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**Prospects and Challenges Surrounding Japan's  
Electrical Equipment Industry:  
General Electrical Equipment Manufacturers'  
Restructuring of Operations and Future Prospects**

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Development Bank of Japan**

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# **P**rospects and Challenges Surrounding Japan's Electrical Equipment Industry: **General Electrical Equipment Manufacturers' Restructuring of Operations and Future Prospects**

## **Summary**

1. The revenues of major companies in the Japanese electrical equipment industry, which is one of the key manufacturing industries in Japan, have been declining sharply since 2001 and most of them are being forced to restructure their operations drastically. This report reviews the current competitiveness of Japanese electrical equipment manufacturers and investigates the industry's future prospects in view of the restructuring efforts being undertaken by the manufacturers, focusing on the differences between the major American and Japanese electrical equipment manufacturers in terms of profitability and business models adopted.

2. A comparison of the major American and Japanese electrical equipment manufacturers in terms of profitability shows that there were distinct changes in the 1980s and 1990s. Both the return on assets (ROA) and operating profit on sales of Japanese electrical equipment manufacturers were not significantly different from those of their American counterparts in the early 1980s, but the differences gradually grew and became significant in the 1990s. By segment, the operating profit on sales for American semiconductor manufacturers and Japanese component & device manufacturers has been high, while there have been marked declines in the operating profit among Japanese general electrical equipment manufacturers. In terms of total assets turnover, the figures for American manufacturers have been consistently higher than those for Japanese manufacturers. The widening gap in ROA is the result of the widening gap in operating profit on sales.

Regarding the contribution of each segment to the declines in profitability of Japanese general electrical equipment manufacturers, the overall profitability was reduced structurally by the semiconductor segment and over the time

series by the home appliances and heavy electric apparatus segments. In particular, the profitability of the Japanese semiconductor segment is low (even though it has the top five companies in terms of sales) in contrast with its American counterpart (that has five specialized manufacturers), which is the most profitable segment in the United States.

3. With regard to the semiconductor segment, investigation of changes in semiconductor shipment share by nationality of manufacturer revealed that the share of Japanese manufacturers has been declining since peaking at the end of the 1980s and the gap with the share of American manufacturers has been widening. The Japanese manufacturers have been producing a full range of semiconductor products, but have been unable to maintain their market shares for products that dominate the overall semiconductor market such as memory devices, and so their total shares have also been decreasing.

On the other hand, American manufacturers are more specialized in the semiconductor business, and manufacturers with the highest sales have strong areas where they hold large market shares. In addition, their use of foundry manufacturers in other countries such as Taiwan has helped increase their market shares.

Although capital spending on semiconductor production facilities has been vast worldwide and continues to increase, that of Japanese manufacturers was exceeded in 1990s by American manufacturers and then by Asian countries, and the gaps are widening. The Japanese manufacturers' ratios of R&D expenditure to sales are higher than those of American manufacturers, but this has not improved their revenues. The Japanese manufacturers are now facing difficult choices as to the positioning of their semiconductor divisions.

One area in which Japanese manufacturers have a dominant market share is home appli-

ances and in particular audio-visual equipment, as the domestic user base expanded significantly in the late 1980s. The decreased profitability in the home appliances segment is partly due to recent drops in unit prices of these products.

4. The profitability gap between American and Japanese electrical equipment manufacturers is partly due to the differences in business model. Specifically, the top Japanese manufacturers by sales are general manufacturers, whereas the top American ones are specialized manufacturers. There are also differences in business policies. American manufacturers have been radically restructuring their businesses (i.e. eliminating unprofitable divisions and concentrating resources in core businesses), such as General Electric (GE) in the 1980s and IBM in the early 1990s, while Japanese manufacturers have been expanding. Recent instances of M&A also illustrate that American manufacturers are reinforcing their business base by focusing on existing strengths.

The increasing modularization and other developments in the electrical equipment industry have led to an emphasis on reducing production costs rather than using more sophisticated production technologies, and this has accelerated outsourcing such as the use of EMS companies by American PC manufacturers and the use of foundry companies by semiconductor manufacturers. Manufacturers have begun to recognize the existence of an added value curve called the “smile curve”, a notable characteristic of PC production processes, which has been affecting Japanese manufacturers’ restructuring efforts. The difference between American and Japanese manufacturers in terms of business model as well as the increasing modularization and digitization have caused the profitability gap to widen between American and Japanese manufacturers.

5. Over the past several years, Japanese general electrical manufacturers have made various efforts to restructure their operations. In particular, there were marked increases in employee cutbacks and withdrawals from markets in 2001 as the IT recession worsened. On the other hand, there have also been new efforts such as general electrical manufacturers have entered the EMS

market and restructured their organizations to speed up decision-making by introducing a company-in-company system. Production bases have been increasingly shifted to overseas countries in the long term, and efforts to strengthen software and service divisions to capitalize on the ongoing expansion of PC and Internet users have also been increasing.

Japanese general electrical manufacturers have been forming partnerships with each other in maturing domestic home appliances markets and with Chinese manufacturers in Chinese markets that are expected to expand in the future. In the information and communications technology (IT) equipment segment, they have been forming partnerships with American and European manufacturers with a view to becoming a top manufacturer that dominates competitors in industry standards. In the semiconductor and other electronic component & device segments in which capital spending on facilities and R&D expenditure are huge and increasing, Japanese general electrical manufacturers have been actively building partnerships with domestic and foreign manufacturers to reduce the burden. These moves reflect the fact that there are now fewer profitable fields as new manufacturers have entered the field and increased the competition.

Business partnerships in the electrical equipment industry are different from those in other industries such as between manufacturers of materials, etc. as they are formed on a segment-by-segment basis rather than as partnerships between companies or through acquisition.

Because Japanese general electrical manufacturers, unlike American manufacturers, have grown to their current sizes by entering new business areas, they are unlikely to shed many unprofitable divisions rapidly and transform themselves into an American-style specialized manufacturer. Instead, they will tend to slowly reinforce operations in their strong areas while gradually shedding unprofitable divisions through forming partnerships with domestic and overseas manufacturers.

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## Introduction

The ten-year period between 1990 and 2000 is seen as a decade of decline in the international competitiveness of Japanese industry. Japanese companies suffered falling sales and many major firms, in both manufacturing and non-manufacturing industries, were acquired by American and European companies during this period as the domestic economy slumped. In contrast with the 1970s and 1980s when major Japanese companies enjoyed rising revenues and profit as their products, especially home appliances and automobiles, sold well throughout the world, the 1990s was a major turning point.

The electrical equipment industry, which is one of the key manufacturing industries in Japan, also suffered a loss in competitiveness in the 1990s: both the sales of major manufacturers and the share of Japanese firms in the international semiconductor market declined.

The decline in the competitiveness of Japanese electrical equipment manufacturers is partly attributable to the recent rise of emerging manufacturers from South Korea, Taiwan, and other countries that have become increasingly competitive in various aspects including technology and brand power. In particular, the recent dramatic rise of Chinese manufacturers has been viewed in some quarters as a threat to Japanese manufacturers. The shifting of production bases, especially for assembly processes, to developing countries to take advantage of lower costs including labor, and the rise of developing countries' manufacturers by acquir-

ing technological competitiveness and the resultant expansion of their market shares, are inevitable. Indeed, Japanese companies developed in the same way. However, American electrical equipment manufacturers, which seemed to have been surpassed by their Japanese counterparts' growth up until the 1980s, regained their competitiveness in the 1990s and are now central players in the global IT industry; they have overtaken Japanese electrical equipment manufacturers and widened their lead in market shares in the semiconductor and other markets and boosted profitability. Thus, it is not an inevitable one-way process that developing countries' manufacturers will overtake industrialized countries' manufacturers as the competitiveness gap narrows.

Major Japanese manufacturers have been drastically restructuring since the global IT recession in 2001. Although there are some pessimistic forecasts about the future of the Japanese manufacturing industry as a whole, a simplistic extrapolation from current trends cannot accurately forecast future prospects, as evidenced by the fact that most forecasts published in the 1990s were pessimistic about the future of American manufacturers.

This report identifies, taking into account the above-mentioned considerations and mainly by comparing the major American and Japanese manufacturers in terms of profitability and business models, the factors that contributed to the decline in the competitiveness of Japanese electrical equipment manufacturers and proposes measures for regaining competitiveness.

# I Profitability Comparison between Major American and Japanese Manufacturers

## 1. Entities Used for Analysis

### Perspectives

To analyze the international competitiveness of an industry, it is necessary to define the entities (country, company, etc.) used for the analysis. This report analyzes the competitiveness of the top manufacturers by sales in the American electrical equipment industry and their counterparts in Japan, in terms of profitability, dominance in the market, etc. In this report, the nationality of a company is based on the location of the headquarters of the consolidated company group, as manufacturers often have production and sales bases internationally. With this background, the analysis considers the various restructuring efforts of Japanese manufacturers.

### Entities Used for Analysis

Chapter I uses the closing data of major American and Japanese electrical equipment manufacturers (consolidated closing data; the same applies hereafter unless noted otherwise), because these data cover many years and thus allow a sound statistical analysis. The entities used for analysis are the top sales companies which are headquartered in Japan or America<sup>1</sup> and operating mainly in the electrical equipment industry.<sup>2</sup>

<sup>1</sup> North America: Hereafter in this report, "America(n)" refers to the United States and Canada unless otherwise specified.

<sup>2</sup> The range of the electrical equipment industry is wide, and has partly overlapped the general machinery, precision machinery and auto parts industries in recent years. This report uses a definition of the term "Japanese electrical equipment companies" that roughly corresponds with but is slightly different from that used in the new industrial classification of the Tokyo Stock Exchange, and defines the term "American manufacturers" based on the standard industrial classification (i.e. companies falling under SIC Code 3570 to 3577 and 3600 to 3699). In terms of company size, this report uses the companies that were listed as the top consolidated sales companies on the basis of 2000 sales (17 Japanese companies and 25 American companies), which are considered to occupy important positions in American and Japanese industry. For a list of

The analysis makes comparisons between American and Japanese companies, as well as between companies operating in different business areas, in terms of long-term profitability (from the 1980s to 1990s) based on return on assets (ROA), and total assets turnover and operating profit on sales obtained by decomposing the ROA figures.

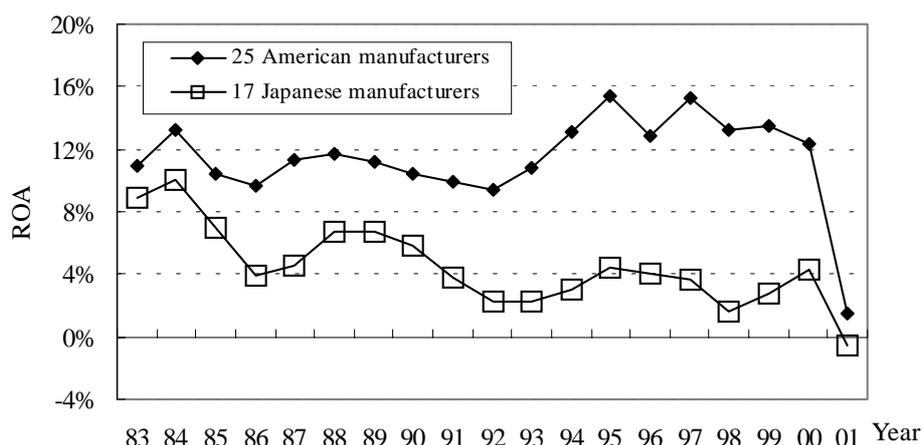
## 2. Comparison of Companies in Terms of Profitability Since the 1980s

### 2.1 Return on Assets (ROA)

Figure 1-1 compares major American and Japanese electrical equipment manufacturers in terms of the time series changes in ROA, which is a main indicator of corporate profitability. Although simplistic comparisons must be avoided because companies use varying accounting standards, the ROA figure for 25 American manufacturers<sup>3</sup> was roughly steady throughout the 1980s and rose slightly in the mid 1990s, whereas that for 17 Japanese manufacturers dropped between the late 1980s and early 1990s and remained low at about 4% for the remainder of the 1990s, hence the gap with American manufacturers gradually widened. In addition to this widening, American manufacturers maintained their profitability, and the gap was already widening even in the 1980s when Japanese manufacturers were expanding their market shares with various products and increasing revenues.

the companies used for the statistical calculations, refer to the attached table. IBM is not included in the statistics, because it was classified as a service industry company as of 2000.

<sup>3</sup> Only 15 of the 25 manufacturers existed in 1983.



**Fig. 1-1 Comparison of Time Series Changes in ROA of Major American and Japanese Electrical Equipment Manufacturers**

- Notes:*
1. For a list of the companies used for the statistical calculations, refer to the attached table.
  2. Settlement terms differ between companies, especially between American and Japanese companies.

*Sources:* Development Bank of Japan “Financial Data Bank”; Standard & Poor’s “Compustat”

In 2001, the world, including America, entered a serious IT recession and the ROA figures for both American and Japanese manufacturers plunged. Because the ROA figure for American manufacturers dropped more sharply, the gap between American and Japanese manufacturers narrowed. The year 2001, when the IT bubble burst, was an aberration, with consumer spending falling dramatically after the September 11 attacks in the United States. This report focuses on long-term trends such as those in the 1980s and 1990s and treats 2001 as a non-average year.

Figure 1-2 compares the time series changes in ROA of manufacturers operating in different business areas.<sup>4</sup> The ROA figure for

the five American semiconductor manufacturers rose dramatically in the 1990s as Intel and other companies increased their sales, and the ROA figure for the 17 American companies that manufacture information and communications equipment, PCs, etc. remained steady at around 10%. Both the ROA figures for the 10 Japanese general electrical equipment manufacturers and four Japanese electronic component & device manufacturers fell between the late 1980s and early 1990s, but the latter rose toward the late 1990s and reached 13.0% in 2000. On the other hand, the ROA figure for the 10 Japanese general electrical equipment manufacturers remained low throughout the 1990s. Although the figure improved slightly toward 2000, the profitability of Japanese general electrical equipment manufacturers was low relative to that of American manufacturers and Japanese electronic component & device manufacturers, and they have not regained profitability even over the long term.

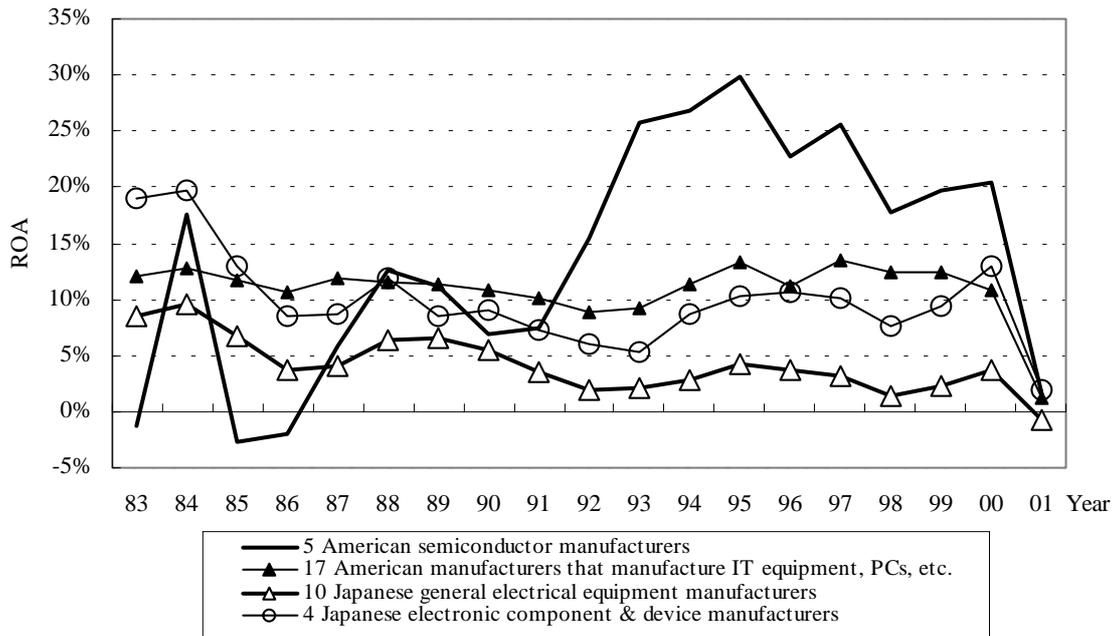
<sup>4</sup> In this report, the 25 American manufacturers and 17 Japanese manufacturers were classified as follows:

American manufacturers:

- (1) 5 manufacturers that manufacture semiconductors and/or related products
- (2) 3 EMSs (see Note 6)
- (3) 17 manufacturers that manufacture information and communications equipment, PCs, etc. including 5 PC manufacturers

Japanese manufacturers:

- (1) 10 general electrical equipment manufacturers
- (2) 4 electronic component & device manufacturers
- (3) 3 other manufacturers



**Fig. 1-2 Comparison of Time Series Changes in ROA of Manufacturers Operating in Different Business Areas**

Sources: Development Bank of Japan “Financial Data Bank”; Standard & Poor’s “Compustat”

## 2.2 Total Assets Turnover and Operating Profit on Sales

This section analyzes the profitability of the manufacturers selected for this research by making comparisons between American and Japanese manufacturers and between manufacturers operating in different business areas, in terms of total assets turnover and operating profit on sales (which are indicators obtained by decomposing ROA).<sup>5</sup>

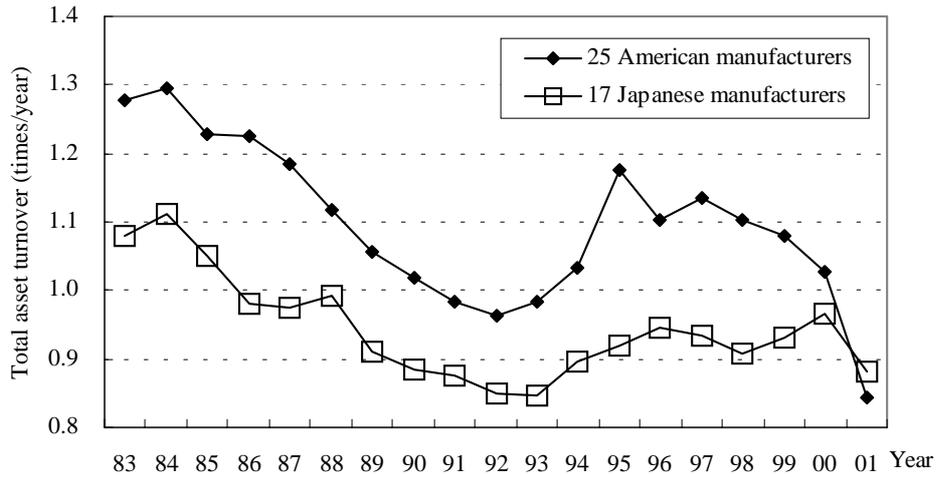
Figure 1-3 shows that the total assets turnover figure for American manufacturers was consistently higher than that for Japanese manufacturers by a certain margin throughout the 1980s and 1990s, although there are some variations. This means that American manufacturers used their assets more efficiently than

Japanese manufacturers.

In 2001, the total assets turnover figure for American manufacturers dropped sharply and became lower than the total assets turnover figure of Japanese manufacturers for the first time since 1980s. On the other hand, the operating profit on sales for American manufacturers had been similar to that for Japanese manufacturers at around 8% in 1983, but rose consistently thereafter while that for Japanese manufacturers continued to fell, resulting in a wide gap between American (12.0%) and Japanese manufacturers (4.4%) by the year 2000. Thus, the widened gap in ROA is largely due to the widening differential in operating profit on sales.

