Industrial Development in Postwar Japan

Hirohisa Kohama

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In the six decades since the end of World War II, Japan has transformed from a developing country into one of the largest economies in the world. In this new book, Hirohisa Kohama analyzes the industrial development of Japan within the framework of development economics. Not satisfied with a macro approach to the issue, the author also focuses his attention on the companies and the individuals that have pushed Japan's economy forward.

Kohama situates the "miraculous growth" of the 1960s Japanese economy in the trade liberalization policy of 1960 and the income-doubling plan that commenced in 1961, yet also analyzes the prewar structures that were in place to facilitate such a "miracle." The author combines policy analysis with empirical, industry-specific analysis, arguing that private dynamism was the real driver of change, rather than policy alone.

This book will be of great interest to students and researchers engaged with economic development, economic history and the Japanese economy.

Hirohisa Kohama is Professor of Economics in the Faculty of International Relations at the University of Shizouka.

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Preface

This is an expanded and updated version of my book, *Sengo Nihon no Sangyo Hatten* (*Industrial Development in Postwar Japan*) published in 2001 in Japanese. This book is an analytical description of postwar Japan's industrial development with historical perspectives.

I am a general development-economist, and my research work is not region- or country-specific. I am not an economic historian, but I am interested in every process of structural change. Of course, I am very much interested in the modern economic growth process of Japan. My earlier book, *Lectures on Developing Economic Japan's experience and its Relevance*, written with Kazushi Ohkawa (1989) is an example of my interest in the Japan's modern economic growth.

Japan experienced high growth in the 1960s. *The Economist* reported on the miraculous growth of Japan twice in the 1960s: "Consider Japan," (September 1 and 8, 1962) and "The Rising Sun," (May 29 and June 3, 1967), as discussed in Chapter 10. Japan's high growth is based on the development of the manufacturing sector development. The main actor was an active and dynamic private sector. Japanese government, especially MITI's industrial policy, is not the secret of Japan's high growth. Private dynamism and fierce competition are the key to understanding the rapid catching-up of Japan in the postwar period.

Japan's high-growth period was a process of shifting from a developing economy to a developed economy as I discuss in Chapter 1. This book makes an empirical analysis of this shift based on industry-specific development.

The Japanese economy was stagnant in the 1990s and the first half of the 2000s. Japan was poor in the high-growth era of the 1960s, but people and private companies in Japan were very energetic in those days.

Many friends helped me in preparing this book. Yukio Yoshimura of Citibank Japan Ltd (former vice-president of the World Bank), Fukunari Kimura of Keio University, and Juro Teranishi of Hitotsubashi University gave me various constructive suggestions. Tsutomu Shibata of the World Bank Institute and Shinji Asanuma of Hitotsubashi University encouraged the publication of this book.

Hirohisa Kohama
Tokyo

1 Introduction

Japan as a developing economy

In this book, I analyze postwar Japan's industrial development within the framework of development economics. In the six decades since the end of World War II, the country has caught-up with the industrial world. During the immediate postwar period, and before the period of rapid economic growth in the 1960s, however, the Japanese economy was that of a developing country. After all, the standard of living in Japan in the 1930s was not even comparable to that of Argentina in the 1930s (Maddison 1995).[1]

Looking at twenty-first century, high-tech Japan and seeing the Japanese economy bothered as it is by its huge trade surplus, younger and non-Japanese readers might think that, with a brief exception, the Japanese economy has always been that of an industrial country. But that is a serious misunderstanding. Although there may be many views to the contrary, I believe that until around 1960, the Japanese economy was that of a developing country (Ohkawa and Kohama 1989, chapter 1). The expression "newly industrializing country" did not exist at the time, but one could describe the Japanese economy of the 1950s in that way, comparable to Taiwan (China) and the Republic of Korea in the 1970s (Kohama and Watanabe 1996, introduction).

Understanding the postwar miracle

When the Japanese economy posted annual growth rates exceeding 10 percent in the 1960s, the boom was dubbed "miraculous growth." Two events spawned that miracle. First, trade liberalization began on June 24, 1960, with the announcement of the Trade and Foreign Exchange Liberalization Policy. The policy, with its schedule for trade liberalization, represented a major turning point for the postwar economy. Second, the income-doubling plan got its start in 1961. (The reader who wants to know more about the era of miraculous growth is directed to Kohama and Watanabe 1996, chapter 5).

Separating postwar Japanese industrial development from the prewar period is probably not a good idea. The system that supported Japan's rapid postwar growth originated in the prewar period (Okazaki and Okuno-Fujiwara 1999). Some analysts concede, however, that the rational and powerful systems that existed then have now fallen apart.

A change in manufacturing systems

For a time, some analysts claimed that the strength of Japanese manufacturing lay in quality control, and indeed that may be the case today. But this system was imported from the United States. Sasaki (2000) makes the following plea: "There is no quality control being done in Japan, so parts are poor in quality. I want you to go to the States to learn about quality control and the latest vacuum tube technology in the 1950s" (p. 55). The shipbuilding industry was characterized by the same phenomenon. Maema (2000) provides a lively portrayal of the technology revolution in the shipbuilding industry from the human point of view. The typical explanation for the high quality of Japanese ships is that, in contrast to shipbuilders in the United States and the developing countries, Japanese engineers actually went down into the shipyards to work side-by-side with the blue-collar workers. As presented in Maema (2000), Hisashi Shinto notes:

> What shipbuilders learned from the U.S. was that the university graduate designers had to get down into the oil and grease and work with the shipyard workers. In Japan, everything was left to the craftsmen in the yards, so there was absolutely no progress toward building the ships better. The problem is that one cannot see that sort of thing anymore in the U.S.
>
> (Vol. 2, pp. 107–8)

I am afraid engineers do not want to go to the production site as the economy has matured. Japanese engineers learned the cooperation with workers at the production site from the United States, but engineers in some sectors do not go to the production site any more.

Help from the world community

Japan joined the Organisation for Economic Co-operation and Development (OECD) in 1964. The Tokyo Olympics started on October 10 of that year. Just before the Olympics, on October 1, the Tokyo to Osaka stretch of the *Shinkansen* (the bullet train) made its inaugural run. The Japanese government at that time could never have funded such a project entirely on its own. A portion of the funding came from the World Bank, as did the bulk of the funding at this time for basic infrastructure and capital spending for heavy industry (Table 1.1). Until the mid-1960s, Japan was most certainly on the receiving end of World Bank loans. That dependency alone does not mean that Japan was a developing country at the time, but it is an important factor when analyzing the character of Japan's postwar economic development.

A change in the labor market

Another way in which one can define Japan as a developing economy until around 1960, is by examining the concept of the turning point of the labor

Table 1.1 World Bank loans to Japan

Year	*Project*	*Loan (US$1,000)*
1953	Power plant	21,500
	Power plant	11,200
	Power plant	7,500
1956	Steel plant	5,300
	Steel plant	2,600
	Machine tool for car plant	2,350
1957	Ship engine plant	1,650
	Ship engine plant	1,500
	Steel plant	20,000
	Agricultural land development	1,330
	Agricultural land development	1,133
	Non-project	984
	Non-project	853
	Irrigation	7,000
1958	Steel plant	8,000
	Power plant	37,000
	Power plant	25,000
	Steel plant	33,000
	Steel plant	10,000
	Power plant	29,000
	Steel plant	22,000
1959	Power plant	10,000
1960	Steel plant	24,000
	Steel plant	20,000
	Freeway	40,000
1961	Steel plant	6,000
	Steel plant	7,000
	Power plant	12,000
	Shinkansen (bullet train)	80,000
1962	Freeway	40,000
1963	Freeway	75,000
1964	Freeway	50,000
1965	Freeway	25,000
	Power plant	25,000
	Freeway	75,000
	Freeway	25,000
1966	Freeway	100,000
Total		862,900

Source: World Bank, Tokyo Office (1991), pp. 114–17.

market. Any development economics text provides a definition of the turning point, although texts disagree about when it occurred (see, for example, Hayami 2001, pp. 81–5). Some analysts claim that the turning point was in the 1920s. Others cite the early 1960s. Yoshikawa (1995, chapter 2) argues that the turning point came in the late 1960s to around 1970. Still others define two turning points, one in the 1920s and another in the 1960s (Minami 1994, chapter 9; Yasuba 1980, chapter 5).

Simply put, the turning point was the transition from an economy in which employers could find as much simple labor as they needed, to an economy that gradually became characterized by a labor shortage. Put another way, the transition was from an economy in which the bourgeoisie could afford housemaids to one in which maids are a rarity. The transition also brought the shift from a buyer's market for middle-school graduate-workers to a seller's market, a time when analysts said that "middle school graduates are the golden egg" (Yasuba 1980, p. 158).

This kind of change in the labor market creates structural change in the economy. After the turning point, the international competitiveness of labor-intensive industries begins to decline. Initially, exports of labor-intensive products decrease.[2] With the passage of time, and in the absence of import barriers, consumers who had formerly purchased domestically-produced, labor-intensive products shift to purchasing imported goods, and as a result imports increase. In some economies this shift happens because of structural shifts and adjustments resulting from market mechanisms; in others this sort of structural adjustment happens as a result of government policy changes. In either case, the structure of the labor market is a good indicator of whether a country can be classified as developed or developing.

Defining the scope of my analysis

Although the focus of my analysis is the manufacturing industry, I will also consider market structure and small- and medium-sized enterprises. The period of my analysis is the entire postwar period, but some of my sector analyses will focus primarily on the immediate postwar period to the era of rapid growth, depending on the type of industry.

The term "industrial development" encompasses sector, subsector, and micro meanings. I cannot, however, imitate business historians (such as the experts who appear in Itami *et al.* 1998a, 1998b, 1998c) and analyze all these aspects of development. Peering beyond the surface of microeconomic aspects to analyze the development of individual corporations is also beyond my ability. I have a specific meaning in mind when I choose "sector, subsector, micro" and not "macro, sector" as the basis for my analysis. To understand the process of economic development, a comprehensive understanding of development from the macro, sector, and micro points of view is essential. "Macro" should not need any explanation, but "sector" has no fixed definition. Comparisons against gross domestic product can be made from the perspective of the agricultural, industrial, and service sectors, although some analysts view the economy in terms of the steel sector, the automobile sector, and so on, and still others call these subsectors. In this book, I analyze both major sectors (agricultural, industrial, and service sectors) and subsectors such as steel and car industries. I use "sectors" and "subsectors" rather ambiguously.

Turning to the micro point of view, I must point out that economic development is a long process of structural change. I have come to the realization that

this process cannot be analyzed simply from a macro point of view. Moreover, it is the companies, or the individuals themselves, that embody the forces actually engaged in economic activity, and that move the economy. For example, were it not for Shizuo Takano, former senior vice-president of the Victor Corporation, the familiar VHS format for home video might have remained unknown to us (Sato 1999). Soichiro Honda was, without question, a genius, but without Takeo Fujisawa, the Honda Corporation might not have come into existence. And Masaru Ibuka probably could not have built Sony into what it is today without Akio Morita. When Morita was asked, "What kind of company is Sony?" he replied, "It's the fulfillment of Mr. Ibuka's dream." Likewise, when Honda's Fujisawa was asked, "What kind of company is Honda?" he answered, "It's a company that lets Soichiro Honda do what he wants to do" (Yonekura and Itakura 2001, p. 165). Any analysis of economic development that fails to recognize the significance of flesh-and-blood individuals – the micro element – is seriously flawed.

This book is a continuation of an earlier work, *Fifty Years of the Postwar Japanese Economy: From a Developing Country to an Advanced Country*, written in Japanese (Kohama and Watanabe 1996), which I undertook with a colleague. Because of diverging interests with my co-author, I have decided to write this book by myself.

In *Fifty Years of the Postwar Japanese Economy*, we examined the growth of the postwar economy within the framework of development economics and analyzed the economy from the macro and sector-macro points of view. Of course, we did refer also to individual corporations. For example, we presented the famous story about the Kawasaki Steel Chiba steelworks, and we touched on the feud between Soichiro Honda and then vice-minister of MITI, Shigeru Sahashi, over the Temporary Law for Promotion of Specific Industries (the *Tokushinho*) (pp. 160–2).

In the epilogue to *Fifty Years of the Postwar Japanese Economy*, we wrote that we had not been able to address the fascinating topic of the development of the Japanese economy on an industry-by-industry basis. The present book is an attempt to do just that. In other words, this book views postwar Japanese economic development within the framework of development economics and examines that development in terms of specific industries and individual corporations. This book aims to analyze the roles and philosophies of some individuals as they contributed to the growth of particular industries. Needless to say, I do not mean to separate the processes of industrial development in the prewar period from the postwar period, so I will on occasion refer to the prewar period as well.

I begin the story with analyses of changes in industrial and trade structures. In other words, I focus not on the electrical industry in a broad sense, but on televisions, videos, semiconductors, and so on; not on the chemical industry, but on pharmaceuticals and dyestuffs; not on the steel industry, but on steel plate, I-beams, steel rod, high-strength steel pipe, and seamless pipe. I am sometimes astonished when I recall the *Asahi Shimbun* article title, "Positive

Correlation between Profitability and Stock Price: Dai-Ichi Life Insurance Survey of 1,108 Companies – 'Pensions' Selectively Advanced." Well, naturally, I guess. Such a thing would not have found its way into the newspaper until this point in Japan's economic development. At one time, when the economy improved, all sectors improved. Apparently that era is over. Bearing that passing in mind, this book examines the growth of Japanese industry from the subsector, microeconomic point of view.

2 Economic development as structural change

Structural change in postwar Japan: the subsector view

As I wrote in Chapter 1, this book is an analysis of postwar Japanese economy from the standpoint of subsectors and microeconomics, and is grounded in development economics. Let us start with some general views about structural change in the economy. The distinctions between macroeconomics and microeconomics are clear, but the differences between sectors and subsectors are somewhat vague. Generally speaking, the three "major sectors" are primary (agriculture), secondary (industry), and tertiary (service) sectors. Sub-categories such as the steel and car industries are called subsectors.

Let us look first at increases in per capita income. Table 2.1 shows a comparison of Japanese and U.S. per capita gross national product (GNP) from 1950 to 2005. The GNP scale has been converted to dollars based on current exchange rates. U.S. per capita GNP in 1950, at the start of the Korean War, was more than 13 times that of Japan, but by 1960 it was only about six times greater. By 1965 the gap had shrunk even more: U.S. per capita GNP was slightly less than four times greater than Japan's. The Trade and Foreign Exchange Liberalization Policy came out in June 1960, and the cabinet decided on the income-doubling plan in December of the same year. Japan joined the Organisation for Economic Co-operation and Development (OECD) in April 1964, and the Tokyo Olympics were held in October of the same year (see Chapter 10). The September 1985 Plaza Accord affected the difference between Japanese and U.S. per capita income, and the gap was more or less eliminated by 1990. By 1995 the ratio of Japanese to U.S. income was roughly 3:2, although this difference owes something to the magic of exchange rate fluctuations. A comparison of per capita GNP in terms of purchasing power parity between the two countries, however, shows that Americans had US$42,000 to US$32,010 for the Japanese in 2005, and the Japanese were able to buy only about three-quarters as much as Americans (WDI 2007).

The development of manufacturing industries brought about this rapid growth in income, particularly during the period of brisk economic growth. Table 2.2 establishes three broad categories (primary, secondary, and tertiary industries) and one subordinate category (manufacturing) to show the extent of industrial

Table 2.1 Income level comparison: Japan and U.S.A. (US$)

	Japan (1)	*USA (2)*	*(2)/(1)*
1950	138	1,882	13.64
1955	267	2,411	9.03
1960	457	2,803	6.13
1965	917	3,557	3.88
1970	1,947	4,841	2.49
1975	4,466	7,173	1.61
1980	8,907	11,558	1.30
1985	11,155	16,997	1.52
1990	23,898	22,106	0.92
1995	39,640	26,980	0.68
2005	38,950	43,560	1.12

Sources: WDI (2003); WDI (2007).

Note
Per capita GNP or GNI in current prices.

Table 2.2 Industrial structure change: primary, secondary, and tertiary industries (%)

	1947	*1955*	*1960*	*1970*	*1980*	*1990*	*2002*
Value added							
Primary	38.8	19.2	12.8	5.9	3.6	2.4	1.3
Secondary	26.3	33.7	40.8	43.1	37.8	37.2	29.1
Manufacturing	na	27.5	33.8	34.9	28.2	27.5	19.7
Tertiary	34.9	47.0	46.4	50.9	58.7	60.4	69.6
Employment							
Primary	53.4	41.0	32.6	19.4	10.9	7.1	4.7
Secondary	22.2	23.5	29.2	34.0	33.6	33.2	29.7
Manufacturing	16.3	17.6	21.8	26.0	23.6	23.6	19.3
Tertiary	23.0	35.5	38.2	46.6	55.4	59.1	65.7

Sources: Kohama and Watanabe (1996), p. 17; *Japan Statistical Yearbook 2004*; Economic and Social Research Institute (ESRI), Cabinet Office of Japan website: www.esri.cao.go.jp/jp/sna/h16-nenpou/16annual-report-j.html.

structural change. After World War II, primary industries represented nearly 40 percent of total value added, but by the mid-1990s, primary industries accounted for a mere 2 percent of total added value. In terms of employment share, primary industries accounted for more than half of total employment immediately after the war, but by 2002 represented no more than 5 percent. The share represented by secondary industries increased during the period of rapid growth, but went into slow decline after that period. Manufacturing industries showed a similar trend, and if we compare 1970 with 2002, the share of added value fell by 15.2 percent, and the employment share declined by 6.7 percent. At the same time, the share of the tertiary (service) sector increased by corresponding amounts.

Table 2.3 Industrial structure of Japan (1950–2002, value of shipment) (%)

	1950	*1955*	*1960*	*1970*	*1985*	*2000*	*2002*
Food	13.8	17.9	12.4	10.4	11.0	11.6	12.5
Textiles	21.4	16.2	11.2	6.4	3.1	1.0	0.9
Apparels	1.7	1.3	1.2	1.4	1.4	1.2	1.0
Wood products	3.7	4.1	3.5	3.2	1.6	1.1	1.0
Furniture	0.7	1.0	1.0	1.5	1.1	1.0	0.8
Paper and pulp	4.0	4.2	3.9	3.3	2.8	2.6	2.7
Publishing and printing	2.9	3.3	2.5	2.9	3.4	4.3	2.8
Chemicals	11.9	11.0	9.4	8.0	7.7	7.8	8.4
Petroleum and coal products	1.4	1.9	2.4	2.6	4.8	6.6	7.1
Rubber products	2.4	1.4	1.5	1.1	1.1	1.0	1.1
Leather products	0.7	0.6	0.5	0.5	0.4	0.2	0.2
Ceramics	3.5	3.4	3.5	3.6	3.3	3.0	2.9
Iron and steel	9.6	9.6	10.6	9.5	6.6	3.9	4.1
Non-ferrous metals	4.2	4.1	4.3	4.4	2.4	2.0	2.1
Metal products	2.8	3.2	3.9	5.4	5.0	5.1	5.1
General machinery	4.2	4.7	7.8	9.9	9.2	10.0	9.5
Electric machinery	2.6	3.7	8.3	10.6	15.3	19.6	17.1
Transport equipment	5.9	5.5	8.5	10.5	13.5	14.6	17.8
Precision instrument	0.8	0.8	1.1	1.3	1.6	1.4	1.3
Others	1.6	2.0	2.5	3.6	4.6	1.8	1.7
Light manufactures	41.3	40.4	29.3	22.8	18.2	15.9	16.2
Machinery	13.6	14.8	25.7	32.3	39.6	45.6	44.4

Source: Kohama and Watanabe (1996), p. 17; *Japan's Postwar Manufacturing Census*; *Census of Manufactures*.

Note
Light manufactures = food, textiles, apparels, wood products and furniture; Machinery = general machinery, electric machinery, transport equipment and precision instruments.

The core industries in the manufacturing sector also changed in significant ways. Table 2.3 shows the structural changes in the manufacturing sector in terms of the two-digit industry classifications (Japan's industrial classification system is based on the United Nation's International Standard Industrial Classification of All Economic Activities (ISIC). For details, go to the ISIC website (http://unstats.un.org/unsd/class/family/historical/isic/default.htm). Until 1950, more than 20 percent of income produced by the manufacturing sector came from the textile industry. If light industries are described as the food, textile, apparel, wood product, and furniture industries, then light industries accounted for more than 40 percent of total revenues produced by the manufacturing sector in the 1950s. By 2002 that share had fallen to 16 percent. Even more dramatic has been the decline in the textile industry, which in 2002 had a mere 1 percent share. Thus, in the 52-year period from 1950 to 2002, the share occupied by the textile industry fell by more than 20 percentage point.

In 1950 textile industry shipments amounted to ¥491.7 billion (Tsusan Tokei Kyokai 1982). In terms of subsectors of the textile industry (four-digit industrial classifications), 13 industries represented more than 1 percent of total shipments:

- Raw silk manufacturing industry (industrial classification code 2011), ¥28.5 billion
- Cotton spinning (2021), ¥137.9 billion
- Wool spinning (2023), ¥30.6 billion
- Flax spinning (2025), ¥5.15 billion
- Hemp yarn spinning (2031), ¥10.8 billion
- Cotton and rayon cloth production (2041), ¥97.5 billion
- Silk and artificial silk cloth production (2042), ¥51.9 billion
- Wool cloth production (2043), ¥44.8 billion
- Rayon cloth production (2044), ¥5.1 billion
- Hosiery fabric and the hosiery fabric manufacturing industry (2051), ¥5.3 billion
- Cross-woven knit fabric manufacturing (2053), ¥9.3 billion
- Cotton, linen, and rayon fabric machine dyeing (2061), ¥22.4 billion
- Wool carding (2091), ¥7.7 billion.

The textile industry accounted for 20 percent of the manufacturing sector in 1950, whereas the raw silk manufacturing industry accounted for 5.8 percent. In 2002 the textile industry accounted for only 1 percent of total manufacturing, as mentioned above. Raw silk manufacturing is negligible now, even though silk was one of the major exports when Japan started its modern economic growth in the 1880s. The share of silk products (silk and yarn fabrics) was more than 30 percent of Japan's total exports in 1890 (T. Nakamura 1993, p. 43).

The electrical equipment manufacturing industry (abbreviated as "electric machinery" in Table 2.3) stands in contrast to the textile industry. In the 52-year period from 1950 to 2002, the share of electric machinery has increased by 14.4 point. In 1950 the value of shipments by the electric machinery industry was ¥60.7 billion, about one-eighth that of the textile industry. In terms of subsectors (four-digit industrial classifications), the following classifications of electric machinery accounted for 1 percent or more of the total value of shipments:

- Generators, electric motors, and other rotating electrical equipment (industrial classification code 3511), ¥12.9 billion
- Transformers (3512), ¥2.4 billion
- Circuit breakers, power distribution panels, and power control equipment (3513), ¥3.9 billion
- Power line fittings (3514), ¥3.2 billion
- Electric welding equipment (3515), ¥1.8 billion
- Other industrial electrical equipment (3519), ¥1.5 billion
- Consumer appliances (3521), ¥1.6 billion
- Electric light bulbs (3531), ¥4.9 billion

- Wired communication devices (3541), ¥8.9 billion
- Wireless communications devices (3542), ¥5.6 billion
- Other communications devices (3549), ¥1.2 billion
- X-ray equipment (3551), ¥1.1 billion
- Electrical instruments (3561), ¥4.5 billion
- Electron tubes (3571), ¥1.7 billion
- Storage batteries (3591), ¥2 billion
- Primary batteries (3592), ¥2.9 billion
- Other electrical equipment (3599), ¥741 million.

In 1950 data were not available for radios, televisions, audio equipment, computers, semiconductors, or integrated circuits. The shipped value of electric light bulbs represented more than 8 percent of the total value of the electric machinery industry in 1950.

In 2002 the electric machinery manufacturing industry shipped goods with a total value of ¥46.04 trillion (*Census of Manufactures* 2002, pp. 9–10), and shipments of light bulbs accounted for about 1 percent of that total.[1] In terms of the four-digit classifications for electric machinery subsectors, shipments in 2002 were largest in the following areas:

- Integrated circuits (industrial classification code 2903), ¥5.41 trillion (11.7 percent of the value of total electric machinery shipments)
- Miscellaneous electronic parts (2919), ¥4.46 trillion (9.7 percent)
- Radio communications equipment (2812), ¥2.99 trillion (6.5 percent)
- Relay switches, switchboards, and electrical control equipment (2713), ¥2.60 trillion (5.7 percent)
- Video recording and duplicating equipment (2742), ¥2.27 trillion (4.9 percent)
- Personal computers (2822), ¥2.20 trillion (4.8 percent).

Between 1950 and 2002, the transportation equipment industry's share increased by 11.9 point, and by looking at the statistics for the subsectors, we can see significant structural change. The total value in of the transportation equipment sector in 2002 was ¥48.00 trillion (*Census of Manufactures 2002 (summary)*, p. 10). This figure represents 17.8 percent of the ¥269.36 trillion worth of manufacturing total in that year, as shown in Table 2.3. In terms of transportation equipment subsectors, automobiles (industrial classification code 3011) represented 44.9 percent of the total value of transportation equipment shipments; automobile parts (3013) was 39.2 percent; these two subsectors alone represented 84.1 percent of the total value of transport equipment manufacturers. By contrast, in 2002 shipbuilding (3031) had only a 3.7 percent share. In 1950 shipbuilding was larger than automobiles. The value of shipments in the steel shipbuilding industry (3641) represented a 33.3 percent share of total manufacturers, or one-third of the total. That same year, automobiles and automobile parts (3061) posted a 27.3 percent share. The first year that

Table 2.4 Export structure of Japan (1953–2006) (% of export share)

	1953	*1954*	*1955*	*1960*	*1965*	*1970*	*1975*	*1980*	*1985*	*1990*	*1995*	*2000*	*2006*
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Foodstuff	9.4	7.6	6.2	6.3	4.1	3.4	1.4	1.2	0.8	0.6	0.5	0.4	0.5
Textiles	36.1	40.3	37.3	30.1	18.7	12.5	6.7	4.8	3.6	2.5	2.0	1.8	1.1
Textile fibers	na	na	2.9	2.0	1.8	1.0	0.8	0.5	0.4	0.3	0.3	na	na
Textile yarn	na	na	29.1	22.7	13.5	9.0	5.2	3.9	2.8	2.0	1.6	na	na
Clothing	2.9	3.4	5.2	5.4	3.4	2.4	0.6	0.4	0.4	0.2	0.1	na	na
Chemicals	5.7	5.5	5.1	4.5	6.5	6.4	7.0	5.3	4.4	5.5	6.8	7.4	9.0
Non-metallic minerals	4.9	4.6	4.7	4.2	3.1	1.9	1.3	1.4	1.2	1.1	1.2	1.2	1.1
Metals and metal products	15.1	15.6	19.2	14.0	20.3	19.7	22.4	16.5	10.6	6.8	6.5	5.5	6.3
Iron and steel	10.9	10.3	12.8	9.6	15.3	14.7	18.2	11.9	7.8	4.4	4.0	3.1	4.6
Non-ferrous metals	na	na	3.3	0.6	1.4	1.3	1.0	1.5	0.8	0.8	1.0	1.1	0.3
Metal products	na	na	3.0	3.8	3.6	3.7	3.2	3.0	2.0	1.6	1.6	1.3	1.4
Machinery	15.9	13.5	13.4	25.5	35.2	46.3	53.8	62.7	71.8	74.9	74.7	74.3	68.6
General machinery	na	na	na	na	7.4	10.4	12.1	13.9	16.8	22.1	24.1	21.5	19.7
Electric machinery	na	na	na	na	9.2	12.3	11.0	14.4	16.9	23.0	25.6	26.5	21.4
Transport equipment	na	na	na	na	14.7	17.8	26.1	26.5	28.0	25.0	20.3	21.0	24.2
Precision instruments	na	na	na	na	3.9	5.7	4.7	7.9	10.1	4.8	4.7	5.4	3.3
Others	12.9	13.0	na	15.3	12.1	9.9	7.4	8.1	7.7	8.5	8.2	9.5	13.4

Source: Ministry of Finance (Japan).

automobile and automobile parts (3061) shipments exceeded the value of shipments in the steel shipbuilding industry (3641) was 1953 (Tsusan Tokei Kyokai 1982, pp. 635, 645).

Let us now turn to changes in trade structure. Table 2.4 summarizes this transformation in the export structure from the mid-1950s to 2006. In 1954, one year after the end of the Korean War, Japan earned nearly 40 percent of its foreign exchange from textile exports, a fact we must not forget because it provides an important clue to understanding that postwar Japan was a developing economy at the start of the period of rapid economic growth. The rapid decline in the share of textile shipments shown in Table 2.3 indicates that the share of textile exports fell rapidly in tandem with textiles' share of total industrial exports, and as table 2.4 indicates, in 2006 textile exports represented a mere 1.1 percent of the total. At present machine exports represent three-quarters of all Japanese exports. Just at the start of Japan's rapid economic growth era in the mid-1950s, machine exports did not make up even 20 percent of the total (Table 2.4).

To gain a better understanding of the transformation in the export structure in the period from 1950 to 1980, bracketing the era of rapid growth, let us take a closer look at particular types of exported goods (Statistics Bureau, Management and Coordination Agency, 1999). In 1950, one-quarter of Japan's total exports was synthetic fibers. The rest of Japan's exports broke down as follows:

- Steel exports, 8.8 percent
- Non-ferrous exports, 7.0 percent
- Raw silk exports, 4.8 percent
- Fish (fresh and processed) exports, 3.5 percent
- Ship exports, 3 percent
- Apparel, 2.8 percent
- Cotton fabric, 2.7 percent
- Sewing machines, 1.1 percent.

Although surprising now, MITI was making an all-out effort at the time to promote sewing machine exports (Hayashi 1961).

By 1960 steel exports had risen to 9.6 percent. Cotton fabric stood at 8.7 percent; ships 7.1 percent; apparel 5.5 percent; fish 3.4 percent; toys 2.2 percent; automobiles 1.9 percent; footwear 1.8 percent; and sewing machines 1.4 percent. Footwear exports accounted for a little less than 2 percent of the total in 1960, but when Nike began production in Asia in 1972, the company placed its manufacturing operations in Japan (Tassell 1997).

By 1970 steel exports were 14.8 percent, ships 7.4 percent, and automobiles 7.0 percent. Automobile exports had finally caught-up to ships. Radio exports (3.6 percent) remained greater than television exports (2 percent), and exports of synthetic fabrics stood at 3.3 percent. In 1980 automobile exports passed 18 percent, 6 percent higher than the 12 percent share for steel exports. Ship exports had a 3.6 percent share, marking a clear decline in ship exports.

At present, automobile exports remain high (16.3 percent of total exports in 2006), and semiconductors and electronic parts (7.2 percent) make up the leading export products (*Monthly Statistics of Japan* July 2007).

In the mid-1950s – only about 50 years ago – when Japan was about to start the rapid-growth era, the most popular employers for workers who had graduated from university were sugar refiners. Sugar refining is a declining industry in Japan, therefore it is not popular for university students in Japan.

At one time a companies' lifespan might be only about 30 years (*Nikkei Business* 1984). When we look at the 20 top corporations of the postwar period in terms of sales volume at different times, that lifespan may be hard to imagine today. In 1950, however, of the 20 top companies, five were textile, five were mining, and five were steel companies. Gradually, these top companies became electric machinery, automobile, and oil companies. Thus, as Tables 2.3 and 2.4 make clear, evidence of the structural changes that took place in the postwar period can be seen even in the top corporations.

The regional structure of the economy

As we have seen, a variety of structural changes took place during the period when the economy was rapidly catching up with the west. Japan's industrialization rate of 19.7 percent (2002) is about 15 point lower than the 33–36 percent industrialization rates seen during the period of rapid economic growth (added value of manufacturing industries divided by gross domestic product) (Table 2.2). Because primary industries have a decreasing share of the economy, the service sector has become the largest sector in the economy. This trend is known as Petty-Clark's law.

When we look at the industrialization rate (manufacturing value-added share divided by gross domestic product) for the period of rapid growth, rates exceeded 30 percent during the war, whereas rates hovered in the 20 percentiles during the 1930s and 1950s (Ohkawa, Takamatsu, and Yamamoto 1974, p. 203). According to *World Development Indicators 2005*, industrialization rates range widely, from less than 5 percent for countries such as Angola, Botswana, the Democratic Republic of Congo, Guinea, Mali, and Nigeria to 40 percent for Puerto Rico and Swaziland, and 35 percent for Thailand in 2003. G7 countries' industrialization rates were between 17 and 24 percent in 2003.

Bearing this in mind, let us now turn to the relative industrialization rates for each of Japan's regional administrative divisions in 1995 (Table 2.5). Note that the numbers used in Table 2.5 for each administrative division (for example, 1 for Hokkaido, 19 for Yamanashi, and 43 for Kumamoto) are fixed and are used for all statistics associated with these divisions. The 1995 average rate of industrialization in Japan was 23.9 percent. The variation in industrialization rates is extremely wide, ranging from Shiga's high of 47.6 percent to Okinawa's low of 5.9 percent. This spread of nearly 42 percent is remarkable for being even greater than the relative rates of industrialization between different countries.

Economic development in terms of industrialization rates shown in table 2.5 indeed differs among regions in Japan, although attaching a value judgment to

Table 2.5 Industrialization rate by prefecture in billion yen (1995)

	Gross prefectural product	*Manufacturing value added*	*Industrialization rate (%)*
Japan total	490,715	117,204	23.9
1 Hokkaido	19,645	2,139	10.9
2 Aomori	4,453	483	10.8
3 Iwate	4,563	863	18.9
4 Miyagi	8,341	1,279	15.3
5 Akita	3,797	691	18.2
6 Yamagata	3,927	971	24.7
7 Fukushima	7,627	2,013	26.4
8 Ibaraki	10,700	3,998	37.4
9 Tochigi	7,897	2,961	37.5
10 Gunma	7,722	2,691	34.8
11 Saitama	19,500	5,907	30.3
12 Chiba	18,230	4,345	23.8
13 Tokyo	84,129	8,375	10.0
14 Kanagawa	29,218	9,144	31.3
15 Niigata	9,240	2,018	21.8
16 Toyama	4,342	1,590	36.6
17 Ishikawa	4,465	972	21.8
18 Fukui	3,108	780	25.1
19 Yamanashi	3,095	938	30.3
20 Nagano	7,970	2,529	31.7
21 Gifu	7,082	2,115	29.9
22 Shizuoka	14,745	6,147	41.7
23 Aichi	32,208	11,328	35.2
24 Mie	6,253	2,710	43.3
25 Shiga	5,400	2,572	47.6
26 Kyoto	9,930	2,455	24.7
27 Osaka	38,862	8,458	21.8
28 Hyogo	20,038	6,017	30.0
29 Nara	3,521	983	27.9
30 Wakayama	3,246	832	25.6
31 Tottori	2,058	376	18.3
32 Shimane	2,329	420	18.0
33 Okayama	7,488	2,487	33.2
34 Hiroshima	10,928	2,898	26.5
35 Yamaguchi	5,546	1,802	32.5
36 Tokushima	2,540	612	24.1
37 Kagawa	3,645	847	23.2
38 Ehime	4,915	1,325	27.0
39 Kochi	2,383	339	14.2
40 Fukuoka	16,904	3,080	18.2
41 Saga	2,749	631	23.0
42 Nagasaki	4,807	608	12.6
43 Kumamoto	5,578	959	17.2
44 Oita	4,261	1,112	26.1

(*Continued*)

Table 2.5 Continued

	Gross prefectural product	*Manufacturing value added*	*Industrialization rate (%)*
45 Miyazaki	3,138	515	16.4
46 Kagoshima	4,926	670	13.6
47 Okinawa	3,266	192	5.9

Source: *Japan Statistical Yearbook* 1995, p. 292; 1999, p. 154.

Notes
Gross prefectural product: FY1995 figures. Manufacturing industry value added: 1995.
Figures are for establishments with four or more employees.
Industrialization rate = (manufacturing industry value added)/(gross prefectural product).

this fact is unnecessary. In the case of Okinawa, for example, historical reasons account for the prefecture having skipped the process of industrialization and proceeded directly to the development of a service economy, and thus Okinawa has a low industrialization rate. Furthermore, Petty-Clark's law explains Tokyo's low rate of industrialization (10 percent), second only to that of Okinawa. Petty-Clark's law applies over time, as a single country's economy changes over time. It is also appropriate for cross-national comparisons at a single point in time. It may apply as well to comparisons between Japan's administrative divisions at a single point in time.

I will next compare the industrial structure and income levels in each of the administrative divisions. For this purpose I will divide the industry structure into primary, secondary, and tertiary industries. Although secondary industries include manufacturing, in a broader sense they also include mining, construction, and so on, so the share represented by secondary industries is different from what is being addressed in the industrialization rates presented in Table 2.5. In a strict sense, any discussion of industrialization ought to include the development of the manufacturing sector, but care must be exercised because secondary industries are often used as representative of industry in general. This representation is not an issue in the case of Japan itself, but when statistics are used to compare the industrialization of countries in the world, the mining sector may be considered as part of industry, a fact that is particularly characteristic of oil-producing nations such as Indonesia, and can result in widely varying figures.

Let us begin with a comparison of the Japanese population. Tokyo's population is just under 12 million people, and Osaka and Kanagawa prefectures each have populations of over eight million. Some prefectures have populations of under one million, such as Fukui, Saga, Shimane, Tottori, and Yamanashi. In terms of prefectorial industrialization, Tokyo has the lion's share of industrial activity, representing 17 percent of the country's total. Osaka, Aichi prefecture, and Kanagawa prefecture have 7.9, 6.6, and 6 percent shares of Japan's total industrial activity, respectively. Obviously, prefectures that have small

populations have less industrial activity; Kochi, Shimane, and Tottori prefectures each have less than 0.5 percent of Japan's total industrial activity.

What are the per capita income levels at the prefectorial level? Average Japanese per capita income is around ¥3.12 million. The highest income levels are in Tokyo, at ¥4.25 million, 35 percent above the national average. Following Tokyo, the ranking is Aichi, Saga, Kanagawa, Shiga, Chiba, and Osaka prefectures. Per capita income in Tokyo is twice that of Okinawa, which has the lowest income level.

Despite Saga prefecture's relatively small population and low level of industrial output, per capita income is high. In a broad sense, Saga's high per capita income is probably a result of the high productivity that is characteristic of the local industries (Shimohirao 1996). Some prefectures have small populations and low income levels. From a macroeconomic point of view, one could say that income levels are low because productivity is low, but this view needs to be adjusted by adopting a microeconomic approach.[2]

Let us examine Japan's industrial structure. On average, primary industries represent 1.6 percent of the economy. Five prefectures exceed 5 percent: Aomori, Kagoshima, Kochi, Iwate, and Miyazaki. The figures for Kanagawa, Osaka, and Tokyo prefectures are nearly zero. In terms of secondary industries, we see essentially the same trend as was seen in prefectorial industrialization rates. Shiga prefecture at 54 percent is the highest. Prefectures where the share of secondary industries exceeds 40 percent are Aichi, Gunma, Hyogo, Ibaraki, Mie, Okayama, Shizuoka, Tochigi, Toyama, Nagano, and Yamanashi. Hokkaido, Kagoshima, Nagasaki, Okinawa, and Tokyo have secondary industry shares of under 25 percent.

Trends in tertiary industries are governed by a variety of factors. The prefecture that has the highest share of tertiary industries is Okinawa at 77.6 percent. Prefectures and metropolitan areas that have tertiary industry shares in excess of 70 percent are Fukuoka, Hokkaido, Kagoshima, Kyoto Nagasaki, Osaka, and Tokyo. As predicted by Petty-Clark's law, the statistics clearly indicate that the economic activities are shifting to tertiary industries. By contrast, notwithstanding the fact that its share of primary industries is high and secondary industries low, Kagoshima has a large proportion of tertiary industries.

Is there some correlation in the industrial structure on the development stage? Per capita income levels do not always reflect an economy's stage of development.[3] First, I correlated the per capita income data with the shares of primary, secondary, and tertiary sector industries presented in Table 2.5. Statistically speaking, the correlation between the share of primary industries in a prefecture's economy and per capita income is significantly negative (t-value = −6.36), but the correlation with secondary industries is significantly positive (t-value = 2.77). The correlation with the share of tertiary industries, however, is negative, but not statistically significant (t-value = −1.58). Thus, Petty-Clark's law generally applies for primary and secondary industries, but its applicability as far as tertiary industries are concerned is doubtful because of historical factors.

Let us now examine the value of products shipped for each regional administrative division in 1998. Aichi prefecture was the leader in value of shipped products, accounting for 11.4 percent of the national total (*Census of Manufactures* 1998, p. 310). Following Aichi, in descending order, were Kanagawa, Osaka, Tokyo, and Shizuoka. The respective values of shipments from Tokyo and Osaka were half that of Aichi prefecture. Aichi comes out on top in terms of value added to manufactured products. The statistics for value-added productivity change the rankings, and by this measure Shiga prefecture is the leader with ¥17.7 million in value-added productivity, with Chiba, Yamaguchi, Kanagawa, Oita, Aichi, Mie, Ibaragi, Tokyo, and Hyogo following in descending order (1997 figures in *Japan Statistical Yearbook*). For the 21 industrial classifications, I compared the top four prefectures in terms of shipment. Aichi was the top and appeared 14 times, followed by Osaka (12 times), Kanagawa (seven times), and Shizuoka (six times). These data help explain why the aggregate value of products shipped from Aichi prefecture is so great (Kohama 1999a, table 8).

The structure of the manufacturing industry

In this section I will discuss the size structure of Japan's manufacturing industry.

Small- and medium-sized industries and economic development

We must not overlook the important role played by small- and medium-sized industries in the industrialization of Japan. Even as they have been called a source of Japan's international competitiveness in the postwar era, small and medium enterprises (SMEs) have also been the focus of a variety of negative assessments, given their character as sweatshop-style subcontractors to big companies, particularly in their role as parts-suppliers to leading manufacturers of electronics, automobiles, and other products. Some economists take a critical view of small- and medium-sized subcontractor companies; others argue that developing countries that do not foster peripheral industries (such as the Japanese-style parts-suppliers) are unlikely to industrialize. The future of such countries, where the link between assembly plants and parts-suppliers is weak, is doubtful. Others argue that the development of small- and medium-sized industries is crucial to developing countries as a means of solving labor use problems.

Economic development is a modernization process, and integral to that process is a dynamic interrelationship between the modern elements and the existing traditional elements of the society. When an economy is viewed as a whole, industry can be thought of as the modern element, whereas agriculture is the traditional element. If we review the history of the economic development process of most countries, however, both modern and traditional elements coexist within industry, and in many countries the agricultural sector is characterized by what could properly be described as modern industry. For example, more than just the tropical climate is needed to supply the orchids that are sold as souvenirs in the airports of southeast Asia. Of course, the climate is one

important factor, but bio-technology and factory production make the orchids possible, because without the technology, countries could not grow consistent quality, low-priced orchids. Others believe that large corporations, in effect, stand for modern, forward-thinking industry, whereas SMEs are the traditional industries. If you look closely at SMEs, however, you will realize that the problem is not so simple.

According to this classic polarization model, the capitalization and number of workers employed by modern industries grows steadily, but the workers who are not employed by modern industries end up working in the small-scale or marginal industries. Otherwise, these workers are simply unemployed or underemployed, and the situation becomes such that the intermediate scale, medium-sized industries can no longer survive. The Japanese experience is often cited as an example of success. In Japan, however, this kind of classic polarization pattern has not occurred, and development has gone forward in a competitive environment where small, medium, and large companies coexist (Ohkawa and Kohama 1989, pp. 105–8). As I suggested earlier, enabling the development of efficient medium-scale industries is an important way to deal with the employment problems in developing countries. In this arena, the Japanese experience offers valuable lessons, with the caveat that making a carbon-copy of one country's experience and attempting to apply it to another is unrealistic.

