. In order to avoid rivalry and promote specialization, the Japanese computer industry must continue to shift towards high-tech product lines having higher value added.

c. Semiconductors

The movement of assembly operations into the Asian NIEs, ASEAN and other Asian countries that began in the 1980s was aimed at taking advantage of cheap local labor and exporting finished products back to Japan. With the rapid appreciation of the yen in the late 1980s, this shift of production of electronics products to the Asian NIEs and ASEAN has accelerated, and the semiconductor products assembled locally by Japanese firms are increasingly sold locally to satisfy local demand.

Meanwhile Japanese firms are beginning to work on integrated production at the point of consumption as a means of reducing trade frictions with the United States and Europe.

Fujitsu planned to commence integrated DRAM production in the United States in the second half of 1989. Until now, it has been processing wafer in Japan, and assembling the 256K and 1M DRAMs in the California plant. An Oregon plant completed at the end of 1988 will add initial processing for DRAMs to the existing processing facilities for ASICs. It is planned that most of the greater part of the chips pre-processed in Oregon will be assembled in California and sold in the US market. A portion will also be sold in Southeast Asia and Europe.

Currently NEC is producing 256K DRAMs in the United States at a rate of 5 million a month, and it is planning to build a new integrated plant for 4M DRAMs in California, to go on line in 1991. The firm has also signed a cross-OEM agreement with Texas Instruments under which 256K DRAMs will be supplied by NEC to TI in Europe and by TI to NEC in Japan. It is claimed that this represents an attempt to avoid disorderly marketing and achieve planned production and sales.

Toshiba and America's Motorola have already established a joint venture in Japan for the mass production of 1M DRAMs, and have reached agreement on the joint development and production of 4M DRAMs, magnetic disks and microprocessors. Toshiba is to supply 4M DRAM technology, and in return will obtain DISC technology from Motorola. Following up on its supply of 1M DRAM design technology to Germany's Siemens, Toshiba also plans to forge a closer relationship relating to gate arrays.

Oki Electric planned to start assembly production of 256K DRAMs by the end of 1989 in the United States. Wafers are to be supplied from Japan, but it is expected that a shift to integrated manufacture will take place in the near future.

These firms also are planning integrated production of semiconductor devices in Europe, as mentioned earlier in this paper. Thus, despite the confrontation over the question of access to the Japanese market, cooperation is growing between American and Japanese firms and between European and Japanese firms.

3. The Role of Japanese Firms in International Specialization

Japan's electronics industry is facing a major transition period as it grows to become one of the leading industries of the 21st century.

The electronics industry has always had a strong international flavor, and since the 1970s off-shore production, primarily in Asia, has become established on a firm foundation. Since the beginning of the 1980s, the rapid development of LSI technology and the growth of semiconductor markets, together with the upgrading of the production technology capabilities of the developing nations of Asia, have meant that despite concomitant trade frictions, increasing international specialization has gradually redrawn the world map as far as the electronics industry is concerned.

a. Stages in the Development of International Specialization

The term international specialization refers to a variety of levels and covers considerable ground. If one follows the development of an electronic product, its commercial introduction and its maturity, and the roles played and processes followed by various countries or territories in terms of specialization, four developmental stages can be distinguished (see Figure 4.1).

1. Development of New Products and Establishment of Production Technology

The electronics industry is technology intensive, requiring basic research, product development, and huge amounts of investment in production facilities. Thus a leading company must have great capital resources and an ability to take risks. The followers frequently depend on the leaders for R&D, and come in at the production stage.

Among the processing and assembly industries, electronics is distinguished by having processes that are automated and use the most advanced technology and others that require a large amount of skilled labor. Furthermore, technological change is so rapid that new products displace others very quickly, creating a significant risk of plant obsolescence. After a firm has developed electronic components or products under existing conditions, there will be a period during which production is monopolized by this firm. Since large investments are at stake, the establishment of techniques of mass production and maintenance of uniform quality are crucial to the viability of the enterprise. Unless the production technology measures up to the situation, the advantages of being first will not be realized and it will be impossible to recoup the investment.

2. Process Specialization

It is the development of new products that creates new demand, and once production begins to take off rivals will begin to enter the market. Then the market will develop in an environment of price cutting and increasing demand.

As the scale of production grows, profit levels will stabilize, but as demand peaks there is less room for financial flexibility and cost-cutting measures become necessary.

Most commonly, this situation is triggered by pressures due to increases in the cost of labor or fluctuations in interest and exchange rates.

This is what prompts the shift of the labor-intensive elements of the production process to areas or countries where wages are lower. The advantage of doing this is especially great for a country like Japan, where labor costs are high. The shift of the labor-intensive stage of processing of ICs to the Asian NIEs provides a classic example of this.

3. Product Specialization

As products enter the market and production methods are diffused widely, competitive strengths average out and the front-runner's advantage is eroded. However, since a fairly stable market exists, firms get to the point where they want to maintain their share of the market, while shifting personnel, resources and funding to the development and manufacture of new products.