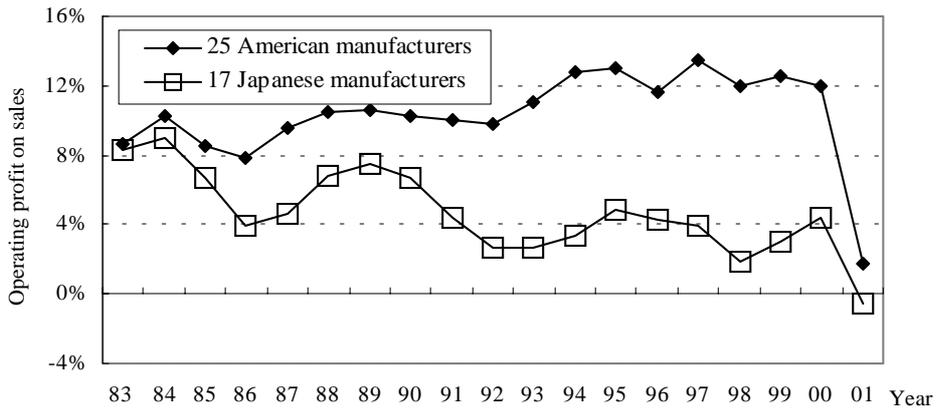
<sup>5</sup> From the relationship (Operating profit and loss / Average total assets (start and end of settlement term)) = (Operating profit and loss / sales) x (Sales / Average total assets (start and end of settlement term)), the following relationship is derived:

$$\text{ROA} = \text{Operating profit on sales} \times \text{Total assets turnover.}$$



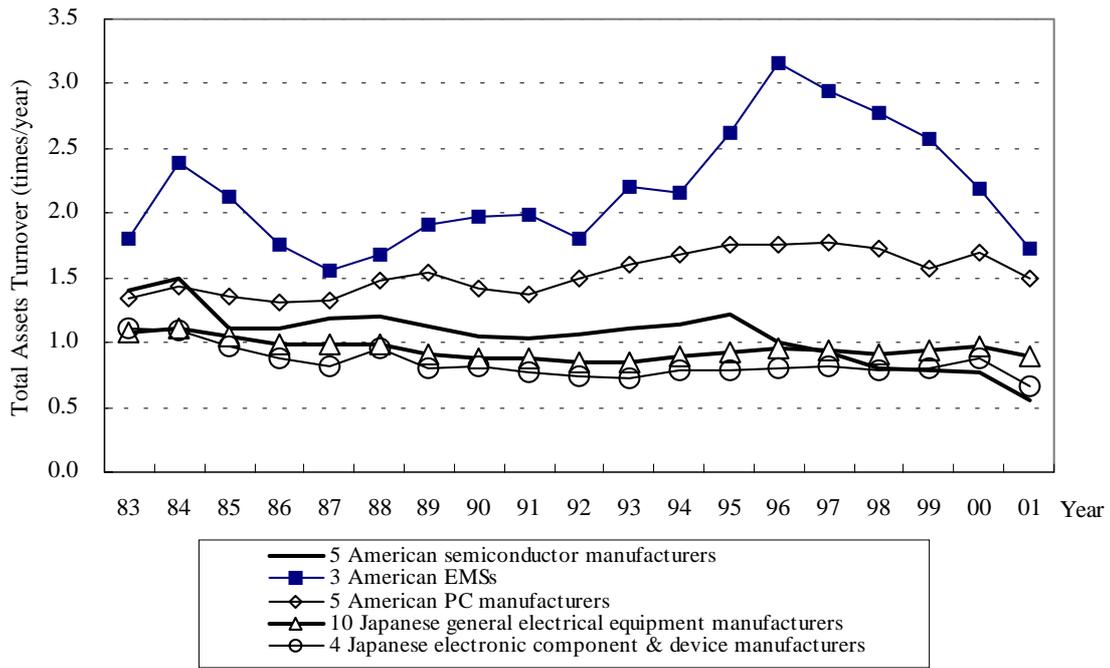
**Fig. 1-3 Comparison of Time Series Changes in Total Assets Turnover of Major American and Japanese Electrical Equipment Manufacturers**

Sources: Development Bank of Japan “Financial Data Bank”; Standard & Poor’s “Compustat”

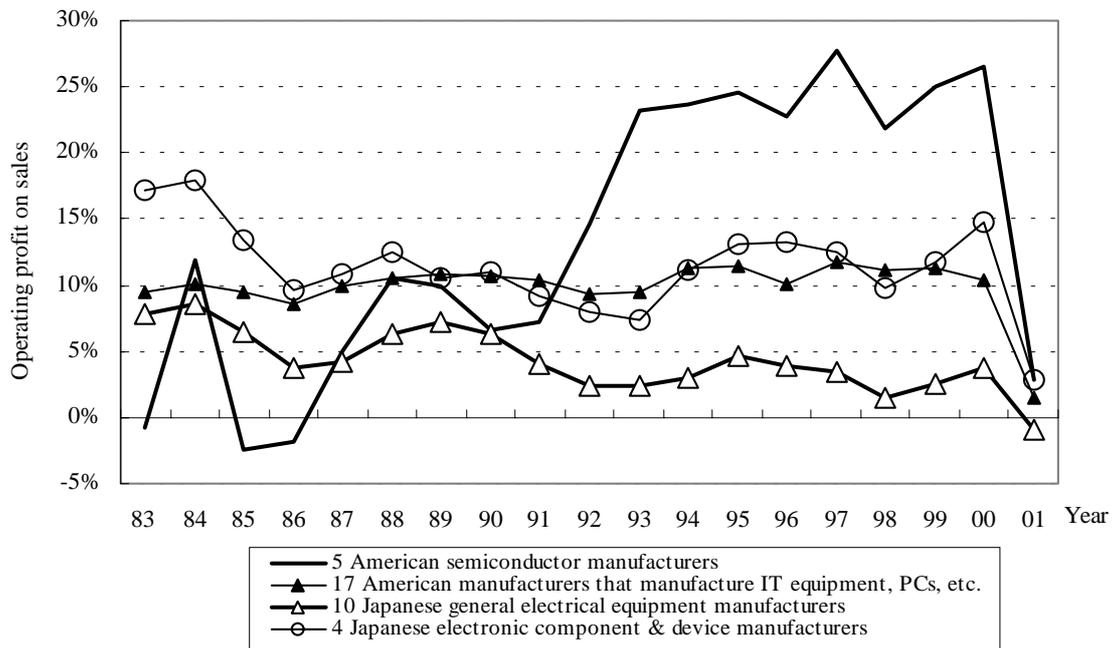


**Fig. 1-4 Comparison of Time Series Changes in Operating Profit on Sales of Major American and Japanese Electrical Equipment Manufacturers**

Sources: Development Bank of Japan “Financial Data Bank”; Standard & Poor’s “Compustat”



**Fig. 1-5 Comparison of Time Series Changes in Total Assets Turnover of Manufacturers Operating in Different Business Areas**



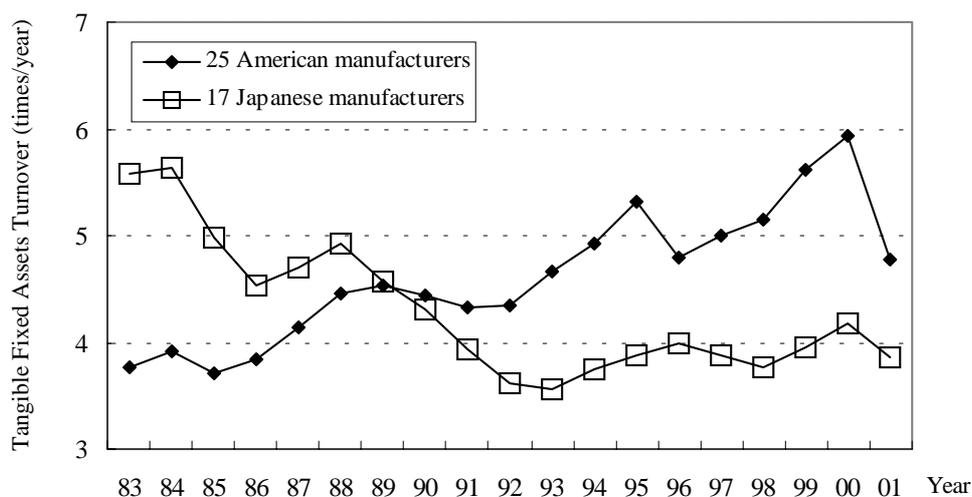
**Fig. 1-6 Comparison of Time Series Changes in Operating Profit on Sales of Manufacturers Operating in Different Business Areas**

A comparison of manufacturers operating in different business areas in terms of total assets turnover and operating profit on sales shows that the total assets turnover figures for the three American EMSs<sup>6</sup> and the five American PC manufacturers rose in the 1990s while the total assets turnover figure for the five American semiconductor manufacturers fell. There were no significant fluctuations in the total assets turnover figures for the other groups (both American and Japanese).

With regard to operating profit on sales, the figure for the five American semiconductor manufacturers rose dramatically in the 1990s. The operating profit on sales for Japanese electronic component & device manufacturers also rose in the 1990s. On the other hand, the operating profit on sales for Japanese general electrical equipment manufacturers fell in the early 1990s and remained low, and so the gap with American manufacturers and other Japanese company groups widened.

Figure 1-7 shows the tangible fixed assets

turnover for American and Japanese manufacturers. Although the turnover of Japanese manufacturers had been higher than that of American manufacturers in the 1980s, they were surpassed by American manufacturers in the 1990s, which means that American manufacturers improved the efficiency of using their facilities in the 1990s while the efficiency of Japanese manufacturers decreased. Figure 1-8 compares manufacturers operating in different business areas in terms of tangible fixed assets turnover. The turnover for American EMSs and PC manufacturers rose sharply in the 1990s, reflecting increased sales of EMSs which do not have their own factories<sup>7</sup> and active outsourcing of work to EMSs, etc. by PC manufacturers. In contrast, no Japanese manufacturer significantly improved its tangible fixed assets turnover during this period, due to differences between American and Japanese manufacturers in management policies including Japanese manufacturers' adherence to a policy of not outsourcing.

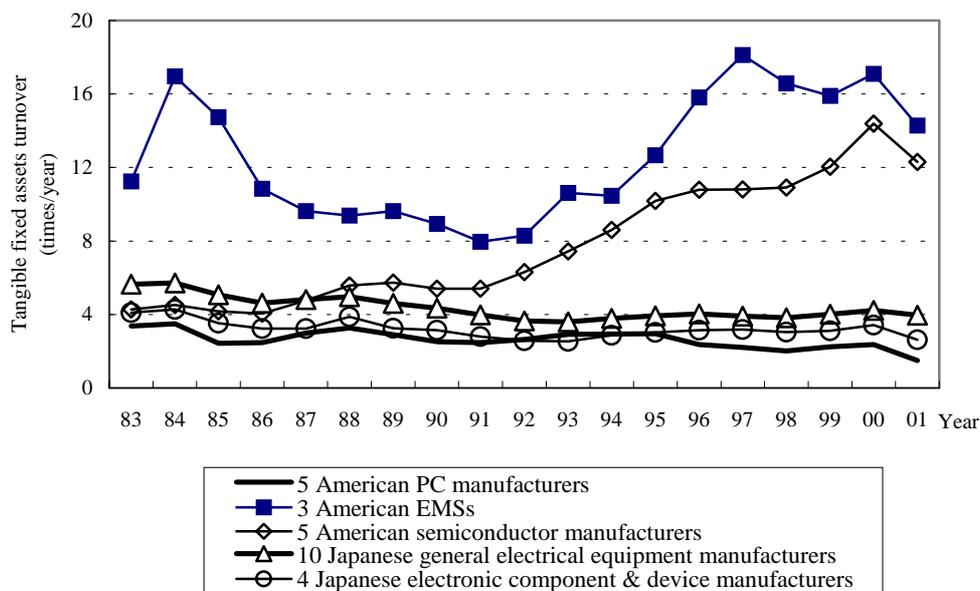


**Fig. 1-7 Comparison of Time Series Changes in Tangible Fixed Assets Turnover of Major American and Japanese Electrical Equipment Manufacturers**

Sources: Development Bank of Japan "Financial Data Bank"; Standard & Poor's "Compustat"

<sup>6</sup> EMS (Electronics Manufacturing Services) are contractors that manufacture and/or assemble electronics equipment (PCs, cellular phones, etc.) without branding. In this report, the term EMSs means EMSs as business entities (e.g. Solectron in the United States).

<sup>7</sup> They are reducing their apparent tangible fixed assets by using leased factories and production facilities.



**Fig. 1-8 Comparison of Time Series Changes in Tangible Fixed Assets Turnover of Manufacturers Operating in Different Business Areas**

Sources: Development Bank of Japan “Financial Data Bank”; Standard & Poor’s “Compustat”

### 3. Time Series Changes in Japanese Manufacturers’ Profitability by Business Area

#### 3.1 Method Used to Statistically Calculate Time Series Changes in Japanese Manufacturers’ Profitability by Business Area

The previous comparison of major American and Japanese manufacturers in terms of profitability showed that the ROA and operating profit on sales of Japanese general electrical equipment manufacturers remained low throughout the 1990s. As each of the general electrical equipment manufacturers operates in a broad range of business areas, it is not possible to accurately determine from published data which business areas are the unprofitable ones even though total profitability is clearly low. Although it has become possible in recent years to grasp profitability in individual business areas (segments) to a certain extent as a result of increased corporate disclosure, the segmentation structure used varies among companies and

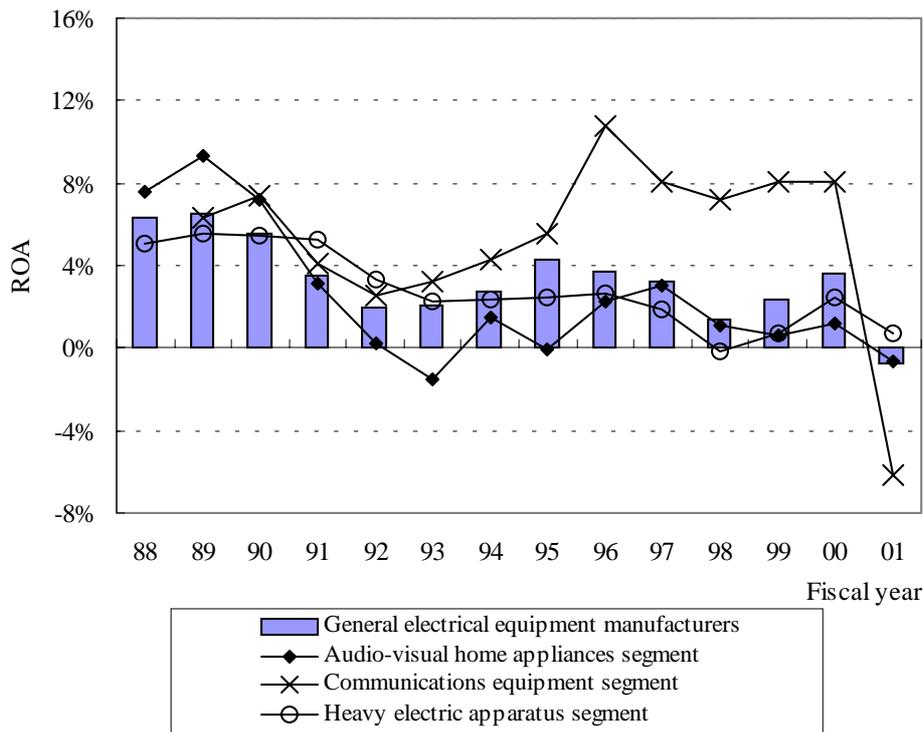
the existing published data do not cover a long period. This section deduces the causes of the low profitability of Japanese general electrical equipment manufacturers by segment by analyzing time series data on specialized manufacturers’ profits and other data.

The time series changes in Japanese general electrical equipment manufacturers’ profitability were statistically calculated by segment by using, as samples, the audio-visual home appliances, communications equipment, and heavy electric apparatus segments for which published settlement data are available on specialized and semi-specialized manufacturers, including the part of the general electrical equipment manufacturers’ consolidated settlement data that corresponds to these segments. Separate statistical calculations were made for the semiconductor segment, which occupies an important position in all general electrical equipment manufacturers with respect to profitability. The objective was to identify which segments of the general electrical equipment manufacturers are unprofitable.

### 3.2 Summary of the Results

Figure 1-9 shows the time series changes in the total ROA of Japanese general electrical equipment manufacturers and the ROA of each segment. The total ROA as well as the segment-specific ROA figures fell consistently from the end of the 1980s to the early 1990s, and the decreases in the ROA of the audio-visual home appliances segment were most

pronounced. In addition, the ROA of the heavy electric apparatus segment fell below the total ROA of the general electrical equipment manufacturers in 1994 when capital spending on facilities by the domestic electric utility companies passed the peak<sup>8</sup> and remained so for the remainder of the 1990s, dragging down the total ROA. On the other hand, the ROA of the communications equipment segment rose in the late 1990s. This is attributable to the rapid



**Fig. 1-9 Changes in the Total ROA of Japanese General Electrical Equipment Manufacturers and the ROA of Each Segment**

*Note:* 10 general electrical equipment manufacturers, 4 audio-visual home appliances manufacturers, 5 communications equipment manufacturers and 4 heavy electric apparatus manufacturers

4 audio-visual home appliances manufacturers = Pioneer, Victor Company of Japan, Columbia Japan, Aiwa

5 communications equipment manufacturers = Iwatsu Electric, NEC Infrontia, Toyo Communication Equipment, Anritsu, Matsushita Communication Industrial

4 heavy electric apparatus manufacturers = Fuji Electric, Meidensha, Takaoka Electric Mfg., Nissin Electric

*Source:* Development Bank of Japan “Financial Data Bank”

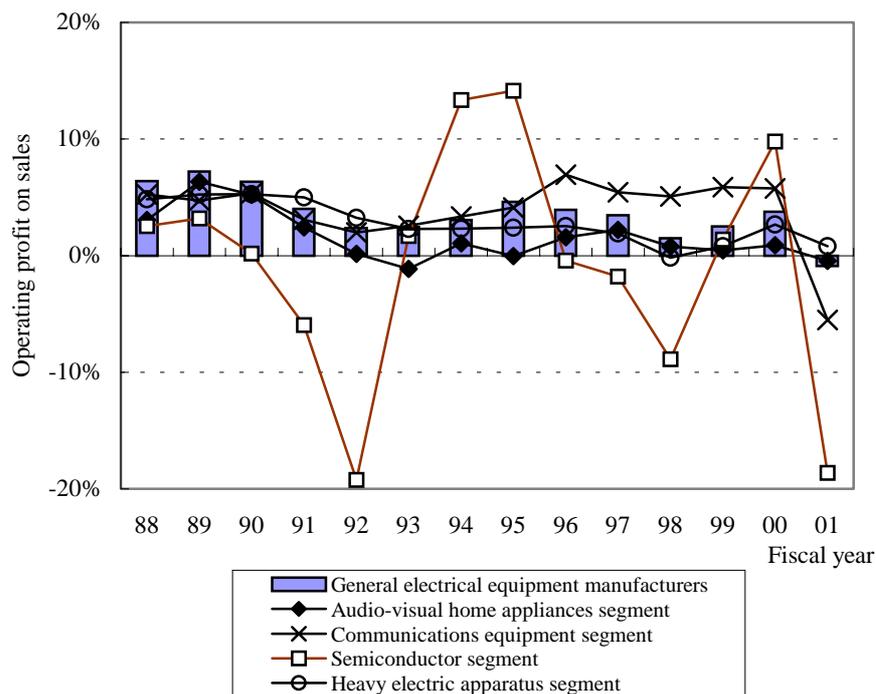
<sup>8</sup> From “Research on Facility Investment Plans” published by the Development Bank of Japan. The total capital spending on facilities made by the 9 electric utilities peaked at 4.9 trillion yen in FY 1993 and fell to 2.9 trillion yen in FY 2000.

expansion of the cellular phone market and the resultant increases in capital spending on facilities by communications equipment companies.

Figure 1-10 shows the time series changes in the total operating profit on sales of Japanese general electrical equipment manufacturers and the operating profit on sales of each segment. The operating profit on sales of the semiconductor segment<sup>9</sup> fluctuated widely, making both positive and negative contributions. These wide fluctuations are attributable to the replacing of

old products with new products due to the decreasing circuit line width and increasing degree of integration, the market climate changes caused by the fluctuations in supply and demand, and other factors.

Even though the profitability of the semiconductor segment is essentially unstable due to the silicon cycle, the profitability remained approximately the same as that of the four Japanese electronic component & device manufacturers even in 1994 and 1995 when revenues were high (operating profit on sales =



**Fig. 1-10 Changes in the Total Operating Profit on Sales of Japanese General Electrical Equipment Manufacturers and the Operating Profit on Sales of Each Segment**

*Note:* For the names of the companies used for the calculations for the semiconductor segment and the statistical calculation method used, refer to footnote 9.

*Source:* Development Bank of Japan “Financial Data Bank”

<sup>9</sup> The operating profit on sales of the semiconductor segment of the major Japanese general electrical equipment manufacturers (Hitachi, Toshiba, Mitsubishi Electric, NEC and Fujitsu) was statistically derived through calculations using data from “DBJ Research Report No.259” for fiscal years 1988 to 1998 and intermediate values taken from the Nikkan Kogyo Shimbun (Daily Industrial Journal) and reports from securities analysts (Nikko Salomon Smith Barney, Mizuho Securities, Nomura Securities Financial Research Center) for fiscal 1999 and succeeding years.

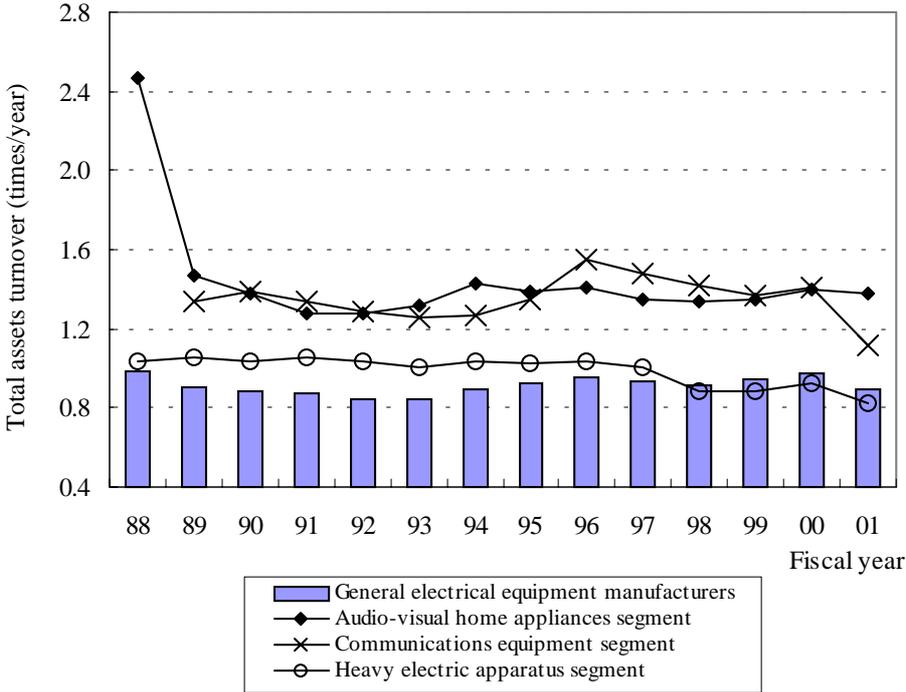
were high (operating profit on sales = slightly less than 15%). There is a large gap with the figure (more than 20%) achieved by American semiconductor manufacturers during the same period, and the operating profit on sales in 1988 and 1989 when Japanese manufacturers had more than half of the world market was not so high (statistically calculated value = approximately 3%). There thus appears to be the structural problem among Japanese semiconductor manufacturers (segment) that their profitability is low even during a boom period or when they have strong market dominance. This point will be discussed further in the following chapters.

In this section, the profitability of Japanese general electrical equipment manufacturers was estimated by segment using published settlement information of some manufacturers. The analysis revealed that declines in the operating profit on sales of the audio-visual home appliances segment, which was one of the most

profitable segments up until 1980s, as well as declines in the operating profit on sales of the heavy electric apparatus segment, which enjoyed stable profitability in the 1980s, contributed to the declines in profitability during the 1990s. In addition, a comparison of the profitability of major American and Japanese semiconductor manufacturers showed a wide gap in profitability between the two, even though they have comparatively dominated the global semiconductor market.