The size distribution of the manufacturing industry

Let us first look at changes in privately held companies. Table 2.6 shows the share of the manufacturing sector represented by privately held companies in 1957, 1966, and 1987, broken out according to size of enterprise. The detailed statistics in Table 2.6 are summarized at the bottom, divided into companies with 1–19 employees, 1–299 employees, and more than 300 employees. According to the Small and Medium Enterprise Basic Law, manufacturing sector SMEs can have up to 300 employees, or capitalization of under ¥100 million, so from a statutory point of view, I had a reason for using 300 employees as the cutoff point.[4] The 1–19 employee range has no particular statutory significance, but it is an arguably reasonable distinction if one assumes that even within the category of SMEs, modern companies coexist with those that are not modern. This limit serves as a way of classifying them. Although it is not shown in Table 2.6, approximately 4 percent of all privately held companies employed 20 percent of all workers. Naturally, such companies do not have the number of employees needed to make them internationally competitive or technological powerhouses. As Table 2.6 shows, three-quarters of all manufacturing sector companies in 1957, just when the period of rapid economic growth was getting under way, were privately held enterprises. Over 80 percent of the companies with 1–19 employees were privately held. By 1987, 57 percent of all manufacturing sector companies were privately held, and 65 percent of enterprises with 1–19 employees were privately held, a drop of nearly 15 percent in each category.

Table 2.6 Number of privately held manufacturing companies and their share

	1957			*1966*			*1987*		
	No. of companies	*Share (%)*		*No. of companies*	*Share (%)*		*No. of companies*	*Share (%)*	
		Privately held companies	*Companies*		*Privately held companies*	*Companies*		*Privately held companies*	*Companies*
1–3 employees	198,453	96.8	3.2	214,879	96.8	3.2	299,402	88.1	11.9
4–9 employees	101,921	71.8	28.2	194,112	70.6	29.4	221,947	49.4	50.6
10–19 employees	58,438	41.2	58.8	80,219	34.6	65.4	75,675	16.1	83.9
20–29 employees	19,206	21.4	78.6	27,415	13.9	86.1	36,092	7.3	92.7
30–49 employees	13,332	12.8	87.2	21,839	9.1	90.9	18,812	3.1	96.9
50–99 employees	8,460	6.4	93.6	15,449	3.8	96.2	14,419	1.2	98.8
100–199 employees	3,146	3.0	97.0	6,643	1.4	98.6	7,489	0.3	99.7
200–299 employees	981	0.9	99.1	1,852	0.8	99.2	2,387	0.1	99.9
300–499 employees	645	0.5	99.5	1,508	0.7	99.3	1,603	0.9	99.1
500–999 employees	411	na	na	908	0.2	99.8	1,061	0.0	100.0
1,000 or more employees	433	na	na	957	0.3	99.7	775	0.0	100.0
1–19 employees	358,812	80.6	19.4	489,210	76.2	23.8	597,024	64.6	35.4
1–299 employees	403,937	73.2	26.8	562,408	67.4	32.6	676,223	57.5	42.5
300 or more employees	1,489	na	na	3,373	0.5	99.5	3,439	0.8	99.2
Manufacturing total	405,426	73.0	27.0	565,581	67.1	32.9	679,662	57.2	42.8

Source: Small and Medium Enterprise Agency, Ministry of International Trade and Industry 1959, 1969, 1990.

Let us now look at the breakdown of SMEs according to establishments, number of employees, value of shipped products, and added value. At present, we have statistics only for enterprises listed as having four or more employees in the *Census of Manufactures 2002* so complete comparisons over time are not possible.[5] The share represented by a small or medium sized industry (between one and 299 employees) has remained virtually unchanged since before the period of rapid growth. For example, companies in the 1–19 employee range represented somewhat less than 90 percent of the total in 1955, and that figure was virtually unchanged at 85.5 percent in 1998. The approximately 70 percent share represented by SMEs in terms of number of employees has changed little, and the number of companies having 1–19 employees has declined slightly. Similarly, the share of all companies represented by SMEs in terms of value of shipments and value added has seen no substantial change. Thus, clearly SMEs have coexisted with large enterprises during the process of industrialization in Japan's postwar period.

Turning to the scale structure of enterprises classified according to type of business, I do not have data for all manufacturing subsectors and am able to analyze only representative industries: light industries such as the apparel and fiber manufacturing industry, the electric machinery manufacturing, and automobile industries serve as representatives of the assembly sector (Kohama 1999a, tables 4–7). In the case of apparel, no matter what the indicator, SMEs (1–299 employees) represent more than 90 percent of the total. Naturally, more than 99 percent of the apparel business establishments fall into this category, and these SMEs make up over 95 percent of the total in terms of both shipped value and value added, and the bulk of these companies have fewer than 200 employees. In both 1955 and 1975, only one company had more than 1,000 employees, and in 2002 no companies had more than 1,000 employees (*Census of Manufactures 2002*).

Although 97–98 percent of establishments in electric machinery manufacturing are SMEs, SMEs make up only approximately 50 percent of the total in terms of number of employees. In terms of number of employees, 96–97 percent of the companies in the apparel industry are SMEs, so by this measure the difference in the scale structure between these two industries is significant. Similarly, in terms of shipped value and value added, SMEs represent approximately 30 percent of the total in the electric machinery manufacturing industry, figures that contrast sharply with the over-90 percent share represented by the apparel industry.

Let us examine the automobile assembly and automobile parts industries. I look at only 1997 figures for the automobile manufacturing industry (industrial classification code 3111) and automobile parts and accessories manufacturing industry (3113). The statistics include motorcycles, but if we look at the scale structure of the automobile assembly industry, we find 50 establishments, of which SMEs represent only 24 percent of the total. In terms of the number of employees, shipped value, and value added, SMEs account for less than 1 percent, indicating that the presence of SMEs is extremely small in the

automobile assembly industry. Almost all automobile assembly operations are done in establishments of 1,000 or more people.

The scale structure of the automobile parts manufacturing industry is very different from the automobile assembly industry. As in the case of the apparel industry, 97 percent of the automobile parts manufacturing companies are SMEs. Even in terms of numbers of employees, one-third of car parts manufacturers are SMEs, and parts manufacturers of this size produced 23–27 percent of the total shipped value and value added. In contrast to the apparel industry, the number of establishments that have more than 1,000 employees in the automobile parts manufacturing industry is high, even though these establishments represent approximately 30 percent of the total shipped value and value added.

Subcontractors in a dual structure

The dual structure of Japan's economy is an important issue when we consider the relationship between Japan's industrialization and SMEs. Many studies on dual structure and SMEs examine the subcontractor system, and the reader is referred to these for more information (Hashimoto 1998; Kiyonari 1996; Kiyonari *et al.* 1996; Koseki 1998; H. Nakamura 1985, 1992; Nakazawa 1998; Seki 1993; Shinohara 1976). Because this book works within the framework of development economics to analyze the development of Japanese industry in the postwar era, I limit my focus to the role of SMEs in the processes of economic development.

Development economics frequently uses concepts of dualism and dual structure, usually referring to the coexistence of modern and pre-modern elements within one economic system. Sometimes this concept refers to the coexistence of industry and agriculture as the modern and pre-modern elements, but it may also refer to studies of the relationship between modern and pre-modern elements within the industrial sectors.

When we speak of the scale structure of small- and medium-sized industries, the first problem has to do with the disparity between wage rates at SMEs and large corporations. The wage rate disparity over the course of the postwar period is easy to see in the *Small and Medium Enterprise White Paper* published annually by the Small and Medium Enterprise Agency. The *White Paper* contains appendix tables that have comparative data for wage rates and other related data by the scale of the enterprise. Although the disparity in wages is shrinking, the wages paid at larger companies continue to differ from those at SMEs (Koike 1999, chapter 7). For example, if the wages paid by manufacturing companies that have 500 or more employees are set as a standard 100, then in 1999 companies that had 5–29 employees paid 54.3 relative to those wages, while those with 30–99 employees stood at 60.1, and those with 100–499 employees at 76.5 (*Small and Medium Enterprise White Paper 2000*, statistical appendix table 22, p. 30). As figures presented in Kohama (1999a, table 3) clearly indicate, the larger the size of the company, the higher its productivity (see also *Small and Medium Enterprise White Paper 2000*, statistical appendix table 22, p. 30, for

the scale of the enterprise). Productivity probably has to do with the high capital-to-labor ratio of large companies. At this point Shinohara's "hypothesis of capital concentration" comes into play. The Japanese economy had a high rate of growth and a relative shortage of capital, and because of imperfections in the capital markets and the labor markets, capital tended to concentrate in the large companies, with the outcome that the capital-to-labor ratios of the big companies is high (Kiyonari *et al.*1996, pp. 41–2; Shinohara 1976, p. 75). Koike (1999, chapter 7) writes that many arguments and suggestions state that "wage disparities between companies of different sizes have been virtually eliminated at the present time," a fact that can probably be explained by the likely elimination of these disparities as a country becomes industrialized, even though such disparities may have existed during its development process.

Let us now turn to a discussion of the subcontracting system. Although the base data used to create Table 2.7 are rather old, they illustrate the situation of the subcontracting system in the passenger car assembly industry (manufacturers of complete cars).[6] The data indicate a very pronounced pyramid, with 168 primary subcontractors, 4,700 secondary subcontractors, and 31,600 tertiary subcontractors. Fewer than 20 percent of primary subcontractors are SMEs, but 88.5 percent of secondary subcontractors and 97.5 percent of tertiary subcontractors are SMEs, representing nearly the entirety of this category.

A variety of systemic changes and institutional innovations are necessary for economic development. This condition holds true for the main bank system, a system that in the past was effective, but that is no longer functioning because of changes in the times and the economic environment. People typically find that getting rid of systems and policies that were once effective is hard, however. This difficulty may, in fact, be true of the relationship between large companies and small- and medium-sized parts-manufacturers in the automobile industry. Although the term "subcontractor" may be misleading in the context of the auto parts industry, the relationship between large automobile assembly companies and the parts-suppliers probably made economic sense. No matter how hard one tries to argue this position, however, the mere existence of a relationship by no means suggests policy implications. Although one cannot argue that the relationship developed out of pure historical happenstance, outsourcing was indeed a more competitive approach than in-house production, and that outsourcing in turn led to low cost and high quality with attendant improvements in competitiveness.

An understanding of the notion of what Asanuma (1989a, p. 74) terms "relation-specific skill" in the context of custom parts developed to enhance the automakers' competitiveness is important here. This approach, which contrasts with the use of interchangeable parts, assumes functionally similar elements between parts but requires parts that are specific to a particular company. The quality of these parts determines the quality of the final product. Relationship-specific skill posits the existence of a specific core corporate entity (that is, a large auto assembly plant), that has specific requirements. Parts-suppliers are deployed to supply intermediate manufactures that are appropriate to this

Table 2.7 Number of subcontractor establishments for each part for a certain passenger car manufacturer (1977)

	Percentage represented by SMEs for each layer	*Machine parts*	*Electrical parts*	*Drive, transmission, and steering parts*	*Suspension and brake parts*	*Gauges, etc.*	*Chassis parts*	*Body parts*	*Other parts (tires, etc.)*
First tier subcontractors	20.5	25	1	31	18	18	3	41	31
Second tier subcontractors	88.5	912	34	609	792	926	27	1,213	924
Third tier subcontractors	97.5	4,960	352	7,354	6,204	5,936	85	8,221	8,591
Percentage represented by SMEs by auto part		97.6	89.9	96.5	96.7	96.7	93.9	97.0	93.7

Source: *Small and Medium Enterprise White Paper 1978*, pp. 168–9. Original data: Small and Medium Enterprise Agency 1977.

Notes
The number of establishments for first tier is the actual number of establishments; adjustments made for redundancy in numbers of establishments for second and third tier subcontractors. Estimated 4,700 establishments for second tier, and 31,600 establishments for third tier subcontractors.
Partner factories are included in the number of subcontractor establishments.
Given the date of the materials, the original survey appears to be from 1977, although this is not clearly indicated in the white paper.

core company's specifications in the most efficient way possible. Relationship-specific skill is the capacity of the parts-supplier to maintain and develop this relationship with the core corporation. This ability to maintain and develop the relationship between the core company and the suppliers is enhanced by the interrelationship between the two through technology-related investment and know-how, accumulated through the process of manufacturing (Asanuma 1998a, 1998b; Fujimoto 1995).

Policies for the promotion of small- and medium-sized industries

The Japanese government has put into place a variety of policies for the promotion of small- and medium-sized industries. According to the *Outline of Small and Medium Enterprise Policy* (www.chusho.meti.go.jp), Japan's policy for supporting SMEs has four principle components:

- Strengthening the management base for SMEs (rectification of disadvantages for SMEs)
- Supporting structural reform of SMEs
- Promoting measures for small businesses
- Research and dissemination of information.

Strengthening SMEs management base includes providing financial and credit support for SMEs (coordinating with such organizations as the Small Business Finance Corporation and the National Finance Corporation; financing through the Shoko Chukin Bank, higher level financing through the Japan Small and Medium Enterprise Corporation; and strengthening the credit-worthiness and ability to secure financing by SMEs through insured finance corporations and credit associations) as well as providing preferential tax treatment and establishing associations to systematize and optimize conditions for subcontractor companies.

Measures to strengthen the management base of SMEs (which is to say, to correct disadvantageous conditions) are predicated on the notion that inefficiencies will develop in the economy as a whole if SMEs are left to the mercy of market mechanisms. You may argue, however, that banks will lend money for capital spending to large enterprises, but will not lend to small businesses, or that when banks do lend money, the interest rates are comparatively higher than those charged to large enterprises, but the reason for these practices just may be that they make economic sense in the short run, and as long as conditions are static. The risks associated with large enterprises are different from those of SMEs, and loan conditions such as collateral are also different. Nevertheless, at times establishing financial policies in support of SMEs is economically logical from the point of view of medium- and long-term perspectives and dynamic efficiency, as well as in terms of national economic policy as a whole (Teranishi 1991).

Support of structural reform encompasses supporting the development of new businesses, enhancing technological capabilities, promoting information technology,

supporting the development of local industries, taking energy and environmental countermeasures, and supporting internationalization. Support for small businesses essentially includes the same set of measures and also includes small business improvement loans (the *Maru-kei* system), the facilities-modernization loan system, the equipment leasing system, and the small business mutual aid system, among others. Promotion policies and laws are listed in Table 2.8. Many

Table 2.8 Chronology of government policies promoting small and medium enterprises (SMEs)

Year	*SME-related policy*
1946	Commercial and Industrial Union Law
1948	Law establishing the Small and Medium Enterprise Agency Basic Framework for Implementation of Small and Medium Enterprise Diagnosis (established diagnostic system)
1949	People's Finance Corporation Law; Small and Medium Enterprise Union Law
1950	Small and Medium Enterprise Credit Insurance Law
1952	Law on the Promotion of Corporate Rationalization Provisional Law on the Security of Specially-designated Small and Medium Enterprises
1953	Small and Medium Enterprise Finance Corporation Law; Chamber of Commerce Law Credit Guarantee Association Law; Small and Medium Enterprise Security Law
1956	Law on Funding Assistance for the Promotion of Small and Medium Enterprises; Department Stores Law Law on the Prevention of Delayed Payments to Subcontractor Firms Law on Temporary Measures for Textile Industry Facilities (Senkoho); Law on Temporary Measures for the Promotion of the Machine Industry (Kishinho)
1957	Law on Temporary Measures for the Promotion of the Electronics Industry (Denshinho), Law Related to Organizations for Groups of Small and Medium Enterprises (Dantaiho)
1958	Law on Small and Medium Enterprise Credit Insurance Public Financing
1959	Law on Special Measures for the Adjustment of Retail Businesses
1960	Law on Temporary Measures for the Promotion of Small and Medium Enterprises, Law Relating to Commercial and Industrial Organizations (Shokokaiho)
1962	Law on Shopping Center Promotion Associations, Establishment of Small and Medium Enterprises Guidance Center
1963	Law on Promoting B46 (Kinsokuho), Law Establishing Assistance Fund for Small and Medium Enterprise Modernization Small Business Investment Company Limited Law Small and Medium Enterprise Basic Law, Small and Medium Enterprise Guidance Law
1964	First Small and Medium Enterprise White Paper, Cabinet Decision (1963 edition)
1965	Small Enterprise Mutual Relief Projects Law

(*Continued*)

Table 2.8 Continued

Year	*SME-related policy*
1966	Law on Financial and Other Assistance for Small Business Modernization (Revision and name change of previous law) Revision of Law on the Promotion of the Modernization of Small and Medium Enterprises (establishing the system for SME structural reform)
1967	Small Business Promotion Corporation Law, Law on Temporary Measures for Structural Reform of Specified Textile Industries
1969	Partial revision of Law on the Promotion of Modernization of Small and Medium Enterprises (Establishing system for SME structural reform); SME Information Center gets under way
1970	Law on the Promotion of Subcontractor Small and Medium Enterprises
1971	Law on Temporary Measures for Preferential Treatment of Small and Medium Enterprises
1973	Partial revision of Law on the Promotion of Modernization of Small and Medium Enterprises (knowledge intensification) Large Scale Stores Law (Daitenho), Law on the Promotion of Small and Medium Retail Business System for Financing Management Improvements of Small and Other Enterprises
1974	Law on Temporary Measures for Structural Reform of the Textile Industry Law on the Promotion of Traditional Craft Industries (Densanho)
1976	Law on Temporary Measures for Conversion Countermeasures for Small and Medium Enterprises (Jigyotenkanho)
1977	Law on Sector Adjustments of Small and Medium Enterprises; Law on Small and Medium Enterprise Bankruptcy Prevention Relief
1978	Law on Countermeasures for the High Yen for Small and Medium Enterprises; Law on Temporary Measures for Stabilization of Specified Depressed Industries Law on Temporary Measures for Support of Small and Medium Enterprises in Specified Depressed Regions (Former Jokamachiho)
1979	Law on Temporary Measures for Producing-Area Small and Medium Enterprises (Sanchiho)
1980	Law on Organizations for Small and Medium Enterprises, The Institute for Small Business Management and Technology Law on Temporary Measures for Support of Small and Medium Enterprises Relating to Specified Businesses (new Jokamachiho)
1981	Start up of Small and Medium Enterprise Overseas Investment Advisory System
1983	Law on Temporary Measures for Support of Small and Medium Enterprises Relating to Specified Businesses
1985	Law on Temporary Measures for Promoting the Development of Technologies for Small and Medium Enterprises (Gijutsuho)
1986	Law on Temporary Measures for Conversion Countermeasures for Small and Medium Enterprises (New Jigyotenkanho) Law on Temporary Measures for Support of Small and Medium Enterprises in Specified Regions (Tokuteichiikiho)

(*Continued*)

Table 2.8 Continued

Year	*SME-related policy*
988	Law on Temporary Measures to Promote the Development of New Fields by Fusing the Knowledge of Small and Medium Enterprise Entrepreneurs for Different Fields (Yugokaho)
1989	Law on Temporary Measures for the Smooth Implementation of New Businesses (Shinkijigyoho)
1991	Law for Promoting Reform of Employment Administration to Secure Labor in Small and Medium Enterprises (Rokakuho)
1992	Law on Temporary Measures for the Revitalization of Specific Small and Medium Enterprises (Shuseki kasseikaho)
1993	Law Relating to Supporting Small Business Operators Through Chambers of Commerce
1995	Law on Temporary Measures for Promoting Business Creation Activities of Small and Medium Enterprises (Law Promoting SME Creation Activities)
1997	Law on Temporary Measures for Revitalizing Specified Industries

Source: Kohama and Watanabe (1996), p. 202; *Small and Medium Enterprise White Paper 1998*, pp. 253–70.

of these laws have long names and seem to overlap with one another, but the table does make clear that policy support for SMEs is broad and comprehensive (Kiyonari 1996, chapter 5; Kiyonari *et al*. 1996, chapter 5; Kohama and Watanabe 1996, pp. 200–5; H. Nakamura 1985, chapter 9; *Small and Medium Enterprise White Paper 1998*, pp. 253–70).

Technology innovation in small- and medium-sized industries

The primary reason for the success of small- and medium-sized industries in Japan is their ability to survive in the midst of competition from other SMEs, both in the product markets and the factor markets. The most important and decisive factor in the success of small- and medium-sized industries is the proliferation of appropriate technology. The process of technological innovation had an enormous impact on employment expansion as Japan made the transition from secondary import substitution to secondary export substitution (Ohkawa and Kohama 1989, p. 113 and chapters 3 and 4).

The important lesson to be drawn from the Japanese experience is that while adding efficiency through technological innovation, small- and medium-sized industries also absorbed workers in the labor pool, a fact that must not be overlooked. As I mentioned at the beginning of this chapter, some theorists argue that developing economies should include, as part of their development strategy, the promotion of small- and medium-sized industries as a means to promote the absorption of labor, but this view is mistaken. Given small- and medium-sized industries' limited ability to develop new technologies or to increase productivity, no matter how much policy is directed at promoting these industries,

essentially no relationship exists between them and economic development. Economic growth happens when particular small- and medium-sized industries, which have adopted modern management practices and show a willingness and ability to adopt and absorb new technologies, begin to develop.

Hideichiro Nakamura comments extensively on this issue in his "nucleus enterprise theory" (H. Nakamura 1985, chapters 3 and 4; see also Kiyonari 1996, pp. 72–7; H. Nakamura 1990, 1992, chapter 2). Hideichiro Nakamura's argument starts from the discovery of a class of companies from the end of the 1950s through the 1960s "which could not be described as huge companies, but which clearly exceed the bounds of small and medium enterprises" (H. Nakamura 1985, pp. 35–6). Hideichiro Nakamura lists four characteristics of nucleus enterprises:

- They are companies not associated with a large corporate *keiretsu*[7] group and are able to make independent management decisions.
- They are distinguished from other SMEs in societal terms because they have reached the stage of development at which they need to raise capital and get their stock listed in the Second Section of the Tokyo Stock Exchange.
- They retain their strong private, family-run character despite having gone public on the equity markets.
- They hold on to markets for their own products through product development and production technology, and they are highly profitable (H. Nakamura 1985, pp. 35–6).

These points are important. Companies that raise capital and have something unique to sell, such as products developed on their own and with their own production technology, while retaining the character of closely held, family-run businesses, thrive. Such businesses contrast with SMEs during the period of rapid growth when, I believe, it was possible for many SMEs to stay with standardized technologies, getting by just fine doing subcontractor work even if they did not have their own individual technologies. These days, in an era of borderless, international supplier-networks, survival is becoming increasingly difficult for companies if they do not have something unique to sell. The same truth holds for SMEs in developing countries. Companies that hang on simply by clinging to big parent corporations (large-scale assembly companies) in terms of management and technology will not survive over the long-term and will ultimately contribute little to the economic development of the countries in which they operate.

Economic trends and the shift to high tech

Finally, I will examine changes that occurred in the constitution of the Japanese economy and industry. Japan was faced with a wide variety of problems during the postwar period, particularly during the period of rapid growth. Throughout

the period, however, for every downturn, the economy soon got back on track. No matter what the industry, companies great and small recovered.

That era seems to have ended. We now see a polarized economy in which some industries do well and others do not, even when the economy enters the up-side of the recovery cycle. Gone is the time when analysts could easily identify a strong industry. I believe that we are now in an era when, in a broad sense, one can no longer say that a company is vital and strong simply because it has solid technology, no matter what the industry and no matter how large or small the company. Thus, new graduates just entering the work force will need to find some other set of criteria to decide where they want to work. The white-collar, salaried employee who has an exclusive focus on how his or her own company is doing is an endangered species. This fact is readily apparent to anyone who looks at the current state of the Japanese financial industry.[8] The October 4, 1999 issue of *Nikkei Business* (p. 29) compared the total market value of stock of the 20 top corporations in 1989 and 1999 and found Japan has entered a period of "deregulation industries" whereas the United States is entering a period of "deindustrialization." A glance at Table 2.9 shows that in 1989, at the peak of Japan's bubble economy, an overwhelming proportion of the 20 top companies were banks, occupying 11 of the top 20 slots. Today, however,

Table 2.9 Stock value ranking (top 20)

1989		*1999*	
Rank	*Company*	*Rank*	*Company*
1	Nippon Telephone & Telegraph (NTT)	1	NTT
2	Industrial Bank of Japan	2	NTT DoCoMo
3	Sumitomo Bank	3	Toyota
4	Fuji Bank	4	Tokyo–Mitsubishi Bank
5	Tokyo Electric Power	5	7-Eleven Japan
6	Dai-Ichi Kangyo Bank	6	Fujitsu
7	Mitsubishi Bank	7	Sony
8	Sanwa Bank	8	Sumitomo Bank
9	Toyota	9	Takeda Chemical Industries
10	Nomura Securities	10	Sanwa Bank
11	Nippon Steel Corp.	11	Fuji Bank
12	Matsushita Electric Industrial	12	Matsushita Electric Industrial
13	Hitachi	13	Dai-Ichi Kangyo Bank
14	Long-Term Credit Bank	14	Honda
15	Kansai Electric Power	15	Softbank
16	Mitsui Bank	16	Hitachi
17	Tokai Bank	17	Industrial Bank of Japan
18	Mitsubishi Trust and Banking	18	Ito-Yokado
19	Sumitomo Trust and Banking	19	Tokyo Electric Power
20	Tokyo Gas	20	Sakura Bank

Source: *Nikkei Business*, October 4, 1999, p. 29.

Long Term Credit Bank has gone bankrupt, and after another two or three years, hardly any of the past greats in Japanese banking will remain on the list.

Let us examine the high-tech industry. In Japan, the leading industry had been the machine industry. In connection with this fact, Ohkawa and I argued that high-tech industries were leading Japanese economy (Ohkawa and Kohama 1989, chapter 8). Although the debate itself was not in error, I believe that the terms of the debate have not been completely understood. For example, asserting that the machine industry is more technologically advanced when compared with the steel industry is an error. Furthermore, claiming that within the machine industry itself, the large assembly companies have more sophisticated technology than the small- and medium-sized parts-suppliers is a misunderstanding. If within the ranks of the large machine-assembly companies some companies have less sophisticated technology, then equally true is the assertion that some SMEs are in fact high-tech industries (Koseki 1998). One must not forget the fact that among the so-called in-town small factories are many vigorous companies, whereas many big companies have no vitality at all. Unfortunately, the latter can be an accurate description of most big Japanese companies.

The relationship between the Bank of Japan's director of the Research and Statistics Department and the manager of the Economic Research Section depicted by Kimura is probably typical (Kimura 2000, pp. 219–28).[9] Of course, in some instances at big companies, a manager who defies the company president can become president of the company himself. Tadashi Kume, Honda's third president, had a big argument with the founder, Soichiro Honda about whether to go with the air-cooled engine or the water-cooled engine. Legend has it that after that bitter fight, Kume stayed away from work for over a month. Takeo Fujisawa, then senior vice-president of Honda, persuaded then president Soichiro Honda to adopt the water-cooled engine, and Soichiro Honda accepted Fujisawa's advice. (NHK "Project X" Production Staff 2000, p. 237).[10]

Even famous corporations will disappear if they lack vitality. "The business just doesn't go on forever" (Makino *et al*. 1999).

3 The textile industry

A leading industry in developing countries

A country starts industrialization by establishing light industries. The textile industry is a representative industry of light industries. When Japan started its modern economic growth in the mid-1880s, the cotton textile industry was a major part of Japan's industrialization. The textile industry was one of the leading export industries of Japan in the 1950s.

The textile industry and the development phase

Most people believe that a country's industrial development phase begins with the growth of light industries such as the textile industry and the food production industry. No doubt, the lower the income level of a country, the larger the share of textile production.[1] A review of the history of Japan's industrialization shows that until around 1897, industrial production consisted primarily of cotton spinning, silk spinning, and fabrics (Arisawa 1966, p. 16). As mentioned in Chapter 2, silk products were the leading exports when Japan started the modern economic growth in the 1880s. The silk industry has a long tradition in Japan. It has characteristics of both a traditional industry and a primary industry.[2] Therefore, the production of silk thread and raw silk cannot unequivocally be called a modern industry. The manufacture of cotton thread and fibers, however, was no doubt an example of industrialization in the context of Japan in the Meiji era, lasting from the reign of the Meiji Emperor to the start of the modern era (1868–1912). Furthermore, after the war, around 1954, immediately prior to the start of the period of rapid economic development, nearly 40 percent of Japan's exports consisted of textile products (see Table 2.4).

When we development economists find that a low-income country does not have much of a textile industry, we want to know why. For example, Ghana is a low-income country with per capita income of U.S.$320 (WDI 2005, p. 22). Ghana is a typical low-income country in sub-Saharan Africa and is said to be succeeding in its structural adjustment program. Underlying the question of why Ghana does not have an appreciable textile industry is the rationale that Ghana, as a low-wage country, would enjoy a comparative advantage in the labor-intensive textile industry. Well, isn't the textile industry labor intensive?

An examination of industrial statistical classifications shows that, in a broad sense, the textile industry is coded as 11 (manufacture of textile mill products) and 12 (manufacture of apparel and other finished products made from fabrics and similar materials) in the classification system for manufacturing statistics.[3] Fibers are also included in the chemical industry as rayon and acetate manufacturing (industrial classification code 1741) and synthetic fibers (1742). The chemical industry is typically viewed as equipment and capital intensive, but the apparel industry as labor intensive.

On a survey trip to a developing country, I often visit a clothing factory. I find row upon row of Juki and other sewing machines operated by young workers.[4] I am immediately impressed with the degree to which this industry is labor intensive. The traveler visiting Southeast Asia should not neglect sightseeing, but he or she would do well to visit local factories, too. Although pursuing study through books and articles is important, seeing the world with one's own eyes is equally important. Truly, a picture is worth a thousand words. Another such example is a sneaker factory.[5]

The manufacture of everyday shoes is a prime example of labor-intensive industry. Sneakers are put together out of parts that are spread out alongside a long assembly line and applied to semi-finished sneakers one after the other using adhesives (*Far Eastern Economic Review*, December 10, 1998, p. 66). Once a certain consistent level of quality is achieved, sneaker production can be outsourced to low-wage countries. Sneakers are a typical example of a product suitable for outsourcing to a developing country. As I mentioned in Chapter 2, astonishing as it may seem, the subcontracting manufacture of Nike sneakers in Asia began in 1972 in Japan (Tassell 1997). The period of rapid growth in Japan was already coming to a close and had already passed the turning point in the labor market, yet outsourced sneaker production had just started (Tassell 1997). In 1972 the gap in income levels between Japan and the United States was still large, and per capita GNP in Japan, standing at U.S.$2,843, was half that of the United States, at U.S.$5,895 (IMF-IFS Yearbook 1998).

Thus, from the point of view of economics, I question the wisdom of making generalizations about the unique characteristics of production technology in the textile industry, encompassing apparel manufacturing as it does. For example, some analysts incorrectly argue that low-income countries have a comparative advantage in the textile industry. Even though T-shirt manufacturing is a labor-intensive industry, and low-income countries have a comparative advantage, the synthetic fibers industry is not labor intensive. The following is a bit off-topic, but I purchased my first Ethiopian-made T-shirt in December 1989 in Berlin, about one month after the fall of the Berlin Wall (November 9, 1989). I slipped out of a session of the international conference I was attending. Near the shattered remains of the Berlin Wall, I saw a souvenir vendor selling T-shirts. I bought some emblazoned with the images of Gorbachev and Batman. Those T-shirts were made in Ethiopia. I identified the division of labor between the north and the south. Europeans purchase T-shirts made in Ethiopia, like Japanese people purchase T-shirts made in Vietnam.

Is the textile industry labor intensive?

Although the data presented are somewhat dated, Table 3.1 presents a comparison of the capital-to-labor ratio (K/L) and factor input ratio (FIR = Lw/K) by industry in India, Japan, and Malaysia.[6] The factor input ratio concept is not used as frequently as the capital–labor ratio, but it is quite significant, although some cautions are in order when using the factor input ratio. The capital–labor ratio (K/L) figures in Table 3.1 are arranged from the most capital-intensive industries to the most labor-intensive industries according to the 1957 figures for Japan. Table 3.1 is divided, for the sake of convenience, into three categories, but these divisions have no particular significance. Category A contains the most

Table 3.1 Capital/labor ratios (K/L) and factor/input ratios by industry

		Japan (1957)		*Japan (1966)*		*India (1981)*		*Malaysia (1981)*	
		K/L	*Lw/K*	*K/L*	*Lw/K*	*K/L*	*Lw/K*	*K/L*	*Lw/K*
A	1 Oil	121	0.26	882	0.09	144	0.09	180	0.10
	2 Chemicals	84	0.32	230	0.28	83	0.16	28	0.25
	3 Steel	63	0.35	272	0.22	88	0.14	41	0.23
	4 Paper and Pulp	56	0.36	122	0.38	61	0.16	17	0.25
	5 Non-ferrous metals	48	0.58	161	0.39	90	0.15	30	0.25
B	6 Transport equipment	30	1.01	110	0.50	30	0.43	22	0.32
	7 Electrical machinery	27	0.79	69	0.69	25	0.50	11	0.42
	8 Foods	24	0.53	77	0.49	10	0.33	31	0.15
	9 Ceramics	23	0.72	96	0.49	25	0.26	31	0.15
	10 Fibers	22	0.56	61	0.52	13	0.64	17	0.27
	11 Printing	22	0.99	54	0.98	14	0.25	13	0.43
	12 Rubber	21	0.81	68	0.66	28	0.34	20	0.22
	13 General machinery	16	1.31	62	0.81	23	0.50	11	0.48
	14 Precision machinery	15	1.37	47	0.96	24	0.40	12	0.49
C	15 Leather and hides	13	1.31	39	1.13	13	0.55	8	0.39
	16 Metals	12	1.55	56	0.82	15	0.50	12	0.37
	17 Lumber	9	1.29	50	0.70	8	0.50	14	0.36
	18 Furniture	7	1.72	44	0.86	12	0.54	5	0.67
	19 Apparel	5	1.79	25	1.04	11	0.62	4	0.74
Manufacturing industry averages		29	0.62	91	0.51	45	0.20	18	0.27

Source: Ohkawa and Kohama (1989), p. 94, p. 116.

Notes
K = capital; L = labor; w = average annual salary.
Units: Japan = 1,000 yen; India = 1,000 rupees; Malaysia = 1,000 ringgits.
Fibers: textiles except apparel.

capital-intensive industries, including the petroleum, chemical, and steel industries, and requires no further discussion. The problem becomes how to compare the differences between the capital–labor ratios of the fiber and steel industries, and those of the fiber and machine tool industries.

In microeconomic terms, the capital–labor ratio is a line connecting the point at which a budget constraint line is tangent to the iso-production curve with the origin. Comparing the fiber and apparel industries, the apparel industry is overwhelmingly labor intensive, and is in fact the most labor-intensive industry, even among other labor-intensive industries such as the lumber and furniture industries. This fact holds true even when comparing statistics of India, Japan, and Malaysia.

A further complication arises when comparing the fiber, machine (particularly the general machinery industry), and precision machine industries. We tend to use the term "heavy chemical industry" casually, but probably many people think that the heavy chemical industry includes the petrochemical industry, the steel industry, and the machine industry. According to the statistics for Japan and Malaysia, however, the capital–labor ratios of the general machinery and precision machine industries are lower than those for the textile industry. In other words, the textile industry is actually more capital intensive than the general machinery and precision machine industries. Thus, viewed from the standpoint of manufacturing technology, thinking of the machine industry as subsumed in the heavy chemical industry is unrealistic.

The capital-to-labor ratios shown in Table 3.1 do not take into consideration labor quality and merely represent figures for capital-stock divided by the headcount of labor inputs.[7] The factor input ratio (Lw/K) takes into account labor quality, multiplying labor inputs by wage rates. If one thinks of Lw as the labor input, the machinery industry may be more labor intensive than the textile industry. Naturally, some may argue that this labor input reflects human capital and so should be added to the capital stock (K).

The growth and decline of the textile industry

The textile industry produces a variety of products. It starts with raw materials and proceeds in stages through spinning, fabric-making, and sewing. As I indicated earlier, the textile industry (for example, the spinning industry or the fabric industry) generally includes apparel and other fiber product manufacturing, and the synthetic fiber manufacturing industry (the chemical industry, as far as industrial classification is concerned).

The 1995 shipments of the textile industry amounted to ¥10.706 trillion. The industry had 104,000 establishments and 999,400 employees. Textiles represented 3.5 percent of total manufacturing industry shipments, 16 percent of establishments, and a 9.1 percent share of all manufacturing employees. Compared with other industries, the textile industry's value of shipments and number of employees per establishment is low.

The 2002 shipments of the textile industry were ¥6.278 trillion. The industry had 27,399 establishments and 489,214 employees.[8] Textiles represented 2.3

percent of total manufacturing industry shipments, 9.4 percent of establishments, and a 5.9 percent share of all manufacturing employees.

The textile industry has declined in relative economic importance. In 1950 textiles represented over 20 percent of the total value of all manufactured goods shipments (see Table 2.3).

Figure 3.1 shows long-term production trends in the production volumes of synthetic fibers and spun yarn since the beginning of the Showa era (the reign of the Showa Emperor, Hirohito, 1926–89). Although the production of spun yarn declined rapidly around 1970, the production of synthetic fibers remained flat. With 1990 as the base year (100), production index in 1996 fell below 75, and steep declines were registered in the 1990s (*The State of Japanese Industry 1997*, graph on p. 56). Export ratios (exports divided by production) were generally hovering around 30 percent at this time. Import penetration ratios (imports divided by domestic demand), which were less than 40 percent in 1987, exceeded 60 percent by 1996 (*The State of Japanese Industry 1997*, graph on p. 57).

The number of textile products increases as production proceeds from upstream production, including thread and cotton production, synthetic fibers, and yarn spinning to midstream production, including cloth production and dyeing, to downstream production, including knitting, secondary products, and the like. The further textile production moves from midstream to downstream production, the greater the fraction of production handled by small and medium enterprises. Table 3.2, which is based on the *Business Activities Survey 1996 Vol. 1* (Ministry of International Trade and Industry 1997) looks at the employee scale structure of the textile industry in a broad sense. Because this particular study focuses on companies that have 50 or more employees and capitalization of over ¥30 million, we do not learn about the corporate structures of companies with fewer than 50 employees. Nevertheless, we can get a clear reading of the differences between the synthetic fiber industry and the apparel industry.

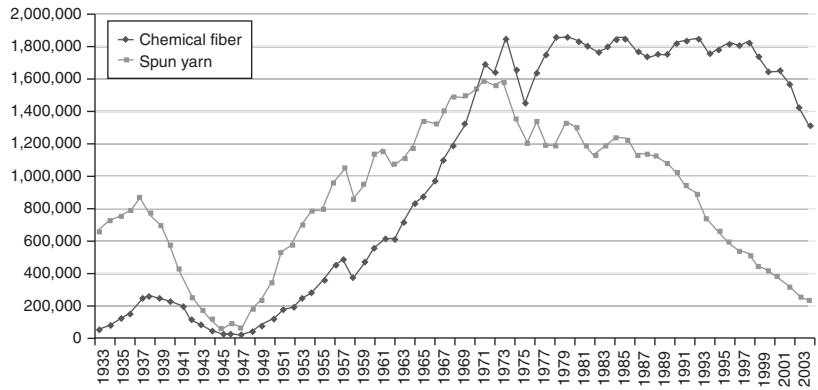

Figure 3.1 Long-term trend of textiles production (source: *Yearbook of Textiles and Consumer Goods Statistics*, various years, www.meti.go.jp/statistics/data/h2d6100j.html).

Table 3.2 Scale structure of the textiles industry (1996)

Number of employees	*Number of companies*	*Share of number of companies (%)*
Fiber industry	457	100.0
50–99	189	41.4
100–199	167	36.5
200–299	48	10.5
300–499	23	5.0
500–999	17	3.7
1,000 or more	13	2.8
Thread-making and spinning	56	100.0
50–99	18	32.1
100–199	22	39.3
200–299	10	17.9
300–499	2	3.6
500–999	2	3.6
1,000 or more	2	3.6
Woven and knitted fabric manufacturing	144	100.0
50–99	73	50.7
100–199	42	29.2
200–299	12	8.3
300–499	5	3.5
500–999	5	3.5
1,000 or more	7	4.9
Dyeing and finishing	129	100.0
50–99	46	35.7
100–199	55	42.6
200–299	18	14.0
300–499	4	3.1
500–999	4	3.1
1,000 or more	2	1.6
Other fiber industries	128	100.0
50–99	52	40.6
100–199	48	37.5
200–299	8	6.3
300–499	12	9.4
500–999	6	4.7
1,000 or more	2	1.6
Apparel and other textile products	563	100.0
50–99	230	40.9
100–199	194	34.5
200–299	53	9.4
300–499	42	7.5
500–999	29	5.2
1,000 or more	15	2.7
Woven and knitted apparel manufacturing	408	100.0
50–99	156	38.2
100–199	145	35.5
200–299	39	9.6
300–499	33	8.1

(*Continued*)

Table 3.2 Continued

Number of employees *Industry*	*Number of companies*	*Share of number of companies (%)*
500–999	23	5.6
1,000 or more	12	2.9
Personal accessories, etc.	155	100.0
50–99	74	47.7
100–199	49	31.6
200–299	14	9.0
300–499	9	5.8
500–999	6	3.9
1,000 or more	3	1.9
Chemical and man-made fiber manufacturing	21	100.0
50–99	1	4.8
100–199	3	14.3
200–299	5	23.8
300–499	3	14.3
500–999	2	9.5
1,000 or more	7	33.3

Source: Ministry of International Trade and Industry (1997), p. 248, p. 260.

Although 85 percent of apparel industry companies have fewer than 300 employees, the figure is 43 percent for the chemical fibers industry.

The 1995 worldwide production of fibers (yarn production), was 41.4 million tons. Of this total, 49.4 percent were natural fibers, and 50.6 percent were chemical fibers (see Table 3.3 for fiber classifications). Japan had a 3.5 percent share of this production. Table 3.4 shows the changes in Japan's fiber production

Table 3.3 Classification of textile fibers

Chemical fiber/man-made fiber
Regenerated fiber
Viscose rayon staple fibers, cuprammonium rayon staple fibers
Semi-synthetic fiber
Acetate staple fibers
Synthetic fiber
Nylon yarn, vinylon yarn, acrylic yarn, polyester filament fibers, polyethylene filament fibers, polypropylene filament fibers
Inorganic fiber
Glass fiber, carbon fiber
Natural fiber
Vegetable fiber
Cotton yarn, flax yarn
Animal fiber
Woolen yarn, silk

Source: *Textiles Handbook 1998*, p. 322.

structure. In 1960, at the beginning of the postwar rapid-growth period, natural fibers represented 60 percent of the share, and synthetic fibers, 40 percent. In absolute terms, natural fiber production declined from 760,000 tons in 1960 to 250,000 tons in 1997, and the share represented by natural fibers also declined precipitously. Japanese natural fiber production in 2003 represented less than 15 percent of the total, a figure that sets Japan widely apart from the world average share of natural fiber production (*Textiles and Consumer Goods Statistics of Japan* at www.meti.go.jp/statistics/data/h2d6100j.html).