At that point either there is a local market, or there is latent demand, and the production of existing products shifts to areas or countries where there is room for cost cutting. The products to be shifted are determined by factors such as value added, quality and function, and life cycle. This is product-based specialization.

Color TV sets are a classic example of product specialization between countries like Japan and the United States and the Asian NIEs. Other examples of product specialization include products for which importing offers a cost advantage over domestic production (e.g. importing of general electronic components to Japan from the Asian NIEs) and importation of finished products targeted at a specific demand level (e.g. importing into Japan of single-function popular-type VCRs), as well as OEM arrangements (e.g. cross-supply of ICs by Japanese and US manufacturers).

4. Specialization by Product Line

As the specialization progresses, there may be specialization in terms of groups or lines of products offering a specific feature or function.

Sony anticipates that in 1990 its industrial electronics operations will account for more than 30 per cent of sales, and it is reported to be planning to raise this to 50 per cent within a few years. For consumer products such as VCRs, CD players and color TV sets, which are manufactured and sold in Europe, Sony plans to have a local content of 80 per cent by the end of 1992, which will eventually rise to 100 per cent.

There is a similar trend in other firms to expand operations in the area of industrial electronic equipment, while the manufacture of consumer electronics products is transferred offshore. Thus it is possible that in the future specialization will develop in terms of such broad categories as consumer products or industrial equipment.

b. The Relationship between Japan and the Asian NIEs and the ASEAN Countries in terms of Specialization

1. Process Specialization

Initial processing of wafers or chips for semiconductor devices is done in Japan, and the chips are then sent to Malaysia and Singapore for fabrication and assembly. That is to say, the technology-intensive processing is done in Japan and the labor-intensive processing is farmed out to these countries.

Thailand's IC industry is totally specialized in assembling for US firms, which then repatriate the product. Thailand, having gained production expertise on work commissioned by US companies, is on the way to becoming a source of supply for components for the Asian region. Purchases by South Korea, Hong Kong, Malaysia and Singapore of ICs from Thailand in 1987 almost equalled those purchased from the United States (see Figure 4.2).

During the 1970s, South Korea's electronics industry did manufacturing and assembly for Japanese and US firms, but was largely relegated to the labor-intensive aspects of making semiconductors. Today South Korean companies are mass producing 256K and 1M DRAMs, and are preparing to catch up with Japan and the United States. However, even South Korea, which is generally held to be the most industrialized of the Asian NIEs and the ASEAN countries, still has a considerable amount of process specialization in relation to Japan.

For example, in the manufacture of consumer products, South Korea purchases sophisticated components from Japan and other developed nations. In fiscal year 1987, the local content of South Korean-made product was 65 per cent for VCRs, 50 per cent for cassette tape recorders made for export, and 40 per cent for personal computers.

South Korea has given preferential allocation of both capital and labor to its processing and assembly industries, and the issue to be faced in the future is developing the components industry, involving as it does large investments for R&D and the accumulation of basic technology.

In manufacturing microwave ovens for the United States, Sanyo Electric sends the main element, magnetrons, from Japan and the other components from Singapore, to Malaysia for pre-assembly, with final assembly carried out in the United States.

In manufacturing color TV sets for the United States, NEC sends components to Malaysia to be assembled, with final assembly being carried out in the United States.

2. Product Specialization

Product specialization involves specialization in product function or price, as in the case of VCRs, as well as specialization in cost competitiveness, as in the case of audio equipment. Japan is still the center of VCR production but, as its cost competitiveness is eroded by appreciation of the yen, imports from South Korea are increasing.

Domestic manufacturers are increasingly concentrating on models offering high fidelity sound and higher picture quality. Japanese firms such as Japan Victor, Hitachi, and Sony are planning to produce VCRs in Malaysia. In 1991, Sony will design and develop VCRs in Malaysia. Sony is planning to incorporate local needs into products and procure more of its parts and materials locally. Japan Victor is planning to manufacture all low-end two-head monaural VCRs for the United States in Malaysia, and in the future, will produce all hi-fi VCRs for the United States there.

In 1988 the value of production of the average made-in-Japan VCR (value of production - value of exports) / (number of units manufactured - number of units exported) was $345 per set, while the average unit price of imports (value of imports - number of units imported) was $180 per set. In 1989, the Japanese firm Maruman announced that it would sell hi-fi VCRs that were being supplied to it by South Korea's Daewoo on an OEM basis at a 15 per cent lower price, revealing the distance that South Korea has already travelled on the road to catching up.

Items in which product specialization is evolving between Japan and the Asian NIEs and the ASEAN countries include calculators, in which Japanese firms have become almost entirely uncompetitive, virtually all audio products (radio-cassettes, headphone stereos, mini-components and so on), medium- and small-screen TVs, and household appliances. These are products in which there is only a narrow range of quality and technology.