#### 4. Profitability Characteristics of Japanese Manufacturers

In the 1990s, there were significant declines in operating profit on sales for Japanese manufacturers and especially in those for Japanese general electrical equipment manufacturers, in contrast with American manufacturers that maintained high operating profit on sales. Although the effects of the prolonged recession in the



**Fig. 1-11 Changes in the Total Assets Turnover of Japanese General Electrical Equipment Manufacturers and the Total Assets Turnover of Each Segment**

Source: Development Bank of Japan “Financial Data Bank”

Japanese economy in the 1990s (a macroeconomic factor) on the profitability of Japanese manufacturers cannot be ignored<sup>10</sup>, a comparison with the figures for Japanese electronic component & device manufacturers clearly shows that the declines in the profitability of Japanese general electrical equipment manufacturers are serious, and may have causes unique to the general electrical equipment industry.

Sales in the Japanese markets, which are a major outlet for the products of Japanese manufacturers, fell in the 1990s because of the recession. All Japanese general electrical equip-

ment manufacturers (except Sony) depended on these markets for more than half of total sales in fiscal 2000.

The following chapters examine the segments that have been dragging down profitability in time series or relative to the American counterparts for reasons of low profitability, and then examine the differences between the business models used by American and Japanese manufacturers, which are considered to be correlated with the profitability gap between the two groups, focusing on general electrical equipment manufacturers.

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<sup>10</sup> Sales in the Japanese markets which are a major outlet for the products of Japanese manufacturers fell in the 1990s because of the recession. All Japanese general electrical equipment manufacturers (except Sony) depended on these markets for more than half of total sales in fiscal 2000.

## II Industry Trends by Segment

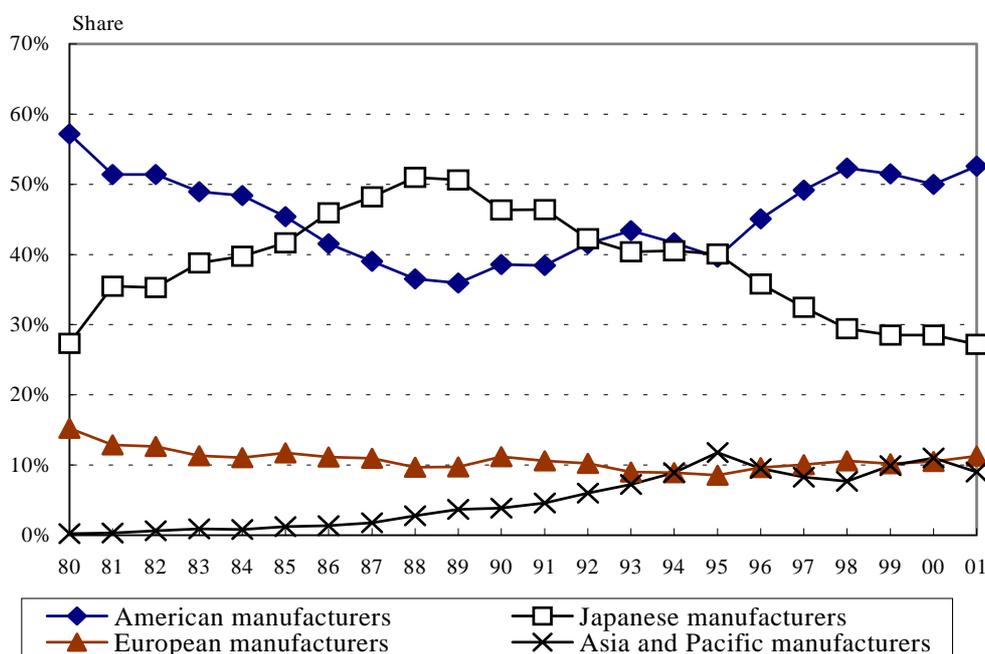
The previous chapter showed that one of the reasons for the low profitability of Japanese general electrical equipment manufacturers relative to that of American manufacturers was a wide gap between the two groups in the operating profit on sales of the semiconductor segment. In addition, in terms of segment-by-segment contribution to the sharp declines in the profitability of Japanese manufacturers in 2001, the semiconductor segment, which suffered the sharpest declines in sales, was the highest contributor. This chapter identifies the factors that have been dragging down profitability by segment using relevant indicators.

### 1. Semiconductors

#### 1.1 Market Trends

An examination of the time series changes in the market share of Japanese manufacturers in

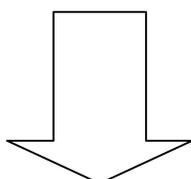
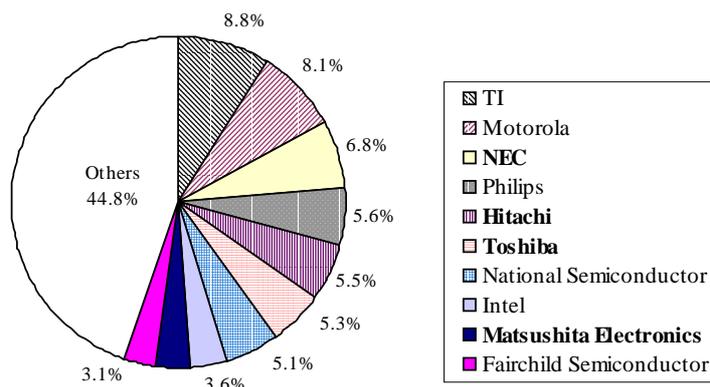
the world semiconductor market (by area classification based on the nationalities of the shipping manufacturers) shows that Japanese manufacturers increased their market share in the 1980s and surpassed American manufacturers to acquire the top share, with more than half the world market. However, the Japanese manufacturers' market share peaked in 1988 to 1989 and then continued to fall, allowing American manufacturers to catch up and eventually surpass Japanese manufacturers in the early 1990s. The gap in market share continued to widen throughout the 1990s, with the market share of Japanese manufacturers at the end of the 1990s falling to less than 30%, roughly the same as that in 1980. In addition, there were only three Japanese manufacturers among the top 10 companies in 2001, as opposed to six in 1991.



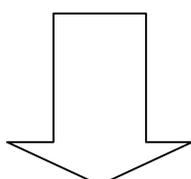
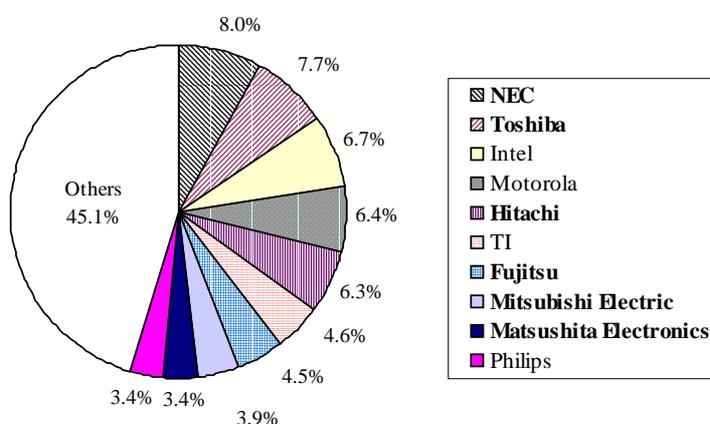
**Fig. 2-1 Changes in the Market Shares of the American, European, Asia and Pacific and Japanese Manufacturers in the Global Semiconductor Market**

Source: Gartner Dataquest (April 2002) GJ02225

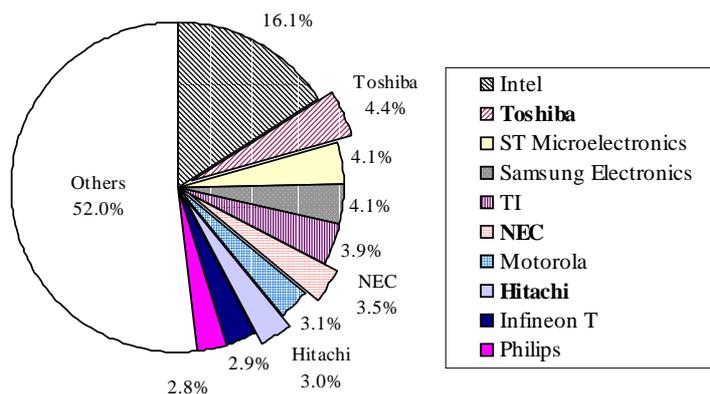
1981 World total = 14,668 million dollars



1991 World total = 59,695 million dollars



2001 World total = 154,909 million dollars



**Fig. 2-2 Changes in the Shares of Manufacturers in Semiconductor Sales**

Source: Gartner Dataquest (April 2002) GJ02226

Figure 2-3 shows the business areas covered by American and Japanese manufacturers. Japanese manufacturers are producing the full spectrum of semiconductor products, while American manufacturers are more highly specialized. In terms of market share, Japanese manufacturers in the segments surveyed are not among the top companies in the MOS type integrated circuit<sup>1</sup> segment that accounts for a high percentage of the overall semiconductor market, but hold large market shares for semiconductors as a whole as they produce a broad range of semiconductor products. In other words, there is no area in which a Japanese manufacturer is particularly strong. On the other hand, American manufacturers hold leading market shares in the large MOS type integrated circuit segment and other segments. Figure 2-5 shows the shares (by sales) of the top-share manufacturers in 1991 and 2001 for DRAM products<sup>2</sup>, which are typical MOS type memory products. Major Japanese manufactur-

ers altogether held more than half the market in 1991, but their market share fell as South Korean and American manufacturers increased their market shares through specialization, cost reductions, etc. In 2001, the share of Japanese manufacturers was about 20%.

Manufacturers from South Korea, Taiwan and other Asian countries as well as Japanese companies from other industries (such as steel manufacturers) entered the semiconductor market in the 1980s, when the semiconductor businesses of Japanese manufacturers were booming. The South Korean manufacturers have expanded mainly in the DRAM segment, and the Taiwanese manufacturers have expanded based on the foundry business model. Meanwhile, some of the Japanese entrants from other industries have sold their semiconductor businesses to specialized foreign semiconductor manufacturers and have withdrawn from the semiconductor market as industry conditions have worsened.<sup>3</sup>

	Hitachi Toshiba Mitsubishi Electric Fujitsu NEC Sony Matsushita Electric Industrial Sharp Sanyo Electric	Intel Micron TI IBM Motorola
MOS memories		
MOS micro		
MOS logic		
Linear (analog)		
Digital Bipolar		
CCDs (sensors)		
Opto		
Discrete		

**Fig. 2-3 Sub-segments within the Semiconductor Segment**

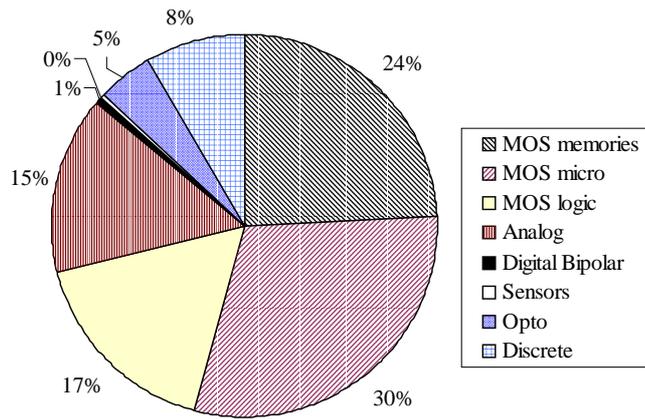
*Note:* indicates that the manufacturer is among the top-three companies in the world in terms of market share and indicates a rank of fourth or lower (based on figures statistically calculated for 2000).

*Source:* Prepared by the Development Bank of Japan from publications of the Semiconductor Industry Research Institute of Japan

<sup>1</sup> MOS stands for Metal Oxide Semiconductor. MOS type integrated circuits are integrated circuits with a 3-layer structure that comprises the semiconductor (silicon substrate, etc.), oxide and metal layers.

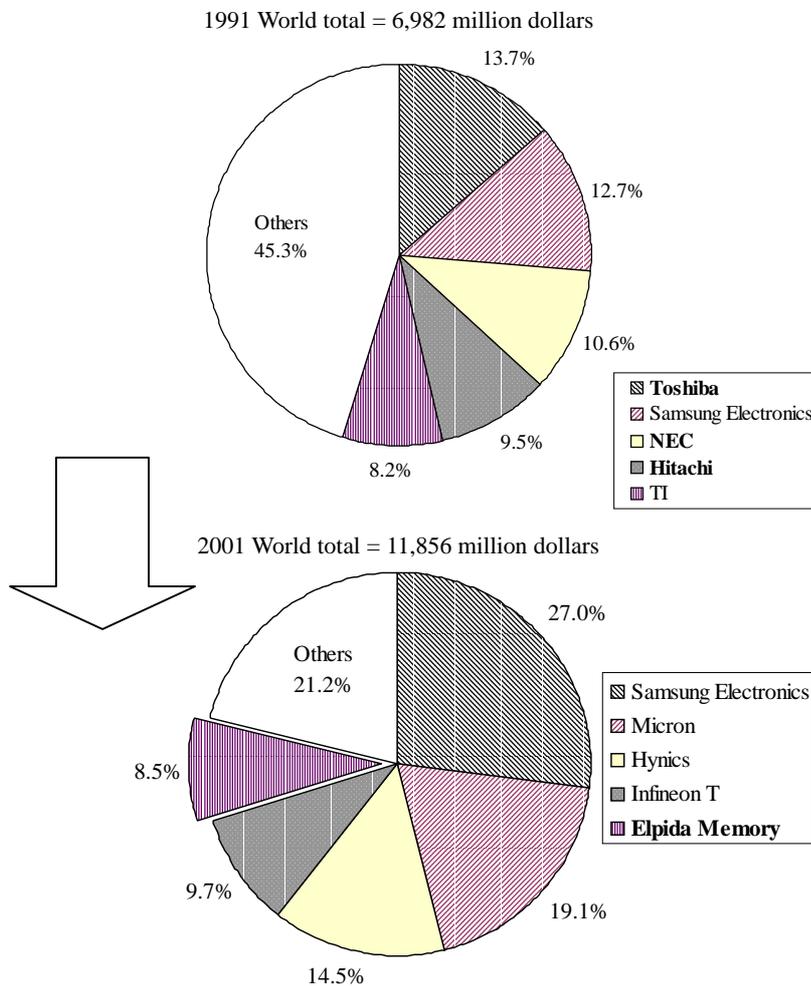
<sup>2</sup> DRAM: Dynamic Random Access Memory.

<sup>3</sup> Nippon Steel sold Nippon Steel Semiconductors to UMC (Taiwan) in 1998, and Kobe Steel sold KMT Semiconductors to Micron Technologies (United States) in 2001.



**Fig. 2-4 Composition of the Global Semiconductor Market (2000)**

Source: WSTS statistics



**Fig. 2-5 Shares (by Sales) of the Top-share Manufacturers in 1991 and 2001 in the DRAM market**

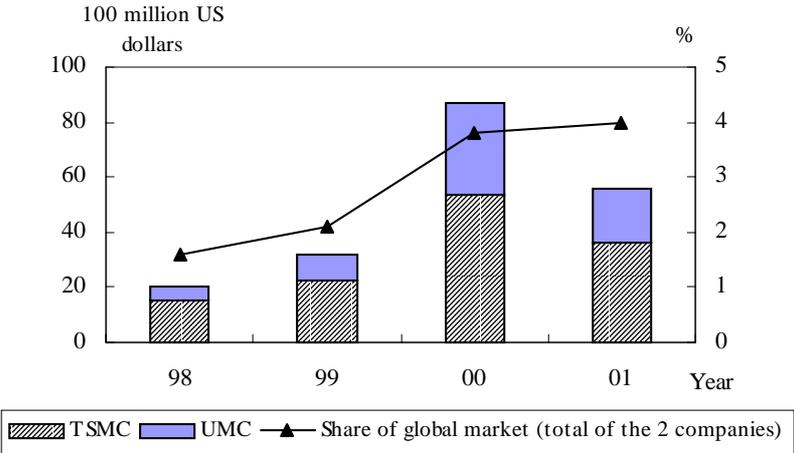
Source: Gartner Dataquest (April 2002) GJ02227

The loss of market share of Japanese manufacturers to American manufacturers is partly attributable to the foundry manufacturers<sup>4</sup> based in Taiwan and other countries, which specialize in contract-based production of semiconductors. These foundry manufacturers have grown for the following reasons: 1) as know-how, profits and added value associated with semiconductor production shifted from semiconductor manufacturers to production equipment manufacturers and as market competition intensified partly due to new entries, cost competition became a more important management issue than competition in quality which is harder to differentiate, and 2) differentiation in design (what to produce) also became more important for management than differentiation in quality, leading to the separation of design and production (i.e. pursuing product differentiation and cost competitiveness separately), thus favoring firms that specialized in design or production. Against this background, American manufacturers, helped by the national

government (SEMATEC<sup>5</sup>) and improvements in the competitiveness of American semiconductor production equipment manufacturers, regained and increased their market shares by utilizing foundry manufacturers for production. In contrast, Japanese manufacturers, which adhered to the policy of doing everything in-house from design to production, experienced loss of market share to American manufacturers.

**1.2 Trends in Capital Spending on Facilities and R&D**

Figure 2-7 shows the time series changes in the capital spending on facilities by manufacturers surveyed by nationality. Japanese manufacturers' capital spending was the highest in the world in the early 1990s but was surpassed by that of American manufacturers and then by Asian manufacturers around the mid 1990s as the Japanese manufacturers' market share fell. The gap continues to widen.



**Fig. 2-6 Changes in the Sales of Major Taiwanese Semiconductor Foundry Companies**

*Note:* Both companies depend on American manufacturers for 50 to 60% of their sales.  
*Sources:* Prepared by the Development Bank of Japan from annual reports of the 2 companies and WSTS data

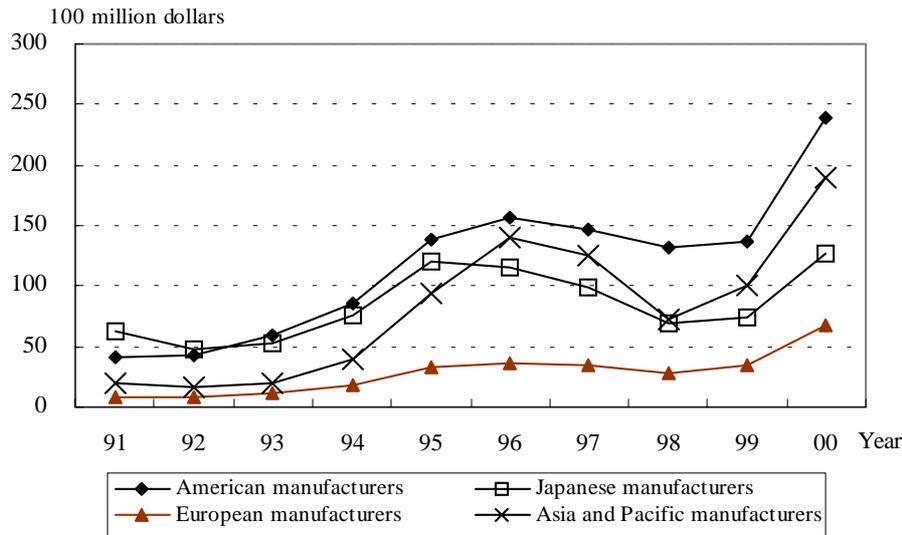
<sup>4</sup> Foundry manufacturers are manufacturers that specialize in contract-based production of semiconductor integrated circuits without developing products in-house. TSMC (Taiwan Semiconductor Manufacturing) and UMC (United Microelectronics) in Taiwan are typical foundry manufacturers.

<sup>5</sup> SEMATECH (Semiconductor Manufacturing Technology Institute) is a semiconductor production research institute established jointly by the national government and the private sector in the United States in 1987.

Considering the low level of capital spending on facilities by Japanese manufacturers relative to those of capital spending on facilities by American and Asian manufacturers in the semiconductor industry, which is a typical facility-intensive industry, it will be difficult for Japanese manufacturers to regain their market share (sales).

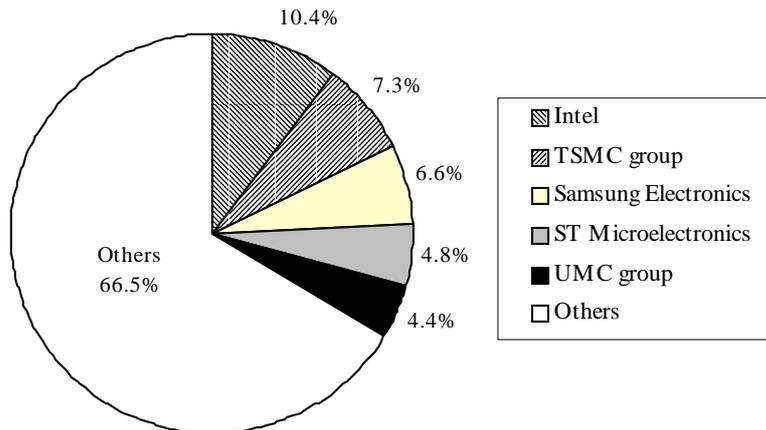
Many domestic and overseas manufacturers in the semiconductor industry have experi-

enced periodic large deficits due to the silicon cycle and other reasons while facing the need to continuously increase capital spending on facilities in line with the decreasing circuit line width and increasing degree of integration. Specialized overseas semiconductor manufacturers are convincing their investors, who finance their operations, of the need to consider this risk of temporary deficits as part of the necessary investment in facilities (according to



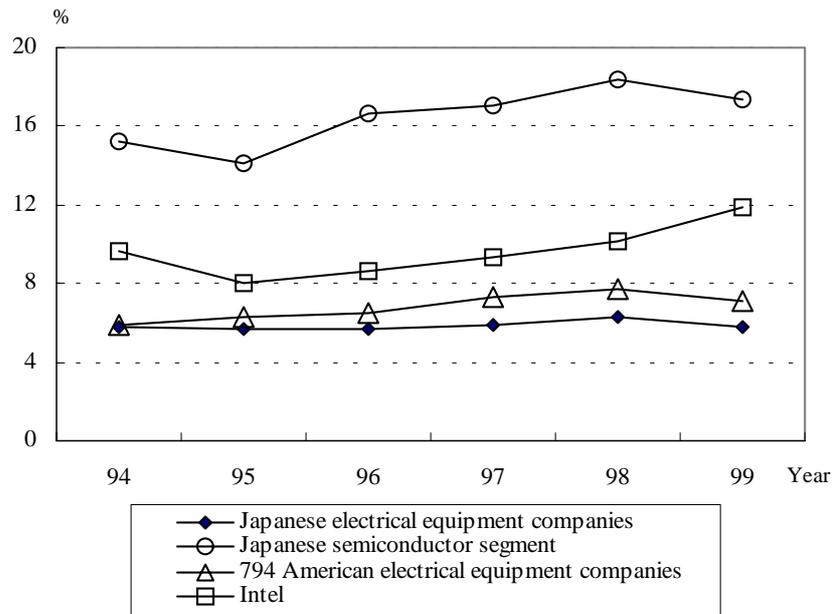
**Fig. 2-7 Changes in Capital Spending on Semiconductor Production Facilities by Company Nationality**

Source: Gartner Dataquest (August 2001) GJ02228



**Fig. 2-8 Shares of Manufacturers in Capital Spending on Semiconductor Production Facilities (2000)**

Source: Gartner Dataquest (August 2001) GJ02229



**Fig. 2-9 Changes in the Share of Total R&D Expenditure as a Percentage of Sales by Company Group**

Sources: Ministry of Public Management, Home Affairs, Posts and Telecommunications “Survey of Research and Development”; publications of the Ministry of International Trade and Industry; Standard & Poor’s “Compustat”

a Japanese general electrical equipment manufacturer). Because of the current recession in the global semiconductor market that is forcing other semiconductor companies worldwide to limit their capital spending on facilities, since 2001 most Japanese manufacturers have been increasingly resorting to concentrating capital spending on facilities in high-priority areas or deferring facility investments while looking for new business models including those based on partnerships.