Let us next turn to trends in textile industry employment. In 1950 the textile industry accounted for more than 20 percent of total employment in manufacturing industries; by 1990, however, this figure fell to 10 percent (Kohama and Watanabe 1996, p. 171). Table 3.5 shows the trend in the number of workers employed in the textile industry. Although the textile industry once absorbed the greatest number of manufacturing workers, and the number of these employees increased until 1970, textile industry employment subsequently fell rapidly, and 1990 employment levels were less than 80 percent of 1970 levels. If we look at fibers only, omitting apparel, the number of fiber workers fell by 1980 to 68 percent of 1970 levels, and by 1990 was no more than 50 percent of 1970 levels. Furthermore, in these figures we see an even more marked decrease in employment in the silk, spinning, and fabric-making industries.

Thus, the textile industry was next in line for industrial adjustment after the

Table 3.4 Production structure of Japanese textiles industry

	Textile fibers total	*Chemical fibers*	*Natural fibers*	*Cotton yarn*
Production (million tons)				
1960	1,270	512	758	544
1965	1,566	795	771	567
1970	2,036	1,290	746	526
1975	1,776	1,149	627	460
1980	2,479	1,832	647	504
1985	2,408	1,835	573	437
1990	2,348	1,812	536	426
1995	2,093	1,804	289	215
2000	1,837	1,643	194	159
Production share (%)				
1960	100.0	40.3	59.7	42.8
1965	100.0	50.8	49.2	36.2
1970	100.0	63.4	36.6	25.8
1975	100.0	64.7	35.3	25.9
1980	100.0	73.9	26.1	20.3
1985	100.0	76.2	23.8	18.1
1990	100.0	77.2	22.8	18.1
1995	100.0	86.2	13.8	10.3
2000	100.0	89.4	10.6	8.7

Source: *Japan Statistical Yearbook*, various years.

Table 3.5 Number of workers in textiles industry (index: 1970 = 100)

	1960	*1965*	*1970*	*1975*	*1980*	*1985*	*1990*
Manufacturing total (thousand)	9,545	11,507	13,541	13,158	13,042	13,837	14,544
Manufacturing total (1970 = 100)	70	85	100	97	96	102	107
Textiles industry total (thousand)	1,801	2,015	2,157	1,995	1,871	1,771	1,707
Textiles industry total (1970 = 100)	83	93	100	92	87	82	79
Textiles except apparels	98	101	100	80	68	60	50
Silk	178	132	100	70	53	30	23
Spinning and twisting	111	109	100	70	54	44	36
Fabrics	123	112	100	79	65	51	37
Knit fabrics	54	76	100	84	78	78	70
Dyed and finished textiles	88	103	100	88	81	72	61
Other textiles	79	94	100	85	75	70	67
Apparels	56	78	100	117	123	126	136

Source: Kohama and Watanabe (1996), p. 173.

Note
Figures in 1960–70 do not include Okinawa.

coal industry as the Japanese economy underwent structural change in the postwar period. The Japanese government implemented the Temporary Law Concerning Textile Industry Equipment (1956–61, 1961–4), the Temporary Law Concerning Textile Industry Equipment and other Industries (1964–70), and the Temporary Law Concerning Designated Textile Industry Structural Reform (1967–73) intended to promote the sale and disposal of excess production equipment and to promote structural reform of the industry. These laws designated the spinning, fabric-making, knitting, and dyeing sectors, and promoted strategic mergers and modernization of facilities by providing, among other things, preferential financing. In 1974 the Temporary Law Concerning Textile Industry Structural Reform was enacted (and extended for another five years in 1979). This law no longer limited its scope to specific textile industries and emphasized the need to modernize and enhance the efficiency of fiber-producing areas by changing over from traditional fiber manufactures.

Changes in supply and demand

Turning now to supply and demand in the textile industry, Table 3.6 shows trends in the supply and demand, import penetration (imports divided by domestic demand), and net export ratio (NER), for textile products starting in 1960. NER is defined as:

Table 3.6 Demand and supply of textiles (million tons)

	Production	*Imports*	*Domestic demand*	*Exports*	*Year-end inventory*	*Imports/ domestic demand*	*Inventory/ production*	*NER*
Textiles total								
1960	1,270	4	743	487	263	0.5	20.7	0.985
1965	1,566	6	1,050	495	385	0.6	24.6	0.975
1970	2,036	63	1,444	610	482	4.4	23.7	0.813
1975	1,776	131	1,309	639	634	10.0	35.7	0.660
1980	2,050	278	1,706	601	571	16.3	27.9	0.367
1985	1,983	466	1,784	631	595	26.1	30.0	0.150
1990	1,822	817	2,188	462	567	37.3	31.1	–0.278
1995	1,382	1,369	2,373	394	534	57.7	38.6	–0.553
2000	1,089	1,692	2,353	439	433	71.9	39.8	–0.588
Natural fibers total								
1960	758	3	439	297	163	0.7	21.5	0.980
1965	771	4	517	245	199	0.7	25.8	0.970
1970	746	49	637	147	214	7.7	28.7	0.500
1975	627	91	650	87	248	14.0	39.6	–0.022
1980	643	172	716	105	233	24.0	36.2	–0.242
1985	579	347	789	117	244	44.0	42.1	–0.496
1990	543	548	994	108	257	55.1	47.3	–0.671
1995	293	828	1,059	78	223	78.2	76.1	–0.828
2000	194	909	1,010	98	166	90.0	85.6	–0.805
Chemical fibers total								
1960	512	1	304	190	100	0.2	19.5	0.993
1965	795	3	533	249	186	0.5	23.4	0.980
1970	1,290	14	807	463	267	1.7	20.7	0.941
1975	1,149	40	659	552	386	6.1	33.6	0.865
1980	1,406	106	990	495	338	10.7	24.0	0.647
1985	1,404	118	995	514	350	11.9	24.9	0.627
1990	1,281	269	1,194	354	309	22.5	24.1	0.136
1995	1,089	542	1,314	316	311	41.2	28.6	–0.263
2000	895	783	1,343	341	367	58.3	41.0	–0.393
Cotton yarn								
1960	544	1	282	241	115	0.2	21.1	0.996
1965	567	1	341	206	133	0.3	23.5	0.989
1970	526	33	437	112	130	7.6	24.7	0.545
1975	460	67	465	74	160	14.4	34.8	0.050
1980	504	150	576	78	146	26.0	29.0	–0.316
1985	437	306	638	96	146	48.0	33.4	–0.522
1990	425	486	830	88	157	58.6	36.9	–0.693
1995	215	719	880	62	156	81.7	72.6	–0.841
2000	159	807	888	81	116	90.9	73.0	–0.818
Synthetic fibers								
1960	154	0	125	15	36	0.3	23.4	0.948
1965	388	1	269	113	110	0.4	28.4	0.982
1970	898	10	517	356	208	1.9	23.2	0.945

(*Continued*)

Table 3.6 Continued

	Production	*Imports*	*Domestic demand*	*Exports*	*Year-end inventory*	*Imports/ domestic demand*	*Inventory/ production*	*NER*
1975	924	34	508	481	319	6.7	34.5	0.868
1980	1,180	100	841	418	295	11.9	25.0	0.614
1985	1,196	111	855	437	311	13.0	26.0	0.595
1990	1,102	257	1,074	279	282	23.9	25.6	0.041
1995	960	499	1,202	258	279	41.5	29.1	–0.318
2000	815	733	1,259	293	266	58.2	32.6	–0.429

Source: *Japan Statistical Yearbook*, various years.

Note
NER = (exports – imports)/(exports + imports)

$$(\text{exports} - \text{imports}) \div (\text{exports} + \text{imports})$$

It varies between –1 and +1. NER can be thought of as the simplest ex post indicator of international competitiveness. When the NER is positive, the country is a net exporter. The smaller the indicator, the more the country loses international competitiveness with the passage of time.

A look at the NER for the Japanese textile industry as a whole reveals a rapid decline in international competitiveness. Japan became a net importer of textile products in the late 1980s and a net importer of natural fibers even sooner, in the early 1970s. Conversely, despite a decline in the international competitiveness of Japan's synthetic fibers industry, for Japan to become a net importer in this sector took until the early 1990s. In short, the timing of Japan's transition to a net importer depends on which fiber we are considering. Viewed in terms of all natural fibers, Japan had already become a net importer by the mid-1970s, but the country became a net importer of synthetic fibers nearly 20 years later in the early 1990s.

As mentioned previously, import penetration (the ratio of imports to domestic demand) in Japan rose rapidly. Import penetration for all textile products stood at just 10 percent in 1975, but by 2000 this figure had risen to over 70 percent. The rise in import penetration for natural fibers was even more pronounced, soaring from 14 percent in 1975 to 90 percent in 2000.

According to optical disk advertisements by the Teijin Corporation (Teijin means Teikoku rayon silk), which I have seen in the bullet train and elsewhere, the decline of the textile industry only tells us that diversification is proceeding on-track. But that isn't necessarily so. That is not to say that overseas production isn't booming. The overseas production ratio of textile industry is significantly lower than that for electric machinery, however.

4 The steel industry

A typical industry of semi-industrial countries

Production processes and products of the steel industry

Japan's crude-steel production peaked in 1974. It was less than 100 million tons in 1998 and 1999, but since 2000 Japan has produced more than 100 million tons of crude steel. Japan produced 116.2 million tons in 2006, of which 86.0 million tons was produced by steel converters, 74.0 percent of the total. The remaining 26.0 percent was produced by electric furnaces (www.jisf.or.jp/data/seisan/index.html). As is apparent in Figure 4.1, Japan no longer has any open-hearth furnace steel production. Advanced countries, such as Korea, do not use the open-hearth method for crude-steel production, although roughly 22 percent of Russia's 2005 steel production was made in open hearths (*Steel Statistics Handbook 2006*, pp. 40–5).

Steel is iron with a 0.35–1.7 percent carbon content. It is typically called "carbon steel" or "ordinary steel" and is used in structural components, machine parts, tools, and many other applications. At construction sites, steel is used in the wide flange beams that constitute a building's superstructure. Steel is the reinforcement inside concrete. In automobiles, despite increasing inroads made by plastics, frames and bodies are still made almost exclusively of steel. The breadth of steel's applications in industry is readily apparent from the "steel" row of input–output tables. In addition to elemental carbon, steel is alloyed with silicon, manganese, chromium, nickel, vanadium, molybdenum, and other elements to produce specialty or alloy steels, which are used in a wide range of special applications.

Several methods are used to make steel, including the converter (oxygen top-blown converter, which is the same as LD converter), the open-hearth, and the electric furnace. The oxygen top-blown converter and the continuous casting process are the most important technological innovations for postwar Japan's steel industry, as will be discussed later. The increasing size of blast furnaces, the development of gigantic bulk ore-carrying ships, along with the development of steel plants on the coastal areas, also contributed to the development of the Japanese steel industry.

Figure 4.2 outlines steel production flows. Interested readers are directed to a somewhat more detailed description, complete with figures, which is to be found at the beginning of *Steel Statistics Handbook 2006* (p. 1). The blast furnace,

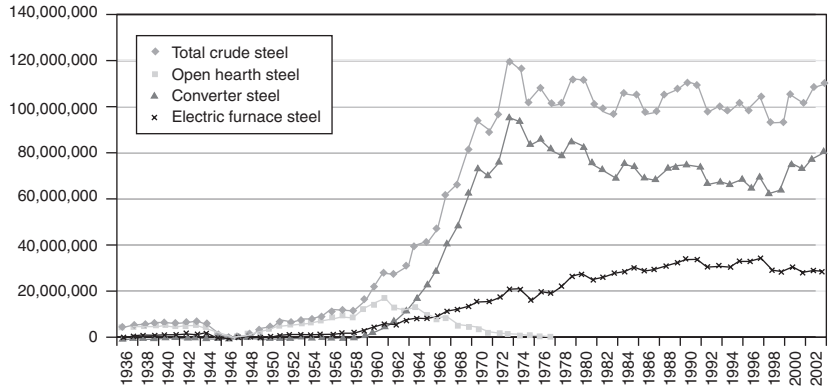

Figure 4.1 Crude-steel production of Japan (source: *Steel Statistics Yearbook 1996*, p. 156; *Steel Statistics Monthly*, March 1998, pp. 12, 14; *Steel Statistics Monthly*, October 2000, pp. 20, 22; *Steel Statistics Handbook 2003*).

which is iconic of the steel industry, is where nearly all pig iron is produced. Electric furnaces are stocked mainly with steel scrap, as shown at the right of Figure 4.2. As indicated at the beginning of this section, open-hearth steel production has ceased in Japan, but in its day, the open-hearth used a combination of pig iron and steel scrap to produce steel.

Simply stated, the steel production process is the following. A blast furnace produces pig iron by heating iron ore in combination with coke, which serves as a reducing agent (bear in mind that coke is not the heat source, but a reducing agent). Coke itself is produced in coke ovens from coking coal. Pig iron can also be made using natural gas as the reducing agent in a process known as "direct reduction." Although the steel industry is typified by economies of scale, the ideal scale for the direct reduction method, in contrast to the blast furnace, is quite small.

The molten steel is then cast into the shape of semi-finished or finished products. Compared with forging, casting makes creating intricate and large shapes easy. Cast-steel products are used in construction equipment, engines, pumps, tractors, and other machines. Forged steel is produced by pressing or hammering steel billets or ingots and is primarily used to make machine parts. Continuous casting or ingot roughing mills produce billets or blooms, which are semi-finished steel products. These billets and blooms are then rolled to create a variety of products as shown in Figure 4.2.

Table 4.1 provides a grouping of the steelmakers. There are approximately 30 steel manufacturers around the world, and their relative shares of crude-steel production are shown in Table 4.2. In 2002 the world's leading steel manufacturer was Arcelor of Luxembourg, with 4.9 percent share of world crude-steel production.[1] LNM Group of the Netherlands occupies the second position with a 3.9 percent share. Nippon Steel of Japan was the third with a 3.3 percent share. POSCO of Korea was the fourth with a 3.1 percent share. In eighth place is NKK (the former Nippon Kokan). Kawasaki Steel is in 11th place, Sumitomo

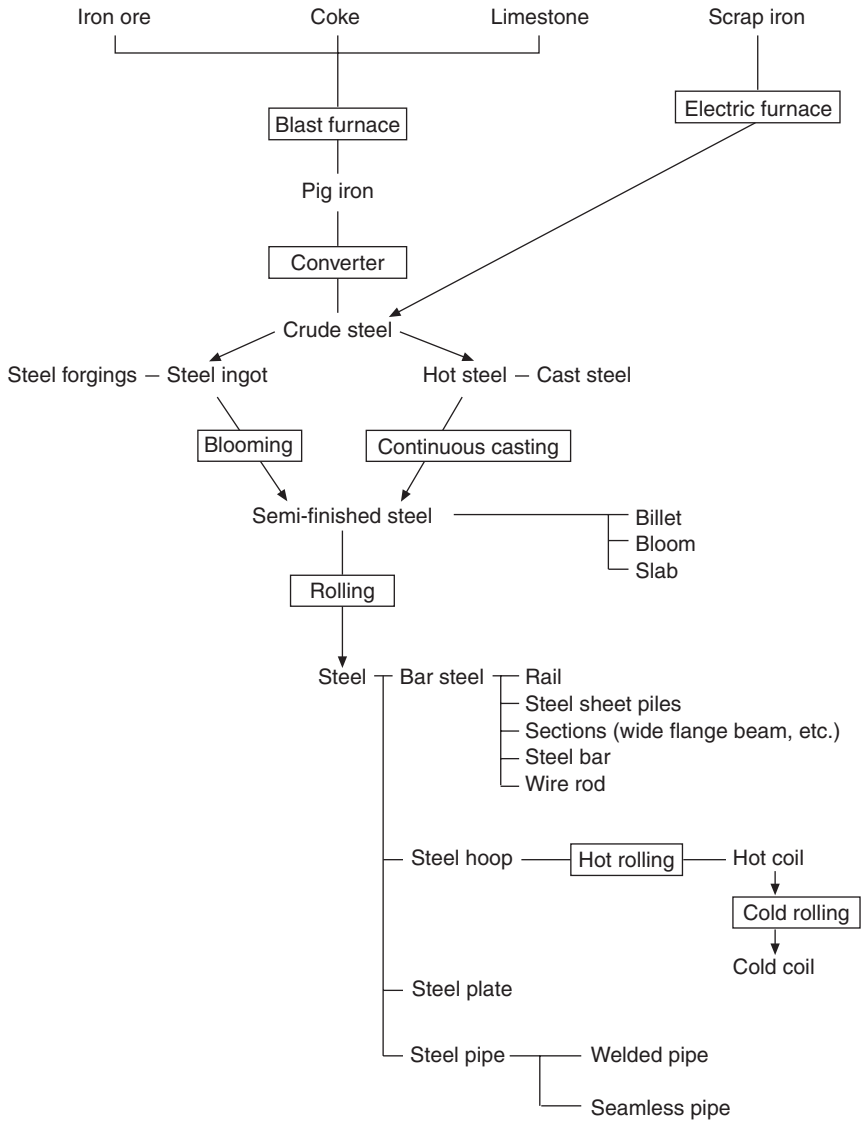

Figure 4.2 Steel production flow.

Metals in 13th place, and Kobe Steel in 27th place. These are Japan's five leading steelmakers, the "Big Five."

Korea's POSCO was established as Pohang Iron and Steel Company in April 1968. POSCO lit its first blast furnace in 1973, the year of the first oil shock, so this company is one that has grown very rapidly indeed.[2] POSCO started as a state-owned enterprise, and was completely privatized in October 2000. The growth of Korea's steel industry is a classic example of the latecomer's advantage.

Table 4.1 Grouping of steelmakers

Integrated steelmakers	Have blast furnaces, and goes from iron ore to finished steel products using an integrated production process.
Electric furnace steelmakers	Use electric furnaces to melt primarily steel scrap to produce steel products.
Steel rolling mills	Roll and otherwise process semi-finished steel products.
Rerollers	Use steel scrap and other materials to make steel products.
Cast and forged manufacturers	Use molten steel poured into molds to create steel castings, or hammer-forging of ingots of billets to create forged steel products.

Source: *The State of Japanese Industry 1997*, p. 142.

Table 4.2 Major steelmakers and crude-steel production (2002)

Company	*Country*	*Production (million tons)*	*Production share (%)*
1 Arcelor	Luxemburg	44.0	4.9
2 LNM Group	Netherlands	34.8	3.9
3 Nippon Steel	Japan	29.8	3.3
4 POSCO	South Korea	28.1	3.1
5 Shanghai Baosteel	China	19.5	2.2
6 Corus	U.K.	16.8	1.9
7 Thyssen Krupp	Germany	16.4	1.8
8 NKK	Japan	15.2	1.7
9 Riva	Italy	15.0	1.7
10 US Steel	U.S.A.	14.4	1.6
11 Kawasaki	Japan	13.7	1.5
12 Nucor	U.S.A.	12.4	1.4
13 Sumitomo	Japan	11.8	1.3
14 Gerdau	Brazil	11.5	1.3
15 SAIL	India	11.4	1.3
16 Magnitogorsk	Russia	11.0	1.2
17 China Steel	Taiwan	10.5	1.2
18 Anshan	China	10.1	1.1
19 Severstal	Russia	9.6	1.1
20 Novolipetsk	Russia	8.6	1.0
21 Shougang	China	8.2	0.9
22 Bethlehem Steel	U.S.A.	8.1	0.9
23 Wuhan	China	7.6	0.8
24 NISCO	Iran	7.3	0.8
25 INI Steel	South Korea	7.3	0.8
26 Krivorozstal	Russia	6.9	0.8
27 Kobe Steel	Japan	6.6	0.7
28 BHP Steel	Australia	6.4	0.7
29 Benxi	China	6.2	0.7
30 Mariupol (Llych)	Ukraine	6.1	0.7
Crude-steel production – World Total		902.0	100.0

Source: International Iron and Steel Institute (2003), pp. 1–2.

The latecomer's advantage and social capability

With the exception of England, which began the industrial revolution, all countries, including France, Germany, and the United States are latecomers to industrialization. Among the G7 countries, Japan is the latest of the latecomers. As they industrialize and struggle to catch up with competing countries, all latecomer countries – without exception – import the best technology from earlier developers. The Meiji-era Japan of the ninteenth century not only needed to import technology, but it needed to import the concepts of a constitution, a military, and nearly all other systems from Europe as well. Economic historian Alexander Gerschenkron described the latecomer's advantage, in which latecomers are able to import the most up-to-date technology from more advanced countries, thereby reducing the number of years required for the latecomer to attain a given level of industrialization when compared with the time it took for the more advanced country to reach that same level of industrialization. This effect is also known as the "compressed process," or "telescoping process" (Gerschenkron 1962; Ohkawa and Kohama 1989, pp. 82–4; Watanabe 1985, chapter 2). I should add, however, that the latecomer's advantage represents no more than a *latent potential* for development. Whether or not a country realizes its latecomer's advantage depends very much on the social capability of the country.

Even though all developing countries today are latecomers, some countries catch up rapidly with industrial countries, and others do not develop economically, tending instead to retrogress. All developing countries are able to gain access to a spectrum of technologies, from the newest of the new technologies to somewhat older technologies. The question is, which technology should a country import that will best suit its own economic and social environment? And further, what factors within that country must be improved to receive that technology? The ability to adapt to new technology can be called "social capability."

Although social capabilities naturally include such factors as a country's general level of education, they also refer to the level of workplace training and craftsmanship. For example, the rapid industrialization of nineteenth-century Meiji Japan was ordained from above. Nearly all the machines necessary for factory production were imported, and precious foreign-exchange was used for these important purchases. At the shop-floor level, however, a machine could not simply be repaired by buying parts; Meiji-era Japanese craftsmen are said to have actually fabricated replacements for metal parts out of low-cost wood. Such creativity is an excellent example of social capability and technical adaptability.

Two technical developments emerged as critical for the development of the Japanese steel industry, an industry that in turn led Japan's rapid postwar economic development. These two developments were the basic oxygen furnace (BOF), in which pure oxygen is blown into the molten iron resident in the steel converter (which is also known as the "LD converter") and the continuous casting. Without these two developments, the rapid growth of the Japan's steel industry would have been unthinkable. The basic oxygen furnace was developed

in 1952 in Austria, but Japanese companies began the aggressive introduction of the basic oxygen furnace into their steel manufacturing processes around 1957. The process was continually improved and soon marked a genuine innovation in the steelmaking process (Yonekura 1991, pp. 268–73). The key here is that *the process was improved*.

Social capability is an abstract concept that is concerned with the ability of a country to integrate borrowed or imported technology into its own economic environments. It is a difficult notion to quantify. As I said earlier, social capability is heavily dependent on the general level of education, worker training, and capacity for on-the-job training, and it also includes the degree to which legal systems are established and functioning.

Development of the Japanese steel industry

Figure 4.1 shows a graph of Japan's crude-steel production from 1936 to 2003. Figure 4.1 breaks crude-steel production into three components: open-hearth, converter, and electric furnace. The most striking thing about this chart is the steep rise in steel production from the late 1950s to the early 1970s. The first oil shock took place in 1973, which happens to be the year in which Japanese crude-steel production peaked, at approximately 120 million tons. From that point onward, annual production has hovered around 100 million tons. This pattern closely mirrors the transition from Japan's period of rapid growth to a period of lower growth rates (for trends in Japan's postwar economic growth, see Figure 10.3).

Figure 4.1 also shows that Japan's prewar steel production was incomparably smaller than it was after the period of rapid economic growth. Peak steel production prior to the end of the war was reached in 1943, at 7.65 million tons. Japan surpassed that level of production by 1953, at the time as the truce ending the Korean War. In 1956 crude-steel production exceeded ten million tons for the first time. It passed 20 million tons in 1960, 40 million in 1965, 60 million in 1967, and 100 million in 1973. In the 18-year period from 1955 to 1973, steel production tonnage grew at an average annual rate of 15 percent. This rate translates into a doubling of steel production in less than five years.

Let us now turn to steel exports. Figure 4.3 charts Japan's ordinary steel exports from 1961 to 2003. In 1961, at the start of Japan's income-doubling plan, Japanese steelmakers shipped less than two million tons of steel. By 1976 steel exports reached a peak of 32.5 million tons, an annual growth rate on a tonnage basis of 19 percent over the 16-year period. At the start of the period of rapid growth, Japan's steel exports represented about 5 percent of total world steel exports. As Japan made the transition from rapid to slow growth, Japan's share of world steel exports stood at around 20 percent, making Japan the world's largest steel exporter. After 1976, however, Japanese steel product exports began a downward trend which, despite a small amount of growth in the mid-1980s, left the industry fluctuating between 15 and 20 million tons per year during the 1990s. Opinion is divided as to whether or not this trend indicates a true decline in the Japanese steel industry. For example, Itami *et al.* (1997, p. 6)

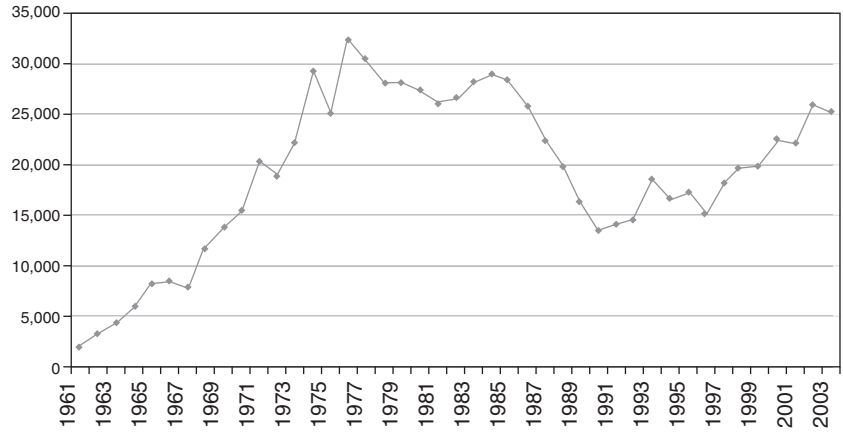

Figure 4.3 Ordinary steel exports of Japan (source: *Steel Statistics Handbook*).

believe the industry is "mature" and not in "decline." Table 2.4 in Chapter 2 shows that steel exports represented 9.6 percent of all Japanese exports in 1960, the start of the country's period of rapid growth. Steel's share had risen to 18.2 percent of total exports by 1975 and declined to 4.6 percent in 2006.

Table 4.3 shows the crude-steel production of the major steel-producing nations in 1955, just before the start of Japan's period of rapid growth, and in 2003. For the sake of convenience, countries with over ten million tons of annual crude-steel production as of 2003 are considered to be major steel-producing nations. The rightmost column of Table 4.3 shows the rate of increase in crude-steel production over the course of the 48-year period from 1955 to 2003.

Japan's 1955 steel production was 9.4 million tons, or 3.4 percent of the world total. The leading steel manufacturer in 1955 was the United States, with production in excess of 100 million tons, representing 39 percent of the world total. The Soviet Union was second after the United States, with 17 percent of world production. Japan was sixth in the world, after the Federal Republic of Germany, the United Kingdom, and France. By 2003 Japan's crude-steel production had increased by a factor of more than eleven, and represented nearly 12 percent of the world's total, ranking second behind China. Korea's and Taiwan's (China) steel production in 1955 was negligible, but by 2003 their respective shares of world steel production stood at 4.9 and 2.0 percent, with Brazil, Mexico, Turkey, India, Spain, and other countries, following. During the same period, world crude-steel production increased 3.5 times, with Brazil, Mexico, and Korea coming on as steel producers; at the same time, however, U.S. and British steel production fell by an amount corresponding to the gains posted by these other countries, so that with the exception of Japan and Italy, the industrial countries' production of crude steel grew at rates below that of the worldwide average. The Russian Federation increased crude-steel production by a mere 1.4 times, because the 1955 statistics are for the entire Soviet Union,

Table 4.3 Crude steel production by country in 1955 and 2003

	1955		*2003*		*2003/1955*
	Production (million tons)	*Share (%)*	*Production (million tons)*	*Share (%)*	
Belgium	5,894	2.2	11,128	1.2	1.9
France	12,631	4.6	19,803	2.1	1.6
Germany	27,342	10.0	44,841	4.7	1.6
Italy	5,548	2.0	26,740	2.8	4.8
Spain	1,213	0.4	16,129	1.7	13.3
United Kingdom	20,108	7.4	12,949	1.4	0.6
Turkey	197	0.1	18,298	1.9	92.9
Russia	45,271	16.6	61,325	6.5	1.4
Ukraine	na	na	36,707	3.9	na
Canada	4,114	1.5	15,399	1.6	3.7
Mexico	761	0.3	15,237	1.6	20.0
United States	106,173	38.9	91,360	9.7	0.9
Brazil	1,162	0.4	31,105	3.3	26.8
China	2,853	1.0	220,115	23.3	77.2
India	1,732	0.6	31,779	3.4	18.3
Japan	9,408	3.4	110,510	11.7	11.7
South Korea	11	0.0	46,306	4.9	4,209.7
Taiwan	40	0.0	18,903	2.0	472.6
World Total	273,000	100.0	945,140	100.0	3.5

Source: *Steel Statistics Handbook 1974*, pp. 42–5; www.worldsteel.org/csm_archive.php

Notes
Countries producing over ten million tons of crude-steel in 2003 are listed in the table.
The world total in 2003 is the 63 countries' total, which is approximately 98 percent of total world crude-steel production.
Gemany's figure in 1955 is the total of West and East Germany. West Germany produced 24.5 million tons of crude-steel in 1955.
Russia's figure in 1955 is the Soviet Union's.

while the 2003 figures are for the Russian Federation only, so they are naturally smaller – if we look at the Commonwealth of Independent States as a whole in 1999, the production growth rate stood at 2.3 times.[3] Thus, in terms of steel production, the Russian Federation exhibits the character of a semi-industrial country, and not that of an advanced country.

Figure 4.4 shows trends in crude-steel production in China, Japan, Korea, the United Kingdom, and the United States. The United Kingdom and the United States are typical steelmaking industrial countries, whereas China and Korea typify developing steelmaking countries. The graph clearly shows the transition of Japan from a developing country to an industrial country. Crude-steel production in the United Kingdom and the United States is that of an industrial country, with a flat or slightly declining trend in production. Although fully integrated steel manufacturing in China and Korea is growing, integrated production grew

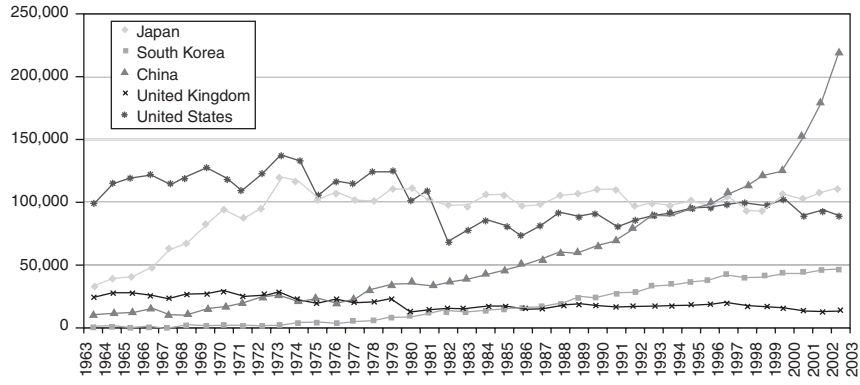

Figure 4.4 Crude-steel production by country (source: *Steel Statistics Handbook*).

rapidly in Japan until the mid-1970s, then reached a plateau or edged downward.[4] From 1982 to 1995, Japan was the largest steel-producing country in the world.

As can be surmised from the trends shown in Figure 4.4, the international competitiveness of the developing steelmaking countries is rising solidly. Japan on the whole has always been a net steel exporter, and I will have more to say on this subject later in the chapter. Different trends become apparent, however, as we look at each country individually. Let us look, for example, at the steel trade between Japan and Korea. Until 1973, when Korea began blast furnace steel production, Japan was engaged in the one-way export of steel products to Korea. In terms of the total of ordinary steel products, Japan has been a net importer of these products from Korea since 1987 (an exception was 1999 – because of the economic crisis in Korea, Japan became a net exporter of carbon-steel products). Furthermore, if we look at steel trade between the two countries on a product-by-product basis, Japan became a net importer of steel plate, which is a relatively easy product to make, at the end of the 1970s, but Japan has been able to maintain its competitiveness in seamless pipe and other, more technically challenging, steel products (Kimura and Kohama 1995, p. 39, figure 2.2). Looking at 2002 figures, the Japanese steel industry had 4,589 establishments, 209,087 employees, and a shipment value of ¥11 trillion, representing 1.6, 2.5, and 4.1 percent, respectively, of manufacturing total (*Census of Manufactures 2002*, pp. 2, 35). The ranking of the steel industry has been in decline in relative terms, however, as shown in Table 4.4. Although the value of shipments as a share of all manufacturing was approximately 10 percent in 1960, that share had slipped to 4.1 percent by 2002. As I suggested earlier, the decline in steel's share of exports has been even greater, falling from 18 percent in 1975 to 4.6 percent in 2006.

We turn next to the supply and demand picture (Table 4.5). Export ratios increased until 1976–7, and then declined by 20 percent, precisely the same pattern shown in Figure 4.3. If we look ex post facto at the net export ratio as an

indicator of international competitiveness, although Japan's net export ratio of steel products shows no change, and the ratio holds constant at nearly one from the late 1960s to the late 1970s, the ratio begins a downward trend in the late 1980s. Imports rose rapidly, beginning in 1979, and by the time of their peak in 1991, imports represented nearly 10 percent of apparent consumption. These days, it is practically a given that a portion of steel products consists of imports, but up until about 20 years ago, speaking of steel imports in Japan would have been virtually unthinkable.

At the beginning of the 1980s, I contributed a paper to the journal *Ajia Keizai* (*Asian Economies*), in which I wrote, "There is really nothing to worry about since the import penetration rate for sheet steel is only about 2 percent" (Kohama 1983, p. 91). Although I received no direct complaints, I recall that the Institute of Asian Economics, the publishers of *Ajia Keizai*, received angry letters of protest from the directors of the Federation of Industrial Organizations (*Keidanren*) and of the Japan Iron and Steel Federation (*Tetsuren*). These letters asserted that if such views were carried by a publication of the Institute of Asian Economics, an organization under the aegis of MITI (at the time), it could give the impression that the Japanese government condoned steel imports as an acceptable fact of life.[5] These days, at a time when we see strategic alliances between companies such as Nippon Steel and Korea's POSCO, that kind of thinking truly belongs to another era (see, for example, "Partnership talks start with POSCO Steel: Interview with Nippon Steel's President Akira Chihaya," *Asahi Shimbun*, June 14, 1998, p. 9).

Competition, technological innovation, and industrial policy

Viewing the development of the Japanese steel industry through the lens of development economics is fascinating. On a foundation of government–private sector (*kan–min*) cooperation and a rapid increase in internal and external demand, the process of technological innovation proceeded and blast furnaces grew in size, the LD steel converter became the main method of steel production, and giant bulk ore-carriers were built to carry the raw materials to Japan's giant seaside steelworks.

Up until 1960, Japan was a developing economy (see Chapter 1). The move to economic self-sufficiency and industrial rationalization in the 1950s could be restated, in present-day development economics terms, as the key factor in efforts toward structural adjustment between the government and private industry. In Japanese, the *kan* (government) should be taken to mean government in a very Japanese sense. In historical terms, *min* (private sector, or business) is a main actor of development, which is supported by the government. The early 1950s got underway with the Steel Industry First Rationalization Plan,[6] the Coal and Mineral Industry Rationalization Plan, the Five-Year Electric Power Development Plan, and the Industrial Rationalization Plan for planned shipbuilding (Kosai 1988), but in fact, one cannot cite any particular success attributable to this government–business interrelationship.

Table 4.4 Changes in the steel industry's relative position

	1950	*1953*	*1954*	*1955*	*1960*	*1965*	*1970*	*1975*	*1985*	*1990*	*1995*	*2000*	*2002*	*2003*
Share of shipment value (%)	9.6	—	—	9.6	10.6	—	9.5	—	6.6	—	—	3.9	4.1	—
Export share (%)	—	10.9	10.3	12.9	9.6	15.3	—	18.2	7.8	4.4	4.0	3.1	—	3.8

Source: Tables 2.3 and 2.4.

Table 4.5 Trends in the supply and demand for crude steel

	Production	*Imports*	*Exports*	*Apparent consumption (million tons)*	*Export ratio*	*Net export ratio*	*Import penetration (%)*
1960	22,138	308	3,144	19,302	14.2	0.822	1.6
1965	41,161	32	12,705	28,488	30.9	0.995	0.1
1970	93,322	126	22,323	71,125	23.9	0.989	0.2
1975	102,313	120	34,353	68,080	33.6	0.993	0.2
1980	111,395	1,273	33,661	79,007	30.2	0.927	1.6
1985	105,279	3,066	34,967	73,378	33.2	0.839	4.2
1990	110,339	7,555	18,862	99,032	17.1	0.428	7.6
1995	101,640	7,534	24,834	84,340	24.4	0.534	8.9
2000	106,444	5,564	31,447	80,561	29.5	0.699	6.9
2002	107,745	3,585	38,553	72,777	35.8	0.830	4.9

Source: *Steel Statistics Handbook*, various years.

Notes
Exports and imports are converted to quantities of crude steel.
Apparent consumption = production + imports − exports.
Export ratio = exports/production.
Net export ratio = (exports − imports)/(exports + imports).
Import penetration = imports/apparent consumption.

For example, in the summer 1950, the first president of Kawasaki Steel, Yataro Nishiyama, announced the company's plans to build a fully integrated steelworks in Chiba, next to Tokyo. The government and the existing steel industry at the time were vehemently opposed to Kawasaki's plans because of the overcapacity of steel production in Japan at that time. The story goes that the then governor of the Bank of Japan (central bank), Hisato Ichimanda, went so far as to threaten Nishiyama. Allegedly Ichimanda declared, "You just try to build a steel mill on that site. I'll see that it gets planted over in weeds!" Kawasaki Steel went ahead anyway, however, and started up operations at the Chiba Works in June 1953, squeezing within the limits of the Steel Industry First Rationalization Plan by claiming that the plant's 700 ton-per-day output was actually 500 tons. This anecdote is a first-rate example of how private industry, driven by an indomitable will to invest in new plant and facilities, succeeded in overcoming the opposition of both government and industry to become a fully integrated steelmaker. It is also important as an example of entrepreneurship in postwar Japanese industrialization (Yonekura 1994, chapters 8 and 9). This story is but one episode, but what we see here is how the initiative taken by industrialists can actually bring about the reshaping of an industry.

I mentioned earlier the "Big Five" integrated steelmakers. In 1970 there were in fact six integrated steelmakers, until Yawata and Fuji Steel merged. Immediately after the war, however, only three steelmakers remained: Yawata Steel, Fuji Steel, and Nippon Kokan. Latecomers entering the field were Kawasaki Steel, Sumitomo Metals, and Kobe Steel. Notwithstanding that these new entries into the field constituted a majority, one can sense the intention of the Japanese government (MITI) to implement its policies. No doubt the entry of new players (or the latent potential for new entries) intensified competition in the integrated steel industry. Nevertheless, over time the market shares of the respective steelmakers settled out and became fixed (Itami *et al*. 1997, p. 86), so it would seem that the Japanese integrated steel industry has a unique market structure.

Financing for investment in the steel industry came not only from Japanese domestic financing sources, such as the Japan Development Bank (now the Development Bank of Japan), but also from the World Bank, the Export–Import Bank of the United States, and other foreign capital sources. Table 4.6 lists loans provided to the Japanese steel industry by the World Bank and the Export–Import Bank (see also Table 1.1). The reshaping of the Japanese steel industry depended heavily on foreign sources of funds. Japan depended on foreign sources for its investment because it was struggling under persistent current account deficits until the mid-1960s.

Conclusion: the roots of the steel industry's success

Although good fortune underlay the rapid development of the Japanese steel industry, success was due to more than that. At the risk of repeating myself, technological innovation drove progress, including giant blast furnaces, the LD steel converter, continuous casting, and the development of large-size bulk

Table 4.6 Proportions of World Bank and Export Import Bank (EXIM) loans made during the period of industry rationalization investment in the Japanese steel industry

		Amount of investment (A)	*World Bank/ EXIM funds (B)*	*B/A*
World Bank				
First Plan	Yawata Steel	62.00	19.08	30.8
	NKK	59.00	9.36	15.9
	Kawasaki Steel	162.00	72.00	44.4
Second Plan	Kawasaki Steel	72.00	28.80	40.0
	Sumitomo Metal Products	297.10	118.80	40.0
	Kobe Steel	90.61	36.00	39.7
	NKK	238.20	79.20	33.2
	Fuji Steel	264.68	86.40	32.6
	Yawata Steel	423.51	72.00	17.0
Third Plan	Sumitomo Metal Products	na	25.20	na
	Kawasaki Steel	76.00	21.60	28.4
EXIM				
First Plan	Fuji Steel	109.33	37.08	33.9
	Yawata Steel	395.91	93.60	23.6
	Toyo Kohan	58.11	25.56	44.0
	Toyo Kohan	24.32	10.80	44.4

Source: Sawai (1990a), p. 406.

Notes
Figures for Kawasaki Steel's third rationalization plan are estimates.
First rationalization plan: 1951–5.
Second rationalization plan: 1956–60.
Third rationalization plan: 1961–5.

ore transport ships, all of which were critical to the postwar development of the Japanese steel industry. The social capability that I mentioned earlier, in connection with the latecomer's advantage, made all these factors work together. By constructing its steel mills on landfill seaside sites, Japan was able to take the fullest advantage of technological innovation. At the same time, U.S. steelmakers, with their plants located as they were near raw materials in inland locations, increasingly found themselves at a disadvantage. Moreover, with the Japanese economy growing rapidly, the volume of Japan's trade with the world was also growing steadily. Finally, Japan benefited from not having to scrap existing obsolete facilities to build new steel mills to take advantage of technological innovation (Itami *et al*. 1997, pp. 8–9).

The steel industry is a textbook example of how economies of scale work. In effect, the steel industry becomes an oligopoly. The critical issues here are the extent to which the steel industry continues to function in a competitive environment, and whether the industry incorporates technological innovation as part of a long-term strategy. In the case of Japan, the latecomers (Kawasaki Steel, Kobe

Steel, and Sumitomo Metals) produced steel primarily with blast furnaces and fully integrated steel works, entering a market already occupied by the earlier arrivals (Fuji, Nippon Kokan, and Yawata). This fact is of great historical importance. In the case of the automobile industry (Chapter 9), another industry governed by economies of scale, the government (MITI) did not establish guidelines for participation; ultimately it was private industry that had the desire to get into the business.

Korea's POSCO was, until 2000, a state-owned enterprise, but POSCO is one of the world's most efficient steelmakers. Generally speaking, state-owned enterprises are inefficient, notwithstanding the reform of China's state-owned enterprises. But POSCO presents an interesting case because it suggests that, under good management, even a state-owned enterprise can be run efficiently. In the end, it comes down to a question of managerial efficiency.

5 The chemical industry

A huge and heretical industry

The chemical industry is not the name of a product. It is the name of a technology or a "reaction." Japan's chemical industry is a bit different from other manufacturing industries such as electronics and automobile industries in that the chemical industry is closest to the government, and less competitive.

"Chemicals": the name of a technology

With the notable exception of the chemical industry, all the manufacturing industries discussed in this book – the textile, steel, machine tool, electric and electronic appliance, semiconductor and computer, shipbuilding, and automobile industries – are named for their products.