As can be seen from Table 4.1, this type of product specialization is also developing among the Asian NIEs and the ASEAN group themselves. Table 4.1 shows the percentage of products such as color TVs, VCRs, and microwave ovens specialized among the Asian NIEs and the ASEAN countries.

Production in the Asian NIEs has outstripped that of Japan for all these products except VCRs, and we may say that for these items the transfer of production technology is virtually complete.

Japanese manufacturers have gone to South Korea for considerable amounts of OEM production, for example Toshiba for radios and CD players, Hitachi for radio-cassette players, Mitsubishi for car audio equipment, Matsushita for hi-fi equipment, Sony for radio-cassettes and car stereos, and NEC for color TV sets. There are OEM deals with other countries, for example radios and headphone stereos for Toshiba from Hong Kong, and color TV sets for NEC from Taiwan.

Table 4.1 Product Specialization Among Asian NIEs and ASEAN (%)

Product	South Korea	Taiwan	Hong Kong	Singapore Malaysia	TOTAL*
Colour TVs	47	22	7	24	(100)
VCRs	87	13	--	--	(100)
Calculators	81	--	--	18	(99)
Cassette players	22	31	20	28	(101)
Car stereos	45	21	2	31	(99)
Calculators	5	40	55	--	(100)

* Totals may not add due to rounding.

Source: EIAJ Growth in Demand for Electric Devices

OEM arrangements can be expected to increase by leaps and bounds in the future as a result of cross-supplying of components and products.

3. The Development of Specialization

The period when Asia specialized in labor-intensive assembly operations using components and technical guidance from the developed nations is now drawing to a close.

A steady and significant development in electronics is exemplified in South Korea by its shift toward production of products with higher value added and its increased ability to supply parts to the Asian NIEs and the ASEAN countries, and in Taiwan by its high degree of import substitution and production of CD players, personal computers, and computer peripherals and other highly sophisticated products. This trend has been marked by a change from process specialization vis-à-vis Japan to specialization with respect to mutual differentiation of products.

Hong Kong has traditionally concentrated on export-oriented assembly of components and parts procured from Japan, South Korea and Taiwan. As a result of Hong Kong's relatively high wages, its production has recently been increasingly shifted to China. It has also been characterized as being not particularly diligent in R&D, and having a smaller store of technology than the other Asian NIEs. However, in single-function, low-cost products, such as quartz watches, portable radios, TV games, clock radios and others, Hong Kong has the single largest share of the world market. It has developed product specialization in relation to the other Asian NIEs and the ASEAN countries.

Singapore is pursuing a path of enhanced product sophistication and process automation in such products as computer peripherals, printer circuits, semiconductors, robots and telecommunications equipment, and there has been a shift in production from consumer products to industrial equipment. Local content for consumer products is over 90 per cent in the case of TV sets, and 100 per cent for audio equipment.

Singapore may face problems because the layer of peripheral industries is thin relative to the rate of industrial growth and it lacks a large work force. There is now a heavy reliance on workers from Malaysia, Korea, Shanghai, Hong Kong and Sri Lanka. Because of the shortage of domestic workers, the Singapore government is actively encouraging the entry of technology-intensive industries and creation of enterprises that will employ the state's more highly educated citizens.

However, Japanese firms are increasingly attracted by Singapore for developing electronic switching equipment software for developing countries, technology training factories in other Asian countries (Matsushita, Sony and Toshiba), component procurement (Toshiba, Mitsubishi, Sony, NEC and Fujitsu), and IC design (Matsushita and NEC).

There are also firms like Sony that are studying the feasibility of establishing a coordinated regional group structure independent of Japan and encompassing R & D, component purchasing, production, marketing, financing and personnel.

Japanese firms are expanding offshore production while moving toward a manufacturing structure that emphasizes industrial products. Thus there is the possibility that the range of specialization in consumer products in the Asian NIEs and the ASEAN countries will evolve further. In any event, there is an increasing specialization-related interdependence linking Japan, the Asian NIEs and the ASEAN countries, a network of specialization which is evolving into a mechanism for economic growth.

V. IMPLICATIONS FOR ASIAN NIES

THE DYNAMISM OF ASIAN ECONOMIC GROWTH: SPECIALIZATION AND MARKET EXPANSION

1. Balanced Development in Electronics and Related Industries

In its formative years, the growth of Japan's electronics industry was largely based on technology from the United States, the most advanced nation in the field. Subsequently, it has pursued a course of developing production technology based on improving foreign models.

A carefully modulated policy of government assistance has played an important role in this process. As mentioned earlier, it accepted as given the reality of corporate competition, while at the same time promoting efficient and effective cooperation in research and development.

Table 5.1 shows the growth in payments to the United States by Japan's electronics industry for patent royalties and other technology imports. It can be seen that patent and other royalty fees paid by the Japanese electronics industry to the United States are increasing in proportion to its growth. However, the ratio of the technology imports to total production ((b)/(a)) is decreasing. This means that Japan's own technological level is advancing.