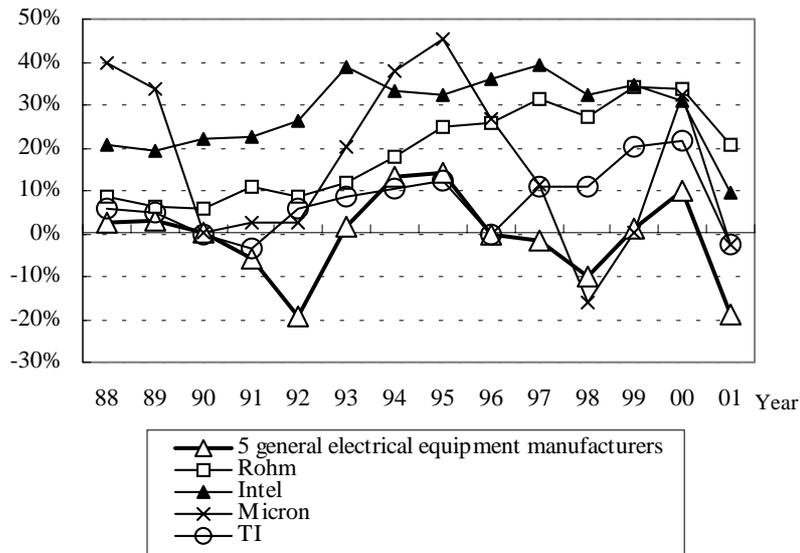
Figure 2-9 shows the time series changes in total R&D expenditure by different company groups. The share of total R&D expenditure made by the 12 major Japanese semiconductor manufacturers (including semiconductor divisions of general electrical equipment manufacturers) as a percentage of their total sales was around 16 to 18% between 1994 and 1999. This is much higher than the electrical equipment industry average of 6% and is also higher than the figures for specialized American semiconductor manufacturers. The fact that the market share of Japanese semiconductor manufacturers

has been shrinking and their profitability has also been low as compared to the major American manufacturers and other groups, despite their vast R&D expenditure, is partly due to their over-diversification which has lowered their R&D efficiency.<sup>6</sup>

Figure 2-10 compares companies in terms of the time series changes in operating profit on sales. Rohm, which is a mid-sized,

<sup>6</sup> “Challenges for the Japanese Semiconductor Industry and Solutions” (May 2002) published by the Semiconductor Industry Strategy Promotion Committee points out that although Japanese general electrical equipment manufacturers have been producing a wide range of electrical equipment and electronic components and devices, their final products (in particular information and communications equipment) have not been very competitive, as a result of which their diversification in product range has not brought the intended results.

In addition, the apparent edge that Japanese manufacturers have over American manufacturers in terms of their share of R&D expenditure as a percentage of sales is attributable to American manufacturers’ strategy of acquiring new experts and expertise and venture companies’ R&D results through M&As compared with Japanese manufacturers.



**Fig. 2-10 Comparison of Time Series Changes in Operating Profit on Sales of American and Japanese Companies**

*Note:* The figures for the 5 general electrical equipment manufacturers are statistically calculated values (see footnote 9 to Chapter I). The operating profit on sales figures for Rohm are consolidated figures for the entire company.

*Sources:* Development Bank of Japan “Financial Data Bank”, Standard & Poor’s “Compustat”

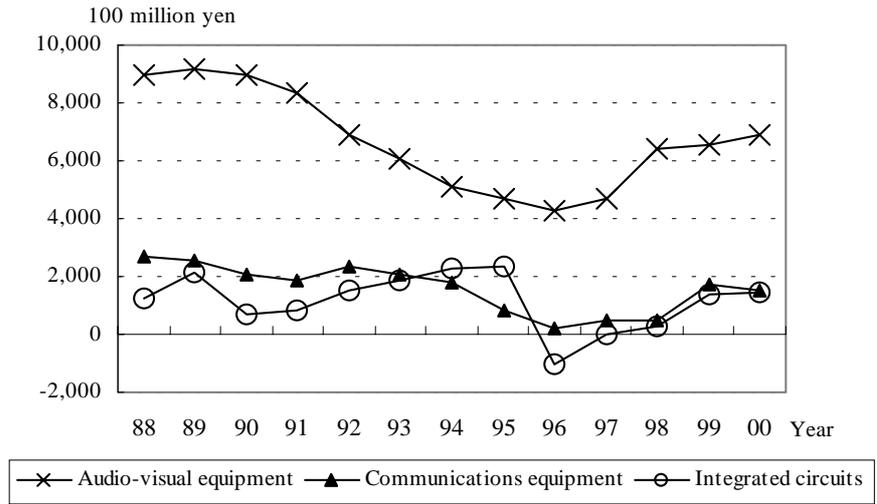
semi-specialized semiconductor manufacturer, consistently increased its profitability (operating profit on sales) throughout the 1990s by specializing in producing custom LSIs and diodes<sup>7</sup> while the profitability of the semiconductor manufacturers producing the full range of semiconductor products remained low. The profitability gap between American and Japanese manufacturers has been steadily growing for many years now, due mainly to the differences in the business models used (specialization/diversification), and the rapid changes in business climate as well as the wide demand fluctuations in the memory segment (particularly DRAM) have heavily impacted semiconductor manufacturers’ profitability. Although Japanese manufacturers have recognized the need to concentrate in core businesses and have been trying to restructure under a “selection and concentration” policy, they have been slow in selecting their core businesses and have not yet

completed the selection phase. Japanese manufacturers are thus unlikely to close the gap with American manufacturers.

### 1.3 Trade Trends

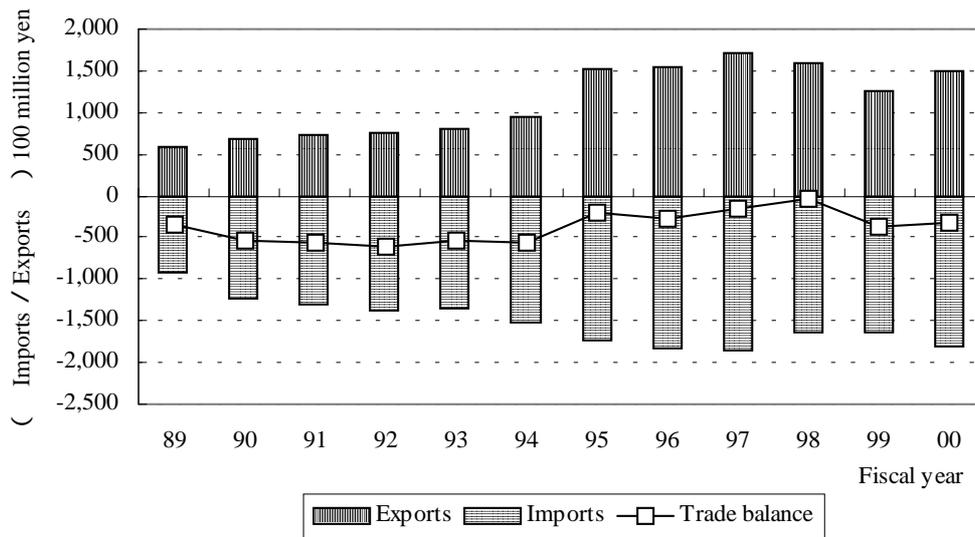
Figure 2-11 shows the time series changes in the trade balance between the United States and Japan with respect to integrated circuits and other types of products. Japan had export surpluses almost every year between 1988 and 2000. On the other hand, companies headquartered in America consistently surpassed those headquartered in Japan in terms of profitability (operating profit on sales) over the same period. These facts suggest that American semiconductor manufacturers have been 1) producing products with high added value, 2) successfully devising measures to achieve good profits in relation to costs and/or sales prices and 3) shifting production bases to developing countries and outsourcing (including utilization of foundry manufacturers).

<sup>7</sup> Diodes are (discrete) semiconductor devices that have a junction structure which allows them to conduct electric current only in one direction.



**Fig. 2-11 Changes in the Trade Balance between the United States and Japan with Respect to Integrated Circuits and Other Types of Products**

Sources: Ministry of Finance "Overview of Japan's Foreign Trade"; Press Journal Inc. "Japan Semiconductor Almanac"



**Fig. 2-12 Changes in the Trade Balance between Japan and the Rest of the World with Respect to Technology-related Trade in the Electrical Equipment Industry**

Note: The industries covered are the communications, electronics and electrical measuring instrument industries.

Source: Statistics Bureau of the Ministry of Public Management, Home Affairs, Posts and Telecommunications "Survey of Research and Development"

Figure 2-12 shows the time series changes in the trade balance between Japan and the rest of the world with respect to technology-related trade in the electrical equipment industry (including semiconductors). Japan consistently im-

ported more than it exported between 1989 and 2000, in marked contrast to the large export surpluses of electrical equipment and components/devices. Although this suggests that Japanese manufacturers have no technological supe-

riority over other countries' manufacturers, it does not prove they are technologically inferior, because the technology trade balance is determined not only by technological superiority or inferiority (R&D capability) but also by other factors including individual manufacturers' patent application strategies (applying for a patent means disclosing technological expertise and know-how). As the number of patent applications made by Japanese manufacturers has been increasing in recent years (indicating greater willingness to fully utilize their intellectual properties to improve profitability), the technology trade balance may improve in the future.

#### **1.4 Challenges**

As manufacturers (including general electrical equipment manufacturers) having a semiconductor business are significantly affected by it in terms of profitability, such companies are struggling to formulate semiconductor business strategies and make good use of their semiconductor divisions and operations. To strengthen their market power by regaining market share and reducing facility investment and R&D costs which are rising year by year, they will need to merge operations and take other drastic action based on partnerships, as well as improve the efficiency of R&D and concentrate resources in strategic businesses. They will also need to revise their business models in order to increase market share by utilizing foundry manufacturers and outsourcing production processes, while strengthening their design divisions and reducing the burden of facility investment.

### **2. Home Appliances**

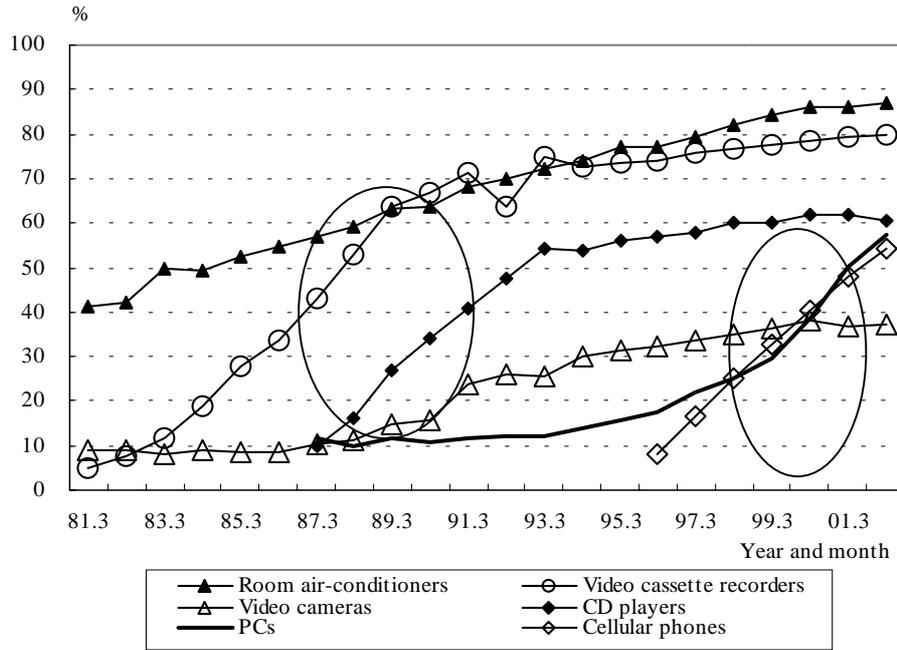
#### **2.1 Declines in Unit Selling Prices**

The Japanese general electrical equipment manufacturers enjoy higher market shares in the home appliances segment than in any other. In particular, they hold large market shares ranging from 40 to 80% in audio-visual home appliances markets, including those for video cassette recorders and CD players, whose user bases expanded rapidly both in Japan and overseas in the late 1980s. Given the large market

shares and dominance of Japanese general electrical equipment manufacturers in the home appliances segment, this should have been one of the most profitable segments for Japanese electrical equipment manufacturers, but in fact their sales in this segment decreased from the 1980s to the 1990s, hence this segment has not necessarily improved their profitability, as mentioned above.

The direct reason for the inability of Japanese electrical equipment manufacturers to achieve high profit levels in the home appliances segment is the recent declines in the unit selling prices of products. An examination of the changes in the wholesale price indices for the major markets over the past 10 years reveals that the unit selling prices of home appliances have declined much more sharply than those of automobiles. These sharp declines have squeezed the margins of Japanese electrical equipment manufacturers and offset the cost reductions achieved through improvements in productivity and the expansion of markets achieved through increases in ownership rates.

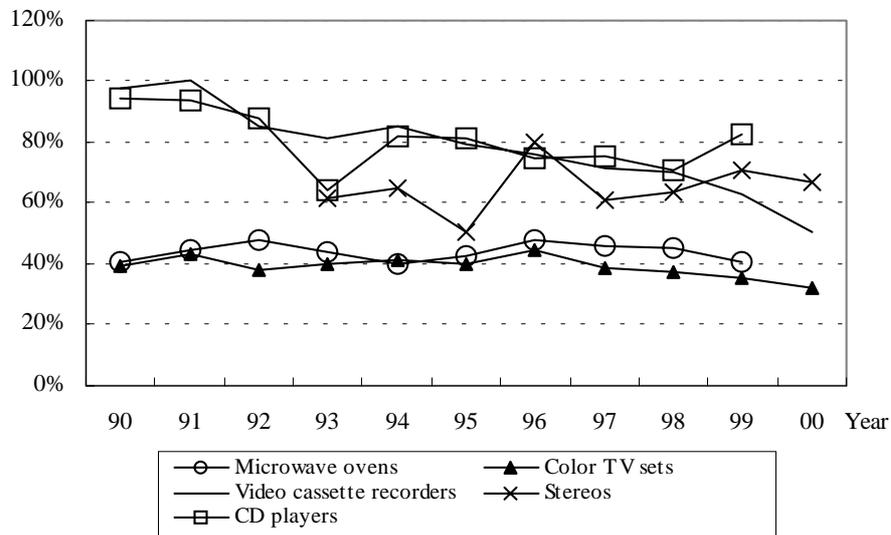
The sharp declines in the unit selling prices of home appliances are largely due to the shifting of manufacturing to countries where production costs are lower such as Asian countries. The overseas production ratios are now more than 90% for such items as color TV sets, and about 80% of Japanese-brand products sold in Japan are imported after being manufactured in other countries (on the basis of figures statistically calculated (by number of units) for 2000). As a result of the recent increases in reverse import ratios, the domestic unit shipping prices of home appliances have been falling year by year and Japanese electrical equipment manufacturers have been forced to limit domestic production to products with high added value such as wide-screen TV sets and to adapt to this trend. The shifting of production bases to countries with lower production costs, the original main purpose of which was to develop overseas outlets for Japanese products, has now caused harsh competition in the domestic market, as evidenced by sharp rises in the overseas production and reverse import ratios for color TV sets, video cassette recorders, etc. over the past 10 years.



**Fig. 2-13 Changes in the Rates of Ownership of Major Electrical and Electronic Equipment (in Japan)**

*Note:* The figures for cellular phones are ownership rates as a percentage of the total population. The figures for other products are ownership rates as a percentage of the total number of households.

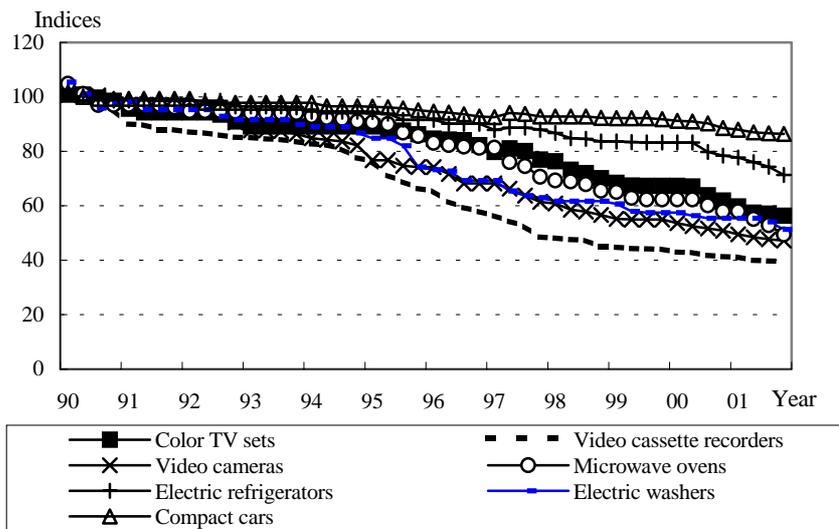
*Sources:* Cabinet Office “Consumption Confidence Survey”; publications of the Telecommunications Carriers Association (cellular phones)



**Fig. 2-14 Changes in the Market Share of Japanese Electrical Equipment Manufacturers in the Markets for Major Home Appliances Products (by number of units)**

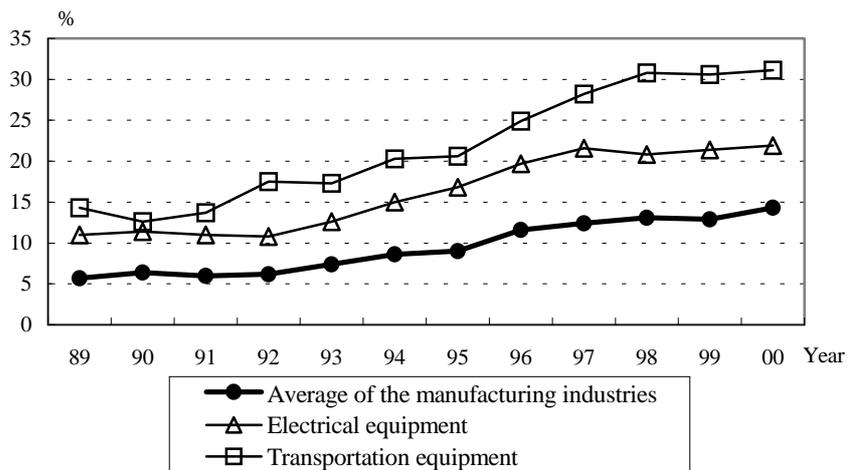
*Note:* Share of Japanese manufacturers = [Number of units produced by Japanese manufacturers] / [Total world demand]

*Sources:* Prepared by the Development Bank of Japan from publications of the Japan Electrical Manufacturers' Association (JEMA), the Japan Electronics and Information Technology Industries Association (JEITA), and the Association for Electric Home Appliances.



**Fig. 2-15 Changes in the Wholesale Price Indices for the Major Markets**

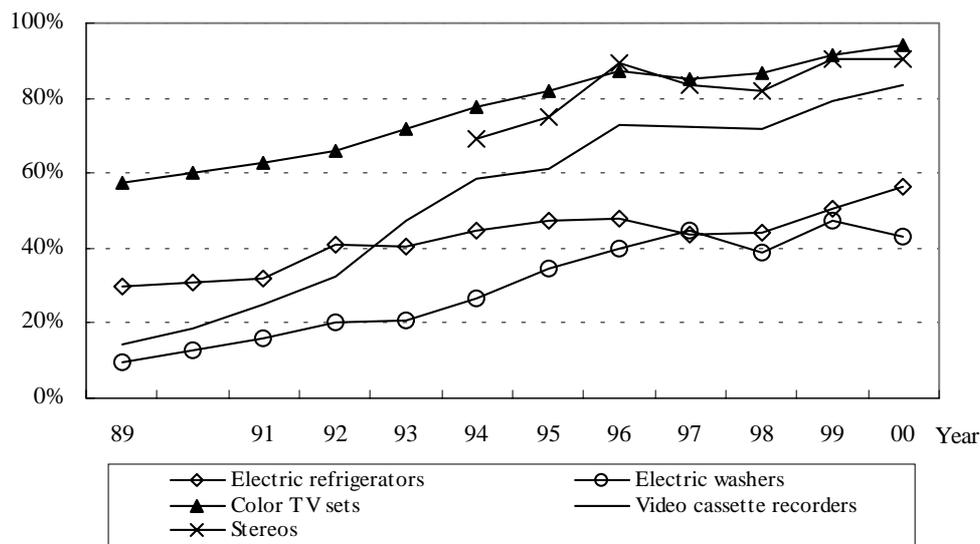
*Source:* Prepared by the Development Bank of Japan from Monthly Financial and Economic Statistics Reports published by the Bank of Japan.