Chemical industry is "the general term for a manufacturing industry which uses chemical processes [such as synthesis, cracking, polymerization, and fermentation] in manufacturing" (Industrial Bank of Japan 1997, p. 87). Thus, the chemical industry encompasses a wide range of products, including petrochemicals, pharmaceuticals, agricultural chemicals, fertilizers, coatings and finishes, and cosmetics. In the automobile industry, passenger cars and trucks are clearly related, and in the steel industry, I-beams and seamless pipe are both made of steel. So, apart from the fact that the chemical industry is research-intensive, making generalizations about the chemical industry is very hard.

Table 5.1 compares research intensity for each subsector of the manufacturing industry in Japan. According to these categories, in six industries researchers comprise more than 10 percent of the total number of employees: pharmaceuticals, the chemical industry, electrical machinery, information and telecommunication equipment, electronics parts, and precision machinery. Researchers' shares of the subcategories in the chemical industry (general chemicals and chemical fibers; oils, fats, and coatings; and other chemicals) shown in Table 5.1 are also more than 10 percent.

Because the chemical industry involves chemical reactions, as does the steel industry (reduction reactions are used in the manufacture of steel), one might argue that steelmaking is a part of the chemical industry. In the steel industry, for example, iron ore is iron oxide and is reduced with coke (carbon), which is made from coking coal, the end result of which is iron. Because the definition of

Table 5.1 Research intensity by industry (FY2002)

	Number of employees	*Number of researchers*	*Researchers/ employees (%)*	*Company research expenditures (billion yen)*	*Company R&D expenditures/ sales (%)*	*Company R&D expenditures/number of dedicated researchers (10,000 yen/person)*
Total manufacturing	8,093,581	404,961	9.5	10,081,287	4.0	2,626
Food industry	886,677	12,886	3.3	250,304	1.1	2,203
Textiles industry	424,695	3,256	4.3	51,237	2.3	2,012
Paper and pulp	252,670	2,692	3.8	53,647	1.2	2,085
Publishing and printing	281,967	1,444	4.0	35,841	1.4	2,522
Pharmaceuticals	219,177	21,889	10.7	965,723	8.9	4,455
Chemical industry	393,113	40,977	12.0	868,574	3.6	2,191
General chemicals, chemical fibers	178,533	19,230	12.1	476,498	3.9	2,517
Oils, fats, coatings	77,169	10,070	15.1	136,295	4.1	1,477
Other chemicals	137,411	11,678	10.3	255,782	3.0	2,228
Petroleum and coal industry	41,327	1,273	4.6	39,507	0.2	3,150
Plastics	280,271	5,324	5.7	107,773	2.4	2,252
Rubber	139,821	6,235	7.2	156,984	4.2	2,658
Ceramics	310,113	6,696	5.1	146,037	2.5	2,323

Iron and steel	242,607	4,917	3.4	129,660	1.5	3,084
Non-ferrous metals	129,717	6,102	6.7	145,822	2.5	2,498
Metal products	481,116	6,486	3.5	78,262	1.4	1,429
General machinery	918,867	45,945	8.2	939,225	4.4	2,302
Electrical machinery	630,629	42,374	10.7	939,995	5.2	2,314
Electrical machinery and equipment	85,364	11,605	16.3	206,641	5.0	1,885
Telecommunications, electronics, electrical instruments	545,265	30,769	9.5	733,354	5.3	2,472
Information and telecommunication equipment	497,252	88,532	20.9	2,233,089	7.4	2,571
Electronics parts	503,120	33,625	12.0	636,013	5.1	2,007
Transport equipment	820,895	47,635	8.7	1,737,925	4.4	3,799
Automobiles	703,197	43,836	9.0	1,677,626	4.6	3,933
Other transport equipment	117,698	3,799	6.0	60,299	1.9	1,953
Precision machinery	192,175	19,228	15.3	452,884	7.8	2,454
Other manufacturing	447,374	7,445	5.26	112,784	1.8	1,652

Source: www.stat.go.jp/data/kagaku/2003np/index.htm

the chemical industry is somewhat vague, the classifications "chemical materials" and "chemical processing" are used for the sake of clarity in the chemical industry (Industrial Bank of Japan 1997, p. 87).

The chemical material industry supplies the chemical processing industry with products. The chemical processing industry, which includes, for example, the petrochemical industry, the electrolyzed soda industry, and the chemical fertilizer industry, takes intermediate products supplied by the chemical material industry to produce final products. Processed chemicals include, for example, pharmaceuticals, agricultural chemicals, cosmetics, fragrances, dyestuffs, and paints and coatings. In a broad sense, the chemical fiber industry is a chemical industry, but it is sometimes classed as a fiber industry. Chemical fibers are classified in the chemical industry in Japan's *Census of Manufactures*, which is published by the Ministry of Economy, Trade and Industry (see, for example, *Census of Manufactures 2002*, p. 22, industrial classification code 174). The major products of the petrochemical industry and its end-products are presented in the Appendix.

Another characteristic of the chemical industry is its image as an equipment-intensive industry. Another way of describing the industry is that it has a high capital-to-labor ratio. Table 5.2 shows that labor productivity in the chemical industry ranks highly, along with the petroleum and beverage industries, at 2.5 times the average manufacturing industry labor productivity of ¥12.4 million in 2002. This figure is another expression of the high capital-to-labor ratio of the chemical industry (Table 5.3). The petroleum and coal product, chemical, beverage, and tobacco industries are characterized by high labor productivity. By way of comparison, although the chemical industry certainly has a high capital-to-labor ratio of ¥50.5 million per worker, a figure that is significantly higher than the average of ¥18.6 million per worker, its ratio is still lower than the petroleum and coal industry (¥128.7 million per worker) .

Still another feature of the chemical industry, and particularly of the petrochemical industry, is that it is an industry in which economies of scale shown by the "power of 0.6 rule" are obtained (Nishikawa 1998, pp. 27–8). This rule is somewhat difficult to explain, but one can understand it intuitively by imagining a spherical tank in an oil refinery. Now consider the proportional relationship between the tank's capacity as the production volume and the tank's surface area (since the space within the tank does not cost anything) as the capital investment. Thus, even if the production volume (tank capacity) is doubled, the investment (the tank's surface area) is raised only to the power of two-thirds, and that ratio can be restated as 0.6, thus the "power of 0.6 rule".[1]

Japan's postwar heavy and chemical industrialization

The improvements in Japan's material prosperity during the postwar recovery period and then the period of rapid economic growth were, in absolute terms, good. This rise in prosperity was supported by the shift from light industrialization to heavy and chemical industrialization, although this term may be

Table 5.2 Labor productivity by industry (2002)

	Number of employees	*Value added (100 million yen)*	*Labor productivity (million yen/ employee)*
Manufacturing total	7,463,435	926,879	12.4
Foods	1,044,113	84,314	8.1
Beverages, tobacco, feed	94,619	32,551	34.4
Textiles	122,719	9,363	7.6
Apparel and other textile products	248,306	10,642	4.3
Wood and wood products	99,913	8,224	8.2
Furniture	101,417	7,968	7.9
Paper and pulp	202,458	25,441	12.6
Publishing and printing	303,109	30,862	10.2
Chemicals	347,052	109,518	31.6
Petroleum and coal industry	21,169	8,325	39.3
Plastics	371,495	36,634	9.9
Rubber	111,644	13,192	11.8
Leather	26,130	1,675	6.4
Ceramics	280,937	34,513	12.3
Iron and steel	198,762	36,961	18.6
Non-ferrous metals	125,880	14,239	11.3
Metal products	547,255	54,494	10.0
General machinery	835,239	93,258	11.2
Electrical machinery	568,189	60,912	10.7
Information and telecommunication equipment	226,772	29,722	13.1
Electronics parts	483,062	52,757	10.9
Transport equipment	823,833	140,669	17.1
Precision machinery	141,632	14,731	10.4
Other manufacturing	137,730	15,916	11.6

Source: *Census of Manufactures 2002.*

vague in the context of economic analysis. Starting in the early 1950s, the core steel, electric power, shipbuilding, and ammonium sulfate industries were gradually modernized, and a series of steelmaking, power generation, and oil refinery plants were constructed in the coastal areas in a belt along the Pacific side of the country. On the heels of these developments, rapid growth was seen in such newly developing industries as synthetic fibers, synthetic resins, petrochemicals, home appliances, and automobiles (Arisawa 1966, pp. 454–5).

I have argued on many occasions that applying today's values to Japan from the late 1950s to the early 1970s (the period of rapid growth), and criticizing Japan for its poor environmental record during this era is simply not fair.[2] For the Japanese of the late 1950s to the early 1970s, the U.S. consumer society was viewed as an ideal, a distant dream (Ohhashi 1998, p. 204). For example, a report by the Japan Development Bank (1963b) contains images entitled: "Forging ahead with the petrochemical industry" (Mitsui Petrochemicals, Otake

Table 5.3 Capital–labor ratio by industry (2001)

	Fixed assets (billion yen)	*Number of employees (1,000 person)*	*Capital–labor ratio (million yen/ employee)*
Manufacturing total	207,353	11,134	18.6
Food	18,570	1,332	13.9
Textiles	3,911	246	15.9
Apparels	3,890	487	8.0
Wood products	2,105	192	11.0
Paper and pulp	6,187	287	21.6
Publishing and printing	9,317	702	13.3
Chemicals	24,981	495	50.5
Petroleum and coal products	4,890	38	128.7
Ceramics	7,784	413	18.8
Iron and steel	11,490	264	43.5
Non-ferrous metals	7,350	181	40.6
Metal products	10,131	857	11.8
General machinery	13,225	1,168	11.3
Electrical machinery	37,186	1,829	20.3
Transportation equipment	25,071	1,026	24.4
Precision instruments	4,240	250	17.0

Source: *Japan Statistical Yearbook 2004*.

Note
Fixed assets is a proxy of capital stock.

Plant in Iwakuni); "On track toward self-sufficiency in synthetic rubber production" (Japan Synthetic Rubber, Yokkaichi Plant); "Farm production gets a boost from chemical fertilizers" (Toyo Koatsu, Chiba Plant); all of which speak of the extraordinary vitality of the Japanese economy at the time.

The chemical industry has various subsectors. Although in the past, the major products were chemical fertilizers and oils, fats, and soaps, as shown clearly in Table 5.4, the main players today are petrochemicals and pharmaceuticals. In 1955 nearly 40 percent of chemical industry shipments were fertilizers (Table 5.4, part A), but its share declined to 1 percent of the total chemical industry shipment in 2002 (Table 5.4, part B).

The section on the chemical industry during the postwar reconstruction period in *A Century of Japanese Industry* (Arisawa 1966) is titled, "Fertilizer in the vanguard" (pp. 385–92), which was written by Tokuji Watanabe. At the very beginning of the section, Watanabe writes, "The postwar history of the chemical industry began with the revitalization of ammonium sulfate" (Watanabe 1966, p. 385). In the same book, we find a section written by Shoji Honda (pp. 486–97) on the chemical industry during the period of rapid growth. The title of this section is "A straight line to petrochemicals," and Honda writes, "The path taken by the chemical industry in the 1955–64 period could best be characterized by a vigorous shift into petrochemicals" (Honda 1966, p. 486).

Table 5.4 Structural changes in the chemical industry (changes in share of value of shipments) (%)

	1950	*1955*	*1960*	*1965*	*1970*	*1975*	*1980*	*1985*	*1990*	*1994*
A: 1950–94										
Petrochemicals	0.0	0.0	5.2	14.7	25.0	38.2	42.2	37.7	36.4	38.4
Inorganic chemicals	13.4	9.8	13.4	11.5	11.5	9.2	8.1	7.7	6.3	6.5
Chemical fertilizers	15.1	38.9	17.8	12.8	6.7	5.9	3.0	2.3	1.5	1.5
Paints and coatings	9.1	3.1	6.0	5.1	5.0	4.5	4.6	5.1	5.2	4.9
Oil fats, soaps, synthetic detergents, surfactants	37.7	17.6	7.5	6.5	5.2	3.8	4.6	4.9	4.4	4.5
Photosensitive materials	0.0	0.0	2.3	2.6	2.9	2.7	2.8	3.8	4.4	5.1
Pharmaceuticals	10.7	10.2	20.0	24.0	20.0	17.0	17.0	19.7	23.3	26.3
Other products	14.0	20.4	27.8	22.8	23.7	18.7	17.7	18.8	18.5	12.8

Source: Industrial Bank of Japan (1997), p. 89.

	1985		*2002*	
	(million yen)	*(%)*	*(million yen)*	*(%)*
B: 1985 and 2002				
Chemical industry total	20,552,413	100.0	22,748,344	100.0
Inorganic chemicals	1,499,721	7.3	1,693,643	7.4
Chemical fertilizers	442,625	2.2	225,748	1.0
Petrochemicals (organic chemicals)	8,315,668	40.5	8,095,374	35.6
Oil fats, soaps, synthetic detergents, surfactants	2,030,558	9.9	2,300,783	10.1
Chemical fibers	1,079,557	5.3	574,038	2.5
Paints and coatings	405,922	2.0	1,220,636	5.4
Pharmaceuticals	3,828,520	18.6	6,813,817	30.0
Other chemicals	3,355,764	16.3	3,844,726	16.9
Photosensitive materials	746,909	3.6	748,010	3.3

Source: *Census of Manufactures 2002*.

The chemical industry and industrial policy

As I suggested earlier, fertilizer production played the leading role in the reconstruction of Japan's postwar chemical industry. Hard as it is to imagine from the vantage point of Japan today, the government's most pressing issue at the time was how to keep the people from starving to death, so the government made the increase of fertilizer production a leading priority, and the proof of this is that by 1949 fertilizer production had recovered to prewar levels, although the recovery of other sections of the chemical industry took time (Arisawa 1966, p. 385). The fertilizer industry was given priority in the government's priority production policy (*Keisha Seisan Hoshiki*) and financing by the Reconstruction Financing Corporation (*Fukkin*) (see Chapter 10).

The shift from coal chemistry to petrochemicals was revolutionary and was based on the Measures for the Development of the Petrochemical Industry issued by MITI in July 1959. The three chief goals of these measures are commonly described as: (a) to secure raw materials that had fallen into short supply because of the growth of the synthetic fibers and synthetic resins (plastics) industries; (b) to move away from dependence on imported ethylene petrochemical products; and (c) to increase the sophistication of Japan's industrial structure and to enhance the competitiveness of Japan's chemical and chemical-related exports (Kudo 1990, p. 283). The phrase "sophistication of Japan's industrial structure" is vague. MITI most likely wanted to push the economy to a rapid growth path by promoting a shift to the heavy and chemical industries, the value-added ratios of which were higher. The specific measures that were employed to achieve this goal included: (a) investment financing through the Japan Development Bank; (b) accelerated depreciation; (c) permission for the introduction of technology; (d) reduction in or exemption from corporate taxes; and (e) allocation of foreign exchange and reduction in or exemption from duties to facilitate the importation of necessary equipment from abroad. In the 1950s, Japan was perennially short of foreign-exchange; the government's permission was needed for the use of precious foreign-exchange and for the importation of foreign technology.

MITI announced a policy for planning the future of the petrochemical industry in December 1959. In May of the following year, MITI established an annual target of at least 40,000 tons of ethylene per plant. At the start of the decade, Japan had four ethylene-producing companies, and another five companies started production in the course of the 1960s (Kudo 1990, pp. 319–20). Table 5.5 shows the timing of the start-up of ethylene production of each of the companies and ethylene production capacity. Annual ethylene production at the time was very small, hovering between 12,000 and 73,000 tons.

Vigorous debate followed the trade liberalization policy that was announced in June 1960, and a difficult search for order began in the new industry under the terms of the new trade regime while reorganization of the industry took place. The most significant issue was whether the industry should be allowed to re-adjust itself freely, or whether that re-adjustment

Table 5.5 Nine ethylene-producing companies

	Companies	*Plant location*	*Ethylene production capacity (Annual production in 1,000 tons)*	*Start of operations*
Starting four companies	Mitsui Petrochemicals	Iwakuni	20	April, 58
	Sumitomo Chemicals	Niihama	12	April, 58
	Mitsubishi Petrochemicals	Yokkaichi	22	May, 59
	Nippon Petrochemicals	Kawasaki	25	June, 59
Later five companies	Tonen Petrochemicals	Kawasaki	40	March, 62
	Daikyowa Petrochemicals	Yokkaichi	41.3	June, 63
	Maruzen Petrochemicals	Chiba	44	July, 64
	Kasei Mizushima	Mizushima	45	July, 64
	Idemitsu Petrochemicals	Tokuyama	73	October, 64

Source: Kudo (1990), p. 321

should be achieved by government and private industry working together. This debate became the grounds for a confrontation between the government, which aimed to maintain its lock on a controlled economy run by bureaucratic fiat, and private industry, which demanded that management of the economy be left to market mechanisms.

To investigate the government's policy of advocating strengthening international competitiveness as trade liberalization was implemented, MITI's Industrial Structure Research Group was established in April 1961. The policy defines the core of the Japanese economy in the first half of the 1960s, and is the fruit of urgent deliberations conducted by the Research Group concerning the most appropriate form for Japan's emerging industrial structure. The Industrial System Subcommittee of the Research Group conducted studies along the lines of a new industrial system and concluded that just as the management of competition in the industrial sector was important, the management and coordination of so-called strategic industries were equally essential to enhance the country's international competitiveness. Giving private industry free rein was not sufficient, MITI said; the government and the financial sector should be involved in some way as well. This philosophy was codified in a legal sense in the "Temporary Law for the Promotion of Designated Industries," (*Tokushin-ho*) (the bill was introduced in March 1963, 43rd Diet Session – this same law was initially designated the "Law for Strengthening International Competitiveness").

MITI intended to improve the international competitiveness by realizing the economies of scale in the framework of the "Temporary Law for the Promotion of Designated Industries." The law allowed MITI to intervene regarding a new entry to an industry and to limit the number of companies in the industry in order to enjoy scale merit. For further discussion of the new industrial system and the background leading up to the "Temporary Law for the Promotion of Designated Industries," see *History of Trade and Industry Policy Vol. 10*, pp. 47–90); Sumiya (2000, pp. 90–4); and Tsuruta (1988).

From the government (MITI) point of view, the goal of the Temporary Law for the Promotion of Designated Industries was to promote cooperation between the government, private industry, and the financial community in reorganizing and streamlining industry, particularly such designated industries as the automobile, specialty steel, and chemical industries, in response to the newly liberalized trade regime.

The *Tokushin-ho* was attacked from all three directions, however – from government, private industry, and the financial community – for imposing too much control on the economy. The argument was that by tying industry's hands, the country's ability to compete in international markets would be *weakened*, not strengthened. Within the government itself a difference of opinion arose, and the *Tokushin-ho* was presented to the Diet three times in 1963–4, and was abandoned before deliberations were complete (*History of Trade and Industry Policy Vol. 8*, p. 106; Maeda 1975, p. 16). The celebrated feud between Soichiro Honda, founder of Honda Motor, and Shigeru Sahashi, MITI's director-general for corporate policy comes to mind and will be discussed in Chapter 9 (see also Sakazaki 1995, pp. 191–2).

Given its failure to obtain passage for the *Tokushin-ho,* MITI proceeded to set up the Petrochemical Coordination Group in December 1964 to promote industrial policy via cooperation between the government and private industry (the companies in the chemical industry supported by the *Tokushin-ho*). In January 1965, the Petrochemical Coordination Group established a permitting standard requiring that new ethylene production facilities have a capacity of no less than 100,000 tons per year. This minimum was raised to 300,000 tons per year in May 1967 (Kudo 1990, pp. 322–3). The intention was to enhance international competitiveness by achieving economies of scale. MITI realized that most companies would encounter difficulty in clearing this 300,000 ton per year production requirement and believed that by imposing the requirement, they could reduce the number of companies, but as shown in Table 5.6, nine companies survived as centers of ethylene production, having in fact achieved this mandated production level (Iwanaga 1977).

Japanese ethylene production capacity stood at 7.96 million tons per year in 2002, if one discounts the scheduled plant maintenance years taken by all manufacturers, and is 7.231 million tons per year with the scheduled maintenance year factored in (*Chemical Products Handbook 2003*, p. 214). The plant with the smallest production capacity, Idemitsu Petrochemical's Chiba Plant, produces at the rate of 413,000 tons per year, and the largest facility is Mitsubishi

Table 5.6 300,000-ton ethylene plan

Company	*Location*	*Date completed*	*Notes*
Maruzen Petrochemical	Chiba	1969	Expansion of existing precursor products company.
Ukishima Petrochemical	Kawasaki	1970	Mitsui Petrochemical and Nippon Petrochemical 50–50 joint venture.
Sumitomo-Chiba Chemicals	Chiba	1970	Initially Sumitomo Chemicals, then expanded by Tonen.
Osaka Petrochemical	Senboku	1970	50–50 joint venture between Mitsui-Toyo Koatsu and Ube Kosan to create the Kansai Petrochemical group.
Mizushima Ethylene	Mizushima	1970	50–50 joint venture between Sanyo Petrochemical (which was a joint venture of Asahi Kasei, Nippon Kogyo [present-day Japan Energy]), and Mitsubishi Kasei.
Mitsubishi Petrochemical	Kajima	1971	Solo investment.
Shin-Daikyowa Petrochemical	Yokkaichi	1972	Mitsubishi Petrochemical built a 200,000-tonne facility in 1968; phase two built by Shin-Daikyowa Petrochemical.
Tonen Petrochemical	Kawasaki	1971	Construction continued by Sumitomo Chiba Chemical.
Sanyo Ethylene	Mizushima	1972	50–50 joint venture between Sanyo Petrochemical and Mitsubishi Kasei; rotation with Mizushima Ethylene.

Source: Kudo (1990), p. 324.

Chemical's Kajima Plant at 901,000 tons. Table 5.7 compares the ethylene production capacity of Japanese companies and rest of the world's top ten companies in 2002. It shows that Japan's ethylene production is extremely low compared with world standards. For example, Dow Chemical alone boasts annual production of 10.5 million tons, which is larger than the total production capacity of all of Japan's 11 companies and 14 plants. Mitsubishi Chemical, with the largest ethylene production capacity at 1.40 million tons per year from its two plant locations in Kajima and Mizushima, has less than one-seventh of Dow Chemical's production capacity. In November 2000, Sumitomo Chemicals and Mitsui Chemicals announced that they would jointly run a venture starting in October 2003 that would create an efficiently managed company to rival the giants of ethylene production like Dow Chemical. They canceled the merger plan in March 2003, however.

Having come through the two oil shocks in the 1970s, the Japanese petrochemical industry is in a long-term slump. Kikkawa (1998, pp. 392–3) identifies four causes for this situation.

- In contrast to U.S. and Canadian natural-gas-based ethylene production, Japanese and European ethylene production, which uses gasoline-derived naphtha as a raw material, is sensitive to crude oil price spikes.
- The Japanese petrochemical industry cannot freely import naphtha at international prices, and the system is constrained so that Japanese ethylene producers must purchase the naphtha they use from Japanese domestic oil refiners at comparatively high prices.
- Dating approximately from the time of the oil shocks, more and more countries have been working toward self-sufficiency in petrochemicals, thus

Table 5.7 Ethylene production capacity by company (2002) (1,000 ton)

Japanese company		*Top-ten company*	
Company	*Production capacity*	*Company*	*Production capacity*
Asahi Kasei Chemicals	504	Dow Chemical	10,464
Idemitsu Petrochemical	1,101	ExxonMobil	7,112
Keiyo Ethylene	768	Equistar	5,215
Showa Denko	653	SABIC	5,179
Sumitomo Chemical	415	Shell Chemicals	4,873
Tosoh	527	BP Chemicals	4,650
Tonen	515	Chevron Phillips	3,720
Nippon Petrochemicals	443	Taiwan Plastics	3,400
Maruzen Petrochemical	525	Nova Chemicals	2,970
Mitsui Chemicals	1,112	BASF	2,880
Mitsubishi Chemical	1,397		
Total	7,960	World total	108,410

Source: *Chemical Products Handbook 2003*, pp. 215, 217.

making it harder for Japanese companies to export their petrochemical products.
- The rise in Japanese domestic demand has been sluggish and the industry has surplus production capacity.

I believe that the most important obstacle is the systemic constraints identified in the second point raised above. MITI has imposed these constraints, and the outcome clearly represents a failure of Japanese industrial policy (see Kikkawa 1998, p. 392, table 6, for a comparison of imported and domestically produced naphtha).

The lagging chemical industry

The chemical industry of Japan, had 5,748 establishments in 2002, with a total of 355,627 employees. The value of shipments was ¥22.77 trillion. The chemical industry in that year represented 1.1 percent of the total number of manufacturing establishments, 4 percent of total manufacturing employees, and 8.4 percent of the value of total shipments, so on the whole, the chemical industry is not inconsiderable in size (*Census of Manufactures 2002*, pp. 440, 444).

Nevertheless, the chemical industry, when compared with the steel and automotive industries, which strongly boosted the Japanese economy, is distinguished by the fact that it has focused on selling within the Japanese domestic market and has shown very little interest in exporting its products. As a result, if we compare the net export ratio, which is the simplest indicator of ex post international competitiveness, with the automobile, electrical machine, and steel industries, we see that although each of these other industries has its own pattern of exporting, the chemical industry hovers right around zero, while the other industries show net export ratios as high as 0.8 or 0.9.[3]

Table 5.8 shows changes in the export shares, value of shipments shares, and relative export shares of the main subsectors of manufacturing industries.[4] Neither the export nor value of shipments shares of chemical products is insignificant, but the relative export share has never exceeded 1. In other words, the value of shipments share has always been greater than the export share. I believe this fact provides compelling evidence that the Japanese chemical industry has never been particularly enthusiastic about competing in world markets. Furthermore, the relative export share of the general machinery industry in 2000 is over 2, and the steel industry in the days when it was the leading industry also had a relative export share exceeding 2.

Compared with its agriculture, construction, or financial services, Japan's manufacturing industries are more efficient because Japan's manufacturing has competed in world markets while serving a large domestic market. In this sense, the chemical industry exists as an anomaly in manufacturing. It isn't just MITI's fault; the chemical industry itself has always done business this way. One could conclude that the adage "without competition there is no efficiency" is an ageless truth transcending both time and national borders.

Table 5.8 Trends in relative export shares (%)

	1955	*1960*	*1965*	*1970*	*1975*	*1980*	*1985*	*1990*	*2000*
Export share									
Foods	6.2	6.3	4.1	3.4	1.4	1.2	0.8	0.6	0.4
Textiles	37.3	30.1	18.7	12.5	6.7	4.8	3.6	2.5	1.8
Chemical products	5.1	4.5	6.5	6.4	7.0	5.3	4.4	5.5	7.4
Iron and steel	12.8	9.6	15.3	14.7	18.2	11.9	7.8	4.4	3.1
General machinery	na	na	7.4	10.4	12.1	13.9	16.8	22.1	21.5
Electrical machinery	na	na	9.2	12.3	11.0	14.4	16.9	23.0	26.5
Transport equipments	na	na	14.7	17.8	26.1	26.5	28.0	25.0	21.0
Precision machinery	na	na	3.9	5.7	4.7	7.9	10.1	4.8	5.4
Shipment Value Share									
Foods	17.9	12.4	12.5	10.4	11.9	10.5	11.0	10.2	11.6
Textiles	16.2	11.2	8.8	6.4	5.1	3.8	3.0	2.4	2.2
Chemical products	11.0	9.4	9.5	8.0	8.2	8.4	7.7	7.2	7.8
Iron and steel	9.6	10.6	9.1	9.5	8.9	8.3	6.7	5.7	3.9
General machinery	4.6	7.8	7.8	9.9	8.3	8.2	9.1	10.4	10.0
Electrical machinery	3.7	8.3	7.8	10.6	8.5	10.4	15.4	16.9	19.6
Transport equipments	5.5	8.5	9.7	10.5	11.6	11.6	13.6	14.5	14.6
Precision machinery	0.8	1.1	1.3	1.3	1.4	1.6	1.7	1.5	1.4
Relative Export Share									
Foods	0.35	0.51	0.32	0.32	0.11	0.12	0.07	0.06	0.03
Textiles	2.30	2.70	2.12	1.96	1.32	1.28	1.17	1.04	0.82
Chemical products	0.47	0.47	0.68	0.80	0.85	0.63	0.57	0.76	0.94
Iron and steel	1.33	0.90	1.67	1.55	2.05	1.43	1.16	0.77	0.79
General machinery	na	na	0.95	1.05	1.45	1.70	1.84	2.13	2.15
Electrical machinery	na	na	1.18	1.16	1.30	1.39	1.10	1.36	1.35
Transport equipments	na	na	1.52	1.69	2.25	2.28	2.05	1.72	1.43
Precision machinery	na	na	3.04	4.44	3.46	4.89	6.13	3.12	3.98

Source: Kohama and Watanabe (1996), p. 24; *Japan Statistical Yearbook*, various years; *Census of Manufactures*, various years.

Note
Relative export share = (export share)/(shipment value share).

Appendix

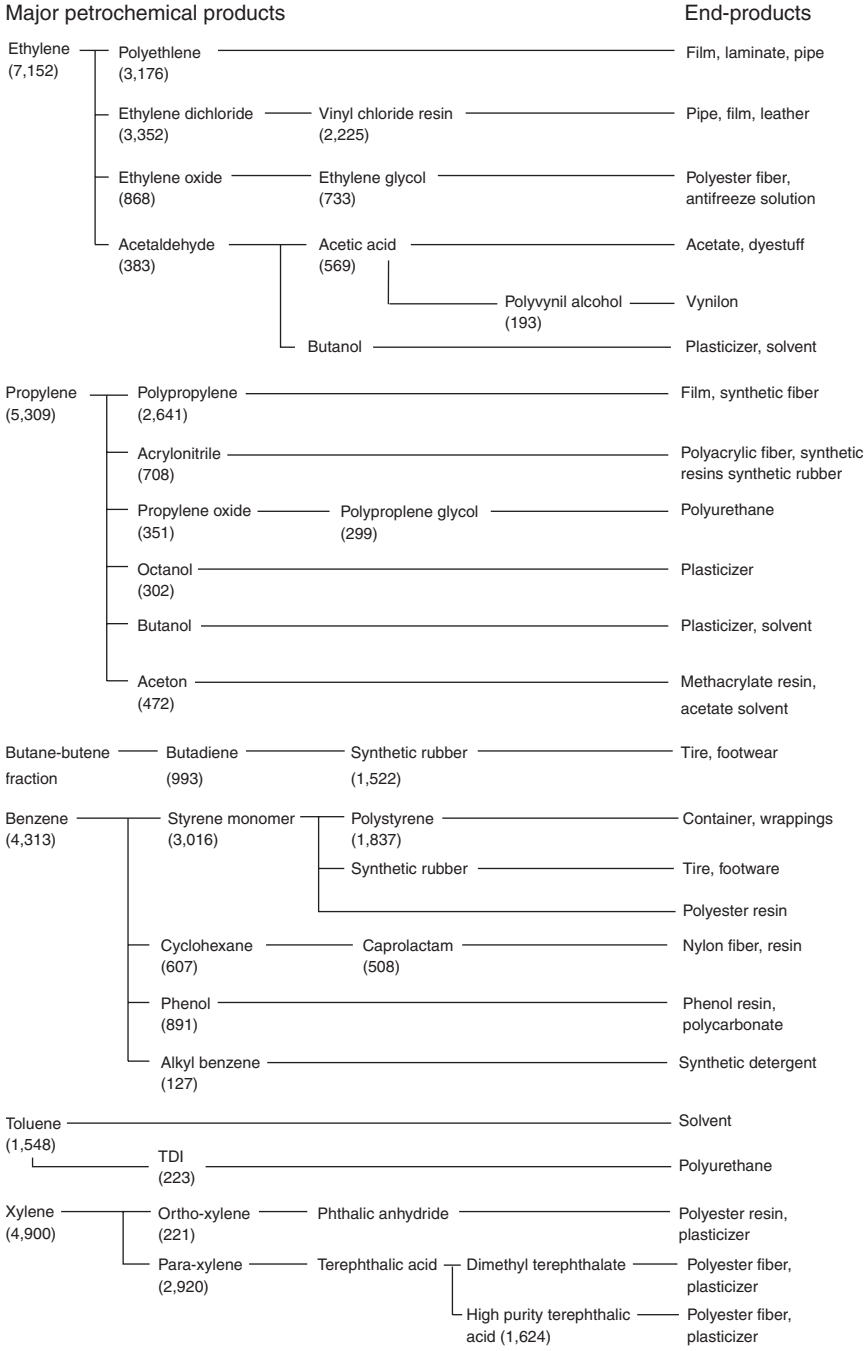

Figure 5.A1 The major products of the petrochemical industry and the end-products (source: *Chemical Business Guide 2004*, pp. 467–8).

Note
Figures in parentheses are Japan's production volume in 2002 (1,000 tons).

6 The general machinery industry

From import substitution to export

The machinery industry is a leading industry for Japan. I analyze the general machinery industry in this chapter, with a focus on the machine tool industry because machine tools are "mother machines."

The machine tool industry

Let us first take stock of the position of the machine tool industry in the overall manufacturing industry scheme. Table 6.1 shows the number of establishments, number of employees, value of shipments, value added, and value-added ratio (the ratio of value added to shipment value) of industries that fall under the two-digit codes in industrial classification in the *Census of Manufactures 2002*). The shares of the shipment values are the same as those shown for the 2002 figures in Table 2.3. This chapter focuses on the machine tool industry within the general machinery industry. The two-digit industrial classification for the general machinery industry (industrial classification code 26) includes boilers, engines, and turbines (code 261), agricultural machinery (code 262), construction machinery (code 263), metal-working machinery (code 264), textile machinery (code 265), special-industry machinery (code 266), office machines (code 268), and so on (*Census of Manufactures 2002*, pp. 43–4).[1]

The total value added by the manufacturing industry in 2002 was ¥102 trillion, which represents 20.5 percent of Japan's ¥498 trillion GDP in that year.[2] The general machinery industry generates slightly more than 10 percent of the total value added by manufacturing industries, representing over 2 percent of Japan's total value added in the economy. In 2002 the general machinery industry employed 941,689 workers, or about 11.3 percent of all manufacturing employees. The total number of employed workers was 63.3 million in 2002 (*Japan Statistical Yearbook 2004*, p. 496). Thus, general machinery manufacturing accounts for 1.49 percent of Japan's total workers.

General machines are defined as "capital goods machines broadly described as those machines used in production activities, including office activities" (Industrial Bank of Japan 1997, p. 140). Thus, included in this category are machine tools, industrial robots, injection molding machines, and other machines

Table 6.1 Japan's manufacturing industry structure (2002)

	Number of establishments	*(%)*	*Number of employees*	*(%)*	*Value of shipment (million yen)*	*(%)*	*Value added (million yen)*	*(%)*	*Value-added ratio (%)*
Manufacturing total	290,848	100.0	8,323,589	100.0	269,361,805	100.0	97,458,726	100.0	36.2
Food	35,739	12.3	1,137,521	13.7	22,984,018	8.5	8,793,806	9.0	38.3
Beverage, tobacco, feed	4,866	1.7	109,170	1.3	10,626,600	3.9	3,353,202	3.4	31.6
Textiles	9,260	3.2	155,071	1.9	2,478,223	0.9	1,079,580	1.1	43.6
Apparels	18,011	6.2	305,373	3.7	2,651,314	1.0	1,259,540	1.3	47.5
Wood products	10,651	3.7	139,334	1.7	2,645,715	1.0	1,014,632	1.0	38.4
Furniture	10,359	3.6	141,297	1.7	2,253,507	0.8	990,595	1.0	44.0
Paper and pulp	8,439	2.9	224,874	2.7	7,152,012	2.7	2,655,179	2.7	37.1
Publishing and printing	19,493	6.7	367,037	4.4	7,411,140	2.8	3,462,763	3.6	46.7
Chemicals	5,045	1.7	353,980	4.3	22,748,344	8.4	11,024,106	11.3	48.5
Petroleum and coal products	1,048	0.4	25,135	0.3	9,576,151	3.6	921,083	0.9	9.6
Plastics	16,809	5.8	417,945	5.0	9,627,805	3.6	3,909,582	4.0	40.6
Rubber products	3,673	1.3	122,183	1.5	2,890,342	1.1	1,368,904	1.4	47.4
Leather products	2,882	1.0	36,729	0.4	548,371	0.2	217,188	0.2	39.6
Ceramics	15,285	5.3	321,735	3.9	7,678,365	2.9	3,779,256	3.9	49.2
Iron and steel	4,589	1.6	209,087	2.5	10,962,676	4.1	3,779,548	3.9	34.5
Non-ferrous metals	3,171	1.1	134,423	1.6	5,668,471	2.1	1,475,350	1.5	26.0
Metal products	36,667	12.6	667,367	8.0	13,736,524	5.1	6,166,669	6.3	44.9
General machinery	34,424	11.8	941,689	11.3	25,477,336	9.5	10,042,388	10.3	39.4
Electric machinery	13,471	4.6	600,328	7.2	17,787,589	6.6	6,257,882	6.4	35.2
Information and communication electronics equipment	2,773	1.0	230,930	2.8	12,367,353	4.6	2,993,964	3.1	24.2
Electronics parts and devices	6,136	2.1	495,082	5.9	15,886,146	5.9	5,326,475	5.5	33.5
Transport equipment	12,266	4.2	853,472	10.3	47,997,396	17.8	14,233,034	14.6	29.7
Precision instrument	4,622	1.6	154,713	1.9	3,550,162	1.3	1,545,192	1.6	43.5
Others	11,169	3.8	179,114	2.2	4,656,245	1.7	1,808,808	1.9	38.8

Source: *Census of Manufactures 2002.*

Note
Figures in this table are of the establishments with four employees and more. Value added of the establishments with four to 29 employees is gross value added.

used in factories, as well as: construction equipment; agricultural machines; textile industry machines; and word processors, copy machines, and other office equipment. Personal computers and fax machines, however, fall under the heading "electrical machinery" (Industrial Bank of Japan 1997, p. 140). The correlation between shipments of capital goods and private investment is extremely strong, so fluctuations in the output of machinery vary more widely from year to year than do GDP or consumption.[3]

Readers who cannot readily picture machine tools, industrial robots, or textile machinery would do well to tour an actual factory. A plant tour, however, may not be so easy to arrange, so it might prove useful to look at books that have colorful figures and visit the related websites.[4] I think seeing the products and factory videos of FANUC aids in understanding machine tools and industrial robots.

For readers who can read Japanese, Kaitai Shinsho Henshu-bu's 1998 publication, *History of Manufactures and Development of Technology*, is a good book.[5] This easy-to-understand book charts the course of Japan's industrial development from a technical standpoint. For example, the book explains the basic varieties and workings of machine tools, provides an understandable guide to computer numerical control (CNC) machine tools and machining centers, and does all this through the use of many photographs (pp. 72–7).

History of Manufactures and Development of Technology not only contains explanations of machines; it also contains many stand-alone feature articles about the industry. For instance, in it is the story of the development of numerical control (NC) machine tools (p. 75). In the fall of 1956, Tsunezo Makino, then the director of the Makino Milling Machine, attended an industrial machine trade fair in India and was told by an official of the Commerce and Industry Ministry of India, a man who had studied at the Massachusetts Institute of Technology (MIT), "MIT has developed machine tools with numerical control, but I think NC machines will be beyond the reach of Japan's technology for some time." Not to be outdone, right then and there Makino said, "Give us two years, and we'll show you!" Immediately upon his return to Japan, Makino asked for assistance from Seiemon Inaba (original chairman of FANUC), who was doing research on NC machine tools at Fujitsu. When Inaba saw how full of fight Makino was, he immediately replied, "Okay, let's do it!" Within the promised two years, they completed the development of Japan's first numerical control milling machine. Japan exhibited its first numerical control milling machine at the 1962 international machine tool fair held in Osaka. As I will discuss later, the kind of "backbone" shown by these two pioneers pushed Japan to world leadership in the machine tool industry.

Readers accustomed to more refined economics journal articles may prefer an explanation of NC machine tool production in terms of accumulated human capital or technical capital, but the fact of the matter is that this kind of stubborn will and entrepreneurial spirit is exactly what is needed to develop technology and to link that technology to actual production and exports.

Structural change in the machine-tool industry

Data about the number of establishments, number of employees, value of shipments, value added, and value-added ratio are provided in Table 6.2. These data are for the general machinery subsectors (three-digit classifications in the *Census of Manufactures 2002*). The metal-working machinery category, which includes machine tools, the general industry machinery category, and office machines category, all have large shares in the general machinery subsectors. In terms of numbers of establishments, the shares for metal-working machinery and for general industry machinery are 20.6 and 20.3 percent, respectively. Measured by value added, the share for general industry machinery is 21.9 percent, for office machines is 14.5 percent, and for metal-working machinery is 12.1 percent.

As I outlined in Table 2.3, the shipments value share of the general machinery industry to the manufacturing total had not even attained 5 percent in 1955, just at the start of the period of rapid economic growth. Table 6.3 traces structural change in the general machinery industry before and during the period of rapid growth. Looking at the three-digit *Census of Manufactures 2002* classifications indicates little change in the structure of the general machinery industry between that time and today. Sewing machines, however, a subsector of the home appliance industry, represented a shipment value share of 8.3 percent in 1955. This share gradually decreased until by 1975 it represented only a 1.8 percent share. In 2003, 410,072 industrial sewing machines were manufactured, and the production value was ¥62,978 million, no more than 0.55 percent of the total production value of general machinery manufacturing, which was ¥11.436 trillion.[6]

At one time the sewing machine played a major role in Japan's postwar machinery exports. Hayashi (1961) had argued that machinery exports in a very broad sense (general machinery, electrical machinery, transport machinery, precision machinery) would be the key to increasing Japan's exports, and he said: "There is a gradually increasing demand for home appliances, such as sewing machines, cameras, televisions, refrigerators, fans, etc., as well as for durable consumer goods like automobiles, bicycles, and other transport equipment" (pp. 65–6). The first item on this list is the sewing machine, and Hayashi also mentions fans and bicycles, which says something significant about the thinking of trade and industry bureaucrats – as well as the mindset of experts – during the initial stages of rapid economic growth.

Expanding exports was a critical policy target for the Japanese economy at that time. For the MITI officials at that time, catching up with the industrial countries (the early-starting countries) was essential. Japan's low rate of machinery exports at the time was an extremely sore point for them.

Exports before and during the period of rapid economic growth in Japan were completely different in character from today. The question in those days was whether the Japanese economy could sell its products, or even survive, in the face of unconstrained competition with the United States and Europe, with their

Table 6.2 Structure of Japan's general machinery industry (2002)

Industry code		*Number of establishments*	*(%)*	*Number of employees*	*(%)*	*Value of shipment (million yen)*	*(%)*	*Value added (million yen)*	*(%)*	*Value-added ratio (%)*
26	General machinery	34,424	100.0	941,689	100.0	25,477,336	100.0	10,042,388	100.0	39.4
261	Boilers, engines and turbines	347	1.0	39,219	4.2	2,069,491	8.1	858,662	8.6	41.5
262	Agricultural machinery	869	2.5	31,730	3.4	955,507	3.8	378,910	3.8	39.7
263	Construction and mining machinery	1,175	3.4	35,964	3.8	1,373,491	5.4	443,261	4.4	32.3
264	Metal-working machinery	7,080	20.6	141,869	15.1	2,714,403	10.7	1,218,859	12.1	44.9
265	Textile machinery	769	2.2	21,455	2.3	430,823	1.7	181,854	1.8	42.2
266	Special industry machinery	4,684	13.6	132,893	14.1	3,456,428	13.6	1,282,895	12.8	37.1
267	General industry machinery	6,993	20.3	195,968	20.8	5,270,302	20.7	2,201,073	21.9	41.8
268	Office machines	2,463	7.2	122,796	13.0	4,913,411	19.3	1,457,860	14.5	29.7
269	Other machinery and machine parts	10,044	29.2	219,795	23.3	4,293,480	16.9	2,019,014	20.1	47.0

Source: *Census of Manufactures 2002.*

Notes
Figures in this table are of the establishments with four employees or more.
Value added of the establishments with four to 29 employees is gross value added.
Special industry machinery includes specific industry machines such as food processing, woodworking, semiconductor manufacturing machines.
General industry machinery includes pumps, air compressors, elevators, conveyors, mechanical power transmission equipment.