Table 5.1 Fees for Technology Imports Paid to the United States by Japan's Electronics Industry (in billions of US$)

	1975	1980	1985	1986	1987
Total production (a)	14.6	39.7	77.8	108.4	129.8
Technology Imports (b)	0.5	1.3	1.8	2.7	3.8
(b)/(a) x 100 = %	0.34	0.33	0.24	0.25	0.29

Source: Statistics Bureau

The mass production of ICs in Japan began in 1965, and in 1968 the FACOM230-60, a domestic mainframe computer using ICs, was developed.

That was in the period when rapid economic growth began, when the processing and assembly industries such as chemicals, electrical machinery and automobiles were created. Cost reduction through economies of scale was accorded the highest priority, and there was a growing demand for computer peripherals as a means of reducing the use of labor.

Per-capita income also increased from $919 in 1965 to $1 949 in 1970, and accompanying a rapid increase in domestic demand for consumer electronics equipment, the industry became a major exporter, primarily to the United States.

During the early stages of growth of Japan's electronic industry, the related industries which comprised its main customers, were in a period of rapid expansion, thus creating a highly advantageous situation. As already noted, the heavy reliance of manufacturers of ICs and computers on heavy electrical, electrical machinery and telecommunication firms created an extremely favorable environment for the development of domestic technology.

Then in the decade between 1975 and 1985, when the Japanese economy was in a period of more stable growth, LSI technology brought successive developments--the first domestic large-scale mainframe in 1974, the 64K-bit DRAM in 1976, Fujitsu's supercomputer, with the world's highest speed in 1982, and a 1M-bit DRAM prototype in 1984.

Figure 5.1 shows the effect of the electronics technology development on the structure of Japanese industry in relation to economic growth and the scale of integration of semiconductors. What is particularly emphasized here is that the growth of Japan's electronics industry has been closely related to the increasing sophistication of the country's industrial structure. In the electronics industry, we have seen that the greater the degree of technological advance the broader and deeper is its involvement with related industries.

Moreover, the growth of related industries provides the electronics industry with an incentive for technological innovation.

In the case of Asia's newly industrializing economies, or NIEs (South Korea, Taiwan, Hong Kong and Singapore), the electronics industry has evolved from manufacturing to export, specializing in labor-intensive processes and assembly operations, to what we might call horizontally specialized operations, either specializing in integrated manufacture of specific products or acting as OEM sources.

Recently there has been a trend, illustrated in Table 5.2, toward increased technology transfer based on the payment of licensing fees, but in the electronics industry, they are, with the exception of South Korea, small in number and value. South Korea has established a solid industrial infrastructure, and its strengthened resolve to manufacture under its own brand names is reflected in the growth of royalty payments. The most common form of transfer of technology in other Asian nations comes from the overseas subsidiaries and joint ventures of American and Japanese firms. For this reason, there is a delay in the development of related industries based on locally developed technology.

Table 5.2 Number and Value of Technology Export Programs from Japan
(figures in parentheses are those involving the electronics industry;
values in **heavy-line frames** are in millions of US$)

	South Korea		Taiwan		Thailand		Malaysia		Indonesia	
	No.	Val.	No.	Val.	No.	Val.	No.	Val.	No.	Val.
1986	732 (161)	**125 (42)**	532 (143)	**50 (11)**	203 (20)	**32 (2)**	128 (22)	**19 (6)**	238 (15)	**90 (3)**
1987	816 (99)	**190 (70)**	590 (99)	**85 (13)**	294 (16)	**50 (2)**	147 (23)	**21 (8)**	338 (14)	**59 (2)**

Source: Statistics Bureau, Management and Coordination Agency

It is said that Japanese corporations with a presence in the Asian NIEs are investing little in R&D. Figure 5.2 shows exports and imports of electronic products for South Korea and Taiwan, and it can be seen that as finished product exports have increased, so too have imports of components. Both countries export minicomputers, personal computers and computer peripherals, primarily to the United States, and both depend on ICs, microprocessors and other components imported from Japan and the United States.

Automobile manufacturers in Japan are major purchasers of the products of the electronics industry. They have begun to set up networks for the mutual exchange of parts in Asia. A bottleneck in this process of horizontal specialization is the underdeveloped parts industries that underpin each nation's automotive industry.

The existing pattern, in which the local economy supplies cheap labor and imports parts from the highly automated economies of Japan and the United States, is rapidly approaching its limits. No further progress in specialization will be feasible without the development of domestically established technologies.

2. The Impact of Technological Innovation

a. Shifts in Production and Technology

Japan's electronics industry has always been marked by fierce competition, in which success depends on technological development.