**Fig. 2-16 Changes in the Overseas Production Ratios for Electrical Equipment and Transportation Equipment (in monetary terms)**

*Note:* Overseas production ratio = [Sales of the overseas subsidiaries, branches and divisions of Japanese companies (manufacturing industries)] / [Sales of Japanese companies and their domestic subsidiaries, branches and divisions (manufacturing industries)]

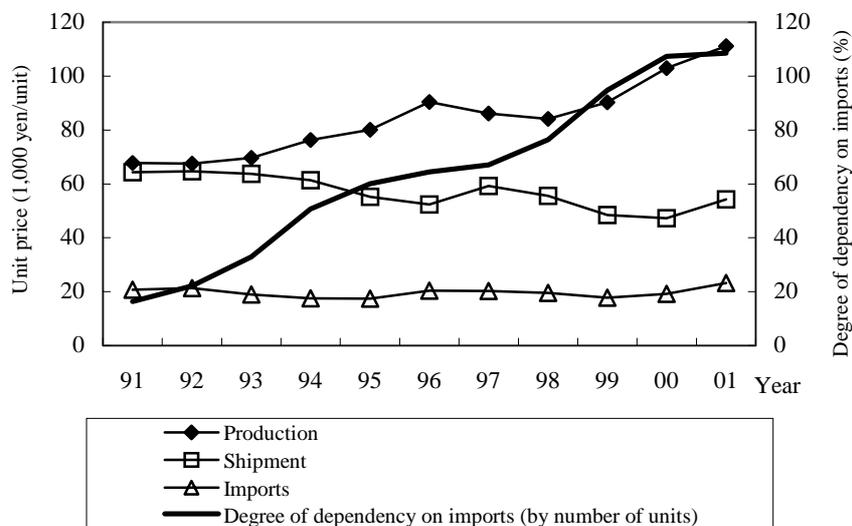
*Source:* Ministry of Economy, Trade and Industry "Trend Survey of Overseas Business Activities"



**Fig. 2-17 Changes in the Overseas Production Ratios for the Major Product Categories (by number of units)**

*Note:* Overseas production ratio = [Number of units produced overseas] / [Number of units produced domestically + Number of units produced overseas]

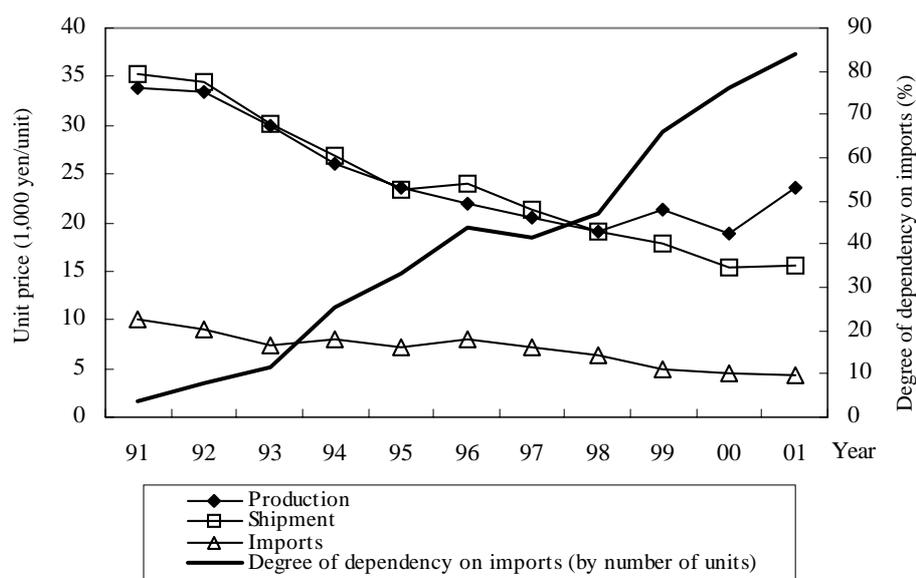
*Sources:* Prepared by the Development Bank of Japan from publications of JEMA and JEITA



**Fig. 2-18 Changes in the Unit Shipment, Import, and Domestic Production Prices of Color TV Sets (excluding Liquid Crystal TV sets)**

*Note:* Degree of dependency on imports = [Imports] / [Domestic production - Exports + Imports]. The unit production prices were calculated by [Total production cost / Number of units produced]. The unit shipment/import prices were also calculated in a similar manner.

*Source:* Prepared by the Development Bank of Japan from publications of JEITA



**Fig. 2-19 Changes in the Unit Shipment, Import, and Domestic Production Prices of Video Cassette Recorders**

*Note:* Degree of dependency on imports = [Imports] / [Domestic production - Exports + Imports].  
The unit production prices were calculated by [Total production cost / Number of units produced]. The unit shipment/import prices were also calculated in a similar manner.

*Source:* Prepared by the Development Bank of Japan from publications of JEITA

Although declines in wholesale price indices (unit prices) do not directly squeeze manufacturers' margins as long as they are due to reductions in production costs achieved by shifting production bases to other countries or through other efforts by manufacturers, the declines in unit prices mentioned above are largely due to the recent shift from selling products mainly through manufacturers' affiliated distributors to sales through mass merchandisers.<sup>8</sup> This has usurped the manufacturers' power to determine selling prices (as seen in the recent increase in the use of "open price" for home appliances instead of "manufacturer's recommended retail price" or "standard retail price")<sup>9</sup> and thus accelerated declines in unit

prices.

From the above analysis, excessive discount competition among Japanese electrical equipment manufacturers for market share may have been a major cause of the recent declines in unit prices and thus the recent declines in the profitability of Japanese electrical equipment manufacturers in the home appliances segment. Japanese manufacturers, which have a strong tendency to follow each other's moves, have reduced their own profitability by competing with each other for a bigger piece of the pie. This emerging industry structure makes it very difficult for Japanese general electrical equipment manufacturers to enjoy good profits in the home appliances segment. Furthermore, the emergence of home appliances manufacturers from other countries including China, which has curbed the expansion of market share by Japanese general electrical equipment manufacturers, as well as Japanese general electrical equipment manufacturers' recent losses in profitability in other segments such as the semiconductor segment, have further reduced profitability.

<sup>8</sup> According to "Home Appliances Distribution Data Pandect" (Ricks Inc.) and other data.

<sup>9</sup> Although declines in retail prices do not necessarily directly cause declines in wholesale prices, the total profits of the manufacturers (including their affiliated distributors (local home appliances stores)) have decreased or have not increased as they should have because of the recent increase in mass merchandisers' share of total number of products shipped.

In the future, new segments, including the digital (information) home appliances segment, are likely to grow significantly as the user bases for products in such segments expand, but in view of the recent declines in the unit selling prices of DVD players, which are hit products in this segment at present, the increase in ownership rates for digital home appliances will not directly translate into improved profitability in the near future. Without strong competitors from other industries or countries as in the past, Japanese electrical equipment manufacturers could have entered new segments or launched new products following each other, competed with each other for larger market share, and still managed to secure profits. However, they must now recognize the fact that increasing digitalization makes it difficult for them to differentiate their products in terms of quality or functions, and that they are no longer able to compete easily with emerging manufacturers in price (costs). These conditions were absent during the period when Japanese electrical equipment manufacturers had a competitive edge over companies from other countries or industries and maintained large shares of the market for video cassette recorders (which are analog products) where they had a head-start over companies from other countries and industries. The major challenges to be addressed by Japanese electrical equipment manufacturers are 1) formulating better patent and technology policies, 2) concentrating resources in the segments where they are strong, 3) making proper decisions as to whether and when to withdraw from maturing markets and 4) adding profitable operations and businesses and shedding unprofitable ones through partnerships, etc. with other companies.

### **3. Information and Communications Equipment**

#### **3.1 Ownership Rates and Market Shares**

The typical sub-segments of the information and communications segment of the electrical equipment industry that experienced sharp increases in ownership rate in the late 1990s are the PC and cellular phone sub-segments. Both

PCs (especially notebook PCs) and cellular phones involve high-density technologies for production, and are one of the strongest areas of Japanese electrical equipment manufacturers (which have manufactured most of the “world’s smallest” and “worlds’ lightest” products), but in fact the market shares of the major Japanese electrical equipment manufacturers in the global PC and cellular phone markets decreased during the period between the emergence of PCs and cellular phones and 2001. In the PC and cellular phone sub-segments, the Japanese electrical equipment manufacturers’ success in monopolizing industry standards in the home appliances segment, including the video cassette recorder sub-segment, was not repeated. The superiority of American and European manufacturers in these sub-segments during this period was largely because the mother market user bases for these products in America and Europe expanded faster than those in Japan. As a result, Japanese electrical equipment manufacturers could not significantly improve profitability and the profitability gap with American manufacturers widened.

The fact that Japanese electrical equipment manufacturers, which are considered to excel in production technologies such as high-density technologies, lost or could not increase market share is mainly attributable to the dominance of a few companies over industry standards and the increasing modularization. In the PC sub-segment, for example, important functions and high added value have concentrated in Microsoft’s OS products and Intel’s MPU products<sup>10</sup>, which have become de-facto industry standards. The Japanese electrical equipment manufacturers are good at producing thinner “products” (in terms of size), but have not been able to decisively differentiate their products from those of foreign manufacturers. In addition, Japanese electrical equipment manufacturers have lagged behind American manufacturers in the rate of spread of the Internet and have totally relied on imports from other countries including the United States for software products, which drive the expansion of the user

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<sup>10</sup> MPUs (Micro Processing Units) are integrated circuits that have all the functions of a CPU (Central Processing Unit) in one chip.

1996		2001	
1	Compaq	1	Dell
2	IBM	2	Compaq
3	Apple	3	HP
4	NEC	4	IBM
5	HP	5	NEC
Total number of units shipped in the global PC market (1,000 units)			
71,334		128,932	

**Fig. 2-20 Top 5 Manufacturers in the Global PC Market in 1996 and 2001 by Number of Units Shipped**

*Note:* The numbers include the numbers of PC servers.

*Source:* Gartner Dataquest (February 2002) GJ02230

1996		2001			
Company	Share (%)	Company	Share (%)		
1	Motorola	26.9	1	Nokia	35.0
2	Nokia	20.2	2	Motorola	14.8
3	Ericsson	12.1	3	Siemens	7.4
4	Matsushita	8.0	4	Samsung Electronics	7.1
5	NEC	6.8	5	Ericsson	6.7
Others		26.0	Others		29.0
Total number of units shipped in the global cellular phone market (1,000 units)					
66,539		399,583			

**Fig. 2-21 Top 5 Manufacturers in the Global Cellular Phone Market in 1996 and 2001 by Number of Units Shipped**

*Source:* Gartner Dataquest (March 2002) GJ02231

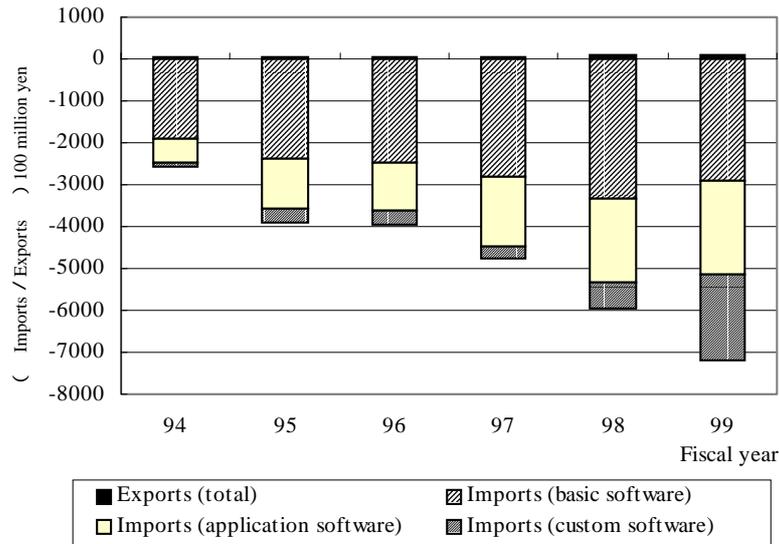
base of PCs, except for game software products.

In the cellular phone sub-segment, the adoption by Japanese home appliances manufacturers, during the transition period from analog to digital, of a transmission method (PDC method) which was not used in major overseas markets resulted in a very low rate of ownership of foreign-made terminals in Japan and conversely a low rate of ownership of Japanese terminals overseas. This occurred due to Japan's unique situation where carriers rather than manufacturers dominate in technological development and market power.

In the future, international differences in transmission methods will probably vanish and Japanese electrical equipment manufacturers will then once again be able to compete equally

with foreign manufacturers as the Japanese manufacturers shift to third-generation transmission methods (W-CDMA, cdma2000). The Japanese manufacturers will therefore need to formulate business strategies that appropriately address the changing business environment.

In the future, international differences in transmission methods will probably vanish and Japanese electrical equipment manufacturers will then once again be able to compete equally with foreign manufacturers as the Japanese manufacturers shift to third-generation transmission methods (W-CDMA, cdma2000). The Japanese manufacturers will therefore need to formulate business strategies that appropriately address the changing business environment.



**Fig. 2-22 Changes in Computer Software Imports and Exports**

*Note:* Game software products are not included.

*Sources:* “Software Foreign Trade Statistics Research” published by the Japan Personal Computer Software Association, Japan Information Technology Services Industry Association and JEITA

### 3.2 Background

As mentioned above, a major reason for the failure of Japanese electrical equipment manufacturers to dominate the information and communications equipment sub-segment in the 1990s in the same way they succeeded in the home appliances segment in the 1980s is the increasing modularization. This point will be discussed in detail in the next chapter.

One recent noteworthy development in the cellular phone sub-segment is that Japanese general electrical equipment manufacturers, which are producing cellular phones under their own brands, are now supplying major components for cellular phones to Nokia in Finland, a competitor that is one of the world’s top manufacturers of cellular phones. This reflects the fact the Japanese general electrical equipment manufacturers have been forced, due to increasing modularization, to secure profits by resorting to component production and a “peaceful coexistence” approach. It also confirms that the production of state-of-the-art cellular phones requires Japanese electrical equipment manufacturers’ high-quality com-

ponents with sophisticated functions, and that these manufacturers are focusing on this sub-segment by taking advantage of the critical importance of their components.

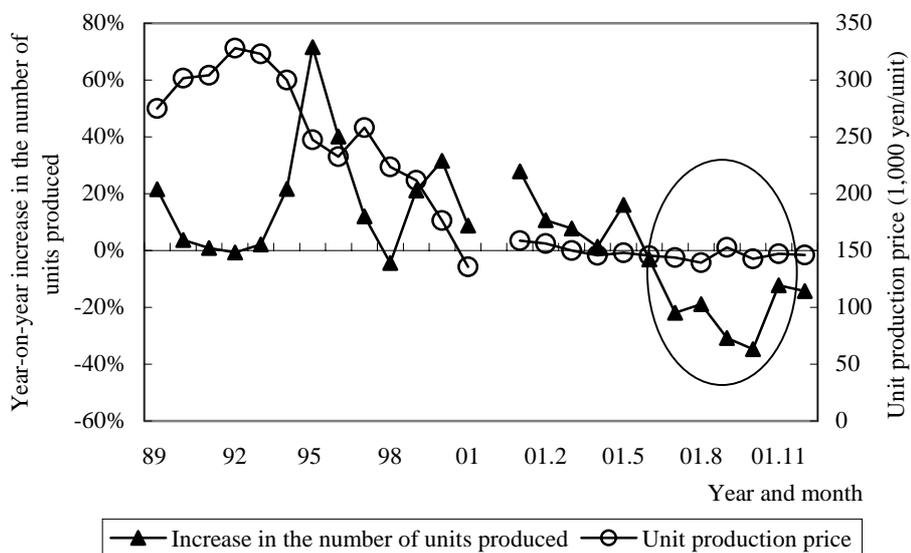
The numbers of domestically produced PCs and cellular phones increased sharply each year until 2000, but have been falling since the second half of 2001 reflecting the IT recession as in the semiconductor segment. In particular, Japanese electrical equipment manufacturers are finding it difficult to make profits in the PC sub-segment partly due to the recent declines in unit production and selling prices. As profits tend to concentrate in a small number of non-final product manufacturers, some final product manufacturers are attempting to use more “open source” software such as Linux<sup>11</sup> on database servers.

In addition, the 2001 settlement figures for American and Japanese manufacturers show that both suffered significant declines in profitability in the communications equipment segment in 2001, as in the semiconductor segment.

<sup>11</sup> A Unix-based operating system (OS) that is available on the Internet, can be freely reproduced and redistributed, and is popular for business servers, etc.

They are now being forced to modify their business models, which worked when production was expanding, to adapt to the current

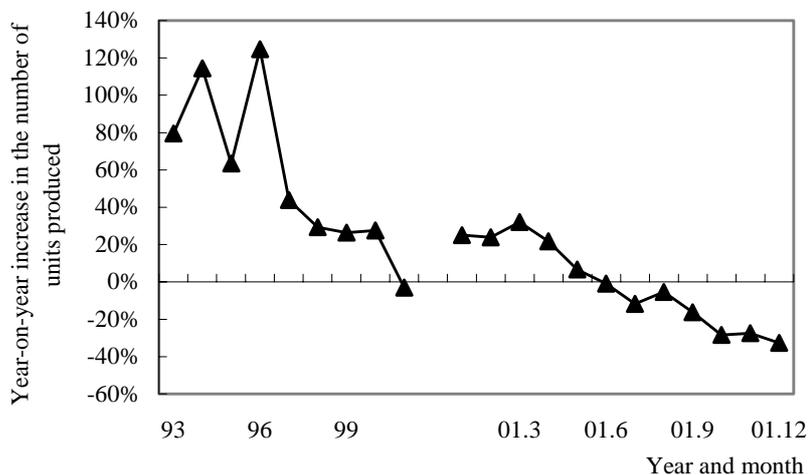
downward trend in production, as seen in recent partnerships among them to increase market shares and reduce development costs.



**Fig. 2-23 Changes in the Production and Average Unit Production Price of PCs**

*Note:* The unit production price was calculated by dividing the total production cost by the total number of units produced.

*Source:* Ministry of Economy, Trade and Industry “Preliminary Report on Machinery Statistics”



**Fig. 2-24 Changes in the Production of Cellular Phones**

*Source:* Ministry of Economy, Trade and Industry “Preliminary Report on Machinery Statistics”

### III Characteristics of the Business Models Being Used by the Major American and Japanese Electrical Equipment Manufacturers

This chapter examines the characteristics of business models being used by the major American and Japanese electrical equipment manufacturers, which may have further widened the profitability gap between American and Japanese electrical equipment manufacturers, as well as the background of the widening of the profitability gap in the 1980s and 1990s.

#### 1. Development and Current Status of the Major American and Japanese Electrical Equipment Manufacturers' Business Areas

A comparison of the main business areas of American and Japanese top sales electrical

equipment manufacturers in 2000 shows that all top Japanese electrical equipment manufacturers by sales are general manufacturers covering a wide range of segments, whereas the top American counterparts are mostly specialized manufacturers although the degree of specialization varies. This means that the distinguishing difference (i.e. "department store" type manufacturers versus "specialized store" type manufacturers) between American and Japanese manufacturers that was observed in the semiconductor segment is also present in the electrical equipment production industry as a whole. Thus from an outsider's perspective, American electrical equipment manufacturers have distinct areas of strength, whereas Japanese electrical equipment manufacturers produce a wide range of products but do not have a particularly strong area.

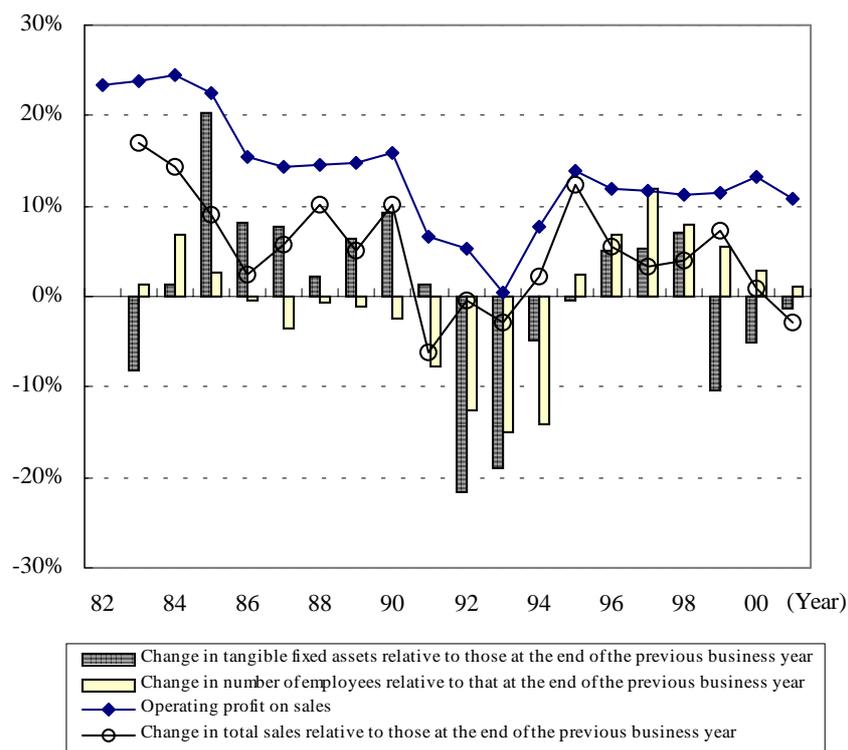
The major American and Japanese electrical equipment manufacturers have developed their portfolios of businesses up to 2000 along

	Hitachi Toshiba Mitsubishi Electric Fujitsu NEC Sony Matsushita Electric Industrial Sharp Sanyo Electric	IBM GE* HP Compaq Motorola Lucent T Nortel N Intel Dell
Electrical home appliances		
Electronic home appliances		
Industrial electronic equipment		
Information equipment (PCs, etc.)		
Communications equipment (cellular phones, etc.)		
Electronic components and devices		
Semiconductors		
Liquid crystals		
Heavy electric apparatus		

**Fig. 3-1 Main Business Areas of Major American and Japanese Electrical Equipment Manufacturers (excluding non-manufacturing segments such as service segments)**

- Notes:*
1. The business areas shown are the major electrical equipment businesses of the companies shown in terms of their shares as a percentage of total sales. Businesses in the non-manufacturing segments such as service segments and non-electrical equipment segments are not included.
  2. Components and devices other than semiconductors and liquid crystals are excluded.
  3. GE has a wide range of production departments other than electrical equipment including industrial equipment, medical equipment, aircraft engines and plastics.