Table 6.3 Structural change in the general machinery industry (1955–70)

	1955	*1960*	*1965*	*1970*	*1975*
Value of shipments (million yen)					
General machinery total	290,907	1,168,334	2,196,126	6,802,838	10,611,168
Boilers, engines and turbines	17,789	93,898	98,510	449,450	582,170
Agricultural machinery	23,084	73,103	136,671	294,490	615,861
Construction and mining machinery	18,853	91,585	212,062	721,447	1,211,496
Metal-working machinery	24,232	167,047	284,359	1,081,144	1,058,500
Textile machinery	44,333	104,126	145,884	348,478	358,965
Special industry machinery	36,734	127,897	296,426	689,650	739,833
General industry machinery	59,309	290,468	564,530	1,765,374	3,118,508
Office machinery and home appliances	36,588	101,845	235,549	702,295	1,455,392
Sewing machine	24,209	48,146	90,731	137,516	192,383
Other machinery and machine parts	29,985	118,365	222,135	750,495	1,470,420
Value of shipments share (%)					
General machinery total	100.0	100.0	100.0	100.0	100.0
Boilers, engines and turbines	6.1	8.0	4.5	6.6	5.5
Agricultural machinery	7.9	6.3	6.2	4.3	5.8
Construction and mining machinery	6.5	7.8	9.7	10.6	11.4
Metal-working machinery	8.3	14.3	12.9	15.9	10.0
Textile machinery	15.2	8.9	6.6	5.1	3.4
Special industry machinery	12.6	10.9	13.5	10.1	7.0
General industry machinery	20.4	24.9	25.7	26.0	29.4
Office machinery and home appliances	12.6	8.7	10.7	10.3	13.7
Sewing machine	8.3	4.1	4.1	2.0	1.8
Other machinery and machine parts	10.3	10.1	10.1	11.0	13.9

Source: Tsusan Tokei Kyokai (1982), pp. 544–98.

prosperity and overwhelming technological and financial superiority. At the time, Japan labored under a chronic balance of payment deficits and economic policies designed to correct this (international payments ceilings). Japan was confronted with major policy issues. Understanding the history of this time is impossible without an understanding of the background and of policy issues in question.

Table 6.4 compares the machinery export shares in the world total machinery exports for Japan and the industrial countries before and through Japan's rapid-growth period. At the end of the Korean War in 1953, the United States had a 42.4 percent general machinery export share (the share of value of general machinery exports to the world total value of exports), the United Kingdom had a 20.1 percent share, and the Federal Republic of Germany had 13.6 percent. Japan had a mere 1.5 percent share. Not included in Table 6.4 are the machinery export shares (the value of machinery exports share to the total exports of each country), of the United States (36.2 percent), the United Kingdom (37.5 percent), and the Federal Republic of Germany (38.3 percent), compared with Japan's 16.2 percent (Japan Machinery Center for Trade and Investment 1972, pp. 14–15).

In 1961, at the beginning of the income-doubling plan, the general machinery export shares of the United States, the United Kingdom, and the Federal Republic of Germany were 27.3, 17, and 22.2 percent, respectively, while Japan stood at 4.5 percent. In 1961 total machinery export shares for the United States, the

Table 6.4 Share of general machinery exports to the world total exports: selected countries (%)

	U.S.A.	*U.K.*	*West Germany*	*France*	*Italy*	*Japan*
1952	40.2	21.5	12.4	5.9	2.3	1.0
1953	42.4	20.1	13.6	5.0	2.2	1.5
1954	38.3	20.2	15.9	5.3	2.2	1.6
1955	36.1	20.3	17.4	5.6	2.5	1.8
1956	37.2	19.4	17.7	4.6	2.5	2.9
1957	34.9	18.6	18.9	5.2	2.9	3.4
1958	33.2	14.6	21.4	6.2	3.2	3.5
1959	28.7	18.9	21.1	6.6	3.1	4.1
1960	28.9	17.5	21.3	7.0	4.1	4.1
1961	27.3	17.0	22.2	6.8	4.7	4.5
1962	27.7	15.9	21.6	6.8	4.8	4.6
1963	26.1	15.9	22.2	6.9	5.0	5.1
1964	26.5	14.5	21.6	6.4	5.2	5.7
1965	26.3	13.9	20.8	6.5	5.4	7.0
1966	25.9	13.3	20.5	6.5	5.7	7.8
1967	26.1	11.6	19.9	6.6	6.0	8.3
1968	25.1	10.8	19.9	6.4	6.1	9.2
1969	24.6	10.4	19.7	6.7	6.0	9.8
1970	23.6	10.2	20.8	7.5	6.3	10.9

Source: Japan Machinery Center for Trade and Investment (1972), pp. 18–19.

United Kingdom, and the Federal Republic of Germany were 36.1, 45.2, and 48 percent, respectively, while Japan's was 29.5 percent.

By 1970 general machinery export shares of the United States, the United Kingdom, and the Federal Republic of Germany were 23.6, 10.2, and 20.8 percent, respectively, while Japan's share had increased to 10.9 percent, barely surpassing the United Kingdom for the first time. Looking at overall machinery export shares in 1970 for the United States, the United Kingdom, and the Federal Republic of Germany, the figures were 47.3, 40.5, and 51.8 percent, respectively. Japan finally reached the ranks of the industrial countries with a 48.1 percent share.

I mentioned earlier that sewing machines were an important early export for Japan. Let us take a look at trends in Japanese sewing machine exports before and during the period of rapid growth (Table 6.5). Sewing machine exports represented approximately 10–17 percent of all machine exports at the start of the 1950s. With all due respect to sewing machine manufacturers, the sewing machine is not much of a machine, although sewing machines for home-use differ from industrial sewing machines.[7] We must not forget that at the time, however, sewing machines brought into Japan much-needed foreign-exchange.[8]

Now I will look specifically at machine tools, an important subsector of the general machinery category. Table 6.6 charts trends in the manufacturing,

Table 6.5 Japan's sewing machine exports (1952–71)

	Sewing machine exports ($ million)	*Total machine exports ($ million)*	*Sewing machine exports/machine exports (%)*
1952	21	126	16.7
1953	22	207	10.6
1954	32	221	14.5
1955	39	274	14.2
1956	40	529	7.6
1957	48	674	7.1
1958	47	690	6.8
1959	58	898	6.5
1960	55	1,041	5.3
1961	55	1,247	4.4
1962	59	1,430	4.1
1963	63	1,711	3.7
1964	79	2,245	3.5
1965	83	3,046	2.7
1966	92	3,829	2.4
1967	97	4,490	2.2
1968	115	5,770	2.0
1969	131	7,249	1.8
1970	130	9,102	1.4
1971	164	12,119	1.4

Source: Japan Machinery Center for Trade and Investment (1972), pp. 22–25.

Note
Machine exports are the total of broadly-defined machine exports.

Table 6.6 Development of machine tools industry, 1949–94

	Production value (million yen)	*NC machine tools (%)*	*Exports (million yen)*	*NC machine tools (%)*	*Imports (million yen)*	*NC machine tools (%)*	*Net export ratio*	*NC machine tools (%)*	*Exports/ production*	*NC machine tools (%)*
1949	771	0	51	0	42	0	0.097	–	6.6	–
1950	537	0	214	0	133	0	0.233	–	39.9	–
1951	1,081	0	286	0	134	0	0.362	–	26.5	–
1952	1,877	0	352	0	848	0	−0.413	–	18.8	–
1953	3,738	0	411	0	2,254	0	−0.692	–	11.0	–
1954	5,385	0	549	0	5,229	0	−0.810	–	10.2	–
1955	3,680	0	715	0	4,042	0	−0.699	–	19.4	–
1956	7,174	0	527	0	2,523	0	−0.654	–	7.3	–
1957	15,549	0	724	0	12,201	0	−0.888	–	4.7	–
1958	21,113	0	479	0	13,777	0	−0.933	–	2.3	–
1959	24,318	0	497	0	10,449	0	−0.909	–	2.0	–
1960	45,169	0	1,624	0	19,701	0	−0.848	–	3.6	–
1961	81,882	0	2,434	0	38,899	0	−0.882	–	3.0	–
1962	100,892	0	2,588	0	47,582	0	−0.897	–	2.6	–
1963	95,102	0	4,295	0	22,796	0	−0.683	–	4.5	–
1964	90,906	0	6,509	0	21,320	0	−0.532	–	7.2	–
1965	70,349	0	8,943	0	13,963	0	−0.219	–	12.7	–
1966	76,453	0	14,611	0	7,586	0	0.316	–	19.1	–
1967	126,041	0	17,642	0	12,839	0	0.158	–	14.0	–
1968	175,986	0	18,583	0	34,176	0	−0.296	–	10.6	–
1969	239,988	0	21,742	0	34,485	0	−0.227	–	9.1	–
1970	312,349	24,320	24,088	591	44,162	3,647	−0.294	−0.721	7.7	2.4

1971	264,405	25,163	28,044	980	39,763	3,175	−0.173	−0.528	10.6	3.9
1972	205,190	24,717	27,408	1,608	22,366	1,754	0.101	−0.043	13.4	6.5
1973	305,223	47,505	35,237	1,758	21,332	1,045	0.246	0.254	11.5	3.7
1974	358,610	58,471	57,664	5,351	37,211	2,391	0.216	0.382	16.1	9.2
1975	230,739	39,856	61,611	8,055	21,575	1,473	0.481	0.691	26.7	20.2
1976	228,604	51,297	76,073	18,108	13,867	583	0.692	0.938	33.3	35.3
1977	312,844	80,548	115,493	36,407	15,720	1,203	0.760	0.936	36.9	45.2
1978	365,525	107,644	162,138	62,807	19,638	2,939	0.784	0.911	44.4	58.3
1979	484,132	205,455	206,577	99,587	26,214	2,731	0.775	0.947	42.7	48.5
1980	682,102	339,422	269,577	172,756	38,221	4,503	0.752	0.949	39.5	50.9
1981	851,312	434,066	310,763	218,970	38,623	4,341	0.779	0.961	36.5	50.4
1982	782,776	421,779	247,576	162,392	43,585	8,488	0.701	0.901	31.6	38.5
1983	702,287	426,616	237,445	155,438	32,517	5,879	0.759	0.927	33.8	36.4
1984	881,486	589,934	315,132	225,923	29,259	7,020	0.830	0.940	35.8	38.3
1985	1,051,128	703,799	395,040	284,755	35,186	11,452	0.836	0.923	37.6	40.5
1986	899,402	610,547	363,606	261,088	33,241	14,033	0.832	0.898	40.4	42.8
1987	688,779	486,665	296,374	205,456	22,073	10,219	0.861	0.905	43.0	42.2
1988	881,070	620,615	321,488	256,132	36,726	14,430	0.795	0.893	36.5	41.3
1989	1,139,206	831,773	428,591	348,250	50,494	19,253	0.789	0.895	37.6	41.9
1990	1,303,442	986,351	455,809	372,016	68,645	29,376	0.738	0.854	35.0	37.7
1991	1,265,587	917,417	411,948	324,221	58,496	25,209	0.751	0.856	32.5	35.3
1992	831,087	602,251	330,291	264,644	41,027	21,112	0.779	0.852	39.7	43.9
1993	592,727	458,358	306,094	240,375	25,230	11,630	0.848	0.908	51.6	52.4
1994	554,080	438,811	328,786	258,327	25,226	8,477	0.857	0.936	59.3	58.9

Source: The Society for Industrial Studies, Japan (1995), p. 1167.

import, export, net export ratio, and exports–production ratio of machine tools from 1949 through 1994.[9] The net export ratio, which is defined as the difference between imports and exports, divided by the sum of imports and exports, varies between −1 and +1. A minus value indicates net imports. Many analysts believe that increases in this ratio signal rises in international competitiveness.[10]

The net export ratio for machine tools was generally negative through to the end of the period of rapid growth. Rapid increases in the net export ratio were seen from the early 1970s, indicating increased international competitiveness. The rapid rise in the export ratio (the ratio of value of exports to the value of production) from the mid 1970s onward was commensurate with the net export ratio.

Table 6.7 shows that the production and trade in NC machine tools (to be discussed in the next section), started in 1970. It shows the trends in the percentage of NC machine tools out of all machine tools. At the end of the 1970s, the ratio of NC machine tools, both in production and exports, exceeded 40 percent. Since the end of the 1980s, NC ratios in production and export figures are around 70–80 percent. In contrast, NC ratios of machine tool imports are much lower. The last column of Table 6.7 shows the percentages of NC machine

Table 6.7 Percentage of machine tools equipped with numerical control unit (%)

	Production	*Exports*	*Imports*	*Exports–imports (% point)*
1970	7.8	2.5	8.3	−5.8
1971	9.5	3.5	8.0	−4.5
1972	12.0	5.9	7.8	−2.0
1973	15.6	5.0	4.9	0.1
1974	16.3	9.3	6.4	2.9
1975	17.3	13.1	6.8	6.2
1976	22.4	23.8	4.2	19.6
1977	25.7	31.5	7.7	23.9
1978	29.4	38.7	15.0	23.8
1979	42.4	48.2	10.4	37.8
1980	49.8	64.1	11.8	52.3
1981	51.0	70.5	11.2	59.2
1982	53.9	65.6	19.5	46.1
1983	60.7	65.5	18.1	47.4
1984	66.9	71.7	24.0	47.7
1985	67.0	72.1	32.5	39.5
1986	67.9	71.8	42.2	29.6
1987	70.7	69.3	46.3	23.0
1988	70.4	79.7	39.3	40.4
1989	73.0	81.3	38.1	43.1
1990	75.7	81.6	42.8	38.8
1991	72.5	78.7	43.1	35.6
1992	72.5	80.1	51.5	28.7
1993	77.3	78.5	46.1	32.4
1994	79.2	78.6	33.6	45.0

Source: The Society for Industrial Studies, Japan (1995), p. 1167.

imports minus the percentages of NC machine exports. With the exception of the early 1970s, the figure is always on the plus side and runs as high as 59.3 percent. If one grants that NC machine tools represent a higher level of technical achievement than conventional machine tools, these figures demonstrate that Japan exports large numbers of highly sophisticated machine tools, and in exchange imports relatively unsophisticated machines from abroad.

Machine tools are the "mother machines"

Machine tools or, more precisely, "metal-cutting machine tools," are the machines that make machines, the "mother machines." The main machine tool classifications are traditional machine tools, traditional NC machine tools, NC machine tools, and machine tools that are integrated into manufacturing systems (Ito 1998, p. 14).

NC machine tools are traditional machine tools that are connected to NC or CNC units (Ito 1998, pp. 19–20). CNC machine tools are also known as mechatronics, a compound word, originally of Japanese coinage, consisting of *mecha*nism and elec*tronics.*

The wheel lathe, which keeps the bullet train running safely; the large vertical lathe which cuts ship propellers; the drilling machine, which drills holes in metals; the milling machine, which planes metals. These are all machine tools.

Roughly speaking, a machining center is the three-dimensional fusion of the lathe and a variety of other machine tools. In automated factories, these groupings are called "flexible manufacturing systems" or "flexible manufacturing cells," in which various machine tools are spatially arranged into a system machine. The original forms of the system machine are the NC lathe, the turning center, and the machining center.

Promotion policies for the machine-tool industry

The main policies for promoting the machine-tool industry are listed in Table 6.8. Let us here consider the import and trial production subsidies in the 1950s.

The year 1952 marked the start of the "Subsidy Program for Machine Tools Imports," a program that offered subsidies worth half the price of machine tools imported by machine manufacturers and that was intended to encourage modernization of obsolete equipment and facilities (Kobayashi and Ohtaka 1995, p. 383). The initial ¥270 million budget in 1952, however, could not be used in its entirety, and Hitachi Koki, Mitsubishi Ship Building, Tsugami, Osaka Machine Tools, Makino Milling Machine, Mitsui Precision Machine, Nippei Electric, Okuma Machine Tools (Okuma), Ikegai, and Niigata Machine Tools imported a total of 26 machine tool units for a total of approximately ¥160 million (Sawai 1990b, p. 154).

Subsequently, the Machine Tool Trial Production Subsidy Program was

Table 6.8 Main policies promoting the machine tool industry

Year	*Policy or law*
1946	Abolition of the Machine Tool Manufacturing Business Law
1950–4	Machine Tool Trial Production Subsidy/Subsidies for Applied Research
1951	Program for Tariff-Free Importation of Important Machines
1951	Establishment of the Japan Machine Tool Builders' Association (JMTBA)
1951–	Special Depreciation Program Law Law for the Promotion of Corporate Rationalization
1952–4	Subsidy Program for Machine Tools Imports
1953–5	Machine Tool Trial Production Subsidy Program
1955	Plan for the Promotion of Machine Industry Organizations (not implemented; see Machine Industry Promotion Law)
1956	First Temporary Law for the Promotion of the Machine Industry
1956	Establishment of the Machine Industry Promotion Federation
1961	Second Temporary Law for the Promotion of the Machine Industry
1961	Basic Plan for the Promotion of Metal-working Machine Tools
1961	Temporary Law for Insuring Installment Credit for Machinery
1962	Establishment of the Japan Machine Tool Exporters Association
1962	First International Machine Tool Fair held in Japan (in Osaka)
1966	Third Temporary Law for the Promotion of the Machine Industry
1971	Temporary Law for the Promotion of Specified Electronics Industries and Specified Machine Industries
1971	Law for the Protection of Machine Industry Credit
1974	"A Vision of the Machine Industry for the 1970s and 80s"
1978	Plan for Technological Innovation in the Machine Tool Industry
1987	"Vision for the Machine Tool Industry"
1990	Start of the Japan–U.S. Machine Tool Industry Cooperation Coordinating Council
1992	Voluntary export restriction to the U.S., extended for two years
1993	Japan–U.S. agreement to eliminate the voluntary export restriction

Sources: Sawai (1990b); Kobayashi and Ohashi (1995).

implemented from 1953 to 1955. This program provided a subsidy equal to one-half of the anticipated selling price for the trial production of a machine tool, and it served as an invaluable incentive to Japanese machine tool makers in the production of high-quality machines, and it helped industry save precious foreign-exchange by buying domestically made machines (Kobayashi and Ohashi 1995, p. 383).

If the goal was facilities modernization, then import subsidies should have been enough, but import subsidies alone would not have advanced the import substitution of machine tool manufacturing, nor would it have led to savings in foreign-exchange. That realization, I believe, underlay the shift from the Subsidy Program for Machine Tool Imports to the Machine Tool Trial Production Subsidy Program. The transition from import replacement of machine tools to a machine tool export paradigm in Japan was primarily driven by private industry, but economic rationalization policies also contributed to a certain degree to this fundamental change.

Appendix

Table 6.A1 Subsectors of the general machinery industry

Census of Manufactures 2002 *industrial classification*		
261		Boilers, engines and turbines
	2611	Boilers
	2612	Steam engines, turbines and water wheels
	2613	Internal combustion engines
	2619	Other engines and turbines
262		Agricultural machinery and equipment
263		Construction and mining machinery
264		Metal-working machinery
	2641	Metal machine tools
	2642	Metal-working machinery
	2643	Metal-working machine parts
	2644	Machinist precision tools
265		Textile machinery
	2651	Man-made fiber machinery
	2652	Weaving and knitting machinery
	2653	Dyeing and finishing machinery
	2654	Textile machinery parts
	2655	Sewing machinery
266		Special industry machinery
	2661	Food processing machinery
	2662	Woodworking machinery
	2663	Pulp and paper industry machinery
	2664	Printing, bookbinding, paper covering machinery
	2665	Foundry equipment
	2666	Plastic working machinery
	2667	Semiconductor manufacturing equipment
	2668	Vacuum equipment
	2669	Other special industry machinery
267		General industry machinery
	2671	Pumps
	2672	Air and gas compressor and blowers
	2673	Elevators and escalators
	2674	Conveyors
	2675	Mechanical power transmission equipment
	2676	Industrial furnaces and ovens
	2677	Oil hydraulic and pneumatic equipment
	2678	Chemical machinery
	2679	Other general industry machinery
268		Office, service industry, household machinery
	2681	Office machines
	2682	Refrigerating machines and air conditioning apparatus
	2683	Amusement machines
	2684	Vending machines
	2689	Other office, service industry, household machinery
269		Other machinery and machine parts
	2691	Fire extinguishing equipment

(*Continued*)

Table 6.A1 Continued

Census of Manufactures 2002 *industrial classification*	
2692	Valves and fittings
2693	Fabricated pipe and fittings
2694	Ball and roller bearings
2695	Piston rings
2696	Molds and dies
2697	Packaging machines
2698	Industrial robots
2699	Machine shops (jobbing and repair)

Source: *Census of Manufactures 2002*, pp. 43–4.

Table 6.A2 Machine tools: products by machine type

Turning machines
- Center lathes
- Roll lathes
- Turret lathes
- Single spindle automatic lathes
- Multi-spindle automatic lathes
- Vertical lathes
- Bench lathes
- Turning Centers

Drilling machines
- Upright drilling machines
- Radial drilling machines
- Multi-spindle drilling machines
- Deep hole drilling machines
- Drilling centers
- Tapping machines
- Other drilling machines

Boring machines
- Horizontal-boring machines
- Vertical-boring machines
- Jig-boring machines
- Fine-boring machines
- Internal-precision machines

Milling machines
- Vertical milling machines
- Bed-type milling machines
- Knee-type milling machines
- Universal tool and cutter milling machines
- Profile milling machines
- Pronomillers
- Rotary table type milling machines
- Crankshaft milling machines
- Camshaft milling machines
- Twin-head milling machines
- Duplex milling machines
- Plate mills

Grinding mchines
- Cylindrical grinding machines
- Universal grinding machines
- Roll grinding machines
- Internal grinding machines
- External grinding machines
- Vertical grinding machines
- Surface grinding machines
- Centerless grinding machines
- Profile grinding machines
- Tool or cutter grinding machines
- Universal tool and cutter grinding machines
- Thread grinding machines
- Jig grinding machines
- Crankshaft grinding machines
- Camshaft grinding machines
- Hob grinding machines
- Grinding centers
- Other grinding machines

Machining centers
- Horizontal machining centers
- Vertical machining centers
- Horizontal/vertical machining centers
- Double colume type machining centers

FMS, FMC and special purpose machines
- FMS (flexible manuifacturing system)
- FMC (flexible manuifacturing cell)
- Modular units
- Single station special purpose machines
- Multi-station special purpose machines

Gear cutting and finishing machines
- Gear hobbing machines

(*Continued*)

Table 6.A2 Continued

Spline hobbing machines	Honing machines
Gear shaping machines	Lapping machines
Gear cutting machines	Polishing machines
Gear grinding machines	Superfinishing machines
Gear shaving machines	Metal sawing machines
Gear lapping machines	Abrasive cutting machines
Gear honing machines	Graphite milling machines
Gear tooth chamfering machines	Ultra precision machines
Gear tooth deburring machines	Aspheric grinding/turning machines
Physico-chemical process machines	Slicing machines
Die sinking EDMs	Other ultra precision machines
Wire EDMs	Combined machine tools
Laser processing machines	Scroll cutting machines
Plasma arc cutting machines	Other machine tools
Electronbeam machines	*Related machinery and equipments*
High quality manual small hole EDMs	CNC units
High precision small hole EDMs	Programming systems
Other machine tools	Servo motors
Planing machines	Spindle motors
Shaping machines	Automatic assembling machines
Key seating machines	CAD/CAM
Broaching machines	Other systems
Tapping machines	Software

7 The electrical and electronics industries

From low tech to high tech

Japan exported ornamental electric bulbs for a Christmas tree to the United States in the 1950s. An ornamental electric bulb is a typical low-tech electrical product. A wide variety of products exist in the electrical and electronics industry. I analyze the development of the electrical and electronics industries with a focus on semiconductor and computer industries.

Rapid growth and the spread of home appliances

As mentioned above, there are many products in the electrical and electronics industry. Let's start the definition of the electrical and electronics industry and explain the sub-categories in the electrical and electronics industry.

The electrical and electronics industry

One day I turned on my car radio and heard the following: "Today is the anniversary of the word processor" (September 9, 1998, a little past 6 p.m., NHK Radio-1). I didn't quite hear the announcement at first and so was not sure if I had heard the announcement correctly. But sure enough, 20 years before that date, on September 9, 1978, the first Japanese word processor was completed. It was reported that at the time, the printer alone cost ¥5 million, and with the word processor itself, the total system went for nearly ¥20 million. An average worker's monthly salary at that time was slightly more than ¥200,000 (Table 9.8). This machine was big, taking up almost five square meters. Akagi *et al*.'s 1998 publication, *The Birth of Electronic Society*, contains a photo of Toshiba's JW-10, the first Japanese word processor. Announcements about the Japanese word processor appeared in December 1978, and actual sales began the following year: 160 units at ¥6.3 million per unit were ordered, and 100 word processors were delivered in 1979. In March 2000, Toshiba stopped making dedicated word processors, deciding to withdraw altogether from that business (see, for example, the *Yomiuri Shimbun*, June 23, 2000, p. 19).

In Chapter 6, I made the point that general machines are defined as capital-goods machines and are broadly described as those machines used in production activities, including office activities. Thus, included in this category are machine

tools, industrial robots, injection molding machines, and other machines used in factories. Also included are construction equipment, agricultural machines, textile industry machines, word processors, copy machines, and other office equipments. Personal computers and fax machines, however, fall under the heading "electrical machinery." For the sake of convenience, however, word processors and copy machines will be considered here along with electrical and electronic machines. The two-digit industrial classification had one category for electrical and electronics industry, but that industry was divided into three categories: electrical machinery (industrial classification code 27), information and communication electronics equipment (code 28), and electronic parts and devices (code 29).

In this chapter, I take a broad view of the development of the electrical and electronic machine industries. In the first half of the chapter, I discuss home appliances, and in the second half I take up semiconductors, computers, and related equipment. These two areas are not clearly separated from each other, so my discussion has a certain amount of overlap. For example, consider the expression "digital home appliances." Are these home appliances? Are they computers? It's hard to know where to draw the line.[1]

To state the seemingly obvious, the electrical and electronics industry consists of the electrical industry, which manufactures electrical equipment, and the electronics industry which manufactures electronic devices (see Industrial Bank of Japan 1997, p. 131; *The State of Japanese Industry 1998*, pp. 160–1, which form the basis of this section). Electrical equipment uses electrical energy, which is converted from current into mechanical energy, light, and heat for use in electrical devices. Electronic devices, by contrast, process and transmit information through the medium of the electric current. Electrical equipment is typically divided into two categories: home appliances and industrial electrical equipment. Home appliances are electrical devices intended for private use such as air conditioners, electric refrigerators, electric washing machines, vacuum cleaners, and microwave ovens. This market is very vigorous: the market for refrigerators and washing machines, so-called "white goods," is sustained by consumers who replace these products. As I will explain, recent years have seen an increasing shift away from Japanese production to offshore production of these products, with more than 200 Japanese companies establishing production facilities in other East Asian countries during the late 1990s (*The State of Japanese Industry 1998*, p. 160). The private-use electrical appliances and home electronics devices that I discuss are collectively known as "home electrical appliances."

Industrial electrical equipment uses a great deal of steel, copper, and other metals, so this category is called "heavy electrical equipment," which includes, for example, generators, power transmission equipment, electric motors, and transformers. With the exception of small electric motors, products in this industry are essentially made to order. The industry is highly dependent on the electric power industry, and its fortunes rise and fall with the amount of investment in electric power industry.

Electronic equipment includes home electronic appliances, industrial electronic equipment, and electronic parts. Home electronic appliances are for individual

Table 7.1 Offshore production facilities of JEITA members (as of December 31, 2001)

	Consumer electronic equipment	*Industrial electronic equipment*	*Electronic components and devices*	*Total*
Europe	40	43	76	144
North America	44	53	130	215
Asia	210	190	643	942
China	71	73	209	330
Central and South America	6	8	10	21
Oceania	1	6	1	7
Africa	2	0	0	2
World	303	300	860	1,331

Source: *Electronics and Information Technology Industries in Japan* (2003), p. 19.

Note
JEITA is Japan Electronics and Information Technology Industries Association.

use, and include VCRs, color television sets, CD players, DVD players, stereos, and video cameras. Demand is relatively stable for color televisions and VCRs, sometimes called "brown goods" in Japan, but overseas production has increased and Japanese domestic production has declined, and in the wake of the September 1985 Plaza Accord and the subsequent yen appreciation, imports of these products have increased. Conversely, the manufacture of digital equipment such as video cameras, CD players, and DVD players has been fairly strong, even though these too are "brown goods." Nevertheless, the Japanese electronics industry has been even more assiduous in developing overseas manufacturing bases as shown in Table 7.1.

Industrial electronics includes computers, telecommunications equipment, and electronic instruments. Downsizing has had a severe impact on the demand for large mainframe computers, and by 1993 the value of personal computer shipments exceeded that for mainframes. Corporations and the government had been the main computer users in years past, and these computers are still called "industrial-use" electronic equipment. In recent years, however, the market for personal computers and cell phones for individual users has expanded, and the name of the category itself has become obsolete. Electronic parts include resistors, condensers and other passive parts, connectors, and printed circuit boards, as well as semiconductors, integrated circuits (ICs), and liquid crystals.

Structural change in the electrical and electronics industries

The electrical and electronics industries are, along with the automobile industry, Japan's flagship industrial sectors. The total value of shipments of these industries (electrical machinery, information and communication electronics equipment, and electronic parts and devices) in 2002 was ¥46.041 trillion, with 1.33 million employees, representing 15.3 and 17 percent, respectively, of all Japanese manufacturing industry (Table 7.2). The value added by electrical and electronics

Table 7.2 Structure of Japan's electrical and electronics industries (2002)

Industry code	*Industry*	*Number of establish-ments*	*(%)*	*Number of employees*	*(%)*	*Value of shipment (million yen)*	*(%)*	*Value added (million yen)*	*(%)*	*Value added ratio (%)*
27+28+29	Electrical and electronics industries	22,380	100.0	1,326,340	100.0	46,041,088	100.0	14,578,321	100.0	31.7
27	Electrical machinery	13,471	60.2	600,328	45.3	17,787,589	38.6	6,257,882	42.9	35.2
271	Electrical generating, transmission, and distribution apparatus	7,741	34.6	282,979	21.3	6,587,393	14.3	2,339,664	16.0	35.5
272	Home electric appliances	1,649	7.4	84,034	6.3	2,949,363	6.4	1,123,862	7.7	38.1
273	Electric bulbs and lighting fixtures	956	4.3	38,725	2.9	1,070,244	2.3	446,371	3.1	41.7
274	Electronic equipment	1,275	5.7	77,332	5.8	3,497,812	7.6	903,738	6.2	25.8
275	Electric measuring instruments	963	4.3	42,283	3.2	1,046,902	2.3	448,827	3.1	42.9
279	Other electrical machinery	887	4.0	74,975	5.7	2,635,875	5.7	995,419	6.8	37.8
28	Information and communication equipment	2,773	12.4	230,930	17.4	12,367,353	26.9	2,993,964	20.5	24.2
281	Communication equipment	1,664	7.4	140,263	10.6	6,890,161	15.0	1,949,133	13.4	28.3
2811	Communication equipment wired	213	1.0	23,824	1.8	1,121,692	2.4	279,903	1.9	25.0
2812	Radio communication equipment	379	1.7	52,321	3.9	2,990,706	6.5	779,003	5.3	26.0
2813	Radio and television set receivers	38	0.2	7,547	0.6	738,470	1.6	122,070	0.8	16.5
2814	Electric audio equipment	803	3.6	44,434	3.4	1,715,700	3.7	644,401	4.4	37.6
2815	Railway signal and safety appliances	121	0.5	5,532	0.4	171,397	0.4	64,966	0.4	37.9
2819	Other communication equipment	110	0.5	6,605	0.5	152,196	0.3	58,789	0.4	38.6
282	Computer	1,109	5.0	90,667	6.8	5,477,192	11.9	1,044,830	7.2	19.1
2821	Computer, except personal computer	162	0.7	13,445	1.0	1,037,425	2.3	262,672	1.8	25.3
2822	Personal computer	449	2.0	28,682	2.2	2,198,567	4.8	248,918	1.7	11.3

(*Continued*)

Table 7.2 Continued

Industry code	*Industry*	*Number of establish-ments*	*(%)*	*Number of employees*	*(%)*	*Value of shipment (million yen)*	*(%)*	*Value added (million yen)*	*(%)*	*Value added ratio (%)*
29	Electronic parts and devices	6,136	27.4	495,082	37.3	15,886,146	34.5	5,326,475	36.5	33.5
291	Electronic parts and devices	6,136	27.4	495,082	37.3	15,886,146	34.5	5,326,475	36.5	33.5
2911	Electron tubes	37	0.2	9,626	0.7	355,018	0.8	198,811	1.4	56.0
2912	Semiconductor devices	172	0.8	46,545	3.5	1,441,305	3.1	427,557	2.9	29.7
2913	Integrated circuits	217	1.0	113,085	8.5	5,406,087	11.7	1,779,353	12.2	32.9
2914	Resistors, capacitors, transformers and composite parts	671	3.0	49,933	3.8	1,185,650	2.6	470,902	3.2	39.7
2915	Electro acoustic transducers, magnetic heads and small motors	217	1.0	10,665	0.8	271,644	0.6	136,896	0.9	50.4
2916	Connectors, switches and relays	569	2.5	31,448	2.4	929,566	2.0	273,836	1.9	29.5
2917	Switching power supplies high-frequency assemblies and remote controls	263	1.2	15,380	1.2	360,712	0.8	111,121	0.8	30.8
2918	Printed circuit	1,314	5.9	67,923	5.1	1,489,823	3.2	556,884	3.8	37.4
2919	Other electronic parts and devices	2,676	12.0	150,477	11.3	4,446,340	9.7	1,371,115	9.4	30.8

Source: *Census of Manufactures 2002*.

Notes
Figures in this table are of the establishments with four employees and more. Value added of the establishments with four to 29 employees is gross value added.
Value added ratio is a ratio of value added to value of shipment.

industries was ¥14.58 trillion in 2002, representing 2.9 percent of Japan's ¥498 trillion GDP in that year. The number of total employed workers was 63.3 million in 2002 (*Japan Statistical Yearbook 2004*, p. 496). Thus, the electrical and electronics industries accounts for 2.12 percent of Japan's total workers.

Table 7.2, taken from *Census of Manufactures 2002*, shows the subsectors of the electrical and electronics industry. Table 7.2 lists the number of establishments, number of employees, value of shipments, value added, and value-added ratios (the ratio of value added to value of shipments). Among two-digit subsectors of the electrical and electronics industry, electric machinery (code 27) has the highest share. The electric machinery shares of the number of establishments, the number of employees, value of shipments, and value added are 60.2, 45.3, 38.6, and 42.9 percent, respectively.

Table 7.3 charts the changes in the share of all shipment values of the various electrical and electronics industry subsectors (according to the three-digit industrial classification codes of *Census of Manufactures*, published annually by the Ministry of Economy, Trade, and Industry) from 1950, through the period of rapid growth, up to 1975, and reports the shipment value of establishments that have four or more employees. As you can see from Table 7.3, however, the industrial classifications used in *Census of Manufactures* have changed through the years so that, for instance, the computer industry had been a four-digit industrial code and was part of the "applied electronic equipments" category, and semiconductors and integrated circuits were once subsumed within electronic parts and devices and electronics and telecommunications device parts.[2]

As illustrated in Table 2.3, the electrical and electronics industries represented a very small proportion of the value of all Japanese industry shipments in the earliest period of this study. The industries' share was a mere 2.6 percent in 1950 and 3.7 percent in 1955. It had reached 8.3 percent in 1960, after the period of rapid economic growth had already begun, and grew rapidly after that, reaching 10.6 percent by 1970 and 15.3 percent by 1985. Table 7.3 illustrates that the present structure of the electrical and electronics industries is markedly different from what it was at the outset. From 1950 to 1975, the largest fractions of the industry were (a) electricity generating, transmission, and distribution apparatus, and (b) communication equipment. In 1970 the combined total shipments of semiconductors and ICs accounted for no more than 2.8 percent of the total shipments of the electrical and electronics industries and had reached 3.5 percent by 1975. By 2002 the combined total shipments of semiconductors and ICs accounted for 14.8 percent of the electrical and electronics industries as shown in Table 7.2.

Let us examine long-term exports and imports in the electronics industry. Table 7.4 shows trends in the production, exports, imports, export–production ratio, and net export ratio of Japan's electrical and electronics industries from 1957 to 1993. The net export ratio is defined as:

$$(\text{exports} - \text{imports}) / (\text{exports} + \text{imports})$$

Its value varies between −1 and +1. A negative value indicates net imports. The larger this ratio, the greater a country's international competitiveness is said to

Table 7.3 Structural change in Japan's electrical and electronics industries (1950–75)

	1950	*1955*	*1960*	*1965*	*1970*	*1975*
Value of shipment (Million yen)						
Electrical and electronics industries	60,756	249,493	1,291,608	2,297,143	7,316,496	10,780,860
Electrical generating, transmission, and distribution apparatus	25,578	96,125	431,543	595,329	1,677,176	2,435,381
Home electric appliances	1,583	20,961	152,211	323,738	692,783	1,380,519
Electric bulbs and lighting fixtures	4,952	9,393	65,845	142,884	369,519	390,866
Communication equipments	15,746	57,996	382,736	690,424	2,441,957	3,359,378
Applied electronic equipments	1,092	4,821	10,456	78,491	430,329	921,266
Computer	na	na	na	na	343,791	713,325
Electric measuring instruments	4,486	7,991	37,047	72,661	228,656	324,912
Electronic parts and devices	1,669	27,027	172,816	311,917	1,268,204	1,651,732
Semiconductor devices	na	342	18,766	32,872	190,717	301,604
Integrated circuits	na	na	na	na	11,213	77,362
Other electrical and electronics industries	5,650	25,179	38,954	81,699	207,869	316,801
Share of shipment value (%)						
Electrical and electronics industries	100.0	100.0	100.0	100.0	100.0	100.0
Electrical generating, transmission, and distribution apparatus	42.1	38.5	33.4	25.9	22.9	22.6
Home electric appliances	2.6	8.4	11.8	14.1	9.5	12.8
Electric bulbs and lighting fixtures	8.2	3.8	5.1	6.2	5.1	3.6
Communication equipments	25.9	23.2	29.6	30.1	33.4	31.2
Applied electronic equipments	1.8	1.9	0.8	3.4	5.9	8.5
computer	na	na	na	na	4.7	6.6
Electric measuring instruments	7.4	3.2	2.9	3.2	3.1	3.0
Electronic parts and devices	2.7	10.8	13.4	13.6	17.3	15.3
Semiconductor devices	na	0.1	1.5	1.4	2.6	2.8
Integrated circuits	na	na	na	na	0.2	0.7
Other electrical and electronics industries	9.3	10.1	3.0	3.6	2.8	2.9

Source: Tsusan Tokei Kyokai (1982).

Note
Figures in this table are of the establishments with four employees and more.

be. The ratio of exports to production in the electrical and electronics industries as a whole has generally hovered around 50 percent since 1980, and the net export ratio has been gradually declining since reaching a peak in the mid-1980s.

Strong increases in the ratio of exports to production in the home electronic appliances were seen through the period of rapid economic growth, and the ratio has been in slow decline since the mid-1980s, a trend that is probably a result of the yen appreciation since the September 1985 Plaza Accord and the resulting increase in so-called "reverse importation" because of a shift to offshore production bases for electronic products. Until the 1960s, Japan was a net importer of industrial electronic equipment, but Japan's international competitiveness in this industry increased as well, and the exports-to-production ratio grew. The exports-to-production ratio of electronic parts grew markedly, and no trend toward a decline in the net import ratio has appeared.

Increased availability of home appliances

During the period of rapid growth in the postwar period, Japan strove mightily to catch up to the industrial countries. Macroeconomic statistics indicate clear shrinkage in the gap in per capita income between Japan and the industrial countries (see Table 2.1 for a comparison of the incomes in Japan and the United States), a fact that was readily apparent in the rapidly increasing availability of durable consumer goods. Younger readers who have always had home appliances may not fully appreciate the gratitude with which appliances were received by Japanese consumers.[3]

If you look at the chronology of the electrical and electronic industries development at the end of this chapter (appendix Table 7.A1) you will see the approximate dates for the appearance of the color television in Japan. Figure 7.1 shows the changes in the diffusion rates of individual items. For reference, I have included the diffusion rates for passenger cars in addition to electrical and electronics products. The first surprise is that right in the middle of the period of rapid economic growth in the mid-1960s, a television set meant a black-and-white set. Readers who have toured a television factory in a developing country may already know this, but I have heard, "The most expensive TV is a Sony, next comes any other company's color TV, and the cheapest ones are black-and-white," which means, remarkably, that black-and-white television sets are still out there.[4] By 1970 nearly 90 percent of households had electric refrigerators and electric washing machines, but in that same year, only 26 percent of households had a color television set. Of course, the penetration rate of color televisions picked up very quickly, and by 1975, 90 percent of households had one. By 1980 nearly every household had a color television set. In March 2004, more than 50 percent of households had a digital camera and more than 60 percent of households had personal computers.