Frequent improvements in the quality and performance of existing products have resulted in a continuing shift up-market, while markets have also been broadened as a result of product diversification through the introduction of new models and the stimulus of demand. Firms that introduce new models increase their share of the market through product differentiation, and they shift production from existing products

to new ones in order to strengthen their market dominance. Furthermore, since the development of new products creates new markets and supersedes existing ones, it changes the competitive ground rules.

Firms that have developed new products tend to shift productive capacity to the new product, with its higher-added value, in order to maintain their leading position and obtain a quicker return on their investment. This trend is evident in the electronics industry, and particularly in the area of semiconductors. Table 5.3 shows 4M-bit DRAM production, as announced by major Japanese semiconductor fabricators.

Table 5.3 4M DRAM Production by Major Semiconductor Fabricators
(thousands of devices per month)

	1M DRAMS (1988/2nd half)	4M DRAMS
NEC	8 000	100 (1989/2) 1 000 (1990)
Toshiba	10 000	30 (1989/1) 1 000 (1990)
Hitachi	5 000	400 (1989/1) 1 000 (1990)
Mitsubishi Elec.	6 000	1 000 (1990)
Oki Electric	3 000	100 (1989/2) (not available)

Source: Nihon Keizai Shimbun, Aug. 1989

Mass production of 4M-bit DRAMs got under way in the second half of 1989, and major semiconductor fabricators are already budgeting hundreds of millions of dollars in order to be able to produce 1 million devices per month in 1990. (Estimates are that the 12 leaders together will spend from five to five-and-a-half billion dollars.)

It was in 1986 that 1M DRAMs went into mass production and by 1988 all firms had facilities for making them, resulting in an enormous leap in capacity. By late 1989, however, the market began to weaken at the same time that demand from the computer industry and other major users for 4M DRAMs was increasing, spurring the semiconductor majors to speed up the generation change.

Figure 5.3 suggests that fabricators were on the verge of recouping their investment in 1M DRAMs, and were in the process of making a major new commitment of resources to the 4M generation.

As already pointed out, the leading products in the Japanese consumer electronics market have shifted successively from radios to TV sets to VCRs, and now to video camera recorders. As can be seen in Table 5.4, for example, the number of

Table 5.4 Production of Color TV Sets in Japan

	1985	1986	1987	1988
Value of production (a) in billions of yen	897.1	723.8	765.1	822.9
Number of sets (b) in millions	18	14	14	13
a/b in thousands of yen	50	52	54	63
(US$)*	(210)	(310)	(370)	(480)
Percentage of 26-inch sets		8	16	30

* Calculated at prevailing rates.

Source: EIAJ.

color TV sets manufactured in Japan is declining, but the value of production is increasing. This is due to the growth in production of large-screen sets with better picture and sound quality, and is just one example of how domestic production is shifting toward items with higher added value.

As this shows, the creation of new products through technological development results in a shift in manufacturing to products with higher-added value, but since demand for the existing products persists, they continue to be produced as well, to the extent that production capacity allows. This means that the level of production as a whole increases, but when the quantity of the new product increases there will be a relative drop in the production of already existing lines. This raises the issue of the optimum allocation of limited operating resources.

When demand is still strong, the production of existing lines will be shifted to other countries or companies which permit continued economic viability of the product. This sort of shift, of course, also occurs domestically between big business and its subcontractors, but in a country like Japan, where differentials in manufacturing costs --- whether based on the work force, capital structure or location -- have largely disappeared, there is little economic advantage in such a shift. This is why attention has turned to moving manufacturing to areas which are both close to the consumer market and comparatively advantageous in terms of market conditions, or to put it another way, optimizing production and optimizing supply. This is the reason why the requisite technology is also being transferred. The division of labor resulting from the agreement between Hitachi, Ltd. and Gold Star, Co. Ltd. relating to the production of 1M DRAMs is surely one example of this process.

The willingness to transfer old technology will be greater, if the new technology is highly advanced, requires a high investment and has a limited life cycle. Any firm with a long-term outlook that attempts to maximize the utility of limited operating resources and, at the same time, continues to expand will be faced with the unavoidable necessity of proceeding with international specialization. That, it is fair to say, is one of the results of technological innovation.

(2) Market Expansion and Technological Innovation

Technological innovation has two aspects, new technology in the product and new technology related to the production process. If new products arising from basic research are not accompanied by concurrent advances in production technology, supplies will be limited and there will be no growth in the market.

One of the factors underlying the growth of Japan's electronics industry is the maximum use it made of its own electronic technology in improving production technology. The price decreases made possible by increased productivity spurred demand. When development occurs with a good balance between product technology and production technology, technological innovation can have a great impact, leading to expanding markets. Figure 5.4 illustrates the concept that technological innovation promotes product diversification through higher-added value and, at the same time, promotes market diversification by creating new markets.

Product diversification also leads to market expansion by broadening the range of available products. The development of Japanese language word processors was responsible for the development of office automation, while the arrival of the minicomputer promoted computerization in small businesses.

Product diversification arising from technological innovation stimulates domestic demand and, at the same time, promotes new export markets. This ultimately leads to an expansion of the world market.