*Sources:* Prepared by the Development Bank of Japan from various publications and data of the companies listed



**Fig. 3-2 Changes in IBM's Sales, etc.**

Source: Standard & Poor's "Compustat"

rather different paths. The major Japanese manufacturers started out producing heavy electric apparatus, information and communications equipment or home appliances and gradually increased their scope of business by adding new areas. But because they did not make any large-scale restructuring or withdrawal from a major market while adding new businesses, their portfolios became similar to one another. This is another reason why Japanese general electrical equipment manufacturers are considered to follow each other.

On the other hand, American manufacturers tend to buy and sell their businesses like commodities, as seen in GE's business restructuring<sup>1</sup> in the 1980s and IBM's shift<sup>2</sup> in the

early 1990s from computer businesses to service businesses. This is a characteristic of American corporate culture.<sup>3</sup> Recent instances of M&A, such as those made by IBM to strengthen their computer service businesses and the acquisition by Intel of a communications equipment-related semiconductor business with high growth potential, also show the typical American approach of strengthening the management base around the core of existing

business year (374,000 people) to the end of the 1994 business year (220,000 people).

<sup>3</sup> This report does not discuss in detail whether the terms "Japanese management practices" and "American corporate culture" can be used in the same meaning as individual companies' management policies and corporate cultures, but it is considered that the differences between the United States and Japan in employment environments, including 1) employment practices (i.e. inter-company mobility is lower and the average duration of employment is longer in Japan) and 2) employer-employee relationships (i.e. the average number of working days lost due to strikes is smaller in Japan), contribute to the differences between American and Japanese companies in management policies and practices.

<sup>1</sup> General Electric sold businesses totaling about 10 billion dollars and acquired businesses totaling about 19 billion dollars in the 1980s. The company has generally withdrawn from those businesses where it does not rank 1st or 2nd in the global market.

<sup>2</sup> The total number of employees of IBM peaked at the end of the 1986 business year at 406,000. The company made large employee cutbacks from the end of the 1991

	Acquisition	Selling
IBM	Infomix, Inc. (database business) (1,000 million dollars, 2001) Sequent Computer Systems, Inc. (837 million dollars, 1999)	Sold the global network business to AT&T (4,991 million dollars, 1999).
Intel	Giga A/S (communications LSI) (1,247 million dollars, 2000) Level 1 Communications (communications LSI) (2,137 million dollars, 1999) DSP Communications, Inc. (communications LSI) (1,599 million dollars, 1999)	
TI	Bullbrown (analog semiconductor technologies) (Equity swap, 2000) TDK's semiconductor subsidiary in the United States (575 million dollars, 1996)	Sold the memory business to Micron (800 million dollars, 1998).
Micron	Considering to acquire Hynics (South Korean company) (2001-) Toshiba's memory business (American Factory, 2001) KMT Semiconductors (subsidiary of Kobe Steel) TI's memory business (800 million dollars, 1998)	
Compaq	Negotiating a merger with HP (2001-)	Sold the semiconductor business of DEC to Intel (585 million dollars, 1998).
HP	Negotiating a merger with Compaq (2001-)	Divested the measuring instruments business, which accounted for 16% of total sales (1999).

**Fig. 3-3 Recent Instances of M&A by American Manufacturers**

*Sources:* Prepared by the Development Bank of Japan from annual reports and web sites of the companies listed

strong businesses. The major American manufacturers have been acquiring new experts, R&D results and R&D know-how through acquisitions of semiconductor venture companies in Silicon Valley. These venture companies have contributed significantly to the R&D of American manufacturers, thus giving rise to the apparent gap between American and Japanese manufacturers in the ratio of R&D expenditure to sales, as mentioned earlier.

The cases of GE and IBM are successful examples of shifts to non-manufacturing businesses. On the other hand, Intel, which withdrew from the DRAM market to focus resources on the MPU business in the mid 1980s and has become the world's top manufacturer in the semiconductor segment, is a typical example of the rebirth of an American manufacturer through selective concentration.

The widespread embracement of M&A and the selective concentration policy of American manufacturers means that they are retaining high-profit businesses only. This is a

major contributing factor to the widening profitability gap with Japanese general electrical equipment manufacturers, which cannot easily undertake drastic restructuring because of the Japanese employment practice of avoiding employee cutbacks wherever possible and as a result, have not shed unprofitable and/or low-profit businesses<sup>4</sup>. In America, certain companies including communications manufacturers expanded rapidly in the 1990s, but some of the former top manufacturers by sales have disappeared from the rankings. In Japan, on the other hand, there was virtually no change to the list of top manufacturers by sales throughout the 1980s and 1990s, which means that the industry is structurally stable but there are very limited opportunities for emerging companies to enter the market, in marked contrast to the situation in America.

<sup>4</sup> The American manufacturers' recovery in profitability has been criticized as "a recovery at the expense of employment."

## 2. Impacts of Increasing Modularization and Outsourcing

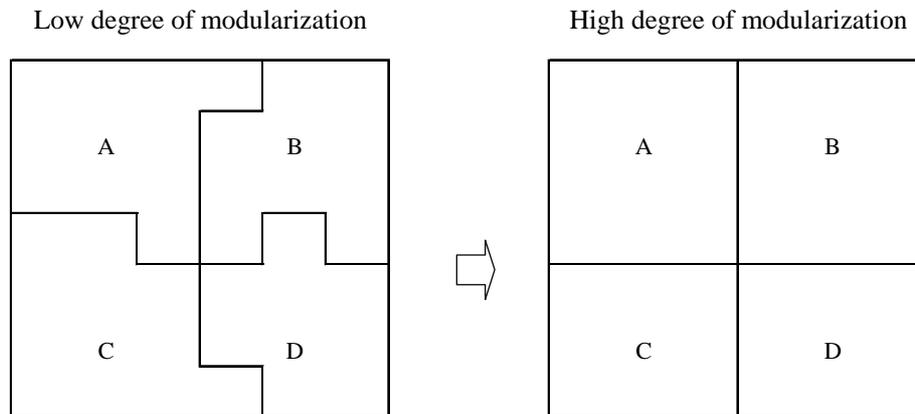
As mentioned above, whereas Japanese general electrical equipment manufacturers pursued expansion, their American counterparts pursued specialization-oriented business models and racked up high profits in the 1990s. The Japanese manufacturers were more profitable than they are now and increased their market shares in such segments as semiconductors and audio-visual home appliances and successfully developed various new products such as CD players up to the 1980s, but the declines and/or near-zero growth in their profits and market shares in the 1990s suggest that the expansionary business model gradually lost its superiority. To clarify this change, it is necessary to understand the impacts of the recent progress of modularization and the associated increased awareness of the importance of the “smile curve.”

In this report, the term “modularization” refers to unification and standardization of standards for components and component groups (modules) that comprise electrical equipment. The trend toward increased modularization began when IBM started promoting unification of standards for modules to ensure compatibility between computers. Modularization is beneficial in

that it facilitates design, fabrication and assembly by dividing a complex device containing many components into a number of components which are independent of each other. In the case of PCs, for example, development, design, fabrication and assembly are made easier by unifying the standards for individual modules such as CPUs (MPU), memories, disk drives, keyboards and displays. That is, modularization allows more efficient new product development centered around core module development and enables anyone with the design drawing to procure the necessary modules and components and fabricate or assemble the equipment. Highly modularizing a final product makes fabrication and assembly technologies much less important, because the quality and performance of the product are largely determined by those of the constituent modules.

The acceleration of modularization in the 1990s is partly attributable to the acceleration of the digitalization of electronic equipment during the same period.

Standardization of modules (i.e. unification of standards) for digital electronic equipment (such as CD players and DVD players) was easier than that for analog electronic equipment (such as record players and video cassette recorders<sup>5</sup>) because digital electronic equipment is more uniform in quality, require fewer components than analog electronic equipment

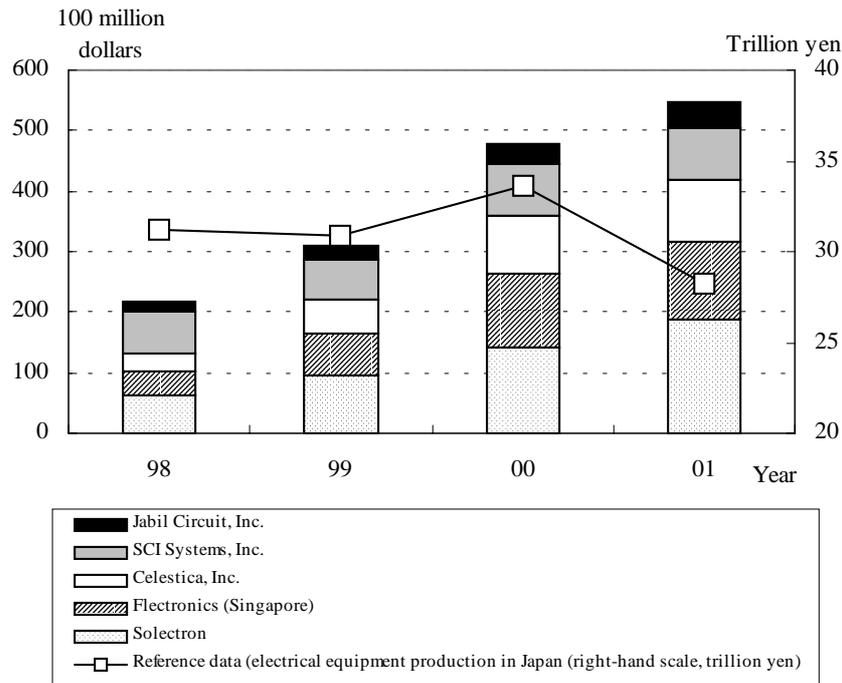


**Fig. 3-4 Conceptual Diagram of Modularization**

*Note:* Changes to the design of each of modules A to D are more likely to affect the designs of the other modules when the degree of modularization is low, and less likely to affect the designs of the other modules when the degree of modularization is high.

*Source:* Prepared by the Development Bank of Japan

<sup>5</sup> In this report, tape-based video cassette recorders are classified as analog equipment.



**Fig. 3-5 Changes in Sales of Major EMSs**

*Note:* Many companies including IBM, Dell, Compaq and Nokia are outsourcing work to EMSs.

*Sources:* Annual reports of the companies listed and publications of JEMA and JEITA

ponents than analog electronic equipment and use components that are more versatile than those for analog electronic equipment.

A high degree of modularization makes cost competition strategically more important than technological competition for management (for example, as a means of increasing market share) because it reduces the technological gap in terms of fabrication and assembly, and makes it easier for emerging manufacturers to enter the market.

Cost reduction entails a shift in production from doing everything in-house to utilizing outside sources, including the outsourcing of fabrication and assembly processes, the division of work between EMSs and fabless manufacturers based on a clear definition of roles, the shifting of production bases to countries where labor costs are lower, and optimization of component procurement (the shifting from “procurement from group companies and affiliated companies” to “procurement from outside sources”).

In the case of PCs, the concentration of important functions and high added value in Microsoft’s basic OS products and Intel’s MPU products reduced the added value of the components and fabrication and assembly processes other than these key devices and this increased outsourcing (division of work based on a clear definition of roles) in the industry to reduce costs. In the outsourcing of work to EMSs by IBM, etc. that was accompanied by the selling of full factories to the former<sup>6</sup>, the efficiency and advantages of outsourcing were enhanced by transferring fabrication and assembly know-how to the EMSs. As outsourcing accel-

<sup>6</sup> IBM sold the entire facilities of its North Carolina and Bordeaux factories to Solectron in 1992. This model has been the mainstream approach to date in production outsourcing to EMSs by final product manufacturers. Some investment banks are acting as intermediaries by holding factories sold by final product manufacturers and leasing them to EMSs, and this has been encouraging final product manufacturers and EMSs to enter into factory sale contracts.

erated and EMSs expanded, final product manufacturers gradually shifted their focus to high added value areas such as design, development and services.<sup>7</sup>

As mentioned above, the recent rapid expansion of the user bases for digital equipment, which reduced the quality differences among products, is another factor behind the shift from quality competition to cost competition. In the case of video cassette recorders, which were originally analog equipment, Japanese general electrical equipment manufacturers dominated the market and then gradually moved production bases to other countries, but in the case of DVD players, which originated as digital equipment, production bases were moved to other countries at an early stage. This difference is attributable to the progress of digitalization and modularization that made it easier to fabricate and assemble the products while making it more important to reduce the assembly cost (to reduce the selling price) as a means of differentiating products.

The recent progress of digitalization and modularization gradually made outsourcing the production processes more advantageous for production efficiency than doing everything in-house, enabling the specialized American manufacturers to overtake Japanese general electrical equipment manufacturers in profitability and market share.

### **3. Increasing Awareness of the Importance of the “Smile Curve”**

The semiconductor segment also experienced shifts in business models, including increased use of outsourcing, as the vast capital spending on facilities and R&D expenditure continued to soar and production know-how was gradually transferred from semiconductor manufacturers to equipment manufacturers. In the markets for multi-purpose products that had become commodities such as DRAMs, the emphasis shifted from technology to cost reduction. In the

multi-purpose DRAM market, for example, specialized DRAM manufacturers offering low-cost products such as Samsung Electronics (South Korea) and Micron Technologies (United States) increased their market shares while Japanese general electrical equipment manufacturers, which had once forced American manufacturers out of the market, gradually lost market share (in fact, some of them withdrew from the market in the late 1990s).<sup>8</sup> The 1990s also saw the emergence and widespread embracement of a new business model based on the separation of design and production whereby fabless manufacturers pursue product development and foundry manufacturers pursue production cost reduction. The separation of design and production that was started by and spread among American fabless semiconductor manufacturers and Taiwanese foundry manufacturers has now been adopted by major semiconductor manufacturers. The declines in the competitiveness of Japanese general electrical equipment manufacturers in product development as well as cost competitiveness in the markets for multi-purpose products, which account for a large proportion of the overall semiconductor market, occurred because they were slow to review their business models and adapt to the changing environment in the semiconductor business.

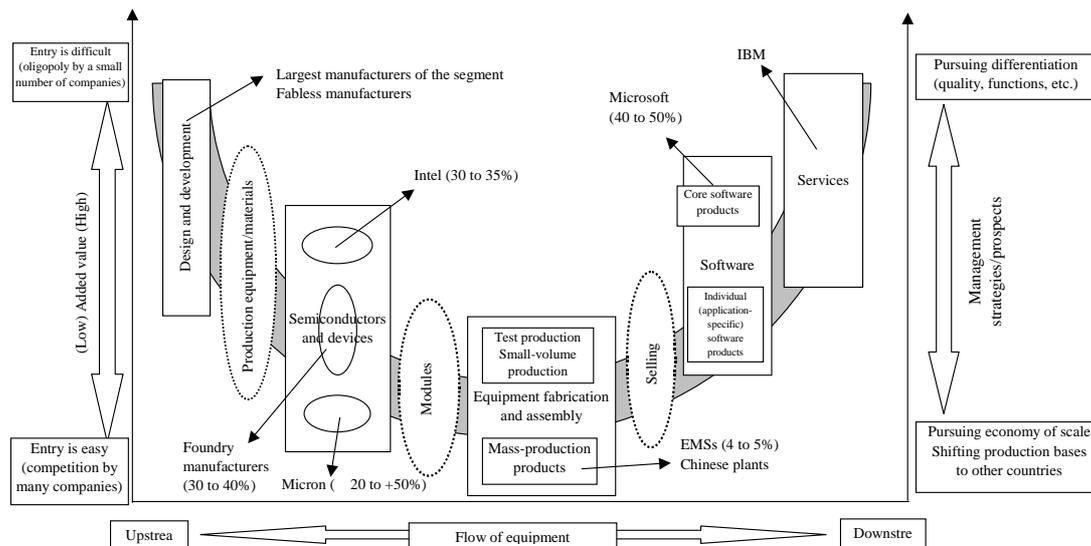
The increasing use of outsourcing explained above has led to increased awareness of the importance of the so-called “smile curve” that defines the relationship between the supply chain and added value, and nowadays Japanese general electrical equipment manufacturers are also taking the smile curve into consideration in restructuring their operations and businesses.

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<sup>7</sup> The increasing modularization is attracting attention from researchers as a phenomenon that has been strongly affecting not only manufacturers’ ways of doing business but also their organizational structures (e.g. by increasing modularization of organizations).

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<sup>8</sup> Oki Electric Industry has withdrawn from the market for multi-purpose DRAMs for PCs. Fujitsu has been shifting entirely from multi-purpose DRAMs to flash memories since April 2000, and Toshiba decided in December 2001 to withdraw from the DRAM market.



**Fig. 3-6 Modularization and the Smile Curve**

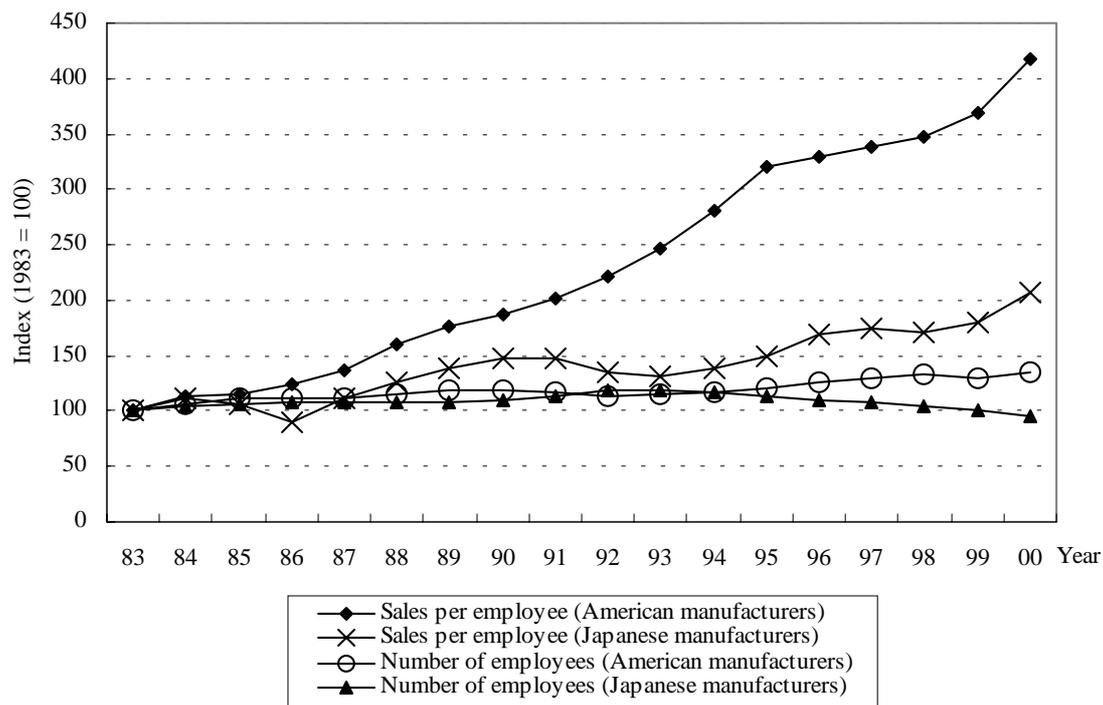
*Note:* The company names are used only as examples. The bracketed figures are the (approximate) average operating profit on sales over the past 4 to 5 years.

*Sources:* Prepared by the Development Bank of Japan from various materials and publications

Figure 3-7 compares major American manufacturers and major Japanese general electrical equipment manufacturers in terms of the time series changes in sales per employee. The sales per employee (index) of American manufacturers has been increasing faster than that of Japanese general electrical equipment manufacturers, which means that American manufacturers enjoy higher labor productivity than their Japanese counterparts. The gap with Japanese manufacturers started widening in the early 1990s, which is attributable to the Americans' adoption of business models based on selective concentration and utilization of outsourcing that enabled them to adapt to the progress of modularization.

This chapter examined 1) the differences between American and Japanese electrical

Equipment manufacturers in terms of the business models used, and 2) the increasing modularization and digitization in recent years, which have greatly contributed to the widening of the profitability gap between American and Japanese electrical equipment manufacturers. Although these two factors alone do not fully account for it, they are strongly correlated with the widening of the profitability gap. Japanese electrical equipment manufacturers have been actively restructuring their operations and businesses since 2001 not only in response to the sharp declines in profitability in 2001 but also in recognition of the importance of the above-mentioned developments that contributed to the widening of the profitability gap between American and Japanese electrical equipment manufacturers in the 1990s.



**Fig. 3-7 Comparison of Time Series Changes in Sales per Employee of Major American and Japanese Electrical Equipment Manufacturers**

- Notes:*
1. The figures for American manufacturers are the averages of the 12 companies that have been publishing their financial data (consolidated basis) since before 1982.
  2. The figures for Japanese manufacturers are the averages of 17 major companies (individual basis).