I do not think it is enough to explain this dissemination of durable consumer goods simply in terms of increases in household income and decline in the relative

Table 7.4 Production, exports, and imports of Japan's electrical and electronics industries: a long-term trend

	Electrical and electronics industries (total)					*Home electronic appliances*				
	Production	*Exports*	*Imports*	*Exports imports*	*Net export ratio*	*Production*	*Exports*	*Imports*	*Exports imports*	*Net export ratio*
1957	1,678	37	81	2.2	–0.373	625	13	0.8	2.1	0.884
1958	2,131	175	93	8.2	0.306	970	43	0.6	4.4	0.972
1959	3,764	514	148	13.7	0.553	1,922	405	0.7	21.1	0.997
1960	4,906	717	173	14.6	0.611	2,406	572	1.0	23.8	0.997
1961	5,850	919	260	15.7	0.559	2,891	684	1.1	23.7	0.997
1962	6,689	1,157	500	17.3	0.396	3,165	841	2.3	26.6	0.995
1963	6,900	1,398	518	20.3	0.459	3,228	1,025	3.5	31.8	0.993
1964	8,468	1,846	570	21.8	0.528	3,895	1,298	9.0	33.3	0.986
1965	8,711	2,241	475	25.7	0.650	3,442	1,511	9.5	43.9	0.988
1966	11,147	3,218	572	28.9	0.698	4,582	2,187	10	47.7	0.991
1967	14,288	3,790	860	26.5	0.630	6,157	2,669	21	43.3	0.984
1968	18,924	5,131	1,021	27.1	0.668	8,288	3,616	33	43.6	0.982
1969	26,948	7,151	1,366	26.5	0.679	12,611	5,005	44	39.7	0.983
1970	33,967	8,651	2,036	25.5	0.619	14,658	5,870	49	40.0	0.983
1971	33,224	9,996	1,937	30.1	0.675	13,785	6,658	62	48.3	0.982
1972	37,876	11,502	1,844	30.4	0.724	15,454	7,474	66	48.4	0.982
1973	45,555	13,306	2,532	29.2	0.680	16,858	7,726	100	45.8	0.974
1974	47,825	16,234	3,598	33.9	0.637	17,484	9,082	169	51.9	0.963
1975	43,294	16,820	3,230	38.9	0.678	16,126	9,455	184	58.6	0.962
1976	58,755	26,950	3,763	45.9	0.755	22,254	16,451	294	73.9	0.965
1977	60,844	26,823	3,781	44.1	0.753	22,422	15,812	290	70.5	0.964
1978	64,320	26,391	3,459	41.0	0.768	21,852	13,867	216	63.5	0.969
1979	70,912	30,542	4,874	43.1	0.725	22,896	14,914	370	65.1	0.952
1980	86,785	45,580	7,013	52.5	0.733	29,321	20,471	382	69.8	0.963
1981	108,189	56,728	7,054	52.4	0.779	36,685	26,004	330	70.9	0.975
1982	113,631	60,741	7,966	53.5	0.768	35,064	25,206	263	71.9	0.979
1983	132,480	71,951	8,083	54.3	0.798	38,336	28,295	203	73.8	0.986
1984	174,541	94,202	10,339	54.0	0.802	47,190	34,954	231	74.1	0.987
1985	185,527	96,951	10,346	52.3	0.807	49,116	38,055	237	77.5	0.988
1986	182,791	85,751	8,545	46.9	0.819	44,347	29,409	324	66.3	0.978
1987	187,699	85,782	10,334	45.7	0.785	39,709	23,172	610	58.4	0.949
1988	212,454	91,202	12,333	42.9	0.762	42,602	22,078	978	51.8	0.915
1989	229,216	100,961	16,915	44.0	0.713	41,915	22,868	1,454	54.6	0.880
1990	239,204	109,939	20,006	46.0	0.692	44,357	26,178	1,131	59.0	0.917
1991	253,035	112,706	21,092	44.5	0.685	46,960	26,964	1,357	57.4	0.904
1992	222,536	113,098	20,456	50.8	0.694	37,603	22,575	1,560	60.0	0.871
1993	210,255	107,456	21,780	51.1	0.663	32,589	17,517	1,725	53.8	0.821

Source: The Society for Industrial Studies, Japan (1995), p. 1161.

Industrial electronic equipments					*Electronic parts*				
Production	*Exports*	*Imports*	*Exports imports*	*Net exports ratio*	*Production*	*Exports*	*Imports*	*Exports imports*	*Net exports ratio*
565	11	72	1.9	–0.735	488	13	9.1	2.7	0.176
572	11	78	1.9	–0.753	589	32	15	5.4	0.362
743	17	120	2.3	–0.752	1,099	92	18	8.4	0.673
1,081	32	148	3.0	–0.644	1,425	113	25	7.9	0.638
1,429	61	230	4.3	–0.581	1,530	174	31	11.4	0.698
1,705	91	376	5.3	–0.610	1,819	225	33	12.4	0.744
1,844	115	472	6.2	–0.608	1,827	258	46	14.1	0.697
2,328	145	508	6.2	–0.556	2,246	404	65	18.0	0.723
2,865	215	399	7.5	–0.300	2,403	515	76	21.4	0.743
3,472	315	392	9.1	–0.109	3,093	716	101	23.1	0.753
4,322	388	585	9.0	–0.202	3,810	732	149	19.2	0.662
5,785	563	684	9.7	–0.097	4,883	953	304	19.5	0.516
7,327	847	855	11.6	–0.005	7,278	1,299	468	17.8	0.470
10,376	1,397	1,220	13.5	0.068	8,933	1,384	767	15.5	0.287
10,890	1,664	1,205	15.3	0.160	8,549	1,674	671	19.6	0.428
12,254	1,851	1,126	15.1	0.244	10,168	2,178	653	21.4	0.539
15,154	2,428	1,421	16.0	0.262	13,548	3,159	1,011	23.3	0.515
17,267	2,986	1,937	17.3	0.213	13,074	4,166	1,491	31.9	0.473
15,804	3,399	1,719	21.5	0.328	11,364	2,955	1,327	26.0	0.380
18,781	4,166	1,543	22.2	0.459	17,720	6,332	1,926	35.7	0.534
20,547	3,991	1,839	19.4	0.369	17,875	7,021	1,652	39.3	0.619
23,724	4,834	1,649	20.4	0.491	18,743	7,670	1,594	40.9	0.656
27,037	5,651	2,186	20.9	0.442	20,979	9,977	2,319	47.6	0.623
30,693	10,491	2,894	34.2	0.568	26,771	14,618	3,675	54.6	0.598
38,170	13,439	2,975	35.2	0.638	33,334	17,285	3,984	51.9	0.625
43,021	15,281	3,148	35.5	0.658	35,546	19,254	4,554	54.2	0.617
50,853	19,908	3,003	39.1	0.738	43,291	23,748	4,877	54.9	0.659
66,709	26,892	3,708	40.3	0.758	60,642	32,356	6,401	53.4	0.670
76,141	29,189	3,976	38.3	0.760	60,270	29,708	6,133	49.3	0.658
79,267	27,375	3,246	34.5	0.788	59,176	28,967	4,975	49.0	0.707
86,251	28,697	3,509	33.3	0.782	61,739	33,913	6,216	54.9	0.690
99,148	29,883	4,353	30.1	0.746	70,704	39,241	7,002	55.5	0.697
107,952	31,920	5,862	29.6	0.690	76,349	46,172	6,900	60.5	0.740
113,350	34,427	6,924	30.4	0.665	81,497	49,334	11,951	60.5	0.610
117,302	35,075	6,874	29.9	0.672	88,774	50,667	12,861	57.1	0.595
105,274	36,916	6,333	35.1	0.707	79,600	53,607	12,562	67.3	0.620
98,172	34,302	6,977	34.9	0.662	79,494	55,637	13,079	70.0	0.619

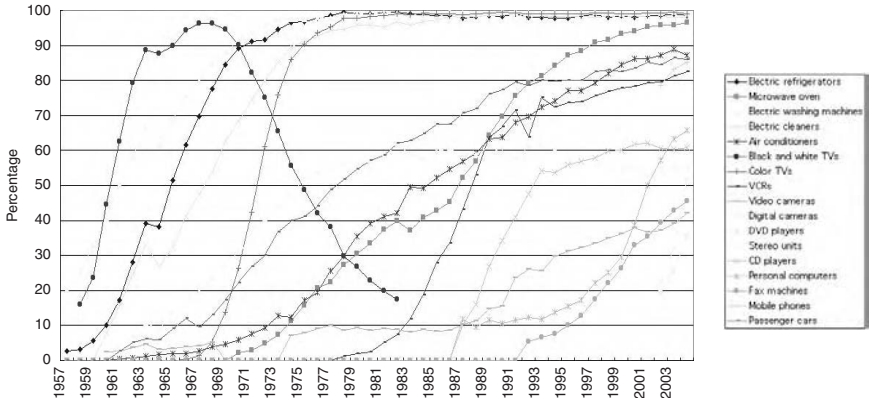

Figure 7.1 Diffusion rates of the selected electrical and electronic consumer durables (source: Cabinet Office of Japan).

prices of these goods; that explanation would miss an essential point. We must not overlook the thinking of such entrepreneurs as Konosuke Matsushita[5] with his so-called "tap-water philosophy" (Hashimoto and Nishino 1998; K. Nakamura 1992a) or Sony's Masaru Ibuka,[6] who believed that "Instead of trying to monopolize a little pie, it's better to create a much larger pie and share it" (Yonekura and Kawai 1998).

Konosuke Matsushita went on his first overseas business trip in January 1951. He was amazed to find that the United States had some seven million television sets and over 100 million radios (the Japanese television station NHK did not begin regular broadcasting until February 1953 – see Table 7.A1). At the time, the price of a radio was equivalent to one-and-a-half month's wages for a Matsushita Electric factory worker, but a General Electric worker in the United States earned enough to buy a radio in a mere two days. This discrepancy came as a shock to Matsushita (K. Nakamura 1992a, pp. 115–16). From this experience Matsushita pushed his tap-water philosophy forward, in which he envisioned "production on the heels of production," with the goal of making "goods as limitless as water" and "prices as low as tap water" (K. Nakamura 1992a, p. 116).

The shift to overseas production

The Japanese yen appreciated as a consequence of the September 1985 Plaza Accord, and with the yen appreciation, the shift to overseas production of electrical and electronic goods accelerated. A survey conducted in June 2000 by the Electronic Industries Association of Japan indicated that Japanese companies had 1,263 overseas subsidiaries, nearly two-thirds of which (941 companies) had been set up since 1986 (*Overseas Company List 2000* by Japan Electronics and Information Technology Industries Association, p. iii).

Figures 7.2 and 7.3 chart Japanese domestic production, exports, imports, and the overseas production of color televisions and VCRs. The graphs clearly show

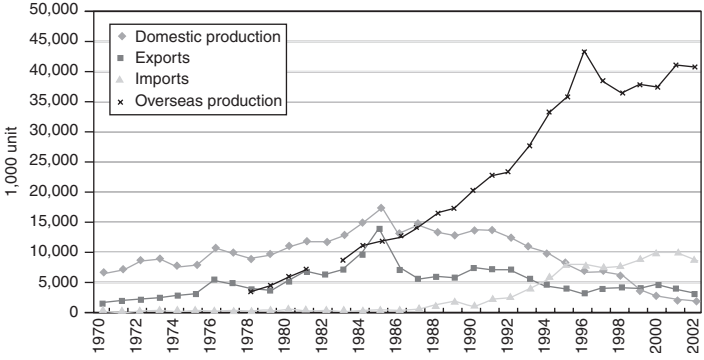

Figure 7.2 Domestic production, exports, imports, and overseas production: color TVs (sources: EIAJ (1995), p. 18; EIAJ (1998), p. 14; *Statistical Handbook of Home Electronic Appliances (June 2003)*, pp. 115, 146, 154, 239).

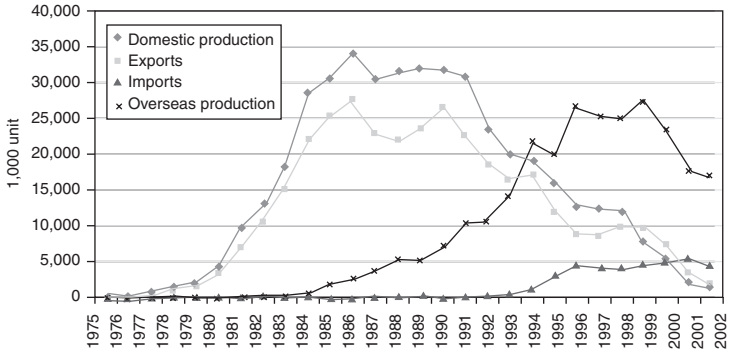

Figure 7.3 Domestic production, exports, imports, and overseas production: VCRs (sources: EIAJ (1995), p. 19; EIAJ (1998), p. 15; *Statistical Handbook of Home Electronic Appliances (June 2003)*, pp. 117, 146, 155, 240).

Note
Exports include DVD players.

that the production of both color televisions and VCRs has rapidly shifted overseas. In 1988 the overseas production of color televisions outstripped Japanese domestic production. In 1994 television imports outpaced exports, and by 1996 the number of imported color television sets exceeded the number of sets made in Japan. Color television production in Japan stood at 1.48 million sets in 2002, whereas 40.76 million sets were produced overseas. In total 2.68 million sets were exported and 8.57 million sets were imported in 2002 (*Statistical Handbook of Home Electronic Appliances 2003*, p. 115, 146, 154, 239).

Although the overseas production of VCRs surpassed Japanese production in 1994, exports continued to exceed imports until 2000. The 2002 figures show that domestic VCR production stood at 1.56 million units, whereas overseas

production was 16.94 million units. In total 2.06 million video players (including DVDs) were exported and 4.77 million units were imported (*Statistical Handbook of Home Electronic Appliances 2003*, p. 117, 146, 155, 240).

Almost all VCRs in Japan now use the VHS (video home system) format, and the struggle to develop the VHS format, led by former JVC vice-president Shizuo Takano, is familiar to the many Japanese viewers of NHK Television's "Project X" series (Ako 2001; NHK "Project X" Production Staff 2000, pp. 73–127). Sato (1999, p. 10) writes about how the "VHS at 20th Anniversary Meeting" held on November 1, 1996 turned into a memorial for Shizuo Takano.

According to the *Overseas Company List 2000*, published by the Japan Electronics and Information Technology Industries Association, 80 television companies and 32 VCR companies have manufacturing operations outside of Japan. We can expect that this shift to overseas production, in which high-quality sets are made in Japan and low- to moderate-quality sets are imported into Japan from overseas subsidiaries, will continue and expand.

The development of the semiconductor and computer industries

In this section I analyze the development of the electronics industry, focusing on the semiconductor and computer industries.

The man who gambled on the blue light-emitting diode: Shuji Nakamura

Have you heard of the blue light-emitting diode? Blue light-emitting diodes, or LEDs, are used in car interiors and for illuminated signs in cities and towns. An incandescent light bulb contains a filament that heats up to emit light, but in a fluorescent tube, ultraviolet light created by electrical discharge inside the tube causes the fluorescent coating inside the tube to emit light. Thus, light bulbs and fluorescent tubes work indirectly by using electricity that acts upon a particular medium and is converted to light. In contrast, an LED converts electricity flowing through a semiconductor directly into light (S. Nakamura 2001a, p. 65).

I hate physics (having received near-failing grades in the subject in high school), and I wouldn't normally buy a book with the title *The World of Contemporary Physics* (Kubo 1998), but my curiosity was piqued by the book's subtitle: "The People Who Opened Up New Frontiers." So I bought it. The title of chapter 4 is "The Materials Science and Glory of Shuji Nakamura:[7] The Man Who Bet on Blue Light Emitting Diodes." I may not like physics, but I do love books for children. Kubo's book is part of the Iwanami Junior Library series.

In any case, Shuji Nakamura has been profiled in the "People Discovered" series of the *Nihon Keizai Shimbun* (evening edition), in articles running from February 24 to 28, 1997, and in "Praised by the *New York Times*: A Japanese Invention that Leaves the World's Corporations Behind" (*Asahi Shimbun,* January 20, 1999, p. 13). Until the end of 1999, Dr. Nakamura was employed by Nichia Corporation of Anan, Tokushima Prefecture in Japan, but he left the

company to become a professor at the University of California, Santa Barbara. He is the recipient of the twenty-first Honda Prize, and as a result has become quite well-known. Dr. Nakamura gives the lie to the still widely held notion that Japanese people lack ability in technical innovation.[8] According to Kubo (1998, p. v), Shuji Nakamura is a man with a very strong personality who had a dream that customer orders would come in from around the world to the smallish company he worked for in Tokushima prefecture. He is also famous and notorious for the patent dispute. I recommend young Japanese readers to read Kubo's 1998 book, the relevant newspaper and magazine articles, and S. Nakamura (2001a, 2001b) to learn more about Shuji Nakamura.

The history of semiconductor development and Japan's incubation policy

Table 7.5 briefly summarizes the history of semiconductor development. This history is the process by which transistors became ICs, then more highly integrated circuits characterized by large-scale integration (LSI), very large-scale integration (VLSI), and ultimately ultra large-scale integration (ULSI).

The first ICs contained about 100 transistors on a single chip. An LSI device contains anywhere from several thousand to several tens of thousands of transistors on a single 5 mm^2 of silicon. VSLI chips contain millions of transistors (the "mega" class), and ULSI chips contain billions of transistors (the "giga" class). These facts are easy to recite, but the human achievement represented by these chips is astounding and must not be overlooked. Interested readers who can read Japanese are directed to Aida (1991a, 1991b, 1992a, 1992b) and Kikuchi (1992).

Aida's book, *The Autobiography of Japan's Rise as an Electronics Nation*, was serialized in six parts on NHK television in 1991. It has been published in book form by Aida. The series is available in a small paperback format in seven volumes in the NHK Library series, and the videos themselves are available from NHK, or can be borrowed from many local libraries.

The history of Japan's semiconductor industry is a textbook example of the process of importing technology, imitating it, and then catching-up and overtaking it. In the 1950s, Japanese companies asked themselves rhetorically, "When you don't know where the next bowl of rice is coming from, who has time to worry about what's for dinner the day after tomorrow?" Despite those basic fears, however, we must never forget the legions of semiconductor engineers who struggled to build the high-tech Japan we know today.

From the standpoint of development economics, demand was the force that stimulated progress in the semiconductor industry, and the essential fact is the rapid fall in prices for semiconductors. For example, a desktop calculator was launched in 1964, the same year as the Tokyo Olympics. It was priced from ¥400,000 to ¥800,000.[9] Only 4,355 such calculators were sold in 1965. In 1980, however, more than 60 million calculators were sold. In the intervening years, the "desktop calculator" shrank in size, small enough to slip easily into a shirt pocket, and became cheap enough for anyone to afford. This outcome was the

Table 7.5 History of semiconductor development

Year	*Invention, development*	*Devices*
1904	Diode vacuum tube (John A. Fleming)	Vaccum tube
1906	Triode vacuum tube (Lee De Forest)	
1947	Invention of transistor (William B. Shockley, Walter H. Brattain, John Bardeen)	Transistor
1949	Invention of junction transistor (William B. Shockley)	
1951	Experimental production of junction transistor (Bell)	
1952	Production of alloy transistor (RCA)	
1956	Development of silicon transistor (TI)	
1957	Development of SCR, FET	
1958	Development of IC (Jsck S. Kilby, TI)	IC
1959	Development of planar IC	
1962	Development of MOSIC	
1968	Concept of transistor MOS DRAM Development of CMOS IC (RCA)	
1970	Development of 1K • DRAM (Intel) Invention of CCD (Bell)	LSI
1971	Development of 4-bit microcomputer	
1975	Development of 8-bit microcomputer	
1976	Development of 64K-DRAM	
1981	Development of 16-bit microcomputer	
1982	Development of 1M-DRAM	VLSI
1985	Development of 4M-DRAM	
1987	Development of 32-bit microcomputer	
1988	Development of 16M-DRAM	
1992	Development of 64M-DRAM	ULSI
1993	Development of 1G-DRAM	
1995	Development of 256M-DRAM	System LSI
1999	Development of 128-bit microcomputer	
2001	Production of 1G-flash memory	
2003	Development of 32M-bit FeRAM	

Source: *IC Guidebook 2003*.

result of efforts to increase the degree of integration in the semiconductors used for calculators, reductions in the number of parts, improvements in liquid crystal and other display devices, and reductions in price. The *IC Guidebook 2000* (p. 19) has a striking graph showing the trend in cumulative electronic calculator production and falling prices.

We find the roots of the Japanese–U.S. semiconductor dispute in the following fact. In 1964 Texas Instruments (TI) applied to MITI to set up a wholly owned Japanese subsidiary to start the production of ICs for use in calculators and the like, but MITI just put off responding to TI's application (Aida 1992a, p. 232).

Aida's book also relates many intriguing episodes in the development of Japan's semiconductor industry. For instance, a Japanese company, Shinkawa, succeeded in producing an automatic wire-bonding system for wiring IC chips,

and did so before a U.S. manufacturer, Kulicke & Soffa. This achievement presented problems in terms of the relative prices of IC elements and technology choice. U.S. manufacturers were already in Asia, taking advantage of the abundant labor pool; they had little incentive to adopt automated manufacturing processes. Conversely, Japan had already become a relatively high-wage country and had not made major inroads into the other Asian countries, a combination of factors that proved a powerful incentive for automating IC production (Aida 1992b, pp. 273–86). As it happens:

> There's a limit to low wages. The most you can hope to cut costs by paying low wages is maybe 10 percent. But a machine, right away that's 50 times faster than a person. And by automating, by removing the human element, product yields go up and quality is outstanding.
>
> (Aida 1992b, p. 286)

Then we have the very typical Japanese quality control story about the semiconductor plant that was looking for the reason product yields and quality were down. A woman working at the plant noticed that the cause of the defects lay in the trains that passed close to the factory, jostling the equipment. This anecdote is a good example of "quality control from the bottom" in Japan's manufacturing industries.

The New Year's party scene from *The Autobiography of Japan's Rise as an Electronics Nation* shows the importance of related companies' networks. A certain company invited 500 related companies to a New Year's networking party. The point was that making semiconductors would be impossible without every one of these 500 companies. In fact, the companies at the lowest rung of the technology ladder ultimately determined the quality of the end product. Parts-supplier networks and good relations between an assembler and parts-suppliers are crucial for the quality of manufactured goods.

Table 7.6 lists the main development policies of the electronics and semiconductor industries and illustrates that MITI implemented a variety of programs for these industries (see Kohama and Urata 1993 for more detailed information about specific policies). Clearly such actions as MITI delaying Texas Instruments' entry into Japan served to protect the nascent Japanese semiconductor industry until it could effectively protect itself. It was a means of buying time. I do believe, however, that the Japanese electronics and semiconductor industries' strong awareness of foreign competition drove them forward, not protectionist government policy.

Kikuchi (1992, p. 138) writes:

> I worked in MITI's research institute for twenty-six years. As far as I can tell, MITI officials had never gone so far as to read the situation in ultra LSI's or had anything to do with promoting the technology. No, my understanding is that it was the companies in the Japanese technology community, laboring as they did in the shadow cast by IBM, that prodded each other forward. This was the vitality of Japanese society; there was no higher good fortune for which to be thankful.

Table 7.6 Japan's promotion policies for the electronics and semiconductor industries

Period	*Policy/legislation*
Promotion policies for the electronics industries	
1956–71	Temporary Law for the Promotion of the Machinery Industry
1967–71	Temporary Law for the Promotion of the Electronics Industry
1971–8	Temporary Law for the Promotion of the Specific Machinery and Electronics Industries
1978–5	Temporary Law for the Promotion of the Information Machinery Industry
Promotion policies for the semiconductor industries	
1966–71	High Performance Computer Research Association (Semiconductor devices)
1976–80	VLSI Technology Research Association
1981–	R & D Association for the Next Generation Industrial Development
1996–	Association of Super-Advanced Electronics Technologies
2001	Semiconductor "MIRAI" Project
2002	Extreme Ultra Violet Technology Research Association

Source: *IC Guidebook 2003*, p. 20.

Characteristics of the semiconductor industry

We must not forget the rapid fall in price-per-bit when considering the semiconductor industry, a fact I touched on in the example of the electronic calculator. This evolution is the result of interactions between demand and technological progress. Remarkably, the semiconductor device unit cost-per-bit today has fallen to 1/100 of what it was at the beginning of the 1980s (*IC Guidebook 2003*, p. 28, figure 1.15; Naono 1996, pp. 25, 27, figures 1.4 and 1.5).

I am sure many readers are well aware of what it feels like to increase personal computer memory. Several years ago I was in a quandary: Should I increase my PC's memory to 24 megabytes or 32 megabytes? Nowadays we start the discussion at 512 megabytes of random access memory (RAM) and go from there.

These reductions in unit costs differ fundamentally from the economies of scale typical in the chemical, steel, and automotive industries. In other words, what we see in the semiconductor industry is a learning curve: as the industry accumulates know-how, yields increase and unit costs go down (*IC Guidebook 2003*, p. 28. figure 1.15).

This price reduction phenomenon is known as the Law of π (pi) (Naono 1996, p. 26; Tanimitsu 1994, pp. 189–91). The rule, which is derived empirically, states that the price per unit of memory will fall by approximately US$3, which is the value of the ratio of a circle's circumference to its diameter, or π (pi), as the capacity increases fourfold (dynamic random access memory [DRAM] size increases by 1, 4, 16, and 64 megabytes, as shown in Table 7.5), regardless of chip capacity. After a while that price will gradually descend to $\pi/2$ dollars, or US$1.50, and tend to stabilize.

Another pattern observed in the industry is the so-called "silicon cycle," in which the semiconductor device market rises and falls according to a three to four year cycle. Several factors control this cycle:

- Semiconductors are parts. Orders for semiconductors tend to come in when times are good, and the industry orders more semiconductors than actual demand because of the lag between inventories and deliveries. The slightest downturn results in excess inventory.
- Semiconductor manufacturers seek to speed depreciation by running their equipment at peak-use rates and, on top of that, the learning curve I mentioned before has a strong tendency to push prices down, so the industry is apt to find itself in an over-supply situation.
- The life cycle of semiconductor products is short, and companies often err in timing the introduction of next-generation devices.

Development of the Japanese semiconductor industry

The Japanese semiconductor industry rapidly caught up to and overtook its American counterpart, and then the lead passed back to the United States. Hiroyuki Itami, Professor of management at Hitotsubashi University in Tokyo, and his associates published a series on Japan's industrial development. They published two volumes on Japan's semiconductor industry in the series. The titles are *The Dynamism of Taking the Lead: Comparative Studies in the Japan and U.S. Semiconductor Industries* (1988b) and *The Japanese Semiconductor Industry: Why Have There Been Three Changes in the Lead?* (1995). Itami (1998, p. 302) delineate three turning points in the semiconductor industry: 1986, when Japan took the lead from the United States; 1992, when the Republic of Korea assumed the lead from Japan; and 1993, when the United States regained the lead from the Republic of Korea.

The 1986 turning point is the point at which Japanese semiconductor manufacturers seized the largest share of the semiconductor world market from the United States, and the 1993 turning point occurred when the United States once again took the lead. The 1992 turning point is the point at which Korea's Samsung Electronics took the lead in DRAM sales, the DRAM being the semiconductor product with the largest sales volume. Japan held an 80 percent share of the worldwide DRAM market for a long time, and DRAM had become a Japanese specialty. Korea's wresting of the lead in this field from Japan is what Itami considers a turning point. See Itami *et al*. (1995, figure 1.5), *IC Guidebook 2003*, (pp. 30, 34, figure 1.23 and figure 1.26), for graphs showing trends in the world semiconductor market.

Table 7.7 shows semiconductor sales trends among the world's top ten manufacturers. Japanese companies occupied the top positions in the late 1980s, but Intel has consistently held the top spot in recent years. Bearing Itami's three turning points in mind, Samsung Electronics moved into the top ten in 1993 and had risen to the second place in 2002.

The signal event in the history of the third turning point in 1992 could be Fujitsu's exit from the general-use DRAM business (see *Nihon Keizai Shimbun*, January 11, 1999, pp. 1, 13). Elpida Memory is now Japan's sole remaining manufacturer of DRAM.[10] Table 7.8 shows the world market shares of DRAM producers in 2003. Samsung Electronics of Korea was the world largest

Table 7.7 World's top ten semiconductor manufacturers

	1971	*1981*	*1986*	*1989*	*1992*	*1995*	*1998*	*2000*	*2002*
1	TI (U.S.A.)	TI (U.S.A.)	NEC (Japan)	NEC (Japan)	Intel (U.S.A.)	Intel (U.S.A.)	Intel (U.S.A.)	Intel (U.S.A.)	Intel (U.S.A.)
2	Motorola (U.S.A.)	Motorola (U.S.A.)	Hitachi (Japan)	Toshiba (Japan)	NEC (Japan)	NEC (Japan)	NEC (Japan)	Toshiba (Japan)	Samsung (South Korea)
3	Fairchild (U.S.A.)	NEC (Japan)	Toshiba (Japan)	Hitachi (Japan)	Toshiba (Japan)	Toshiba (Japan)	Motorola (U.S.A.)	NEC (Japan)	Toshiba (Japan)
4	NS (U.S.A.)	Hitachi (Japan)	Motorola (U.S.A.)	Motorola (U.S.A.)	Motorola (U.S.A.)	Hitachi (Japan)	Toshiba (Japan)	Samsung (South Korea)	STMicro (Europe)
5	Signetics (U.S.A.)	Toshiba (Japan)	TI (U.S.A.)	Fujitsu (Japan)	Hitachi (Japan)	Motorola (U.S.A.)	TI (U.S.A.)	TI (U.S.A.)	TI (U.S.A.)
6	NEC (Japan)	NS (U.S.A.)	Philips (Europe)	TI (U.S.A.)	TI (U.S.A.)	Samsung (South Korea)	Samsung (South Korea)	STMicro (Europe)	NEC (Japan)
7	Hitachi (Japan)	Intel (U.S.A.)	Fujitsu (Japan)	Mitsubishi Electric (Japan)	Fujitsu (Japan)	TI (U.S.A.)	Hitachi (Japan)	Motorola (U.S.A.)	Infineon (Europe)
8	AMI (U.S.A.)	Matsushita Electronics (Japan)	Matsushita Electronics (Japan)	Intel (U.S.A.)	Mitsubishi Electric (Japan)	Fujitsu (Japan)	Philips (Europe)	Hitachi (Japan)	Motorola (U.S.A.)
9	Mitsubishi Electric (Japan)	Philips (Europe)	Mitsubishi Electric (Japan)	Matsushita Electronics	Philips (Europe)	Mitsubishi Electric (Japan)	STMicro (Europe)	Infineon (Europe)	Philips (Europe)
10	Unitrode (U.S.A.)	Fairchild (U.S.A.)	Intel (U.S.A.)	Philips (Europe)	Matsushita Electronics (Japan)	Philips (Europe)	Infineon (Europe)	Micron (U.S.A.)	Hitachi (Japan)

Source: *IC Guidebook 2003*, p. 43.

Note
TI: Texas Instruments; NS: National Semiconductor: AMI: American Microsystems.

Table 7.8 The world market shares of DRAM makers (shipment value in 2003)

Maker	*Share (%)*
1 Samsung (South Korea)	28.6
2 Micron (U.S.A.)	19.1
3 Infineon (Europe)	16.3
4 Hynix (South Korea)	14.7
5 Nanya Technology	4.6
6 Elpida	4.3
7 Others	12.4

Source: *Nihon Keizai Shimbun*, June 9, 2004, p. 1.

Note
The world total DRAM shipment was 17,297 million in 2003.

manufacturer of DRAM and produced more than six times Elpida did. Table 7.9 shows the market shares of DRAM producers in Japan in 2003. More than 40 percent of DRAM demand in Japan was provided by Korean manufacturers. There was a conflict regarding Japan's DRAM imports from Korea (Nakamoto 2004). Elpida and Micron Japan filed a petition for imposing countervailing duties on imports into Japan of DRAMs manufactured in Korea by Hynix Semiconductor. The petition was accepted by Japan's Minister of Finance.[11]

Table 7.10 shows trends in Japanese discrete semiconductors and IC production, exports, imports, export/production ratios, and net export ratio. The discrete semiconductors and ICs are typical export-driven industries and have a high export/production ratio. In recent times, however, the trend has been markedly downward in the net export ratio (the ratio of net exports to the sum of exports and imports), which is likely a result of reverse imports from Japanese-owned foreign subsidiaries.

The pace of the overseas electrical and electronics industries rapidly accelerated in the wake of the 1985 Plaza Accord and the subsequent yen appreciation. The production of discrete semiconductors and ICs was no exception to this trend. Where there had been 25 Japanese-owned overseas semiconductor companies and

Table 7.9 Shares of DRAM makers in Japan (2003)

Maker	*Share (%)*
1 Samsung (South Korea)	22.0
2 Hynix (South Korea)	21.9
3 Elpida	15.7
4 Micron (U.S.A.)	14.3
5 Infineon (Europe)	8.0
6 Others	18.1

Source: *Nihon Keizai Shimbun*, June 17, 2004, p. 3.

Note
The total DRAM sales in Japan was 1,595 million in 2003.

Table 7.10 Discrete semiconductors and integrated circuits (ICs): Japan's production, exports, imports

	Discrete semiconductors					*Integrated circuits (ICs)*				*Discrete semiconductors/ICs*			
	Production (million yen)	*Exports (million yen)*	*Imports (million yen)*	*Exports/ production (%)*	*Net export ratio*	*Production (million yen)*	*Exports (million yen)*	*Imports (million yen)*	*Exports/ production (%)*	*Net/ export ratio*	*Production (million yen)*	*Exports (million yen)*	*Imports (million yen)*
1957	3,852	5	na	0.1	na	na	na	na	na	na	na	na	na
1958	8,818	130	na	1.5	na	na	na	na	na	na	na	na	na
1959	19,042	1,190	na	6.2	na	na	na	na	na	na	na	na	na
1960	25,723	2,310	200	9.0	0.841	na	na	na	na	na	na	na	na
1961	28,242	3,400	300	12.0	0.838	na	na	na	na	na	na	na	na
1962	33,949	3,800	400	11.2	0.810	na	na	na	na	na	na	na	na
1963	33,930	4,100	900	12.1	0.640	na	na	na	na	na	na	na	na
1964	50,001	4,889	1,600	9.8	0.507	na	na	na	na	na	na	na	na
1965	50,423	6,337	2,500	12.6	0.434	na	na	na	na	na	na	na	na
1966	56,697	6,959	3,558	12.3	0.323	na	na	na	na	na	na	na	na
1967	73,644	5,577	4,333	7.6	0.126	na	na	1,826	na	na	na	na	237.3
1968	90,839	6,742	5,586	7.4	0.094	na	na	4,311	na	na	na	na	129.6
1969	125,803	9,739	9,285	7.7	0.024	na	na	7,813	na	na	na	na	118.8
1970	179,664	9,749	12,576	5.4	–0.127	53,250	na	20,559	na	na	337.4	na	61.2
1971	149,180	9,716	7,113	6.5	0.155	50,835	na	24,192	na	na	293.5	na	29.4
1972	174,913	12,728	8,224	7.3	0.215	72,259	na	16,430	na	na	242.1	na	50.1
1973	232,910	20,297	14,703	8.7	0.160	112,314	2,572	33,234	2.3	–0.856	207.4	789.2	44.2
1974	221,573	31,428	17,028	14.2	0.297	125,497	6,672	51,066	5.3	–0.769	176.6	471.0	33.3
1975	158,787	28,262	12,541	17.8	0.385	117,649	13,498	40,037	11.5	–0.496	135.0	209.4	31.3
1976	257,168	47,230	24,110	18.4	0.324	197,081	22,723	62,744	11.5	–0.468	130.5	207.9	38.4
1977	268,092	51,420	22,579	19.2	0.390	208,486	31,682	55,771	15.2	–0.275	128.6	162.3	40.5

1978	251,215	48,845	18,214	19.4	0.457	281,406	52,221	61,303	18.6	–0.080	89.3	93.5	29.7
1979	253,927	56,794	23,353	22.4	0.417	382,927	108,298	98,465	28.3	0.048	66.3	52.4	23.7
1980	293,788	63,177	29,221	21.5	0.367	570,245	183,306	108,861	32.1	0.255	51.5	34.5	26.8
1981	378,376	73,171	37,253	19.3	0.325	688,754	199,640	114,253	29.0	0.272	54.9	36.7	32.6
1982	359,687	70,034	32,309	19.5	0.369	834,883	285,112	127,382	34.1	0.382	43.1	24.6	25.4
1983	420,651	86,897	34,082	20.7	0.437	1,139,523	423,836	152,602	37.2	0.471	36.9	20.5	22.3
1984	610,389	120,413	47,908	19.7	0.431	1,973,850	776,775	222,176	39.4	0.555	30.9	15.5	21.6
1985	567,911	114,755	33,985	20.2	0.543	1,841,791	581,801	165,439	31.6	0.557	30.8	19.7	20.5
1986	552,575	116,137	26,688	21.0	0.626	1,780,234	523,131	146,075	29.4	0.563	31.0	22.2	18.3
1987	561,840	131,406	26,355	23.4	0.666	1,925,000	592,373	162,728	30.8	0.569	29.2	22.2	16.2
1988	629,206	168,814	31,027	26.8	0.689	2,489,896	845,707	225,710	34.0	0.579	25.3	20.0	13.7
1989	652,539	188,894	41,433	28.9	0.640	2,941,597	1,147,781	310,226	39.0	0.574	22.2	16.5	13.4
1990	710,048	204,487	48,159	28.8	0.619	2,913,354	1,101,296	375,424	37.8	0.492	24.4	18.6	12.8
1991	761,624	229,931	59,571	30.2	0.588	3,125,192	1,111,998	407,204	35.6	0.464	24.4	20.7	14.6
1992	668,586	237,675	54,573	35.5	0.627	2,750,617	1,250,598	387,719	45.5	0.527	24.3	19.0	14.1
1993	671,080	253,236	52,314	37.7	0.658	2,878,581	1,452,525	469,726	50.5	0.511	23.3	17.4	11.1
1994	740,977	299,773	56,509	40.5	0.683	3,296,393	1,867,483	619,265	56.7	0.502	22.5	16.1	9.1
1995	878,387	364,160	65,113	41.5	0.697	3,914,205	2,449,232	1,016,735	62.6	0.413	22.4	14.9	6.4
1996	849,450	408,616	84,509	48.1	0.657	3,910,196	2,404,863	1,274,432	61.5	0.307	21.7	17.0	6.6
1997	918,279	476,062	110,996	51.8	0.622	3,844,830	2,433,460	1,336,389	63.3	0.291	23.9	19.6	8.3
1998	889,521	471,647	104,016	53.0	0.639	3,461,169	2,221,390	1,203,772	64.2	0.297	25.7	21.2	8.6
1999	954,566	490,318	99,258	51.4	0.663	3,715,066	2,307,400	1,355,271	62.1	0.260	25.7	21.2	7.3
2000	1,230,954	636,916	134,457	51.7	0.651	4,615,183	2,933,751	1,918,465	63.6	0.209	26.7	21.7	7.0
2001	910,175	529,646	132,757	58.2	0.599	3,428,623	2,372,414	1,699,071	69.2	0.165	26.5	22.3	7.8
2002	900,761	621,407	151,468	69.0	0.608	3,221,886	2,543,457	1,672,328	78.9	0.207	28.0	24.4	9.1
2003	961,825	722,336	174,350	75.1	0.611	3,436,804	2,711,899	1,754,470	78.9	0.214	28.0	26.6	9.9

Source: Electronic Industries Association of Japan (1998), pp. 46, 50, 54–67.

Note
Net export ratio = (Exports + imports)/(Exports – imports).

19 IC companies prior to 1985, there were ultimately 64 companies making semiconductors and 51 companies making ICs (*Overseas Company List 2000*, p. iii).

Industrial policy for the computer industry

These days, "computer" means "personal computer" or simply "PC." By 1993 the production value of all Japanese PCs made surpassed that of general-use computers. In 2002 the total shipment value of Japan's computer manufacturing industries (industrial classification code 2821 plus 2822) was ¥3,236 billion, of which 67.9 percent was PCs (*Census of Manufactures 2002*). Table 7.11 shows market share of PCs by vendor. In 2003 a total of 169 million PCs were shipped worldwide, with U.S. and Japanese manufacturers occupying the top spots: the United States shipped 57.7 million PCs and Japan shipped 12.7 million. NEC's 98 series was said to have topped 20 million units in total shipments (*The Yomiuri Shimbun*, September 26, 1998, p. 11).

Table 7.11 Market share of personal computers (PCs) by vendor

	2002		*2003*	
	1,000 unit	*%*	*1,000 unit*	*%*
World				
Dell	20,110	13.2	25,302	15.0
Hewlett-Packard	21,567	14.2	24,230	14.3
IBM	7,913	5.2	8,608	5.1
Fujitsu/Fujitsu Siemens	5,714	3.8	6,370	3.8
Toshiba	4,233	2.8	4,944	2.9
Others	92,758	60.9	99,402	58.9
Total	152,295	100.0	168,856	100.0
USA				
Dell	12,982	25.3	15,944	27.6
Hewlwtt-Packard	9,217	17.9	10,713	18.6
IBM	2,540	4.9	2,742	4.7
Gateway	2,725	5.3	2,015	3.5
Apple	1,701	3.3	1,693	2.9
Others	22,187	43.2	24,628	42.7
Total	51,352	100.0	57,736	100.0
Japan				
NEC	2,624	21.2	2,650	20.8
Fujitsu	2,426	19.6	2,471	19.4
Dell	854	6.9	1,121	8.8
SONY	1,361	11.0	1,095	8.6
Toshiba	916	7.4	994	7.8
Others	4,195	33.9	4,407	34.6
Total	12,375	100.0	12,738	100.0

Sources: Gartner World (www3.gartner.com/5_about/press_releases/pr15jan2004.jsp). Gartner USA (www3.gartner.com/5_about/press_releases/pr15jan2004.jsp). Gartner Japan (www.gartner.co.jp/press/index.html).

Until the 1970s, however, "computer" meant mainframes. MITI's policy from the 1950s to the 1970s was designed to import advanced technology while confronting computer giant IBM, and doing whatever was necessary to build-up Japanese mainframe manufacturers. See Yonekura and Shimamoto (1998) for a fascinating discussion of incubation policies for Japan's nascent computer industry.

MITI tried to support the mainframe computer industry with a long list of stimulus and protective policies. The Japan Development Bank (now the Development Bank of Japan) provided financing. The industry benefited from preferential tax policies such as special depreciation allowances. The bank provided financial assistance for technical development, while importation and direct investment policies supported the industry.

Financial support policies for the computer industry are based on the laws listed in Table 7.6. These laws were very specific, and they applied to specific sectors of the industry, and even to specific types of machines. The Japan Development Bank and private banks supported these policies by priming the pump, so to speak, with financial support. Readers who want to know specifically which machines were targeted for this kind of development support are directed to Kohama and Urata (1993, pp. 128–32, tables 5.3 and 5.4). Financing provided to the semiconductor and computer-related industries under the Temporary Law for the Promotion of the Machinery Industry, the Temporary Law for the Promotion of the Electronics Industry, and Temporary Law for the Promotion of the Specific Machinery and Electronics Industries is shown in Table 7.12. One can see from these data that in the period from 1957 to 1974, over half of the financing provided to industry by the Japan Development Bank went to the semiconductor and computer industries.

To expand the sales of Japanese-made computers, MITI used the Japan Development Bank financing and joint investment by the computer manufacturers

Table 7.12 Policy loans to the semiconductor and computer industries of Japan

	FY1957–63	*FY1964–70*	*FY1971–74*	*Total*
Financing (million yen)				
Computer	470	1,830	785	3,085
High purity silicon	–	2,030	1,010	3,040
Discrete semiconductors	–	–	295	295
Integrated circuits (ICs)	–	2,290	2,820	5,110
Subtotal	470	6,150	4,910	11,530
Total	2,236	12,090	6,940	21,264
Financing share (%)				
Computer	21.0	15.1	11.3	14.5
High purity silicon	–	18.8	14.8	14.3
Discrete semiconductors	–	–	4.3	1.4
Integrated circuits (ICs)	–	18.8	40.6	24.0
Subtotal	21.0	52.7	71.0	54.2
Total	100.0	100.0	100.0	100.0

Source: Japan Development Bank (1976), p. 457.

to set up a rental company, the Japan Electronic Computer Co., Ltd. (JECC) in August 1961.[12] Between 1961 and 1969, from one-third to two-thirds of all Japanese-made computers were delivered to the Japan Electronic Computer Co., Ltd., and of these 14–36 percent were financed by the Japan Development Bank (K. Nakamura 1992b, p. 214).

A great deal of computer-related financial assistance for technology development was also provided. For example, in July 1962, NEC, Fujitsu, and Oki Electric made use of a 1961 law, the Mining and Industry Technology Research Association Law, to establish the Electronic Computer Technology Research Association. The three-company consortium received ¥350 million in subsidies with the start of the Mining and Industry Technology Testing Subsidy System, the largest amount of money provided under the Mining and Industry Technology Research Association Law since its creation. They provided ¥100 million of their own funds toward a cooperative effort to develop a large computer. The group received ¥1 billion between 1966 and 1971 to support the development of basic technologies for a large computer system.