Color television has become a major export industry for South Korea, with a volume amounting to approximately $ 1 billion in 1988. The value of exports of black and white TV sets, on the other hand, is lower (approximately $ 300 million in 1988), but virtually the whole of their production of these sets is sold abroad.

Japan's audio tape recorder imports come almost exclusively from the rest of Asia -- 42 per cent from South Korea, 29 per cent from Taiwan, 15 per cent from Singapore, 7 per cent from China and 5 per cent from Hong Kong. In each of these countries or territories, production for export is augmented by production to meet increased domestic demand, resulting in an expansion of the overall size of the market.

In the electronics industry, the pace of technological innovation is rapid, and the differences between old and new technologies can be great. The greater the differences in levels of technology, the greater will be the impact on market expansion, as illustrated in Figure 5.4. Furthermore, these expanded markets, with their higher

added value, will encourage the participation of new entrants, spurring further technological innovation in the quest for competitive advantage.

As pointed out in the preceding section, when firms develop new technology, they transfer to the Asian NIEs or the ASEAN countries those technologies that have become mature, either in terms of manufacturing portfolio or cost-competitiveness. Demand for the products of the transferred technology can be met by imports. The recent increase in Japan's imports of manufactured goods provide an example of this. This kind of specialization serves to promote the industrialization of the developing economies.

3. The Dynamism of Economic Development in Asia

Regional trade among the four Asian NIEs is burgeoning, with the total (imports plus exports) reaching $15.5 billion in 1987, an increase of 45.5 per cent over the preceding year. Estimates for 1988 were in excess of $20 billion.

The Asian NIEs send almost half of their exports to the United States, and depend on Japan for imports of most parts and machinery. However, trade frictions with the United States are increasing, inhibiting export expansion. Japanese products have increased in price due to the appreciation of the yen and this has brought important changes to the structure of the NIEs' foreign trade. Local firms with a controlling foreign interest, from Japan as well as other nations, are increasing sourcing of parts in the NIEs and the NIEs themselves are re-evaluating each other as purchasers of exports and providers of raw material imports.

As Figure 5.5 shows the countries with the greatest increase in bilateral trade in 1987 were South Korea and Taiwan with 72 per cent, and it can be expected that there is considerable room for further growth in specialization between South Korea, which has a strong semiconductor sector, and Taiwan, which is highly competitive in electronic components in general. Policies to expand bilateral trade have been put into effect for Taiwan-Singapore, Korea-Singapore and Hong Kong-Singapore.

The dependence of the Asian NIEs on exports to the United States has begun to decrease. With the exception of Singapore, which already has a comparatively low level, the dependence of the other three on exports to the United States dropped in 1988 to an average of 35 per cent a significant 5 percentage points lower than in the previous year (see Table 5.5).

The reason for this is that the NIEs, concerned about increasing trade friction with the United States and the expected abolition in 1989 of U.S. tariff preferences, have been attempting to diversify their markets into Japan, Europe and other Asian countries.

Table 5.5 Export Dependence of the Asian NIEs

	On the United States (%)			On Japan (%)	
	1986	1987	1988 (est.)	1987	1988
South Korea	40.0	38.7	(35.5)	18.1	19.9
Taiwan	47.7	44.1	(39.1)	12.1	14.3
Hong Kong	41.7	37.3	(33.3)	4.7	4.8
Singapore	23.3	24.3	(23.7)	8.8	8.8

Note: Compiled from the statistics of each country or territory.

Meanwhile, the Asian regional import market, made up of the Asian NIEs, ASEAN and Japan, is also expanding. It was estimated that in 1988 imports of the Asian NIEs would grow 34 per cent over the previous year to approximately $200 billion, while those of the ASEAN countries will rise 32 per cent to $60 billion and those of Japan will be up 28 per cent to $190 billion, for a projected total of some $450 billion.

Among the factors accounting for this rise are imports of finished goods to satisfy increased consumer spending in the NIEs and the increase in raw material imports associated with high exports. Also contributing to rapid import growth of ASEAN are capital goods related to the surge in Japanese and Asian NIEs foreign direct investment.

There has also been an increase in direct investments in ASEAN by the NIEs, based on their new accumulations of capital, and it would appear that Asian economies, both in the ASEAN countries and in other regions, are moving toward a multi-layered structure based on both vertical and horizontal specialization.

There are a host of problems facing the Asian NIEs that must be solved before further industrialization and greater structural sophistication can take place. These include the infrastructure bottlenecks that accompany rapid industrialization, declining competitiveness due to more expensive labor costs and soaring exchange rates, the weakness of the technological base due to dependence on imports for high-tech components, and unrealized growth potential due to insufficient R&D.