*Sources:* Development Bank of Japan "Financial Data Bank"; Standard & Poor's "Compustat"

## IV General Electrical Equipment Manufacturers' Restructuring of Operations and Future Prospects

The analyses in the preceding chapters confirmed that 1) the profitability of Japanese electrical equipment manufacturers is lower than that of their American counterparts, 2) the semiconductor and home appliances businesses of Japanese electrical equipment manufacturers are dragging down their profitability structurally and over the time series, respectively and 3) the different business models of American and Japanese electrical equipment manufacturers as well as the quicker response by American manufacturers to important developments including the increasing modularization contributed significantly to the widening of the profitability gap between American and Japanese manufacturers in the 1990s. Against this background, this chapter identifies the objectives of restructuring currently being undertaken by Japanese general electrical equipment manufacturers and discusses the expected improvements.

### 1. Recent Instances of Restructuring

The Japanese general electrical equipment manufacturers were constantly restructuring their operations even before 2001. Their restructuring efforts in the past were mostly expansion-oriented such as entering new electrical equipment segments, upstream electronic component/device/material segments and downstream software and service segments, but their emphasis has been gradually shifting to consider the importance of management efficiency. In particular, there was a surge of seemingly negative restructuring efforts such as withdrawals from markets and closure of factories in 2001 when sales slumped as the IT recession took hold.

In terms of type of restructuring, employee cutbacks is the most common type among Japanese general electrical equipment manufacturers. The purpose of these cutbacks, many of which were started in 2001, is to reduce fixed costs of administrative divisions and pro-

duction costs. In addition, although these employee cutbacks were large-scale and intended to be completed quickly, Japanese general electrical equipment manufacturers have been trying to accelerate and expand them, such as by expanding the scale of cutbacks before the planned end of cutbacks and starting cutbacks earlier than planned.

There have also been many instances of reorganization of operations and withdrawals from markets (segments) due to declines in demand and worsening of the business climate. In the semiconductor segment, in particular, Japanese general electrical equipment manufacturers have been undertaking large-scale restructuring such as withdrawal from markets and closure of factories in multi-purpose memory sub-segments (such as DRAM) and integration of production processes and facilities. These restructuring efforts show that Japanese general electrical equipment manufacturers are formally embracing the approach of shedding money-losing businesses and concentrating resources on profitable areas and businesses with high growth potential (selective concentration approach). It is becoming increasingly difficult to pursue the traditional approaches of expansion by adding new business areas and covering the full product range.

Japanese general electrical equipment manufacturers are also increasingly selling factories to EMSs and outsourcing the production processes of the factories to them. The first Japanese manufacturer to do this was Mitsubishi Electric, which sold its cellular phone production factory in Georgia (United States) to Solectron in 1998, but since 2001 there have been several instances of this even in Japan. These are positive efforts to modify the business model to utilize outsourcing in response to the increasing modularization and digitization. Although in the past many Japanese general electrical equipment manufacturers outsourced production through an OEM arrangement, the selling of factories to EMSs shows that they now formally accept outsourcing.

Type of restructuring		Companies that acted	Background/objective(s)
Employee cutbacks (announced in and after 2001)	Mitsubishi Electric (semiconductor segment, 2,000 people cut by 2002), Toshiba (18,800 cut in total for Toshiba Group), Matsushita Electric Industrial (8,000 cut in total for domestic Matsushita Group), Hitachi (15,900 cut in total for Hitachi Group), Oki Electric Industry (2,200 cut by 2004), NEC (semiconductor segment, 4,000), Fujitsu (16,400 cut in total for domestic and overseas companies, factories, divisions)		Fixed/production cost reduction
Reorganization of operations	Withdrawals	Fujitsu (DRAM), Toshiba (DRAM), Hitachi (components/devices for PCs and CRTs)	Deficit reduction, concentration of corporate resources in high-growth business areas, strengthening of operations in strong areas (those where the company has a leading market share), production efficiency improvement, timely adaptation to changes in market environments
	Transfers	Fujitsu (color laser printers), NEC (sale of a printer factory), Oki Electric Industry (photomask production)	
	Factory closures	Matsushita Electric Industrial (cellular phone factory in the U.K.), Hitachi (home appliances factory in Singapore), NEC (hard-disk factory in the Philippines), Fujitsu (flash memory factory in the United States), Mitsubishi Electric (cellular phone factory in France), etc.	
	Integration of semiconductor production processes/facilities	Mitsubishi Electric, Fujitsu, Hitachi, NEC, Toshiba	
Outsourcing	Production outsourcing to EMS (Solec-tron, etc.) with sale of factory	Mitsubishi Electric (cellular phones), Sony (vehicle-mounted audio-visual equipment, etc.), NEC (servers), etc.	Fixed/production cost reduction
Organizational reforms	Introduction of company-in-company systems, executive officer systems, etc.	Sony, NEC, Oki Electric Industry, Sanyo Electric, Hitachi (transformation of divisions into virtual companies-in-company), Fujitsu, etc.	To speed up the decision-making process, to clarify executive responsibilities
	Reorganization of subsidiaries	Matsushita Electric Industrial (domestic listed subsidiaries), Mitsubishi Electric (American subsidiaries), Fujitsu (network service-related subsidiaries), Sony (semiconductor production subsidiaries), NEC (software development subsidiaries, divestiture of the semiconductor division), Hitachi (divestiture of the display division), etc.	To improve management efficiency by eliminating redundant operations, to speed up the decision-making process
	Divestiture of production divisions and entries into the EMS market	Sony (Sony EMSC), Matsushita Electric Industrial (Factory Center), NEC (DMS), Oki Electric Industry (reinforcement of EMS businesses), etc.	To increase business opportunities, to promote profitability awareness
Shifting of manufacturing and other activities to other countries	Shifting of production bases to other countries	All major Japanese general electrical equipment manufacturers → [4-2, 4-3]	Market expansion, production cost reduction
	Recruiting of SEs in other countries, deployment of software development bases in China, reinforcement of service divisions	NEC, Fujitsu, Hitachi, Oki Electric Industry, etc. "Reinforcement of solution businesses", etc.	To improve added value profitability, to strengthen software development capability (especially in weak areas)
Integration	Business partnerships	All major Japanese general electrical equipment manufacturers → [4-5]	To address increases in the numbers of competitors, to minimize increases in R&D expenditure

**Fig. 4-1 Recent Instances of Restructuring Efforts by Major Japanese General Electrical Equipment Manufacturers**

Sources: Prepared by the Development Bank of Japan from publications, etc. of the companies listed and interviews

In the semiconductor segment, too, some companies are moving away from the traditional approach of doing everything in-house and instead actively utilizing foundry manufacturers.

Some Japanese general electrical equipment manufacturers are introducing company-in-company systems to speed up the decision-making process, as well as executive officer systems to clarify business responsibilities. These are crucial tasks for Japanese general electrical equipment manufacturers to enable them to adapt to fluctuations in their markets such as sharp fluctuations in the DRAM market as well as dramatic changes in the business climate. Some of the major Japanese general trading companies have also adopted these approaches, but whether the attempts by Japanese general electrical equipment manufacturers, which are designed to address problems inherent in general manufacturers covering broad business areas and in large companies, are effective remains to be seen.

On the other hand, some Japanese general electrical equipment manufacturers are integrating or reorganizing subsidiaries rather than divesting or spinning-off subsidiaries (by introducing a company-in-company system, for example), to improve the efficiency of the group as a whole and speed up the decision-making process. Thus, Japanese general electrical equipment manufacturers are now searching for the right combination of company scale and degree of delegation of authority to maximize management efficiency and decision-making speed.

Some Japanese general electrical equipment manufacturers are selling their factories to EMSs and attempting to enter the EMS market themselves to boost profits by utilizing their advanced production technologies and know-how more fully, by manufacturing products for other companies on a contract basis. However, many questions remain to be answered, such as

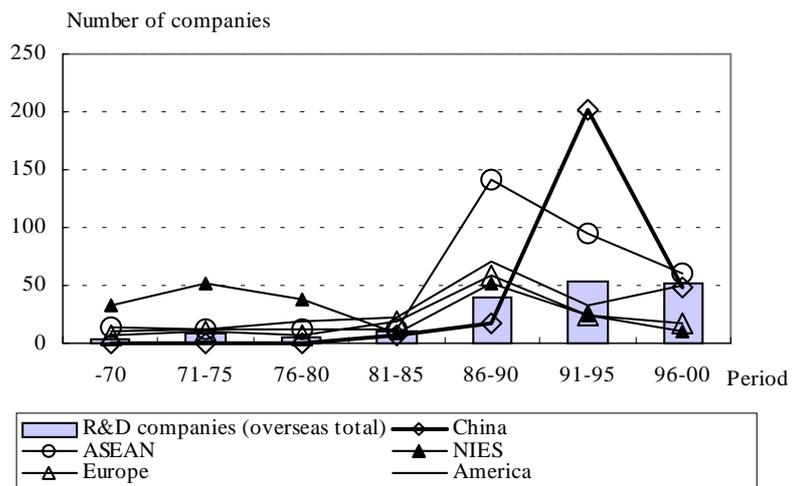
whether there is a lack of production facilities in Japan in the first place, whether their domestic plants with high production and labor costs can compete with the incumbent EMSs, and whether they can win orders from other companies in a country where most companies are still reluctant to outsource work to companies outside their groups, even though such moves will improve the efficiency of production divisions by making them organizationally more independent and thus more conscious of profitability. These moves reflect their recognition of the effectiveness of American manufacturers' business models.

## **2. Shifting of Production Activities, etc. to Other Countries**

In the process of expanding their overseas sales, Japanese general electrical equipment manufacturers have used the following main approaches:

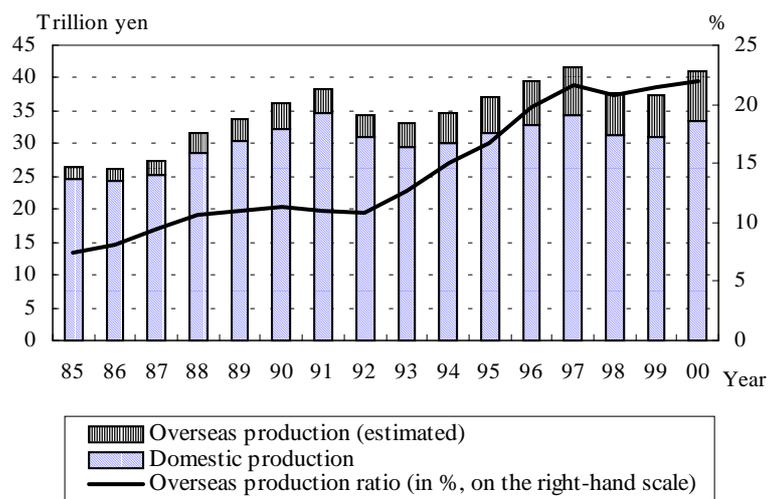
- (1) Exporting domestically manufactured products;
- (2) Manufacturing and selling products in the consumer country;
- (3) Manufacturing products in a country with lower production costs and exporting the products to a third country or importing them back to Japan.

Figure 4-2 shows, by area, the time series changes in the number of overseas production companies established by Japanese general electrical equipment manufacturers. In the 1970s, the share of the overseas production companies established in NIES countries as a percentage of the total was largest while in the late 1980s, the number of overseas production companies increased sharply, especially in ASEAN countries, as the appreciation of the yen accelerated. In the early 1990s, on the other hand, the number of overseas production companies in China increased dramatically.



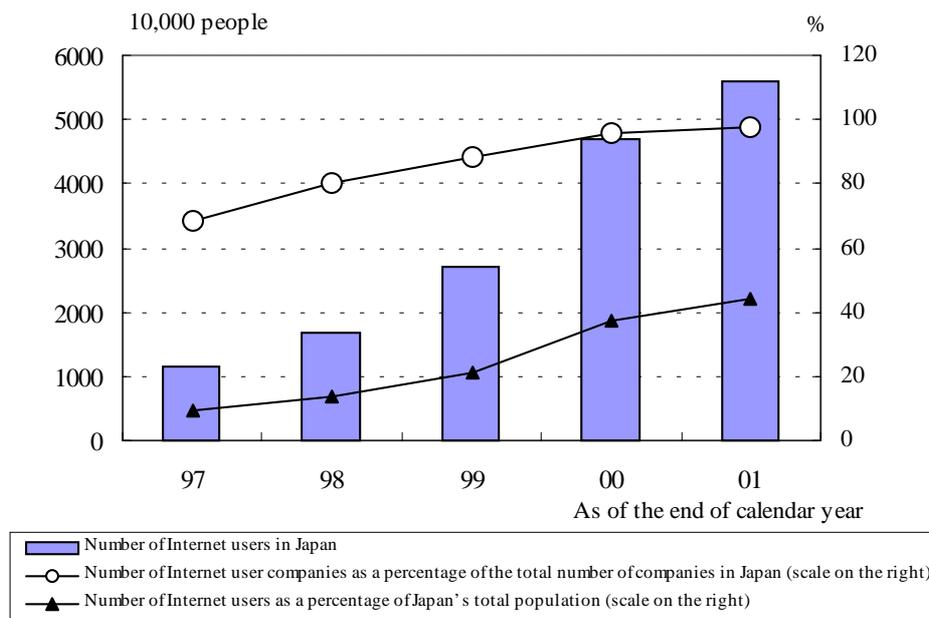
**Fig. 4-2 Changes in the Number of Overseas Production Companies Established by Japanese General Electrical Equipment Manufacturers by Area**

*Source:* Prepared by the Development Bank of Japan from the “Overseas Subsidiaries of Japanese Companies 2000” published by Electronic Industries Association of Japan (presently JEITA)



**Fig. 4-3 Changes in the Electrical Equipment Industry’s Domestic Production vs. Overseas Production**

*Note:* The overseas production was estimated by the Development Bank of Japan from the “Overseas Business Basic Research” published by the Ministry of Economy, Trade and Industry.  
*Sources:* Ministry of Economy, Trade and Industry “Preliminary Report on Machinery Statistics” and publications of JEMA and JEITA



**Fig. 4-4 Changes in the Number of Internet Users**

Source: Ministry of Economy, Trade and Industry “Communications Usage Trend Survey”

As the number of overseas production companies of Japanese general electrical equipment manufacturers increased, their overseas production ratio increased steadily.<sup>1</sup> In 2001, however, Japanese manufacturers closed many of their overseas plants or liquidated overseas production companies, as they shifted from the traditional expansionary approach to a focused approach that emphasizes efficiency.

There were also sharp increases in the number of overseas R&D companies established by Japanese general electrical equipment manufacturers during the 1986-2000 period in line with the sharp increases in the number of their overseas production bases. These overseas R&D companies were mainly set up to develop products and services that met the needs of the local markets and to reduce R&D costs. In re-

cent years, many companies are setting up software development bases in China, which is attractive not only because of the low costs but also because of the high skill levels of Chinese workers and engineers.

Japanese general electrical equipment manufacturers are also strengthening their software and service businesses. This trend is attributable to 1) the increasing profit opportunities as demand for after-sales service grows alongside the expansion of PC and Internet user bases, 2) the recent declines in profitability in all production segments except the “key device” segments and 3) the increasing awareness, among both users and suppliers, of the value of software and services that have traditionally been built into the selling prices of hardware products. Although many Japanese general electrical equipment manufacturers have already launched audio-visual software content provider businesses and Internet service provider businesses, the growing number of Internet users, the increasing diversification in uses of the Internet, the potential growth of the Internet, as well as the expectation that demand

<sup>1</sup> A high overseas production ratio may reduce that country's domestic employment and opportunities for adding value (i.e. deindustrialization). The overseas production ratios for the manufacturing industries of the United States and Germany (27.7% (1997) and 32.1% (1997), respectively) are higher than the 13.4% (FY 2000) for the manufacturing industries of Japan.

for outsourcing will continue to increase as information equipment becomes more complex, thus increasing operation and maintenance work (in companies, for example), have been encouraging Japanese general electrical equipment manufacturers to focus on service businesses.

In addition, the success of IBM in shifting to service businesses in the United States has also affected the business strategies of Japanese general electrical equipment manufacturers. The development of “solution businesses,” which provide everything from hardware to services as a package, to maintain and increase hardware market shares and make up for the shrinking added value (profitability) in hardware businesses, has now become a key task for Japanese general electrical equipment manufacturers.

### **3. Increasing Business Partnerships**

One of the restructuring modes increasingly being used by Japanese general electrical equip-

ment manufacturers is business partnerships among themselves or with manufacturers in other countries. Although Japanese manufacturers have been using business partnerships for many years in the form of collaborative R&D, technology transfers, mutual supply agreements, etc., the integration of the DRAM businesses of NEC and Hitachi in 1999 was the first of the recent attempts to strengthen, through integration, existing main businesses which have been losing competitiveness, profitability, market share, etc. Various partnerships are being formed in many segments including semiconductors, but the analysis that follows only covers those in the important areas of:

- home appliances
- information and communications equipment
- semiconductors and other electronic components and devices

Home appliances			Information and communications equipment			Semiconductors and electronic components/devices		
Partner(s)	Description of partnership		Partner(s)	Description of partnership		Partner(s)	Description of partnership	
Hitachi	<b>BHS Bosch &amp; Siemens (Germany)</b>	Electric washers, etc. (joint venture)	<b>IBM (United States)</b> <b>IBM (United States)</b>	Collaborative development of servers Integration of hard-disk businesses (joint venture)	NEC Fujitsu <b>ST Microelectronics (Italy, France)</b> Mitsubishi Electric	DRAMs (joint venture) PDP (joint venture) Development of Super H (Microcomputer) System LSIs (integration of businesses)		
	Matsushita Electric Industrial	Refrigerators, electric washers, vacuum cleaners, air-conditioners, etc. (development, environmental obligation-related activities, etc.)						
Toshiba	<b>Carrier (United States)</b> <b>Electrolux (Sweden)</b> <b>Midea Group (China)</b>	Air conditioners (joint venture) Refrigerators, electric washers, vacuum cleaners, air-conditioners, etc. (development, mutual supply of products) Refrigerators (technological exchanges, mutual sale)	<b>Siemens (Germany)</b> Mitsubishi Electric	Collaborative development of 3G cellular phone terminals Collaborative development of 3G cellular phone terminals	<b>IBM (United States), Sony</b> Matsushita Electric Industrial <b>[Dissolved] IBM (United States)</b> Fujitsu	Collaborative development of semiconductors Liquid crystals (joint venture), CRTs Liquid crystals Development of system LSIs		
Mitsubishi Electric			Sharp Development of system LSIs Toshiba	Collaborative development of PDAs for European markets Collaborative development of 3G cellular phone terminals	Matsushita Electric Industrial Toppan Printing <b>Chunghwa Picture Tubes (Taiwan)</b> Hitachi	Development of system LSIs Semiconductor photomasks Collaborative development of PDP System LSIs (integration of businesses)		
NEC			<b>Packard Bell (United States)</b> Matsushita Electric Industrial	PCs (subsidiarization) Collaborative development of software programs for cellular phones	Hitachi <b>Samsung SD (South Korea)</b> <b>SVA Electron (China)</b> Toppan Printing	DRAMs (joint venture) Organic EL (joint venture) TFT liquid crystals (joint venture) Circuit substrates (joint venture)		
Fujitsu			<b>Siemens (Germany)</b> <b>Alcatel (France)</b> <b>IBM (United States, under negotiation)</b>	PCs (joint venture) Cellular phone base stations (collaborative development) Collaborative development of computer software programs	<b>AMD (United States)</b> Hitachi <b>Amkor Technology (United States)</b> Toshiba	Flash memories (joint venture) PDP (joint venture) Semiconductor post-processes Development of system LSIs		
Oki Electric Industry			Fujitsu	Development of mobile communication systems (joint venture)	Casio <b>GSMC (China)</b> Hoya	Collaborative development of LSI packages Semiconductors (technology transfer, production outsourcing) Semiconductor photomasks (outsourcing)		
Matsushita Electric Industrial	Hitachi Daikin Industries <b>TCL Group (China)</b>	Refrigerators, electric washers, vacuum cleaners, air-conditioners, etc. (development, environmental obligation-related activities, etc.) Air conditioners (development, etc.) Home appliances (development, marketing)	NEC	Collaborative development of software programs for cellular phones	Mitsubishi Electric <b>Thomson Multimedia (France)</b> Toshiba	Development of system LSIs CRTs (mutual supply) Liquid crystals (joint venture), CRTs		
Sharp	Sanyo Electric Pioneer	Refrigerators, electric washers, vacuum Audio-visual equipment (collaborative			<b>Quanta (Taiwan)</b> Tohoku Pioneer, etc.	Liquid crystals (OEM procurement) Organic EL (joint venture)		
Sony			<b>Ericsson (Sweden)</b>	Integration of cellular phone businesses (joint venture)	<b>IBM (United States), Toshiba</b> Toyota Industries	Collaborative development of semiconductors LCD panels (joint venture)		
Sanyo Electric	<b>Maytag (United States)</b> Sharp <b>Haier Group (China)</b>	Refrigerators, electric washers, vacuum cleaners, air-conditioners, etc. (development, mutual supply) Refrigerators, electric washers, vacuum cleaners, air-conditioners, etc. (development, mutual OEM supply) Home appliance marketing, technology transfer, etc.	<b>Kodak (United States)</b>	Digital cameras (comprehensive partnership)	<b>Kodak (United States)</b> <b>Samsung G (South Korea)</b>	Organic EL (joint venture) Fuel cells (technological cooperation)		
(Reference information) Partnerships formed outside Japan			Compaq (United States) – HP (United States)	PCs	Micron (United States) – Hynics (South Korea) (Under negotiation)	DRAMs		

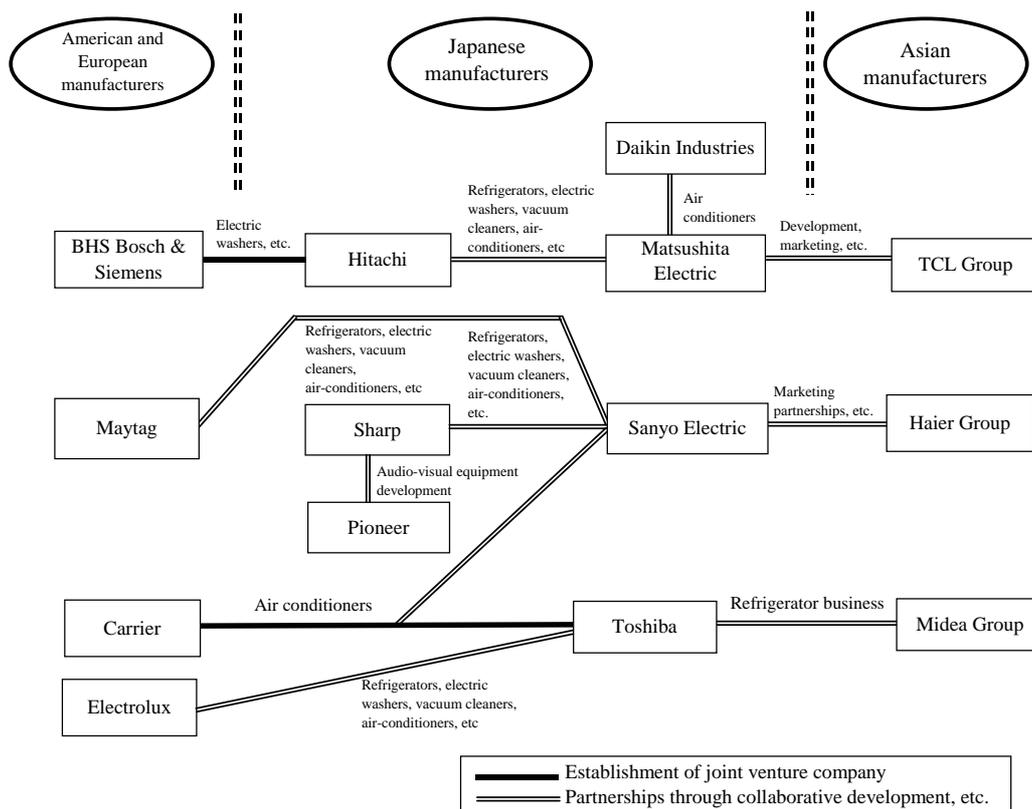
**Fig. 4-5 Partnerships between Major Electrical Equipment Manufacturers (joint ventures, collaborative development, etc.)**

*Note:* The companies shown in bold letters are non-Japanese companies.