Starting in early 1971, MITI began working toward the consolidation of the six major Japanese computer manufacturers into three groups that could receive the subsidies they needed to develop the new computer system mandated by the Temporary Law for the Promotion of the Specific Machinery and Electronics Industries. The philosophy behind this kind of corporate consolidation underlay the abortive 1963 Temporary Law for the Promotion of Designated Industries (*Tokushin-ho*) as discussed in Chapter 5. In 1972 MITI formed the three groups: the Ultra-High Performance Computer Development Technology Research Association (the Fujitsu–Hitachi group), the New Computer Series Technology Research Association (the NEC–Toshiba group), and the Ultra-High Performance Electronic Computer Development Technology Research Association (the Oki Electric–Mitsubishi Electric group). MITI provided these groups with ¥57 billion in electronic computer development promotion funds, or nearly 50 percent of total development outlays to support development of Japan's computers that could compete with the IBM-370 (K. Nakamura 1992b, pp. 220–1).

Probably the most important aspect of Japan's industrial policy for computer industries was protective policy. Table 7.13 shows the timing of computer industry-related liberalization. The Japanese government announced the Trade and Foreign Exchange Liberalization Policy in 1960. Imports not subject to protective barriers at the time accounted for about 40 percent of the total. By 1995 that figure had reached 95 percent (Kohama and Watanabe 1996, p. 159). As Table 7.13 shows, by 1972 trade liberalization had finally reached the computer peripheral equipment industry, and imports and FDI (foreign direct investment) liberalization for computer mainframes were instituted in December 1975. One cannot help but think that protective barriers for Japanese mainframe computers remained in place for far too long, given the competitiveness they had achieved at an earlier point. This kind of protective policy just did not make economic sense.

Table 7.13 Timing of computer industry-related liberalization in postwar Japan

	FDI liberalization		*Import liberalization*	*Technology import liberalization*
	90%	*100%*		
Electronic accounting machines, high-level calculators	August 4, 1974	December 1, 1975	April 19, 1973	July 1, 1974
Computer				
Mainframe	August 4, 1974	December 1, 1975	December 24, 1975	July 1, 1974
Peri Memories and terminals	August 4, 1974	December 1, 1975	December 24, 1975	July 1, 1974
Others	August 4, 1974	December 1, 1975	February 1, 1972	July 1, 1974
Components	August 4, 1974	December 1, 1975	February 1, 1972	July 1, 1974
Software	December 1, 1974	April 1, 1976	July 1, 1974	

Source: Japan Development Bank (1976), p. 483.

Appendix

Table 7.A1 Chronology of Japan's electrical and electronics industries' development

Year	
1945	Tokyo Tsushin Kogyo (Origin of Sony) established in Tokyo
1946	Communication Machinery Manufacturers Association of Japan established
	NHK restarted the exprimental TV broadcasting
1947	Sanyo electric established
	Invention of transistor (William B. Shockley, Walter H. Brattain, John Bardeen)
1949	Invention of junction transistor (William B. Shockley)
1950	RCA developed color TV
1951	Restart of radio broadcasting by private companies
1952	Hitachi signed technology import agreement with RCA
	Toshiba signed technology import agreement with RCA
	Sharp signed TV technology import agreement with RCA
	Matsushita signed cooperation agreement with Phillips
1953	Sharp launched made-in Japan TV set
	NHK started the TV broadcasting
	Sanyo electric acuired RCA patents on radia and television
	Mitsubishi Electric signed radio and TV technology cooperation agreement with RCA
	Nippon Television Network started the TV broadcasting
1954	Toshiba signed TV technology import agreement with EMI
	Color TV broadcasting started in U.S.
1956	NHK started the exprimental color TV broadcasting
1957	Toshiba launched made-in Japan color TV set
	Announcement of Temporary Law for the Promotion of the Electronics Industry
1958	Tokyo Tsushin Kogyo was renamed SONY
	Development of IC (Jsck S. Kilby, TI)
1959	Toshiba launched transistor color TV set
1960	SONY launched 8-inch transistor color TV set
1961	Japan Electronic Computer Co., Ltd. (JECC) established
1962	NEC launched made-in Japan mainframe conputer
	SONY launched micror color TV set
1963	Voluntary TV Set export Restraint to the U.S.
1964	SONY and Sharp launched portable electric calculator
	Import liberalization of color TV set and others
	Three communication machine industries ware designated under the Temporary Law for the Promotion of the Machinery Industry
1965	Toshiba started mass-production of portable electric calculators
1966	Five-year extension of the Temporary Law for the Promotion of the Machinery Industry
	Sharp developed a IC portable electric calculator
1967	50 percent FDI liberalization of home electrical appliances such as a radio, TV set, taperecorder
	Hitachi Electronics Taiwan established
1968	NEC Mexico established
1969	Matsushita Electric and SONY developed a VCR
	NEC Brazil established
1970	NEC established a joint venture with Samsung
	100% FDI liberalization of Braun tub

(*Continued*)

Table 7.A1 Continued

Year	
1971	Temporary Law for the Promotion of the Specific Machinery and Electronics Industries
1972	Casio launched Casio Mini, a ten thousand yen portable electric calculator Hitachi Semiconductor Malaysia established
1973	NEC Electronic Europe established Hitachi started a mass-production of 4K-bit DRAM Matsushita Electronics Malaysia established
1974	Toshiba Electronics Malaysia established NEC Semiconductors Malaysia established, NEC Semiconductors Ireland established Full liberalization of IC imports and FDI of IC industreis
1975	Full liberalization of computer imports and FDI of computer industreis
1976	VLSI Technology Research Association established NEC Electronics Singapore established
1977	NEC Electronics Hong Kong established NEC launched 16K-DRAM Hitachi started a mass-production of 16K-bit DRAM
1978	Hitachi Semiconductor USA established Temporary Law for the Promotion of the Information Machinery Industry Hitachi Semiconductor Hong Kong established
1979	Toshiba launched a Japanese word-processor NEC Electronics Italy established Matsushita Electronics Singapore established SONY launched a headphone streo Toshiba Electronics Taiwan established Fujitsu Microelectronics U.S.A. and Canada established
1980	Hitachi Semiconductor Europe established Hitachi started a mass-production of 64K-bit DRAM
1981	NEC Electronics U.K. and NEC Semiconductors U.K. established Hitachi Semiconductor West Germany established NEC Electronics U.S.A. established NEC Electronics West Germany established
1982	Next Generation Computer Technology Development Institution established NEC launched 16-bit PCs Toshiba Semiconductor West Germany established
1983	Fujitsu Microelectronics U.K. established
1984	Toshiba Vertex Semiconductor U.S.A. and Canada established Matsushita Electronic Component Europe established
1985	SIA (Semiconductor Industry Association of U.S.A.) accused Japan's semiconductor industries against Article 301 of the Trade Act
1986	Fujitsu Microelectronics Singapore established Japan–U.S. Chip Agreement
1987	SONY acquired CBS
1988	Fujitsu Microelectronics Malysia established NEC Technologies Thailand established Matsushita Electronic Component Malaysia established
1989	Toshiba U.S.A. Electronics Component Malaysia established Mitsubishi Semiconductor Europe established

(*Continued*)

Table 7.A1 Continued

Year	
1990	NEC Electronics Taiwan established
1991	Japan–U.S. Chip Agreement revised
1996	Extreme Ultra Technology Research Association established
	Japan–U.S. Chip Agreement re-revised
1997	Masaru Ibuka, one of the founders of SONY, died
1999	Akio Morita, one of the founders of SONY, died
2001	Semiconductor "MIRAI" Project
2002	Extreme Ultra Violet Technology Research Association

Sources: Omichi *et al.* (1995), pp. 376–81; EIAJ 1998 *50-Year History of Japan's Electronics Industries*, pp. 70–98; *IC Guidebook 2003*, p. 11.

8 The shipbuilding industry

The dilemma of industrial adjustment

The shipbuilding industry was a leading industry in the 1960s. Japan's wage rate started to rise, as I discussed in Chapter 1. The required level of technology is not very high for shipbuilding, except for a high-tech ship like an LNG carrier. Then, the shipbuilding industry started to decline. I analyze the rise and fall of the shipbuilding industry and the industrial adjustment policy for the industry.

The image of the shipbuilding industry

The reader's image of the shipbuilding industry may vary according to his or her age. To younger readers, shipbuilding does not represent a very significant share of the economy, manufactures, or exports. For middle-aged Japanese, like me, shipbuilding was once the leading export industry, and I think for many of my generation, that image remains strong. In the 1997 edition of *The State of Japanese Industry* produced by MITI (METI), shipbuilding is classed a production of transportation machines, along with other subsectors such as passenger cars, trucks, car parts, and railroad cars. By 1998, however, shipbuilding has been dropped from the list, along with railroad cars. Itami *et al.* (1992, p. 3) write that 20 or 30 years ago, shipbuilding was Japan's leading industry.

"Chronology of the Japanese shipbuilding industry development," in the *Statistical Handbook of Japan's Shipbuilding Industry 2004*, divides the postwar Japanese shipbuilding industry development into four periods: the 1946–50 period of confusion; the 1951–4 recovery period; the 1955–73 period of rapid advance; and the period of structural change beginning with the first oil shock and continuing to the present. The Industrial Bank of Japan (1997) recognizes two shipbuilding booms, one in 1955–7 and a second in 1965–73, and that the first depression in the industry was in 1977–9, with a second downturn running from the yen's appreciation after the Plaza Accord in 1985 to the present day (Industrial Bank of Japan 1997, pp. 151–4).

We can characterize the period of confusion and the period of rapid advance in the shipbuilding industry in terms of government policy, as industrial development policy and industrial promotion policy. Furthermore, the period of structural change can be cast in similar terms as a period industrial adjustment policy (see Itoh *et al*. 1991; Komiya *et al*. 1988; Sumiya 2000).

What exactly is industrial policy? Itoh *et al*. write (1991, p.4) write: "'Industrial policy' means policy which is intended to influence a country's economic well-being by intervening in the allocation of resources between industries (or sectors), or into the actual organizations of specific industries (or sectors)." Realistically speaking, however, the frame of reference, that is, the *purpose* of industrial policy, which is to say, the way in which government intends to affect the country's economic well-being, and the specific *objects* (the industries or sectors) subject to intervention, will vary over time. These "frames of reference" could be the policymakers themselves, private industry, producers, or consumers. Also, the means employed to realize industrial policy will vary over time. Although Kaizuka argues, "Industrial policy is policy carried out by MITI" (1973, p. 167), Komiya (1988, p. 13) writes, "while [Kaizuka's definition] may be apt in some ways, it is not necessarily correct. I believe, in fact, that it is more to the point to say that 'industrial policy was policies adopted by MITI officials in the industry-specific divisions (*genkyoku*).'"

Industrial adjustment in the context of a changing economic environment is the shifting of capital, labor, and other factors of production, away from declining industries toward growing industries based on changes in comparative advantage. Frequently, shifting factors of production away from declining industries is no easy matter. For example, transferring the skills of unemployed coal miners to other industries, an employment issue that took a considerable amount of time to resolve, proved to be quite difficult. In any event, government involvement is essential to make industrial adjustment go smoothly. A major external shock, such as an oil shock, can suddenly and radically change a comparative advantage structure, and these changes can result in significant friction. Government intervention is called for under such conditions.

In the 1970s, the need for industrial adjustment became strong. The call for government intervention was triggered by two oil shocks, 1973–4 and 1979–80; the transition to a floating exchange rate system (in February 1973); and the yen appreciation after the Plaza Accord in 1985. The steep rise in oil prices had a profound affect on the oil-dependent Japanese heavy and chemical industries. Various Japanese industries, including petrochemicals and aluminum refining rapidly lost competitiveness in the world market. At the same time, the Japanese shipbuilding industry lost ground as the demand for ships stagnated and the Republic of Korea came on the scene as a shipbuilding rival.

Although the term "structurally depressed industry" has no clear definition, the shipbuilding industry was included among the 14 industries designated in the Temporary Law for the Stabilization of Specific Depressed Industries, passed in 1978. Thus, in that sense it is clearly classified as a structurally depressed industry. Nevertheless, Japan remains one of the shipbuilding giants of the world. An article in *Asahi Shimbun* (February 10, 2001, evening edition, p. 7) reminds us that 80 percent of the world's ships are made in China, Japan, and Korea. Japan holds that position now, but it's an unfortunate position, given the way Japan's shipbuilding industry developed after the war.

How does shipbuilding fit in with the rest of manufacturing? A shipbuilding engineer once told me that a ship is just a big shell: "It's not so hard to build one," he said. He seemed to be talking about a gigantic steel tub, and if you group together a bunch of these tubs, you end up with a ship. If that is what shipbuilding is about, then it is very similar in character to steelmaking, a typical industry for a semi-industrialized country.

High-tech industries have clearly assumed the lead in Japan today. Although even the shipbuilding industry no doubt requires a certain degree of research and development (R&D), it is not all that much. Table 8.1 is a comparison of R&D intensity in manufacturing subsectors (the ratio of R&D expenditure to sales). For statistical reasons, the R&D expenditure-to-sales ratio of the shipbuilding industry cannot be obtained, but the ratio of the other transportation equipment industries are probably very similar.[1] Although the R&D expenditure-to-sales ratio of the transportation equipment industry was a bit higher than those of some industries such as the steel and metal products industries, they are below the average for manufacturing industries as a whole, and are quite a bit lower than levels for the electrical machine, chemical, and automobile industries.

Table 8.1 R&D expenditures/sales ratio (2003)

Manufacturing average	*3.99 (%)*
Food	1.08
Textiles	2.25
Paper and pulp	1.16
Publishing and printing	1.35
Pharmaceuticals	8.91
Chemicals	3.59
General chemicals, chemical fibers	3.90
Oils, fats, coatings	4.13
Other chemicals	2.95
Petroleum and coal products	0.23
Plastics	2.44
Rubber products	4.20
Ceramics	2.52
Iron and steel	1.50
Non-ferrous metals	2.45
Metal products	1.39
General machinery	4.43
Electrical machinery	5.20
Information and communication equipment	7.43
Electronic parts and devices	5.13
Transport equipment	4.35
Automobiles	4.56
Other transport equipment	1.87
Precision instrument	7.77

Source: Statistics Bureau of Japan (www.stat.go.jp/data/kagaku/2.htm).

The Japanese shipbuilding and shipping industries in a worldwide context

Japan is one of the leading maritime nations of the world and also one of the world's leading shipbuilders. Table 8.2 shows trends in the shipping tonnage (number of vessels and gross tonnage) by the world's leading maritime nations. Shares are shown in terms of gross tonnage.[2] These figures clearly show Japan's stature as a leading maritime country (if you exclude such flag-of-convenience countries as Panama and Liberia).[3] Figures for shipping tonnage by country at the end of 2002 show Liberia with an 8.6 percent share of world tonnage, putting it in the number one position, as shown in Table 8.2. Panama is ranked second with a 6.1 percent share. Japan had 7,458 ships, with a gross tonnage of 13.9 million gross tons, representing 2.4 percent of the world gross tonnage of 585.6 million gross tons. Although all time series data are not shown in Table 8.2, Japan's shipping tonnage showed a remarkable increase until the mid-1990s, but started to decline in 1997. Japan's postwar maritime shipping and its shipbuilding industries were taken as a pair, and both were beneficiaries of government promotion policies, as I discuss below.

Apart from the number of ships flying the Japanese flag, the postwar growth in ship launchings was remarkable. Table 8.3 shows trends in ship launchings and completions for the main shipbuilding nations. In 1955, just before the period of rapid growth, Japan was the fifth-ranked shipbuilder, behind the United Kingdom, Norway, the Federal Republic of Germany, and France. In 1955, Japanese shipyards launched 4.6 percent of the world's new ship tonnage, or 246,000 gross tons. In that same year, the United Kingdom launched 972,000 gross tons, four times as much as Japan. Although Table 8.3 does not show it, 1956 was the year in which the tables were turned, and from that time until the end of the 1990s, Japan was the leader in shipbuilding, with Korea in close pursuit.

What is also not shown in Table 8.3 is that in 1960, Japan launched 1.73 million gross tons of ships, representing 20.7 percent of the world total for that year. The United Kingdom had fallen to second place, with 1.33 million gross tons, or 15.9 percent of the world gross tonnage. Between 1955 and 1975, the tonnage of ships launched in the world grew by some 30.58 million gross tons, from 5.32 million gross tons to 35.9 million gross tons. In the same period, Japan's ship production increased by 11.74 million gross tons, accounting for some 58 percent of the increase in the total tonnage of ships built in the world in the 1955–75 period.

New ship launchings fell off precipitously in the late 1970s, but began showing a modest recovery in the late 1990s. Korea has shown the kind of extraordinary growth rates in shipbuilding that were seen in Japan in the 1950s and 1960s. Korea's share of world ship production in 1975 stood at a mere 1.2 percent. By 1985 that share had grown to 14.4 percent, and by 1997 it had soared to 32.8 percent. Between 1985 and 2002 the tonnage of ships launched in the world grew by 15.23 million gross tons, from 18.16 million gross tons to 33.38 million gross tons. Korea contributed 68 percent of the increase in ship production in the period from 1985 to 2002. At the time of writing, Japan and

Table 8.2 Shipping tonnage by country

	1955			*1965*			*1975*		
	No. of vessels	*Gross tonnage*	*Share by gross tonnage (%)*	*No. of vessels*	*Gross tonnage*	*Share by gross tonnage (%)*	*No. of vessels*	*Gross tonnage*	*Share by gross tonnage (%)*
World total	29,197	64,005	100.0	41,865	160,392	100.0	63,724	342,162	100.0
Japan	2,367	4,216	6.6	5,386	11,971	7.5	9,932	39,740	11.6
U.S.A.	3,021	11,905	18.6	3,416	21,527	13.4	4,346	14,587	4.3
U.K.	6,891	17,183	26.8	4,437	21,530	13.4	3,622	33,157	9.7
Norway	1,857	4,054	6.3	2,742	15,641	9.8	2,706	26,154	7.6
Liberia	na	na	na	1,287	17,539	10.9	2,520	65,820	19.2
Italy	1,072	3,057	4.8	1,413	5,701	3.6	1,732	10,137	3.0
Panama	na	na	na	692	4,465	2.8	2,418	13,667	4.0
France	1,340	2,973	4.6	1,558	5,198	3.2	1,393	10,746	3.1
Germany (West Germany)	2,085	3,708	5.8	2,525	5,279	3.3	1,964	8,517	2.5
Greece	606	1,801	2.8	1,377	7,137	4.4	2,743	22,527	6.6
Russia (Soviet Union)	na	na	na	1,845	8,238	5.1	7,652	19,236	5.6

(*Continued*)

Table 8.2 Continued

	1985			*1995*			*2002*		
	No. of vessels	*Gross tonnage*	*Share by gross tonnage (%)*	*No. of vessels*	*Gross tonnage*	*Share by gross tonnage (%)*	*No. of vessels*	*Gross tonnage*	*Share by gross tonnage (%)*
World total	76,395	416,269	100.0	82,890	490,662	100.0	89,010	585,583	100.0
Japan	10,288	39,940	9.6	9,438	19,913	4.1	7,458	13,918	2.4
U.S.A.	6,447	19,518	4.7	5,292	12,761	2.6	6,080	10,371	1.8
U.K.	2,378	14,344	3.4	1,454	4,413	0.9	2,249	21,932	3.7
Norway	2,219	15,339	3.7	2,215	21,551	4.4	2,299	22,195	3.8
Liberia	1,808	58,180	14.0	1,666	59,801	12.2	1,535	50,400	8.6
Italy	1,573	8,843	2.1	1,397	6,699	1.4	1,486	9,596	1.6
Panama	5,512	40,674	9.8	5,777	71,922	14.7	1,348	35,798	6.1
France	1,136	8,237	2.0	824	4,194	0.9	815	4,731	0.8
Germany (West Germany)	1,816	6,177	1.5	1,146	5,626	1.1	857	6,546	1.1
Greece	2,599	31,032	7.5	1,863	29,435	6.0	1,548	28,783	4.9
Russia (Soviet Union)	7,154	24,745	5.9	5,261	15,273	3.1	4,943	10,380	1.8

Source: *Statistical Handbook of Japan's Shipbuilding Industry*, various years.

Note
Figures for the vessels with 100 gross ton or more.

Table 8.3 Numbers and tonnage of vessels launched by country

	1955			*1965*			*1975*		
	No. of vessels	*Gross tonnage*	*Share by gross tonnage (%)*	*No. of vessels*	*Gross tonnage*	*Share by gross tonnage (%)*	*No. of vessels*	*Gross tonnage*	*Share by gross tonnage (%)*
World total	1,447	5,317	100.0	2,280	12,216	100.0	2,632	35,898	100.0
Japan	135	246	4.6	710	5,363	43.9	946	17,987	50.1
U.S.A.	30	112	2.1	130	270	2.2	127	1,004	2.8
U.K.	211	972	18.3	158	1,073	8.8	128	1,304	3.6
Norway	135	772	14.5	109	409	3.3	131	1,029	2.9
Italy	40	145	2.7	50	442	3.6	44	847	2.4
France	51	248	4.7	108	479	3.9	58	1,301	3.6
Germany (West)	280	525	9.9	212	1,023	8.4	174	2,549	7.1
Sweden	59	192	3.6	72	1,170	9.6	49	2,461	6.9
Denmark	31	125	2.4	55	360	2.9	60	961	2.7
Spain	na	na	na	na	295	2.4	220	1,638	4.6
South Korea	na	na	na	na	na	na	18	441	1.2
China	na	na	na	na	na	na	na	na	na

(*Continued*)

Table 8.3 Continued

	1985			*1995*			*2002*		
	No. of vessels	*Gross tonnage*	*Share by gross tonnage (%)*	*No. of vessels*	*Gross tonnage*	*Share by gross tonnage (%)*	*No. of vessels*	*Gross tonnage*	*Share by gross tonnage (%)*
World total	1,964	18,157	100.0	1,533	22,467	100.0	1,539	33,383	100.0
Japan	817	9,503	52.3	592	9,263	41.2	397	11,957	35.8
U.S.A.	66	180	1.0	na	na	na	67	152	0.5
U.K.	35	172	0.9	22	126	0.6	4	28	0.1
Norway	57	122	0.7	35	147	0.7	22	80	0.2
Italy	30	88	0.5	19	395	1.8	19	572	1.7
France	25	200	1.1	13	254	1.1	9	234	0.7
Germany (West)	135	562	3.1	91	1,121	5.0	59	1,228	3.7
Sweden	na	na	na	na	na	na	2	59	0.2
Denmark	na	na	na	25	1,003	4.5	8	423	1.3
Spain	58	551	3.0	41	251	1.1	71	222	0.7
South Korea	115	2,620	14.4	158	6,264	27.9	237	12,967	38.8
China	25	166	0.9	64	784	3.5	154	2,207	6.6

Source: *Statistical Handbook of Japan's Shipbuilding Industry*, various years.

Note
Figures for the vessels with 100 gross ton or more.

Korea are world leaders in shipbuilding. In terms of number of ships completed, Japan and Korea together accounted for 75 percent of the world total in 2002.

The postwar Japanese shipbuilding industry

Shipbuilding does not occupy a very large place in today's Japanese economy. Table 8.4 shows the number of shipbuilding establishments, employees, value of shipments, and value added in 2002. By every measure, shipbuilding accounts for less than 1 percent of manufacturing industries total. Japan's total employed workers was 63.3 million in 2002 (*Monthly Statistics of Japan 2002*). At that time, shipbuilding workers accounted for 0.1 percent of that total. Japan's 2002 GDP was ¥498.276 trillion, and the shipbuilding industry accounted for 0.18 percent of the total value added to the Japanese economy (see *Monthly Statistics of Japan*, June 2004 published by the Statistical Research and Training Institute).

Shipbuilding's share of exports is not very large either. Table 8.5 shows the number of ships exported by Japan the share of total exports this represents. Japanese ship exports have accounted for less than 3 percent of Japan's total exports. From 60 to 80 percent of Japanese ship exports are to the flag-of-convenience nations such as Panama and Liberia, so in actuality a certain proportion of exports are purchased by Japanese maritime shipping companies.

Itami (1998, p. 87) begins the book's chapter on shipbuilding with this statement: "The shipbuilding industry is Japan's postwar industrial development in microcosm." Itami says that the shipbuilding industry evolved through recovery, moving through succeeding stages of taking on the world, achieving world leadership, falling into a structural depression, achieving maturity, and feeling pressure from semi-industrialized countries. The changes in Japan's shipbuilding industry from 1950 to 1975 can be seen in Table 8.6. Shipbuilding's share was significantly higher then than it is now (Table 8.4), but even in 1975 the industry accounted for no more than 2–3 percent, both in terms of shipping value and value added in the manufacturing total.

The data in Table 8.6 include figures for wooden boat building and boat repair, although for purposes of this chapter's discussion, these cannot be considered part of the shipbuilding industry. Although in 1950, 1,250 wooden boat building and boat repair dockyards were in operation, the number had fallen to 161 by 1975. The number of workers in these businesses had similarly fallen from 25,637 in 1950 to 1,575, an 84 percent decline. In 1998 only 11 wooden boat dockyards, with a total of 65 employees, remained (*Census of Manufactures 1998*, p. 68).[4] These figures are only for establishments having more than four employees, so the actual number of establishments is probably somewhat larger.

Table 8.7 shows the difference between the statistics for all establishments and the statistics for establishments having more than four workers.[5] Table 8.7 compares the data for all manufacturing establishments alongside the data for the shipbuilding industry, and shows those having more than four workers in 1955 and 1975. The shares of the shipbuilding industry to the manufacturing total are almost the same when we see the figures for all establishments and the

Table 8.4 Structure of Japan's shipbuilding industry (2002)

Industry code	*Industry*	*Number of establishments*	*(%)*	*Number of employees (million yen)*	*(%)*	*Value of shipment*	*(%)*	*Value added (million yen)*	*(%)*	*Value-added ratio (%)*
	Manufacturing total	290,848	100.0	8,323,589	100.0	269,361,805	100.0	97,458,726	100.0	36.2
30	Transport equipment	12,266	4.2	853,472	10.3	47,997,396	17.8	14,233,034	14.6	29.7
303	Shipbuilding, repairing, and marine engines	1,632	0.6	59,305	0.7	2,398,475	0.9	898,573	0.9	37.5
3031	Shipbuilding, ship repairing	603	0.2	35,392	0.4	1,772,226	0.7	656,581	0.7	37.0
3032	Hull blocks	175	0.1	5,291	0.1	78,321	0.0	38,099	0.0	48.6
3033	Small watercraft building and repairing	316	0.1	3,011	0.0	35,777	0.0	16,782	0.0	46.9
3034	Marine engines	538	0.2	15,611	0.2	512,151	0.2	187,111	0.2	36.5

Source: *Census of Manufactures 2002*.

Notes
Figures in this table are of the establishments with four employees and more.
Value added of the establishments with four to 29 employees is gross value added.

Table 8.5 Japan's exports of vessels (1992–2002) (million yen, %)

	Total exports	*Exports of vessels*							*Production of vessels*		*Production value of vessels (B)*	*Exports/ production (A)/(B)*
			Total exports of vessels		*Exports to Panama*		*Exports to Liberia*		*No. of vessels*	*1,000 gross ton*		
		No. of vessels	*Exports value (A)*	*Share to the total exports*	*Exports value*	*Share to the total exports of vessels*	*Exports value*	*Share to the total exports of vessels*				
1992	43,012,300	695	974,602	2.3	na	na	na	na	867	7,057	1,812,199	53.8
1993	40,202,400	775	1,111,501	2.8	na	na	na	na	909	8,902	2,206,224	50.4
1994	40,497,600	871	1,128,977	2.8	na	na	na	na	884	8,259	2,032,738	55.5
1995	41,530,900	831	998,150	2.4	610,747	61.2	166,835	16.7	875	8,683	1,989,691	50.2
1996	44,731,300	762	995,276	2.2	585,124	58.8	84,563	8.5	802	9,275	1,765,046	56.4
1997	50,938,000	785	1,126,624	2.2	737,260	65.4	52,386	4.6	743	9,338	2,040,569	55.2
1998	50,645,000	812	1,288,853	2.5	720,207	55.9	113,883	8.8	601	10,272	2,785,366	46.3
1999	47,547,600	805	1,057,704	2.2	725,134	68.6	87,938	8.3	446	11,052	2,402,224	44.0
2000	51,654,200	679	1,051,688	2.0	651,625	62.0	76,021	7.2	457	12,020	2,231,898	47.1
2001	48,979,200	757	1,002,835	2.0	545,432	54.4	70,536	7.0	462	12,024	2,269,077	44.2
2002	52,109,000	850	1,123,645	2.2	531,328	47.3	109,222	9.7	397	11,957	2,398,475	46.8

Sources: *Statistical Yearbook of Japan*, various years; *Monthly Statistics of Japan*, June 2004. *Statistical Handbook of Japan's Shipbuilding Industry 2004; Census of Manufactures 2002*.

Table 8.6 Japan's shipbuilding industry: 1950–75

	1950	*1955*	*1960*	*1965*	*1970*	*1975*
Manufacturing total						
Number of establishments	156,173	187,101	238,320	345,120	405,515	430,491
Number of employees	3,860,333	4,958,038	7,601,963	9,480,710	11,163,473	10,660,328
Value of shipment (million yen)	2,294,109	6,561,887	15,293,704	29,187,220	68,376,299	125,840,925
Value added (million yen)	730,555	2,098,596	4,837,125	9,515,202	24,213,829	41,472,844
Shipbuilding industry (industrial classification code 364-3643)						
Number of establishments	1,183	861	1,290	1,819	2,145	3,156
Number of employees	147,627	131,389	155,240	179,719	198,327	249,830
Value of shipment (million yen)	60,448	132,775	353,192	687,123	1,352,035	3,351,443
Value added (million yen)	19,475	35,748	118,835	241,413	500,405	1,257,523
Wooden-boat building industry (industrial classification code 3643)						
Number of establishments	1,290	932	779	636	536	161
Number of employees	25,637	19,730	16,037	9,882	5,809	1,575
Value of shipment (million yen)	5,635	10,811	10,675	11,544	12,086	13,216
Value added (million yen)	2,919	5,039	4,866	6,185	6,537	8,796
Share of shipbuilding industry (industrial classification code 364-3643) (%)						
Number of establishments	0.8	0.5	0.5	0.5	0.5	0.7
Number of employees	3.8	2.7	2.0	1.9	1.8	2.3
Value of shipment	2.6	2.0	2.3	2.4	2.0	2.7
Value added	2.7	1.7	2.5	2.5	2.1	3.0

Source: Tsusan Tokei Kyokai (1982), pp. 57, 643, 647.

Notes
Figures in this table are of the establishments with four employees and more.
Shipbuilding industry in this table is industrial classification code 364–industrial classification code 3643 (old industrial classification code).
Share of shipbuilding industry is a percentage share to the manufacturing total.

Table 8.7 Difference by data coverage in 1955 (a) and 1975 (b)

	All establishments		*Establishments with more than four workers*		*(Establishments with more than four workers)/ (All establishments) (%)*
	No. of establishments	*Share (%)*	*No. of establishments*	*Share (%)*	
(a) Data coverage in 1955					
Manufacturing total					
Number of establishments	432,694	100.0	187,101	100.0	43.2
Number of employees	5,511,025	100.0	4,958,038	100.0	90.0
Value of shipment (million yen)	6,769,460	100.0	6,561,887	100.0	96.9
Value added (million yen)	na	na	2,098,596	100.0	na
Value-added ratio (%)	na	na	32.0	—	—
Shipbuilding industry (industrial classification code 364)					
Number of establishments	4,644	1.1	1,793	1.0	38.6
Number of employees	156,821	2.8	151,119	3.0	96.4
Value of shipment (million yen)	145,278	2.1	143,586	2.2	98.8
Value added (million yen)	na	na	40,787	1.9	na
Value-added ratio (%)	na	—	28.4	—	—

(*Continued*)

Table 8.7 (Continued)

	All establishments		*Establishments with more than four workers*		*(Establishments with more than four workers)/ (All establishments) (%)*
	No. of establishments	*Share (%)*	*No. of establishments*	*Share (%)*	
(b) Data coverage in 1975					
Manufacturing total					
Number of establishments	735,970	100.0	430,491	100.0	58.5
Number of employees	11,296,209	100.0	10,660,328	100.0	94.4
Value of shipment (million yen)	127,432,873	100.0	125,840,925	100.0	98.8
Value added (million yen)	42,345,079	100.0	41,472,844	100.0	97.9
Value-added ratio (%)	33.2	—	33.0	—	99.2
Shipbuilding industry (industrial classification code 364)					
Number of establishments	5,766	0.8	3,317	0.8	57.5
Number of employees	255,963	2.3	251,405	2.4	98.2
Value of shipment (million yen)	3,377,746	2.7	3,364,659	2.7	99.6
Value added (million yen)	1,273,620	3.0	1,266,319	3.1	99.4
Value-added ratio (%)	37.7	—	37.6	—	—

Source: Tsusan Tokei Kyokai (1982), pp. 56, 57, 642, 643.

Note
Figures in this table are of the establishments with four employees and more.
Shares are percentage shares to the manufacturing total.
Value-added ratio is the ratio of "value added" to "value of shipment."

figures for establishments with more than four workers in 1955 and 1975. The difference between the figures for all establishments and the figures for establishments with more than four workers for the shipbuilding industry was only 0.1 to 0.2 percent in 1955 and 1975.

The last column of Table 8.7 shows the ratio of "establishments with more than four workers" to "all establishments." Please be aware of the low coverage ratios of "number of establishments," because there are many very small establishments in Japan. All other coverage ratios are more than 90 percent. The ratios for number of employees, value of shipment, and value added were more than 90 percent in 1955 and 1975, but we see big differences in the ratio for the numbers of establishments. In 1955 the ratio of establishments with more than four workers to all establishments was 43.2 percent for the manufacturing total, and 38.6 percent for the shipbuilding industry. The ratios increased slightly in 1975, when it was 58.5 percent for the manufacturing total, and 57.5 percent for the shipbuilding industry.

According to the *Census of Manufactures 1998*, the number of establishments of wooden boat building and wooden boat repair (industrial classification code 3143) was 45. The size of dockyards for wooden boat building and repair was small. The number of establishments having more than four workers was only 11. The number of total workers in this industry was 120 in 1998, but the total number of employees in the dockyards with more than four workers was just 65. The value of shipments of this industry in 1998 was ¥743 million for all establishments, and ¥500 million for those having more than four workers. Value added was ¥515 million and ¥330 million, respectively.

Let us now turn to changes in the share of ship exports. Figure 8.1 shows the trends in Japan's ship export values and the share of ship exports to the total exports from 1950 to 1985. The number and value of ships exported from Japan in 1956, the year Japan surpassed the United Kingdom as the world's leading shipbuilding nation, suddenly jumped to nearly three times 1955 levels. Japan's ship export share against the total exports of Japan rose from

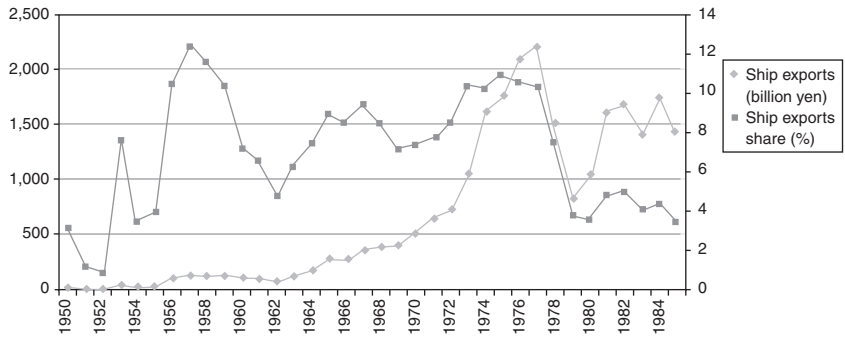

Figure 8.1 Changes in the ship exports value and the share in the total exports: 1950–85 (source: *Historical Statistics of Japan CD-ROM*).

less than 4 percent to more than 10 percent in one year. Japan's ship export share hovered at around 10 percent from the late 1950s, peaking at 12.3 percent in 1957. In the period from 1956 to 1959, ships were Japan's largest exports, exceeding even steel exports (Koga 1995, p. 484). The shipbuilding industry's share of the total exports of Japan fell slightly as the country entered the period of rapid economic growth. After the first oil shock in the mid-1970s, the industry regained ground and rose once again above the 10 percent level. Thus, as far as the share represented by shipbuilding relative to the total exports of Japan is concerned, shipbuilding remained a lead export sector from the mid-1950s to the late 1970s.

Promotion and adjustment policies for the postwar Japanese shipbuilding industry

The *Ten Year History of the Japan Development Bank*, published in 1963, has this to say about policy finance for the shipbuilding industry:

> The freight income by Japan's maritime shipping was approximately 200 billion yen in FY1960. If one considers the substantial losses in foreign exchange that would have ensued had there not been an expansion in Japan's shipping industry, one would be compelled to say that the planned shipbuilding undertaken over the past ten years has played a significant role in improving Japan's balance of payments.
>
> (Japan Development Bank 1963a, pp. 210–11)

One cannot understand the promotion policy for postwar Japan's shipbuilding and maritime transportation without an appreciation of this fact.

Like most developing countries today, until the mid-1960s Japan was saddled with current account and trade deficits, hard as this may be to imagine today (see Figure 10.5). To Japan in the 1950s and 1960s, export promotion was both an absolute good and a very important policy goal.

A variety of policies were used to promote the shipbuilding industry, including tariff protections, income tax exemptions, and special depreciation allowances. Interested readers should see Arisawa (1966), Yonezawa (1988), and Koga (1995) and Table 8.A1 in this volume, which presents a chronology of Japan's shipbuilding industry development. For purposes of our discussion here, I take up the issue of policy financing. Policy financing, which is to say the provision of low-interest government funds, comprises the financing for the planned shipbuilding and export financing by the Export and Import Bank of Japan (now the Japan Bank for International Cooperation).

At the end of World War II, Japan's shipbuilding industry had 50 shipyards and a production capacity of 800,000 gross tons, but because of a shortage of funds, ship owners could not afford to purchase new ships. The government felt it was important to stimulate a stable demand for new ships, and in April 1947 the government set up the Ship Authority of Japan, capitalized with ¥300

Table 8.8 Permits for new ship production by planned shipbuilding: domestic and export markets

	Permits for new ship production		*Share by market (%)*		*Share by financing (%)*		*Share of planned shipbuilding*
	No. of vessels	*Gross tonnage*	*Domestic market*	*Export market*	*Planned shipbuilding*	*Production by own financing*	*Domestic market (%)*
1947	23	24	100.0	0.0	100.0	0.0	100.0
1948	86	223	72.2	27.8	69.6	2.6	96.4
1949	57	319	87.9	12.1	87.5	0.4	99.5
1950	68	310	83.6	16.4	78.2	5.4	93.5
1951	283	613	62.0	38.0	61.0	1.0	98.4
1952	75	486	90.7	9.3	79.0	11.7	87.1
1953	48	412	59.9	40.1	53.7	6.2	89.6
1954	100	935	30.7	69.3	16.5	14.2	53.7
1955	204	2,656	13.4	86.6	6.9	6.5	51.5
1956	261	2,904	35.8	64.2	10.8	25.0	30.2
1957	187	1,845	43.4	56.6	22.5	20.9	51.8
1958	129	1,276	35.3	64.7	20.2	15.1	57.2
1959	166	951	57.8	42.2	18.9	38.9	32.7
1960	258	1,765	48.8	51.2	10.9	37.9	22.3
1961	231	2,059	57.1	42.9	20.3	36.8	35.6
1962	156	2,307	32.2	67.8	17.9	14.3	55.6
1963	307	5,409	19.2	80.2	12.0	7.2	62.5
1964	324	5,107	35.3	64.7	23.3	12.0	66.0
1965	342	7,976	30.6	69.4	24.1	6.5	78.8
1966	459	11,534	23.5	76.5	17.7	5.8	75.3
1967	397	8,949	35.8	66.2	22.3	13.5	62.3
1968	450	9,564	34.1	65.9	23.1	11.0	67.7
1969	566	13,270	35.2	64.8	24.6	10.6	69.9
1970	602	16,675	24.6	75.3	16.1	8.5	65.4
1971	399	14,966	51.8	48.3	25.7	26.1	49.6
1972	502	21,433	17.1	82.9	10.4	6.7	60.8
1973	718	33,790	18.0	82.1	4.6	13.4	25.6
1974	425	9,348	39.1	60.8	17.1	22.0	43.7
1975	565	8,503	18.9	81.1	4.0	14.9	21.2
1976	666	8,423	19.0	81.0	2.0	17.0	10.5
1977	364	4,945	25.3	74.7	5.2	20.1	20.6
1978	251	3,218	39.7	60.3	9.4	30.3	23.7
1979	391	8,939	32.2	67.8	18.2	14.0	56.5
1980	407	9,293	30.6	69.4	19.8	10.8	64.7
1981	391	8,383	36.5	63.4	21.5	15.0	58.9
1982	267	4,351	39.4	60.6	15.6	23.8	39.6
1983	633	12,428	20.8	79.2	8.0	12.8	38.5
1984	299	7,212	34.4	65.6	21.7	12.7	63.1
1985	248	6,451	46.6	53.3	18.8	27.8	40.3
1986	139	4,832	54.4	45.6	26.5	27.9	48.7
1987	134	4,391	12.0	88.0	1.1	10.9	9.2
1988	189	4,849	12.7	87.3	3.4	9.3	26.8
1989	261	8,632	9.2	90.4	6.3	2.9	68.5
1990	279	10,702	9.2	90.8	5.8	3.4	63.0
1991	200	8,156	14.2	85.8	10.4	3.8	73.2
1992	159	5,180	19.5	80.5	11.5	8.0	59.0

Source: The Society for Industrial Studies, Japan (1995), p. 1171.

million in government funds. The plan was to use funds in the Ship Authority of Japan to create a demand for ships, so-called "planned shipbuilding." Permission was granted in September 1947 for the first round of planned shipbuilding (Arisawa 1966, pp. 399–401).[6] Initial funds for planned shipbuilding came from the Reconstruction Finance Fund and subsequently from the Japan Development Bank (Japan Development Bank 1976, pp. 410–37).

Table 8.8 looks at postwar Japanese building of new ships, tracking changes in the relative shares of shipbuilding for domestic use versus ships for export. The domestic ship market shows the shares of ships built with and without planned financing. Until the first oil shock of 1973, we see, with some fluctuation along the way, a rapid rise in the number of permits for new ship production. After the first oil shock, however, applications to build new ships took a precipitous drop. The trend during the period of rapid economic growth was overwhelmingly skewed in favor of the production of ships for export. Conversely, the nature of the planned shipbuilding program as a means to promote recovery in the shipbuilding industry can be understood from the fact that,

Table 8.9 Policy loans for shipbuilding industry (million yen, %)

	JDB loans	*Planned shipbuilding ratio*	*Export financing by Ex-IM*	*Export financing ratio*
1960	133	22.3	395	na
1961	223	35.5	422	78.2
1962	182	55.6	504	76.5
1963	261	62.3	784	84.0
1964	553	67.0	1,156	83.0
1965	850	76.9	1,059	89.0
1966	911	75.4	1,334	85.6
1967	871	67.0	1,466	93.0
1968	980	67.8	1,339	95.2
1969	970	69.8	1,791	98.3
1970	1,072	65.3	2,096	89.0
1971	1,154	49.6	2,108	43.6
1972	1,358	60.7	2,108	12.9
1973	854	25.7	1,515	15.7
1974	968	43.7	971	29.6
1975	743	21.2	716	58.1
1976	232	10.3	2,287	64.3
1977	281	20.6	1,653	46.8
1978	210	23.6	330	12.5
1979	1,022	56.7	188	20.6
1980	1,823	64.5	629	47.2

Source: Yonezawa (1988), p. 375.