It has also been pointed out that in the even longer run population limitations will constitute a problem. South Korea, which is the most populous of the Asian NIEs, has 43 million people, followed by Taiwan with 20 million, Hong Kong with 5 million and Singapore with 3 million, for a grand total of only 70 million people. This raises the

possibility that eventually they may be confronted by the barriers created by the small size of the domestic market and the difficulty of acquiring personnel.

If ASEAN is included, however, the potential market, with Indonesia's 180 million people, expands dramatically. In this respect, it seems highly desirable to promote horizontal specialization to produce growth in each individual economy, which in turn will promote the growth of an Asian economy.

The record of development of Japan, the NIEs, and the ASEAN countries in the electronics industry, provides the basis for a model for regional development of the electronics industry spurred by technological innovation, that is to say, industrialization involving increasing specialization, expanding markets and a continuing transfer of technology.

In Figure 5.6, the height of the triangles at the left represent the level of technology, while the breadth at the base represents the extent of the market. Thus the area of the triangle indicates the scale of production (see also Figure 5.4). The parts of these triangles that merit the greatest attention are the areas of technology where competition arises.

Generally speaking, they indicate the areas in which the developed nations are comparatively weak in terms of manufacturing portfolio and cost competitiveness, leading them to transfer technology and satisfy demand by means of imports. This model mainly provides a conceptualization of the ripple effect produced by the impact of technological innovation in the developed countries.

However, what should be emphasized here is that electronics is an industry with tremendous growth potential. That is why the pace of technological innovation is so rapid. For this reason the energy to make the three triangles expand and at the same time shift upward is significantly greater than in other industries, and the economic and technological ripple effects toward those that follow are much greater.

Nevertheless, the bonds connecting specific countries or territories may be temporary rather than permanent. In recent years, there has been an increase of cases in which production has been transferred from advanced to developing nations directly, bypassing these bonds. However, when the level of technology to be transferred from developed to developing nations is too high, the transfer will not succeed when conditions in the developing nation have not matured for integrating high technology. Moreover, if the front-runner's pace of technological innovation should flag, different connections or bonds will form without doubt.

It may also happen that technology transfer and market expansion may be frustrated by trade frictions and protectionism. Policies to protect and nurture domestic industry can be effective up to a point, but if carried to excess they will result in diminished international competitiveness and a reduction in growth potential.

Ultimately, the important thing is that the inherent growth dynamic of technological innovation in the electronics industry be put to work to the fullest extent by co-operation between nations and between firms.

VI. CONCLUSION

Starting from a core of technology imported from the United States and Europe, Japan's electronics industry has blossomed into a leading domestic industry and one of the most technically advanced and productive industries in the world. Several factors unique to Japan have aided this rapid growth.

The first is that the domestic manufacturers benefited initially from a well-planned degree of protectionism, followed by assistance measures aimed at nurturing domestic technology. These measures were based on the principle of competition; the government's role was simply to provide an environment and give direction to private enterprise. Actual government spending on research has been far less than in other developed countries.

The second factor is that the Japanese computer industry is made up of large electrical and telecommunications manufacturers, which have the engineering and financial resources to keep up with a rapidly-changing technology. The Japanese computer manufacturers are also major semiconductor manufacturers. This enables them to link LSI and VLSI development directly to the development of new computer models. Another advantage of the structure of the Japanese computer industry is that it provides the well-balanced capabilities needed to construct communication networks, in which there is a marriage of communications and computer technology.

A third factor has been the stimulating effect of the Japanese electronics industry on Japan's whole industrial structure. Advances in electronics technology have spurred progress not only in consumer electronics, but in such industries as general machinery, precision machinery and automobiles. There has also been positive feedback from these related industries: their development has promoted the development of new electronics technology. Progress in the electronics industry therefore continues to accelerate.

Although the Japanese electronics industry has grown steadily, it has undergone marked structural changes since 1985. One change is a shift from the old structure of reproduction on a progressive scale, driven by exports of consumer electronic equipment, to a structure more heavily weighted toward industrial equipment, especially computers, and electronic parts, primarily semiconductors. Another change is a shift in the strategy of overseas operations, from offshore production as a means of compensating for the high value of the yen (export detouring) to local production in the country where the foreign market is located, to avoid trade friction and promote local economic development (optimum siting of production and marketing activities).

New forms of cooperation are also developing between Japanese companies and the Asian NIEs and the ASEAN countries. Production of consumer electronic equipment is being portioned out to the Asian NIEs and the ASEAN countries along lines dictated by product function and price, or by cost considerations. Japanese companies are no longer competitive in the manufacture of products that are not significantly differentiated by quality or technology, so they now import these products or obtain them on OEM terms.

Consumer electronics is becoming less of an export industry. Instead, it is moving toward a horizontal division of production, with overseas demand served by local factories, which procure a growing percentage of their parts locally, while the home demand is served by industries that concentrate on achieving higher-added value.

The Asian NIEs are undertaking the production of minicomputers, personal computers, and computer peripheral equipment with integrated circuits and other high-technology components supplied from the United States and Japan.