*Sources:* Prepared by the Development Bank of Japan from various publications

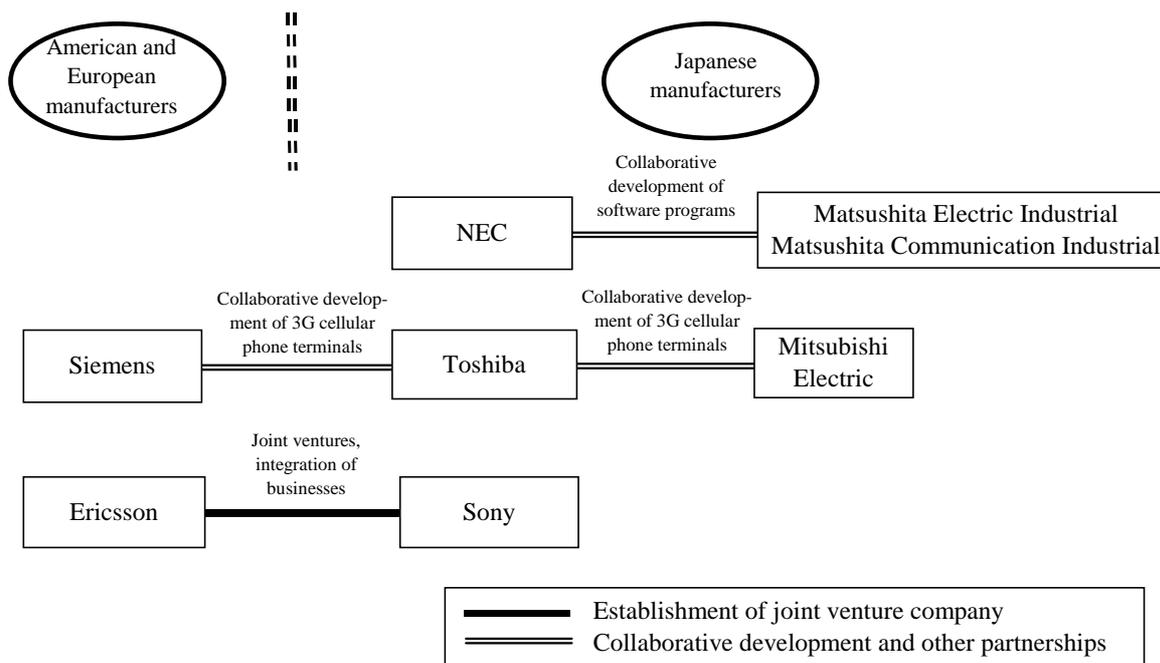
In the home appliances segment, Japanese electrical equipment manufacturers have recently started forming partnerships among themselves in the maturing domestic markets, in order to strengthen their recycling and environmental obligation-related activities to comply with regulations including the newly-introduced Home Appliances Recycling Law (that took effect in April 2001), strengthen divisions and departments responsible for developing IT home appliances for which demand is expected to increase, and avoid excessive competition in domestic markets. Japanese electrical equipment manufacturers have also started forming partnerships with local manufacturers in China, reflecting Japanese electrical equipment manufacturers' strategy of maintaining and increasing market share by taking advantage of the sales channels and cost competitiveness of Chinese manufacturers, which have been increasing their selling power in mainland China as well as in Asian countries.

In the information and communications equipment segment, Japanese electrical equipment manufacturers are forming partnerships with American and European manufacturers as well as among themselves. Meanwhile, the PC sub-segment is characterized by concentration of profits in a small number of non-final product manufacturers that dominate competitors over industry standards such as Intel and Microsoft, partnerships aimed at strengthening market dominance such as the merger of HP (United States), which is one of largest manufacturers in the world, and Compaq (United States), as well as partnerships between Japanese electrical equipment manufacturers and IBM that reflect the Japanese parties' desire to strengthen their software development and service businesses. In the cellular phone sub-segment, Japanese electrical equipment manufacturers, which are commercializing (and shifting to) third-generation cellular phones ahead of the rest of the world, have been ac-



**Fig. 4-6 Major Partnerships in the Home Appliances Segment**

Sources: Prepared by the Development Bank of Japan from various publications



**Fig. 4-7 Major Partnerships in the Cellular Phone Sub-segment**

Sources: Prepared by the Development Bank of Japan from various publications

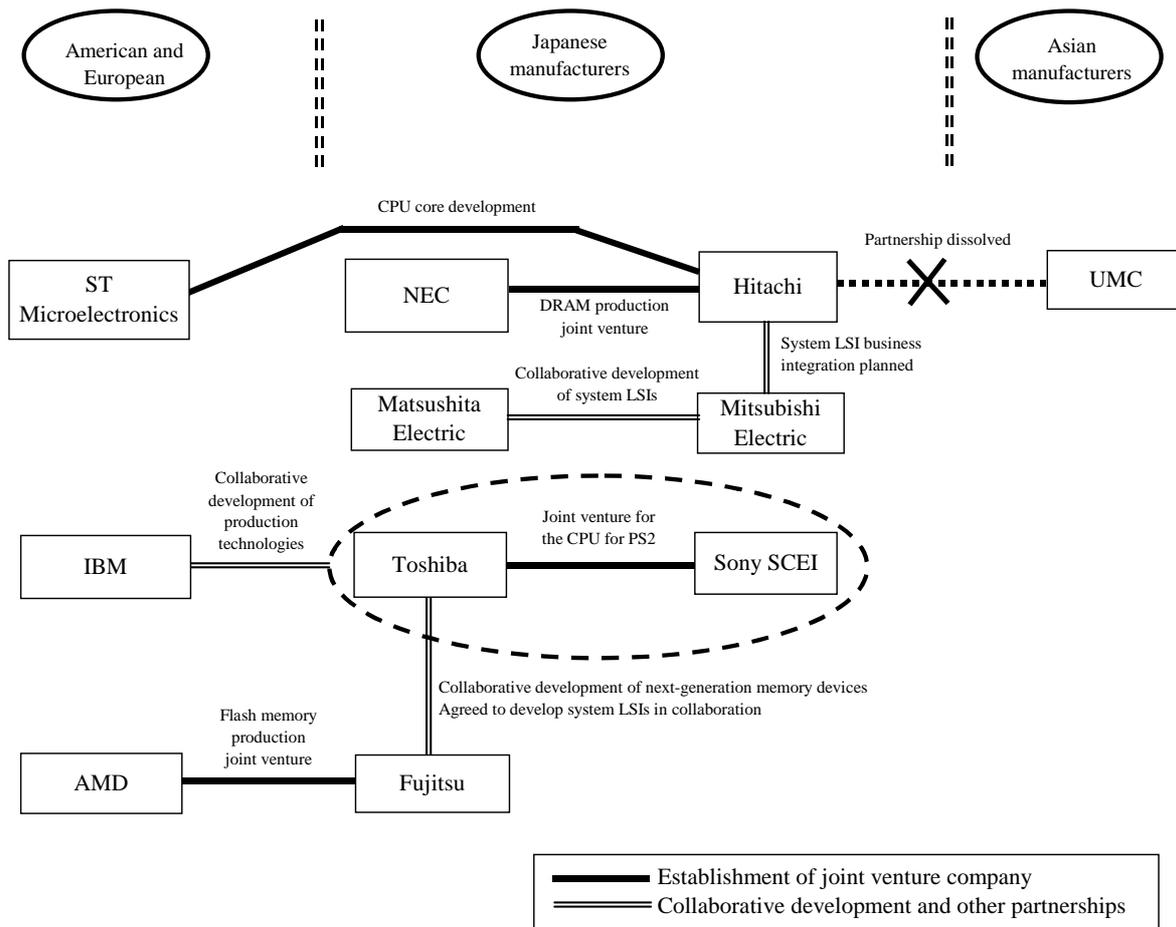
tively forming partnerships with major European manufacturers to strengthen their competitiveness against Nokia, which has dominated the global cellular phone terminal market, as well as partnerships among themselves to speed up the software development process and reduce development costs.

In the area of semiconductors and other electronic components and devices, Japanese electrical equipment manufacturers have been actively forming partnerships to reduce their capital spending on facilities and R&D expenditure that have become vast and continue to rise. As a result of the continuous shrinking of market share in the 1990s and the sharp decline in sales in 2001, the relationships among players in the Japanese semiconductor industry are changing dramatically as can be seen in the integration of the DRAM businesses of Hitachi and NEC, the collaborative development partnership agreement reached between Toshiba and Fujitsu and the (planned) integration of businesses of Hitachi and Mitsubishi in the

system LSI<sup>2</sup> sub-segment, in which Japanese electrical equipment manufacturers have been more actively pursuing development, marketing and other activities than in any other sub-segment. In addition, Japanese electrical equipment manufacturers have been actively forming partnerships in other segments as well, including advanced device segments (such as the organic EL and PDP<sup>3</sup> segments) which are expected to expand, and the liquid crystal device segment. In these electronic component and device segments, Japanese electrical equipment manufacturers have been forming partnerships with material manufacturers (such as the PDP partnership between Matsushita

<sup>2</sup> System LSIs are large-scale integrated circuits that have memory, logic, analog and other functions in one chip and are also referred to as "system-on-chip" ICs. A system LSI allows a system that traditionally had to be constructed on a board to be fabricated on a single semiconductor.

<sup>3</sup> Organic EL and PDP have already been commercialized (mainly for small- and large-sized screens, respectively) and their use is expected to increase.



**Fig. 4-8 Major Partnerships in the Semiconductor Segment**

Sources: Prepared by the Development Bank of Japan from various publications

Electric Industrial and Toray Industries) and production equipment manufacturers (such as the semiconductor photomask partnership between Oki Electric Industry and Hoya) as well, in addition to partnerships among themselves.

The partnerships in all segments share certain common objectives, such as to enhance profitability by gaining dominant power over prices and increasing market share, as well as to reduce fixed costs through reduction of capital spending on facilities. Although the only competitors that Japanese electrical equipment manufacturers had to take seriously were other Japanese electrical equipment manufacturers and certain American and European manufacturers in the 1980s when the Japanese manufacturers had large market shares in the home

appliances and semiconductor segments, for example, and were technologically superior to other countries' manufacturers, as emerging manufacturers from South Korea, Taiwan, China, etc. entered the market one after another in the 1990s while improving their technological expertise and increasing their market share, the areas in which Japanese electrical equipment manufacturers could continue to operate profitably by themselves were gradually squeezed out.

The partnerships being pursued by Japanese general electrical equipment manufacturers are unique in that they are formed on a segment-by-segment basis, whereas partnerships being formed (and mergers being made) in the material manufacturing industries (such

as the paper and pulp industry and other chemical industries) are between companies. Because they cooperate as partners in some areas and compete in others (such as the cellular phone partnerships between Matsushita and NEC and between Toshiba and Mitsubishi and the liquid crystal partnership between Matsushita and Toshiba), the current partnership relationships between Japanese general electrical equipment manufacturers do not necessarily reflect their competitive relations as companies.

**4. Japanese General Electrical Equipment Manufacturers’ Restructuring of Operations and Future Prospects**

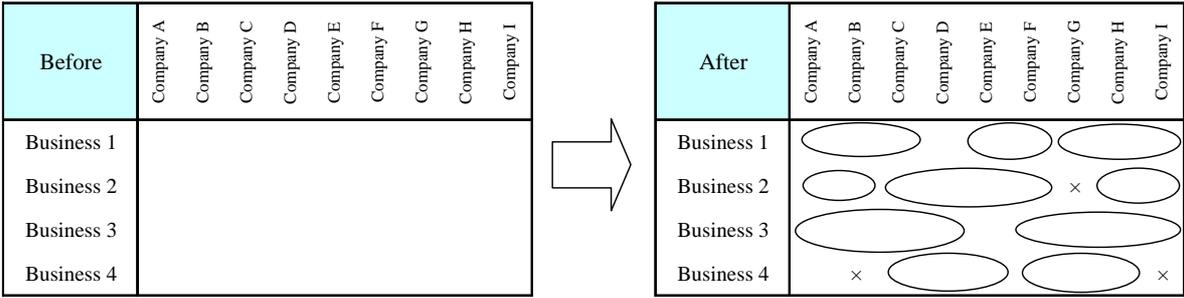
Currently the strength of Japanese general electrical equipment manufacturers is their ability to provide a wide range of electrical equipment including peripherals and to develop components and devices taking into consideration the customer needs for final products, as well as their superiority in solution businesses (provision of products and services as a single package), where they have been actively strengthening their competitiveness. It is also possible that Japanese general electrical equipment manufacturers, which have been manufacturing PCs and cellular phones as well as a wide range of home appliances within their groups, may be successful in the growing IT home appliances

segment and outperform competitors by using their expertise in integrated design and development, etc.

Another advantage of Japanese general electrical equipment manufacturers is that they have spread business risks widely by becoming general manufacturers. Their heavy electric apparatus and communications equipment businesses originally were stable profit sources supported by large and loyal customers (such as electric utilities and large telecommunications companies), enabling them to aggressively enter new segments. In addition, these stable profit sources have helped them hold onto the several money-losing businesses yet post profits for the group as a whole.

However, Japanese general electrical equipment manufacturers, which performed outstandingly in the 1980s, have been overtaken in profitability by specialized American manufacturers partly as a result of changes in the business climate such as the progress of modularization and have been losing market share to American and European final product manufacturers that have been actively utilizing outsourcing. As a result, they must now review and change their business models which were effective in the 1980s.

It would be both difficult and unrealistic for Japanese general electrical equipment manufacturers to try to regain their market



**Fig. 4-9 Strengthening of Businesses through Partnerships**

*Note:* indicates that the company is operating without a partnership.  
indicates that the company has one of the leading market shares, and  
indicates that the company has a low market share.

*Note:* ○ denotes a business partnership, and  
× indicates that the company has withdrawn from the business.

*Source:* Prepared by the Development Bank of Japan

shares and improve their profitability by copying the specialized American manufacturers, that is, by drastically reducing or integrating their wide range of businesses. Business partnerships, which are currently being pursued by Japanese general electrical equipment manufacturers, are the most effective and realistic means of simultaneously achieving 1) selective concentration in segments where they can be profitable, 2) sufficient market share to gain reasonable market dominance and 3) reductions in financial burdens including facility investment based on their current business models. Japanese general electrical equipment manufacturers are likely to gradually build their strong areas while shedding unprofitable businesses through partnerships with domestic and overseas manufacturers.

## 5. Conclusions

Dissolving partnerships, such as the liquid crystal partnership between Toshiba and IBM, the semiconductor partnership between Hitachi and UMC and the partnership between NEC and Thomson Multimedia for displays, suggest that not all partnerships go smoothly.

The key factor in a partnership is whether decisions can be made fast enough, because there is a close correlation between decision-making speed and the effectiveness of the partnership. Recognizing the slowness of their decision making, Japanese general electrical equipment manufacturers have been attempting to speed up the process through organizational reforms including the introduction of company-in-company systems. The effectiveness of these organizational reforms remains to be seen, but fast decision-making, which is difficult even for a single company, may well become more difficult in a partnership between two or

more companies. The higher frequency of partnership breakups between Japanese and overseas manufacturers than between Japanese manufacturers is partly because Japanese and overseas manufacturers place different importance on decision-making speed. In particular, for semiconductor businesses, which are subject to wide market fluctuations as in the DRAM market, it is necessary to develop mechanisms for 1) making quick decisions on the timing of investments and production adjustments in response to changes in business climate, etc., and 2) planning and implementing sound businesses from a long-term perspective.

Although the competition-driven dynamism of the industry as a whole may decrease as a result of business partnerships which reduces the number of business entities (competitors) in the industry, the increasing difficulty of differentiating products as new manufacturers emerge in Asia and other countries, as well as the increasing modularization and digitization, leave Japanese general electrical equipment manufacturers with no choice but to raise profitability by integrating businesses to achieve economies of scale. Japanese general electrical equipment manufacturers have recognized for some time the importance of the “selection and concentration” approach, but have in fact continued to expand into new areas without focus. A realistic and effective path for Japanese general electrical equipment manufacturers is to strengthen their core businesses by focusing corporate resources while partnering with other companies for their non-core businesses.

## Appendix

### Companies and Company Classification Used for Statistical Calculations for Figs. 1-1 to 1-8

(1)

#### 17 Japanese manufacturers

Sales (by fiscal year, consolidated, 100 million yen)

10 General electrical equipment manufacturers	Remark	Notation used in the text (abbreviated notation)	1999	2000	2001
Hitachi, Ltd.		(Hitachi)	80,0125	84,170	79,938
Toshiba Corporation			57,494	59,514	53,940
Mitsubishi Electric Corporation			37,742	41,295	36,490
NEC Corporation		NEC	49,914	54,097	51,010
Fujitsu			52,551	54,844	50,070
Oki Electric Industry Co., Ltd.		(Oki Electric Industry)	6,698	7,403	6,046
Matsushita Electric Industrial Co., Ltd		(Matsushita Electric Industrial or Matsushita)	72,994	76,816	68,767
Sharp Corporation			18,548	20,129	18,038
Sony Corporation			66,867	73,148	75,783
Sanyo Electric Co., Ltd.			20,143	22,410	21,121
Other (3) electrical equipment manufacturers					
Fuji Electric Co., Ltd.			8,518	8,911	8,391
Pioneer Corporation			6,159	6,471	6,689
Omron Corporation			5,554	5,943	5,340
4 Electronic component & device manufacturers					
TDK Corporation		TDK	6,745	6,899	5,750
Kyocera Corporation			8,126	12,851	10,346
Murata Manufacturing Co., Ltd.			4,591	5,840	3,948
Alps Electric Co., Ltd.			5,469	5,731	5,403

(2)

25 American manufacturers

Sales (by fiscal year, consolidated, 100 million yen)

	Remark	Notation used in the text (abbreviated notation)	1999	2000	2001	
5 American semiconductor manufacturers						
	INTEL		Intel	29,389	33,726	26,539
	TEXAS INSTRUMENTS INC.		Texas Instruments (TI)	9,468	11,860	8,201
	MICRON TECHNOLOGY INC		Micron Technology (Micron)	3,764	7,336	3,936
	AGERE SYSTEMS INC			3,714	4,708	4,080
	ADVANCED MICRO DEVICES		(AMD)	2,858	4,644	3,892
3 American EMSs						
	SOLETRON CORP	Canada	Solectron	8,391	14,138	18,692
	CELESTICA INC		Celestica	5,297	9,752	10,004
	SCI SYSTEMS INC			6,711	8,343	8,714
Other (17) electrical equipment manufacturers						
Communica- tions equipment	MOTOROLA INC	Canada	Motorola	30,931	37,580	30,004
	LUCENT TECHNOLOGIES INC		(Lucent T)	38,303	33,813	21,294
	NORTEL NETWORKS CORP		(Nortel N)	22,277	30,293	17,531
	AVAYA INC			8,268	7,680	6,793
Home appli- ances, etc.	GENERAL ELECTRIC CO	Individual	GE	55,712	63,872	68,093
	EMERSON ELECTRIC CO			14,270	15,545	15,480
	WHIRLPOOL CORP			10,511	10,325	10,343
	ROCKWELL INTL CORP			7,043	7,151	7,099
PCs and peripheral equipment	HEWLETT-PAKARD CO		(HP)	42,370	48,782	45,226
	COMPAQ COMPUTER CORP		(Compaq)	38,525	42,383	33,554
	DELL COMPUTER CORP		(Dell)	25,265	31,888	31,168
	GATEWAY INC			8,646	9,601	6,080
	APPLE COMPUTER INC		(Apple)	6,134	7,983	5,363
	CISCO SYSTEMS INC			12,154	18,928	22,293
	XEROX CORP			19,228	18,701	16,502
	SUN MICROSYSTEMS INC			11,726	15,721	18,250
EMC CORP/MA			6,716	8,873	7,091	

Reference information (not included in the statistics)

INTERNATIONAL BUSINESS MACHINES CORP IBM 87,548 88,396 85,866

Sources: Prepared by the Development Bank of Japan from "Financial Data Bank"; Standard & Poor's "Compustat"; securities reports and annual reports of the companies shown

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