In low-priced products the Asian NIEs are strongly competitive. Rather than compete with them, Japanese companies are specializing in higher-technology products and products with higher-value added.

The manufacture of semiconductors is being shared primarily at the process level, labor-intensive final production steps being consigned to the Asian NIEs and ASEAN countries. A start in product-level production sharing has been made, however, in recent technology transfers between Japanese and Korean firms. As Asia's production of electronic equipment rises, so does its consumption of semiconductor parts. The situation differs from that in the United States and Europe, where integrated local production is being pursued to avoid trade friction.

The word "glocalization" (global-localization) has been coined to describe the strategy of Japanese industry. One sign of "glocalization" is the building in the Asian NIEs of parts procurement centers oriented toward the Japanese and world markets, product development centers oriented toward local needs, and headquarters facilities oriented toward the Asian region.

The electronics industries of the Asian NIEs are moving from a vertical toward a horizontal division of production with Japan. Originally confined to labor-intensive steps of manufacturing or final processing and assembly, these industries are now performing integrated local production or supplying products on an OEM basis.

South Korea, Taiwan, Singapore, and Hong Kong are each expanding in domains in which they perform best. A prospect of coexistence through specialization is visible.

Of course, the availability of inexpensive, high-quality labor remains a major attraction for industrial investment by Japanese, American, and other foreign companies. However, the advantage of inexpensive labor will disappear with continuing economic growth. The end is at hand for the existing arrangement of using low-cost local labor to assemble parts imported from countries such as Japan and the United States.

A major issue now facing the Asian NIEs is the development of a parts industry, which they will need in order to produce goods differentiated from those of Japan and the United States. They must also make a determined investment in R&D, to foster their parts industries and to develop domestic-brand products.

The restructuring of Japan's electronics industry, like the restructuring of its other industries, was triggered by yen appreciation and trade friction. The impact of the electronics revolution on industrial structure and markets, however, cannot be ignored.

The incentives for developing new technology are much stronger in the electronics industry than in other industries. The more revolutionary a new technology is, the more investment it demands in production facilities, and the shorter the product life cycle, the greater is the incentive to transfer older technology that is no longer at the leading edge.

Technological progress creates products with increasing diversity and value added. It also creates new or additional markets, thereby increasing market diversity. Since the electronics industry has assumed an international character, this expansion of markets is taking place on a worldwide level. It is the most revolutionary new technologies that have the greatest impact on market expansion.

Given the finite nature of corporate resources, one effect of this technological impact is to promote international specialization. A corporation that attempts to sustain a maximum growth rate within the limits of its resources by optimizing its investment portfolio, production portfolio, and market portfolio will be compelled to accept an international division of activities.

There was a time when Japanese companies were tied to transferring technology, fearing possible boomerang effects. Now that the Asian NIEs have become more industrialized and production is becoming increasingly international, however, the suppliers of technology are finding that they must transfer high technology for the sake of their own development.

The Asian NIEs and the ASEAN countries have begun to specialize among themselves in different processes and products, and mutual trade among the Asian NIEs is growing rapidly. Having accumulated capital, the Asian NIEs are making increased direct investments in the ASEAN countries. Eastern Asia is becoming a region of economic growth with deepening mutual interdependence.

This does not, however, guarantee that trade frictions and protectionism will not create future obstacles to technology transfer and market expansion. Policies that protect and nurture domestic industries are useful up to a certain stage, but if taken too far they lead to a loss of international competitiveness and a decline in growth.

Different companies, different countries, and different regions must cooperate to realize the maximum advantage from the inherent dynamism of the electronics industry.

Figure 2.1: Production of Japanese Electronics Industry

Figure 2.2: Composition of Exports of Japanese Electronics Industry

Figure 2.3: Production of Consumer Equipment

Figure 2.4: Computer Shipments (Excluding PCs)

Figure 2.5: Progress in Factory Automation

Figure 2.6: Production of Industrial Equipment

Figure 2.7: Production of Electronic Parts

Figure 2.8: Research Expenditures by Major Japanese Industrial Sectors

Figure 2.9: Percentage of Japanese Corporate and Government Expenditures on Research

Figure 2.10: Investments in Plant and Facilities by Sectors of Japanese Electronics Industry

Figure 3.1: Overseas Advance of Japanese Companies

Figure 4.1: Stages in the Development of Specialization

Figure 4.2: Thai Exports of ICs by Destination (1987)

Figure 5.1: Influence of Electronics Industry Development on the Structure of Japanese Industry

Figure 5.2: Volumes of Imports and Exports of Electronics Products for South Korea and Taiwan

Figure 5.3: World Demand for DRAM Chips

Figure 5.4: The Impacts of Technological Innovation

Figure 5.5: Bilateral Trade Among the Asian NIEs (1987)

Figure 5.6: Model for Connected Development of the Electronic Industry

Figure 5.1: Influence of Electronics Industry Development on the Structure of Japanese Industry