Notes
JDB: Japan Development Bank.
Planned shipbuilding ratio: the ratio of production by planned shipbuilding to the total production for the domestic market.
Ex-IM: Export and Import Bank of Japan.
Export financing ratio: the ratio of ship exports using Ex-Im loans to the total ship exports.

particularly from the late 1940s to the early 1950s, most planned shipbuilding was for the Japanese domestic market.

Table 8.9 shows trends in financing provided by the Japan Development Bank for planned ship production, and the export financing provided by the Export and Import Bank of Japan in support of the export of Japanese-made ships. From 1963 to 1970, 60–77 percent of the new ships sold to Japanese ship owners were financed by the Japan Development Bank as part of the planned shipbuilding program. In the latter half of the 1960s, nearly all ships for export used finance provided by the Export and Import Bank of Japan. For the Export and Import Bank of Japan, financing for shipbuilding was a very important business. In 1956, the year Japan became the world's leading shipbuilding nation, 80 percent of all Export and Import Bank of Japan financing went to the shipbuilding industry, and following this in 1957, 1958, and 1963–6, over 50 percent of the Export and Import Bank of Japan's financing went to shipbuilding (Export Import Bank of Japan 1983, pp. 426–7).

As I said at the beginning of this chapter, today's Japanese shipbuilding industry does not have much vitality. Yonezawa's paper, "The Shipbuilding Industry," (Yonezawa 1988) was included along with the textile industries in part V, "Industrial Adjustment Policy," of Komiya *et al*.'s book, *Industrial Policy of Japan* (Komiya *et al*. 1988). Without a doubt, plant, equipment, and employment downsizing of the shipbuilding industry presented severe challenges. Let us take, for example, employment restructuring. Table 8.8 clearly shows that the peak year for Japan's shipbuilding was 1973. The oil shock hit the industry at the end of 1974 when the industry employed 270,000 workers (including contractor workers) (*Statistical Handbook of Japan's Shipbuilding Industry 1988*, p. 114). That figure had declined to 76,009 by 1998 (*Statistical Handbook of Japan's Shipbuilding Industry 2004*, p. 86). The same statistical data are not available since 1999.

Diversification of the shipbuilding industry is going forward. Table 8.10 outlines the other transportation industries' diversification activities in 1997. Specific information on the shipbuilding industry is not available in MITI's *Business Activities Survey 1996 Vol. 1*. Statistical information on the transportation industry has two sub-categories, that is the automobile industry and other transport industry. Therefore, I assume that broad trends can be discerned from the data for other transport equipment industries. Statistics for all manufacturing industries indicate that 32.3 percent of companies are dedicated to their own specific business and that these dedicated manufacturers produce 16 percent of total sales. In contrast, similar data for the shipbuilding industry (by extrapolation from the data in Table 8.10) suggest that only 26.2 percent of all shipbuilders are wholly dedicated to shipbuilding, and that these dedicated shipbuilders produce only 11 percent of total sales in the shipbuilding industry. The data clearly show that other transportation equipment industries (and by extrapolation shipbuilding) are far more diversified than the manufacturing average. The lion's share of sales in the transportation equipment industries is generated by companies that have more than a 50 percent degree of diversification ("Diversification 3" in Table 8.10).

Japan's ship production was 11,957 gross tons in 2002 (*Statistical Handbook*

Table 8.10 Diversification of Japan's shipbuilding industry (1997)

	No. of companies	*(%)*	*Sales (million yen)*	*(%)*
Manufacturing total				
Total	14,251	100.0	276,823,806	100.0
Own business only (own business ratio = 100%)	4,598	32.3	44,188,641	16.0
Diversification 1 (0% < Side business ratio ≦25%)	5,434	38.1	107,086,926	38.7
Diversification 2 (25% < Side business ratio ≦50%)	3,118	21.9	71,169,099	25.7
Diversification 3 (50% < Side business ratio)	1,101	7.7	54,379,140	19.6
Other transport equipment industry				
Total	225	100.0	3,829,622	100.0
Own business only (own business ratio = 100%)	59	26.2	430,604	11.2
Diversification 1 (0% < Side business ratio ≦25%)	88	39.1	890,770	23.3
Diversification 2 (25% < Side business ratio ≦50%)	46	20.4	648,991	16.9
Diversification 3 (50% < Side business ratio)	32	14.2	1,859,257	48.5

Source: MITI (1998a), pp. 26, 62.

of Japan's Shipbuilding Industry 2004, p. 7). Today's shipbuilding industry is about one-third the size it was at its peak in 1973 (see Table 8.8). Nevertheless, Japan remains one of the world leaders in shipbuilding (see Table 8.3). Thus, Japan's production share was more than 50 percent of the world total, but declined to 35 percent in 2002 (see Table 8.3).

Although Japan remains one of the world's largest shipbuilding countries, the fact that Japan's shipbuilding is a structurally depressed industry reflects the characteristic dilemma of shipbuilding, and can also be thought of as expressive of the unique development of the Japanese shipbuilding industry. In this respect, shipbuilding is essentially similar to the steel industry: both industries are typical of countries that have semi-industrialized economies. Neither steelmaking nor shipbuilding requires high-end technology; all it takes is a certain level of technical know-how and capital, and these capabilities are characteristic of semi-industrialized countries. This criterion provides the first reason for the dilemma confronting the shipbuilding industry.

The second reason is that, perversely, the recovery and development of the industry went *too* well, as pointed out by Itami (1998, pp. 98–100): both the shipbuilding companies themselves and the Ministry of Transport (now the Ministry of Land, Infrastructure and Transport), which should have been able to take the long view of things, simply could not put that very success behind them and make realistic forecasts of where demand for ships was going. As a result, the

Table 8.11 Annual salaries by industry (2002) (1,000 yen)

Manufacturing average	*4,458*
Food	2,786
Beverages	4,628
Textiles	3,382
Apparels	2,170
Wood products	3,392
Furniture	3,606
Paper and pulp	4,312
Publishing and printing	4,276
Chemicals	6,034
Petroleum and coal products	7,192
Plastics	3,842
Rubber products	4,362
Leather products	2,865
Ceramics	4,383
Iron and steel	6,133
Non-ferrous metals	5,116
Metal products	4,149
General machinery	5,125
Electrical machinery	4,887
Information and communication equipment	6,183
Electronic parts and devices	4,909
Transport equipment	5,850
Automobiles	5,888
Shipbuilding	5,765
Precision instruments	4,543
Others	3,927

Source: *Census of Manufactures 2002.*

industry invested too much in plant and equipment, and then along came Korea, charging up from the rear.

Table 8.11 shows a comparison of average annual salaries by major industries. The average annual salary is intended to serve as a proxy of wage rate. Although 2002 pay scales in the shipbuilding industry were not particularly high, they compare favorably with the pay, for example, of auto workers, and are 30 percent higher than the average for all manufacturing industries. It doesn't look like a depressed industry. And if it isn't a depressed industry, then it would have to have productivity and technological advancement in line with its status as an industry that is not depressed.

Japan's shipbuilding industry is really not the way it ought to be, with its unthinking pattern of going for the required permits and building the ships. Shipbuilding management really must divide the industry into a part that concentrates on oil tankers and other ships that are not technologically demanding, and a part that focuses on sophisticated, high-tech ships. Having the government constantly directing shipbuilding industry restructuring presents a kind of moral hazard for private companies. Private companies' dependence on the Ministry of

Transportation's protection, such as cartels in times of industry depression and subsidies for industrial adjustment, cannot be good for anyone over the long term.

Appendix

Table 8.A1 Chronology of Japan's shipbuilding industry development

Year	
1947	Establishment of Ship Authority of Japan
	11 ships production were permitted in the first round of planned shipbuilding
1950	Abolishment of Ship Authority of Japan
1951	Ex-Im Bank started the financing for the shipbuilding industry
	Hitachi Zosen accepted four large oil tanker orders
1953	Announcement of the Law for Interest Subsidy for Ocean Shipbuilding
1954	Corruption scandal of the shipbuilding industry
	Sugar-link Policy for ship export promotion
	Tax exemptions for incomes by ship exports
1955	Expansion program for shipping industry (Target: 4.5 million tons)
1956	Launch of the world largest oil tanker (8,473,000 DW tons) at NBC Kure Shipyard
	Japan became the world largest shipbuilding country
1957	Japanese shipbuilding companies accepter many megatanker orders (World share: 28.7%)
1958	Completion of the first ore carrier *Nitta-maru* (18,187,000 DW tons) at Kure Shipyard
	Ishikawajima Brazil Shipyard
1959	Temporary Law for the Modernization of Small and Medium shipbuilding Industries
1960	Merger of Ishikawajima and Harima Heavy Industries: Start of IHI
1962	Launch of the world largest oil tanker *Nissho-maru* (130,000 DW tons) at Saseho Shipyard
1963	Six shipping company groups started by the Temporary Law for the Reconstruction of Shipping Industry
	IHI established Jurong Shipyard in Singapore
1965	Launch of the world largest oil tanker *Tokyo-maru* (150,000 DW tons) at IHI Yokohama Shipyard
1966	IHI completed the world largest oil tanker Idemitsu-maru (200,000 DW tons)
1967	Mitsui Shipbuilding merged Fujinagata Shipbuilding
1968	IHI merged Kure Shipbuilding
	Mitsubishi Nagasaki Shipyard completed the world largest oil tanker (320,000 DW tons)
1969	Full liberalization of FDI to the shipbuilding industry
1971	Completion of the world largest oil tanker *Nisseki-maru* (320,000 DW tons)
1973	South Korea announced the shipbuilding industry development plan (Annual production target: 2.5 million DW tons)
	Completion of the world largest oil tanker *Globtic Tokyo* (483,000 DW tons)
1975	Ministry of Transport announced the limitation of shipbuilding facilities
	Recession of the shipbuilding industry

(*Continued*)

Table 8.A1 (Continued)

Year	
1976	Ministry of Transport suggested adjustment of operations to 40 shipbuilding companies
1977	Mie Shipbuilding bankrupted: The largest bankruptcy of the shipbuilding company in postwar Japan 19 small and medium shipbuilding companies bankrupted
1978	Temporary Law for the Stabilization of Specific Depressed Industries Temporary Law for the Small and Medium Enterprises in the Specific Depressed Areas Saseho Heavy Industry faced bankruptcy Establishment of the Association for Promoting Ship Scrapping
1979	Restart the interest subsidy program for the planned shipbuilding Fair Trade Commission approved the anti-recession cartel for the shipbuilding industry
1980	Completed the excess production facilities of the shipbuilding industry (35 percent of the total facilities)
1981	Abolished the interest subsidy for the 38th planned shipbuilding
1983	30 years extension of the Promoting Ship Scrapping Program Ministry of Transport suggested adjustment of operations in FY1983 and FY1984 to 33 major shipbuilding companies Government designated the shipbuilding industry as a depressed industry under the Employment Stabilization Law
1986	Shipbuilding Committee of OECD announced the international cooperation for abolishing production capacity
1987	Temporary Law for the Management Stabilization of Specific Shipbuilding Industries Anti-recession cartel for the shipbuilding industry
1988	Reorganization of the shipbuilding industry Anti-recession cartel for the shipbuilding industry Kanasashi Shipyard bankrupted
1989	Anti-recession cartel for the shipbuilding industry Termination of the antirecession cartel for the shipbuilding industry
1990	South Korea joined the Shipbuilding Committee of OECD
1992	Abolishment of the Temporary Law for the Management Stabilization of Specific Shipbuilding Industries
1993	South Korea became the world largest shipbuilding country
1998	Structural reforms of the small and medium shipbuilding companies under the Law for Promoting Modernization of Small and Medium Enterprises started

Source: Koga (1995); *Handbook of Japan's Shipbuilding Industry 2004*, pp. 381–96.

9 The automobile industry

Entrepreneurship and government intervention

We can observe a dynamic development in the automobile industry in postwar Japan. The development of Japan's automobile industry was not realized by the industrial policy, but rather by the private initiatives.

From an infant industry to the leading industry

Just after World War II, many politicians and bureaucrats argued that the passenger car industry was not necessary in Japan. But passenger car makers survived.

The postwar Japanese automobile industry

In contrast to the shipbuilding industry discussed in Chapter 8, the automobile industry, I believe, is considered by most readers to be Japan's number one industry. Some readers may know that the automobile industry is showing signs of contraction. The first part of this chapter outlines the automobile industry's rise after World War II, up until the present day. I will use statistics to trace developments in the postwar Japanese automobile industry. In the latter half of the chapter, I discuss international issues in terms of industrial policy and trade friction as these relate to the automobile industry.

My focus here is on the end stage of automobile manufacturing, the automobile assembly. The relationship between automobile assemblers and parts-suppliers is absolutely fascinating from the point of view of development economics, and is a theme I have already touched on in Chapter 2 in the context of small- and medium-sized enterprises.

Today, the Japanese automobile industry finds itself confronting difficult times. We see, for example, headlines such as the following: "Nissan production down to 1.39 million vehicles in fiscal 1999" (*Yomiuri Shimbun*, March 5, 1999, p. 8). In this article we learn that a 1.39 million annual vehicle production plan has not been seen at Nissan for nearly 30 years, not since fiscal 1970 to be exact, when production was 1.41 million vehicles. At its peak, in fiscal 1980, Nissan built 2.64 million vehicles in Japan; the production target of fiscal 1999, 1.39 million vehicles, represents no more than 53 percent of that number. This fall in production would surely mean drastic cuts in excess production capacity. Nissan's target

for fiscal 1998 Japanese domestic vehicle sales was 1.01 million cars and trucks; by 1999 that target had been scaled back to 910,000 vehicles (*Yomiuri Shimbun*, March 9, 1999, p. 11).[1]

Nissan was not the only company dealing with the problem of excess production capacity: taken as a whole, Japan had the ability to produce 13.4 million vehicles per year at the end of the 1990s, with what is said to be excess production capacity equivalent to 3.5 million vehicles, a yearly figure that is roughly equivalent to Toyota's entire annual vehicle production (Shinohara *et al.* 1999, p. 22). In global terms, against 1997 worldwide vehicle production (including buses and trucks) of 55.6 million vehicles (*The Motor Industry of Japan 2000*, p. 30), experts estimate that excess production capacity stands at 20 million vehicles (Shinohara *et al*., p. 23; see also *The Economist*, February 13, 1999, graph on p. 17).

Let us look, for example, at the development of the Japanese automobile industry over the 60 years of the postwar period, as shown in Figure 9.1. In 1956, the year Yonosuke Goto wrote famously in the *Economic White Paper* that "the postwar era has already ended," passenger car production had already reached 32,056 per year, and commercial vehicle production was 79,010 units, creating a total of 110,000 vehicles. Total annual vehicle production has stayed around ten million vehicles until the present time. Some argue that the automobile industry developed very rapidly and then went into a panic stop (see Itami 1998, chapter 6; Itami *et al.* 1994). Figure 9.1 makes clear that automobile production fell in the early 1990s with the collapse of the economic bubble of the preceding decade. Some even say that the only industry survivors in the twenty-first century will be Toyota and Honda (Toyo Keizai Shimpo-sha 1999, p. 51).[2]

The Industrial Bank of Japan (1997, pp. 121–4) divides the postwar Japanese automobile industry into the following five phases: (a) the takeoff period (late 1940s

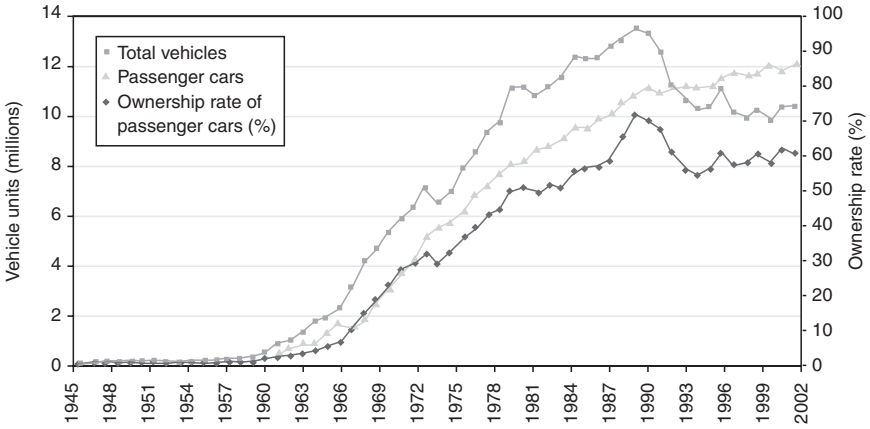

Figure 9.1 Postwar Japanese automobile production and ownership rate of passenger cars (sources: *Motor Vehicle Statistics of Japan 2000*, p. 2; JAMA Active Matrix Database System; Cabinet Office of Japan, www.esri.cao.go.jp/jp/stat/menu.html shohi).

through the 1950s); (b) the period of growing domestic demand (1960s); (c) the period of export-driven growth (1970s); (d) the period of overseas production and major additional expansion of the Japanese domestic market (1980s); and (e) the period of the maturation of the domestic market and expansion of production overseas (1990s). The Japanese domestic market, in which 86 percent of all families have cars, is undoubtedly mature (Figure 9.1). As Table 9.1 shows, passenger car domestic sales grew between 1980 and 1990 by 2.25 million vehicles, and overall vehicle domestic sales increased by 2.76 million vehicles. However, sales fell by 842,787 and 1.8 million vehicles, respectively, in the 1990s. Although Table 9.1 does not provide statistics for individual years, if one does look at the figures for Japanese domestic sales for each individual year in the 1990s, the year 1990, with passenger vehicle sales of 5.1 million units and 7.78 million in sales of all vehicles combined, turned out to be the peak year for sales of all vehicles in Japan.

Figure 9.1 makes clear that the rate of ownership of passenger vehicles was affected by the collapse of the economic bubble at the beginning of the 1990s, resulting in nearly stagnant growth in the diffusion of private passenger cars. In 1976, there were 50.5 owner-driven passenger cars per 100 households, a figure that had risen to 110 cars per 100 households by 2003 (*The Motor Industry of Japan 2004*, p. 13).

"Japan doesn't need a passenger car industry": the postwar Japanese automobile industry

On September 25, 1945, General Headquarters of the Occupation Authority (GHQ) in Japan issued a "Memorandum Concerning Manufacturing Industry Operations" in which the manufacture of passenger cars was prohibited, although a monthly production of 1,500 trucks was permitted.[3] In June 1947, GHQ permitted a total annual production of 300 small passenger cars of less than 1,500-cubic

Table 9.1 Japanese domestic auto sales (number of new cars registered)

	Passenger cars	*Commercial vehicles (buses and trucks)*	*All vehicles*
Number of cars sold in Japan			
1970	2,379,137	1,721,330	4,100,467
1980	2,854,176	2,161,334	5,015,510
1990	5,102,659	2,674,834	7,777,493
2000	4,259,872	1,703,170	5,963,042
2003	4,460,014	1,368,164	5,828,178
Increase/decrease in vehicles sold			
1970–80	475,039	440,004	915,043
1980–90	2,248,483	513,500	2,761,983
1990–2000	–842,787	–971,664	–1,814,451

Source: *Motor Vehicle Statistics of Japan 2000*, pp. 30–1; JAMA Active Matrix Database System (http://jamaserv.jama.or.jp/newdb/eng/index.html).

centimeter (cc) engine size, and a total of 50 larger cars which were produced using parts that Toyota had in stock.

In terms of trucks, 5,487 were built in 1945, 14,154 in 1946, and 9,881 in 1947, which suggests that the industry could not even reach its annual permitted quota of 18,000 vehicles. Furthermore, as one might expect, passenger car production did not reach the level of 50,000 cars per year in 1953, even after the industry had been running at full tilt to meet the special demand for the Korean War procurement.

Unbelievable as it may seem today, in Japan in the 1950s most people believed that the country did not need a passenger car industry. The then governor of the Bank of Japan, power-broker Hisato Ichimada, famous for his threat in 1950 to Kawasaki Steel as it planned construction of the Chiba Steelworks, also said in 1950, "There's no sense in Japan struggling to create an automobile industry. What we have these days is an international division of labor: since America can produce cars cheaply, it's rational for Japan to depend on America for cars" (Amagai 1982, p. 99; Arisawa 1966, p. 398; Udagawa 1992, p. 228). And it was Suehiro Nishio (later chairman of the Democratic Socialist Party), member of the Lower House, who said in 1954:

> The equipment, factories, and production methods of Japanese carmakers cannot be compared to those of foreign companies and they cannot hope to compete. The right policy is to go ahead and give up on making passenger cars and just depend on imports.
>
> (Arisawa 1966, p. 398)

Such was the argument at the time for Japan needing no passenger car industry of its own. Understandably, passenger car production at that time was low (Table 9.2). In 1950 Japan produced only 1,594 passenger cars, whereas the United States produced 6.6 million. Japan's share of the world total of passenger car production was less than 0.02 percent in 1950. Even in 1965, the United States produced 13 times more passenger cars than Japan did.

An infant industry?

Immediately after the war, Japanese cars posed no threat to foreign cars in terms of performance, styling, or price. For example, even after the imposition of a 40 percent duty on imported vehicles in May 1951, compact cars imported from Europe still cost less than Nissan's Datsun or Toyota's Toyopet (Arisawa 1966, p. 399).

The same held true for trucks, as well. The *Nihon Keizai Shimbun* of June 27, 1951 reported to readers: "A Chevrolet truck in the U.S. costs $1,812. Add to this $600 freight to ship it to Japan plus $300 in fees, and it can be bought in Japan for $2,712. Meanwhile, a Japanese truck costs nearly $3,500" (quoted in Ueyama *et al*. 1995, p. 254). If that was the case, then with the imposition of only a 30 percent tariff Japanese trucks could have been protected from foreign imports.

MITI's *Industrial Rationalization White Paper* issued in 1957 included this passage: "The automobile industry should be developed as an export industry.

Table 9.2 Passenger car production: Japan and U.S.A.

	Japan		*U.S.A.*		*World total production*	*U.S.A./Japan (B)/(A)*
	Production (A)	*Share (%)*	*Production (B)*	*Share (%)*		
1950	1,594	0.0	6,628,598	81.1	8,174,000	4,158.5
1955	20,268	0.2	7,950,377	72.2	11,012,000	392.3
1960	165,094	1.3	6,703,108	52.2	12,839,000	40.6
1965	696,176	3.7	9,335,227	49.3	18,952,000	13.4
1970	3,178,708	14.1	6,550,128	29.1	22,498,000	2.1
1975	4,567,854	18.3	6,716,951	26.8	25,026,000	1.5
1980	7,038,108	24.6	6,375,506	22.3	28,609,000	0.9
1985	7,646,816	23.6	8,186,043	25.3	32,353,000	1.1
1990	9,947,972	27.4	6,077,903	16.8	36,273,000	0.6
1995	7,610,533	21.1	6,339,967	17.6	36,070,000	0.8
2000	8,363,485	20.3	5,542,217	13.4	41,229,000	0.7
2003	8,478,328	20.1	4,509,565	10.7	42,117,063	0.5

Source: *World Motor Vehicle Statistics 2004*, pp. 2, 6; *The Motor Industry of Japan 2004*, p. 37.

Note
Share is a percentage share to the world total.

But Japanese automobiles are higher-priced than foreign cars without necessarily offering superior performance. Therefore, a thorough rationalization of the industry is required" (Ministry of International Trade and Industry 1957, p. 369).

Thus Japanese passenger cars and trucks in the 1950s were simply not competitive with foreign vehicles. Given the automobile industry's subsequent development, however, clearly the automobile industry in Japan at that time typified an infant industry. Simply put, the argument for protecting infant industries dictates that protecting immature industries is economically rational. The protection of infant industries is a dynamic issue, and the major premise of the argument is that both capital-stock and technology change. Let us assume that at a certain point – for example, Japan in the 1950s – the Japanese auto industry was absolutely not competitive. In other words, if imports were completely liberalized and tariffs cut to zero, then all Japanese demand for cars could have been met by imports from the United States and Europe, and Japanese auto production would have ceased entirely.[4] If this argument had held sway and the Japanese market had been thrown open to imported cars, then Japan could have turned its full resources to an industry in which it already had competitiveness, such as textiles, and perhaps this approach would have been the best way to optimize living standards all over the world, including Japan, as far as a static world is concerned. This philosophy underlies the theory of comparative advantage that one can find in any textbook on international economics.

The terms of the discussion change, however, when it comes to infant industries. A *necessary* condition for an industry to be called "infant" is that because of the outcome of investment and technology development done during the period

when the industry is protected from foreign competition, the industry will ultimately become competitive. Further, a *sufficient* condition for protecting an infant industry is that the welfare loss suffered during that industry's protected period is sufficiently compensated for by the advantages gained after the industry has in fact become internationally competitive, so that protecting the industry becomes an economically rational thing to do. Thus, the economic rationale for protecting the Japanese passenger car industry for a certain period was that eventually Japan was able to manufacture high-quality passenger cars at low prices and that the benefits of developing this capability exceeded the costs of protecting the industry.

This sort of intuitive explanation is simple, but discussing the protection of infant industries in theoretical, empirical, or policy terms is more difficult. The reader is directed to Itoh *et al*. (1991, chapter 4) for a discussion of the various criteria for identifying an infant industry. Furthermore, discussion is still more difficult in terms of policy design and implementation because a decision must be made beforehand about which industries are in fact infant industries. No one, however, can perfectly predict the future of technological progress or enhanced competitiveness. Empirical studies of even the history of technological progress and competitiveness are difficult. An accessible discussion of this issue is found in Appleyard and Field (2001, pp. 287–90), and I urge interested readers to look at studies mentioned there. Even Krueger and Tuncer's well-known 1982 article about an infant industry uses Turkish data and found that the growth in total factor productivity (TFP) of the protected industry must be higher than that of other industries; it is no more than an empirical study of just one of the necessary conditions subsumed within the infant industry argument.

The development of the automobile industry

Table 9.3 lists the number of establishments, number of workers, value of shipments, and value added for the Japanese automobile industry in 2002. In the context of all manufacturing industries, the auto industry accounts for 3.1 percent of the number of establishments, 8.7 percent of the workers, 16 percent of the shipped value, and 12.7 percent of value added. The number of Japan's total employed workers was 63.3 million in 2002. The automobile workers accounted for 1.1 percent of that total. Japan's 2002 GDP was ¥498.276 trillion, and the automobile industry accounted for 2.5 percent of the total value added to the Japanese economy (workers and GDP data are from *Monthly Statistics of Japan*) published by the Statistical Research and Training Institute, June 2004.

Table 9.4 traces the change in the share of the automobile industry of the total of manufacturing industry from 1950 to 1975. By all measures, the automobile industry grew rapidly compared to other manufacturing industries. In 1950 the shipbuilding industry (another member of the same transportation equipment sector as automobile industry) had more employees, greater value of shipments, and greater value added than the automobile industry. In 1955 shipbuilding (with 131,389) still had more employees than the automobile industry (with 127,082) (compare Table 8.6 and Table 9.4).

Table 9.3 Structure of Japan's automobile industry (2002)

Industry code	*Industry*	*Number of establishments*	*(%)*	*Number of employees*	*(%)*	*Value of shipment (million yen)*	*(%)*	*Value added (million yen)*	*(%)*	*Value added ratio (%)*
	Manufacturing total	290,848	100.0	8,323,589	100.0	269,361,805	100.0	97,458,726	100.0	36.2
30	Transport equipment	12,266	4.2	853,472	10.3	47,997,396	17.8	14,233,034	14.6	29.7
301	Motor vehicles, parts and accessories	9,149	3.1	725,798	8.7	43,162,990	16.0	12,404,585	12.7	28.7
3011	Motor vehicles, including motorcycles	55	0.0	156,424	1.9	21,542,075	8.0	5,860,302	6.0	27.2
3012	Motor vehicles bodies and trailers	221	0.1	40,133	0.5	2,816,899	1.0	528,561	0.5	18.8
3013	Motor vehicles parts and accessories	8,873	3.1	529,241	6.4	18,804,016	7.0	6,015,722	6.2	32.0

Source: *Census of Manufactures 2002*.

Notes
Figures in this table are of the establishments with four employees and more.
Value added of the establishments with four to 29 employees is gross value added.
Value added ratio is a ratio of value added to value of shipment.

Table 9.4 Development of the automobile industry (1950–75)

	1950	*1955*	*1960*	*1965*	*1970*	*1975*
Actual numbers						
All manufacturing industries						
Number of establishments	156,173	187,101	238,320	345,120	405,515	430,491
Number of employees	3,860,333	4,958,038	7,601,963	9,480,710	11,163,473	10,660,328
Value of shipments (million yen)	2,294,109	6,561,887	15,293,704	29,187,220	68,376,299	125,840,925
Value added (million yen)	730,555	2,098,596	4,837,125	9,515,202	24,213,829	41,472,844
Automobile industry						
Number of establishments	1,276	2,406	4,164	6,295	8,096	8,712
Number of employees	73,008	127,082	272,263	413,122	574,767	592,991
Value of shipments (million yen)	37,066	190,605	858,654	1,995,525	5,461,066	10,507,466
Value added (million yen)	13,165	63,689	282,052	598,884	1,640,390	2,690,537
Automobiles as a share of all manufacturing (%)						
Number of establishments	0.8	1.3	1.7	1.8	2.0	2.0
Number of employees	1.9	2.6	3.6	4.4	5.1	5.6
Value of shipments	1.6	2.9	5.6	6.8	8.0	8.3
Value added	1.8	3.0	5.8	6.3	6.8	6.5

Source: Tsusan Tokei Kyokai (1982), pp. 57, 635.

Note
Figures are for establishments with at least four workers. Shares are relative to all manufacturing industries.

As I said at the beginning of this chapter, the 60-year postwar period saw extraordinary development in the automobile industry. Table 9.5 shows the trends in postwar Japanese automobile production. Japanese motor vehicle production, the total of passenger cars and commercial vehicles, first reached 100,000 units in 1956, the year that *The Economic White Paper* declared "the postwar era has already ended." Seven years later, in 1963, vehicle production passed the one million units mark. The peak year of production was 1990, with 13.5 million vehicles rolling off Japan's assembly lines. The production declined to 9.8 million vehicles in 2001, but Japan produced 10.3 million vehicles in 2003.

Passenger car production went from 165,094 cars in 1960, to 1.4 million in 1967, and over five million in 1976. The peak year for passenger car production was also 1990, with approximately 9.9 million vehicles manufactured. Passenger car production fell to 7.6 million units in 1995, or 76 percent of the peak year, but rose again to 8.5 million in 2003.

Another message of Table 9.5 is the clear change in the mix of vehicles produced. Initially, production was skewed overwhelmingly in favor of buses and trucks. Passenger car production first surpassed commercial vehicle production in 1968. In 1950, 95 percent of all vehicles made in Japan were commercial vehicles, and although the share represented by commercial vehicles exhibited a downward trend early on, 70 percent of all vehicles made in 1959 were still commercial vehicles. Statistics such as these illustrate why the argument against getting into passenger car manufacturing carried so much weight.

Table 9.6 shows each company's relative share of vehicle production and the fraction of this production represented by passenger cars from 1975 to 2003.

Table 9.5 Trends in automobile production

	Passenger cars		*Commercial vehicles (trucks, buses)*		*Total vehicles*
	Vehicles	*Share (%)*	*Vehicles*	*Share (%)*	
1945	0	0.0	1,461	100.0	1,461
1946	0	0.0	14,921	100.0	14,921
1947	110	1.0	11,210	99.0	11,320
1948	381	1.9	19,986	98.1	20,367
1949	1,070	3.7	27,630	96.3	28,700
1950	1,594	5.0	30,003	95.0	31,597
1951	3,611	9.4	34,879	90.6	38,490
1952	4,837	12.4	34,129	87.6	38,966
1953	8,789	17.7	40,989	82.3	49,778
1954	14,472	20.7	55,601	79.3	70,073
1955	20,268	29.4	48,664	70.6	68,932
1956	32,056	28.9	79,010	71.1	111,066
1957	47,121	25.9	134,856	74.1	181,977
1958	50,643	26.9	137,660	73.1	188,303
1959	78,598	29.9	184,216	70.1	262,814
1960	165,094	34.3	316,457	65.7	481,551

(*Continued*)

Table 9.5 Continued

	Passenger cars		*Commercial vehicles (trucks, buses)*		*Total vehicles*
	Vehicles	*Share (%)*	*Vehicles*	*Share (%)*	
1961	249,508	30.7	564,371	69.3	813,879
1962	268,784	27.1	721,922	72.9	990,706
1963	407,830	31.8	875,701	68.2	1,283,531
1964	579,660	34.0	1,122,815	66.0	1,702,475
1965	696,176	37.1	1,179,438	62.9	1,875,614
1966	877,656	38.4	1,408,743	61.6	2,286,399
1967	1,375,755	43.7	1,770,731	56.3	3,146,486
1968	2,055,821	50.3	2,030,005	49.7	4,085,826
1969	2,611,499	55.9	2,063,433	44.1	4,674,932
1970	3,178,708	60.1	2,110,449	39.9	5,289,157
1971	3,717,858	64.0	2,092,916	36.0	5,810,774
1972	4,022,289	63.9	2,272,149	36.1	6,294,438
1973	4,470,550	63.1	2,612,207	36.9	7,082,757
1974	3,931,842	60.0	2,619,998	40.0	6,551,840
1975	4,567,854	65.8	2,373,737	34.2	6,941,591
1976	5,027,792	64.1	2,813,655	35.9	7,841,447
1977	5,431,045	63.8	3,083,477	36.2	8,514,522
1978	5,975,968	64.5	3,293,185	35.5	9,269,153
1979	6,175,771	64.1	3,459,775	35.9	9,635,546
1980	7,038,108	63.7	4,004,776	36.3	11,042,884
1981	6,974,131	62.4	4,205,831	37.6	11,179,962
1982	6,881,586	64.1	3,850,208	35.9	10,731,794
1983	7,151,888	64.4	3,959,771	35.6	11,111,659
1984	7,073,173	61.7	4,391,747	38.3	11,464,920
1985	7,646,816	62.3	4,624,279	37.7	12,271,095
1986	7,809,809	63.7	4,450,008	36.3	12,259,817
1987	7,891,087	64.4	4,358,087	35.6	12,249,174
1988	8,198,400	64.6	4,501,407	35.4	12,699,807
1989	9,052,406	69.5	3,973,329	30.5	13,025,735
1990	9,947,972	73.8	3,538,824	26.2	13,486,796
1991	9,753,069	73.6	3,492,363	26.4	13,245,432
1992	9,378,694	75.0	3,120,590	25.0	12,499,284
1993	8,493,943	75.7	2,733,602	24.3	11,227,545
1994	7,802,037	73.9	2,752,082	26.1	10,554,119
1995	7,610,533	74.6	2,585,003	25.4	10,195,536
1996	7,864,676	76.0	2,482,023	24.0	10,346,699
1997	8,491,480	77.4	2,483,607	22.6	10,975,087
1998	8,055,763	80.2	1,994,029	19.8	10,049,792
1999	8,100,169	81.9	1,795,307	18.1	9,895,476
2000	8,363,485	82.4	1,781,362	17.6	10,144,847
2001	8,117,563	83.0	1,659,628	17.0	9,777,191
2002	8,618,348	84.0	1,638,961	16.0	10,257,309
2003	8,478,328	82.4	1,807,990	17.6	10,286,318

Source: *Motor Vehicle Statistics of Japan 2004*, p. 16.

Note
Shares are percentages of total vehicle production. 1945 figures are for September–December only.

Table 9.6 Production by individual automakers

	Toyota	*Nissan*	*Mitsubishi*	*Mazda*	*Isuzu*	*Honda*	*Hino*	*Suzuki*	*Daihatsu*	*Fuji*	*Nissan Diesel*	*Total*
Passenger cars (vehicles)												
1975	1,714,836	1,532,731	288,846	387,145	64,735	328,107	0	50,668	92,123	108,663	0	4,567,854
1980	2,303,284	1,940,615	659,622	736,544	107,057	845,514	0	87,830	155,604	202,038	0	7,038,108
1985	2,569,284	1,864,701	570,865	815,074	213,052	956,410	0	236,198	161,559	259,673	0	7,646,816
1990	3,345,885	2,020,523	833,265	1,118,036	202,347	1,223,389	0	511,832	373,110	319,585	0	9,947,972
1995	2,557,174	1,508,922	908,874	606,232	51,911	811,593	0	602,670	266,431	296,726	0	7,610,533
2000	2,992,889	1,141,461	727,515	697,686	35,111	1,165,347	0	704,462	509,836	389,164	0	8,363,485
2003	3,082,044	1,242,481	645,525	733,295	710	1,117,120	0	799,275	493,390	363,357	0	8,478,328
Total vehicles												
1975	2,336,053	2,077,447	520,238	642,614	244,821	413,753	61,411	184,215	257,678	175,825	27,287	6,941,591
1980	3,293,344	2,644,052	1,104,930	1,121,016	472,127	956,902	74,890	468,683	432,374	425,633	48,121	11,042,884
1985	3,665,622	2,500,088	1,152,777	1,193,692	587,015	1,120,311	69,063	781,901	578,937	584,384	36,351	12,271,095
1990	4,212,373	2,417,010	1,332,938	1,422,624	563,194	1,383,711	100,417	838,969	636,449	516,759	61,693	13,486,796
1995	3,171,277	1,713,982	1,327,553	771,450	346,723	967,321	82,768	862,290	477,323	419,285	55,226	10,195,536
2000	3,429,209	1,324,427	997,270	778,140	261,590	1,223,924	47,978	907,905	679,383	469,080	25,581	10,144,847
2003	3,520,317	1,471,595	882,115	801,084	244,575	1,170,941	83,122	980,731	641,236	450,062	38,848	10,286,318
Share of passenger cars (%)												
1975	37.5	33.6	6.3	8.5	1.4	7.2	0.0	1.1	2.0	2.4	0.0	100.0
1980	32.7	27.6	9.4	10.5	1.5	12.0	0.0	1.2	2.2	2.9	0.0	100.0
1985	33.6	24.4	7.5	10.7	2.8	12.5	0.0	3.1	2.1	3.4	0.0	100.0
1990	33.6	20.3	8.4	11.2	2.0	12.3	0.0	5.1	3.8	3.2	0.0	100.0

Share of passenger cars (%)												
1995	33.6	19.8	11.9	8.0	0.7	10.7	0.0	7.9	3.5	3.9	0.0	100.0
2000	35.8	13.6	8.7	8.3	0.4	13.9	0.0	8.4	6.1	4.7	0.0	100.0
2003	36.4	14.7	7.6	8.6	0.0	13.2	0.0	9.4	5.8	4.3	0.0	100.0
Share of vehicles (%)												
1975	33.7	29.9	7.5	9.3	3.5	6.0	0.9	2.7	3.7	2.5	0.4	100.0
1980	29.8	23.9	10.0	10.2	4.3	8.7	0.7	4.2	3.9	3.9	0.4	100.0
1985	29.9	20.4	9.4	9.7	4.8	9.1	0.6	6.4	4.7	4.8	0.3	100.0
1990	31.2	17.9	9.9	10.5	4.2	10.3	0.7	6.2	4.7	3.8	0.5	100.0
1995	31.1	16.8	13.0	7.6	3.4	9.5	0.8	8.5	4.7	4.1	0.5	100.0
2000	33.8	13.1	9.8	7.7	2.6	12.1	0.5	8.9	6.7	4.6	0.3	100.0
2003	34.2	14.3	8.6	7.8	2.4	11.4	0.8	9.5	6.2	4.4	0.4	100.0
Passenger car production/total vehicle production												
1975	73.4	73.8	55.5	60.2	26.4	79.3	0.0	27.5	35.8	61.8	0.0	65.8
1980	69.9	73.4	59.7	65.7	22.7	88.4	0.0	18.7	36.0	47.5	0.0	63.7
1985	70.1	74.6	49.5	68.3	36.3	85.4	0.0	30.2	27.9	44.4	0.0	62.3
1990	79.4	83.6	62.5	78.6	35.9	88.4	0.0	61.0	58.6	61.8	0.0	73.8
1995	80.6	88.0	68.5	78.6	15.0	83.9	0.0	69.9	55.8	70.8	0.0	74.6
2000	87.3	86.2	73.0	89.7	13.4	95.2	0.0	77.6	75.0	83.0	0.0	82.4
2003	87.6	84.4	73.2	91.5	0.3	95.4	0.0	81.5	76.9	80.7	0.0	82.4

Source: *Motor Vehicle Statistics of Japan 2004*, pp. 16, 18–19.

Note
Figures for Mitsubishi in 2003 are the sum of Mitsubishi and Mitsubishi Fuso.

Hino Motors and Hino Diesel do not produce passenger cars. The figures for passenger car production show that over the past two decades or so, Toyota has lost some share of the market, while Nissan has lost a great deal of it. Conversely, Daihatsu, Fuji, Honda, and Suzuki have gained market share. Furthermore, if one looks at the automobile market as a whole, no significant changes in this pattern are found. Although all automotive manufacturers devote a large share of their production to passenger cars, Suzuki and Daihatsu are growing particularly rapidly.

Let us next turn to domestic demand for passenger cars (Table 9.7). Domestic demand for passenger cars in Japan passed one million vehicles in 1967, two million in 1969, three million in 1987, four million in 1989, and five million in 1990. However, these days domestic demand is under five million units. Until the end of the 1960s, 20 percent of automobile production was exported, but by 1975, this figure had surpassed 40 percent, and by 1985, 67.8 percent of passenger cars made in Japan were exported, which represents the peak export-to-production ratio of passenger cars. The percentage of foreign cars imported into Japan began to climb to 8.7 percent in 1996, but declined to 6 percent in 2003.

The demand for passenger cars in Japan grew, and cars quickly became more common in Japan because the relative price of cars rapidly declined. Table 9.8 shows the decline in the relative price of a Toyota Corolla. The Corolla went on sale in 1966, and at the time it took ten months of an average worker's wages to buy one. By 1970 it only took six months' wages. It took three months' wages in 1983 and 2.4 months' wages in 1991.

Finally, let us look at changes in the value of cars exported from Japan (Figure 9.2). Automobile exports first exceeded 1 percent of all Japanese exports in 1959. That figure reached 5 percent in 1968 and peaked at 21.3 percent in

Table 9.7 Domestic demand for passenger cars in Japan

	Production	*Export*	*Import*	*Apparent consumption*	*Export/ production (%)*	*Import/ domestic demand (%)*
1960	165,094	7,013	3,540	161,621	4.2	2.2
1965	696,176	100,716	12,881	608,341	14.5	2.1
1970	3,178,708	725,586	19,080	2,472,202	22.8	0.8
1975	4,567,854	1,827,286	45,480	2,786,048	40.0	1.6
1980	7,038,108	3,947,160	46,285	3,137,233	56.1	1.5
1985	7,646,816	4,426,762	52,225	3,272,279	57.9	1.6
1990	9,947,972	4,482,130	251,169	5,717,011	45.1	4.4
1995	7,610,533	2,896,216	401,836	5,116,153	38.1	7.9
2000	8,363,485	3,795,854	283,582	4,851,213	45.4	5.8
2003	8,478,328	4,080,494	281,526	4,679,360	48.1	6.0

Source: *Motor Vehicle Statistics of Japan 2004*, pp. 16, 23.

Notes
I consider apparent consumption as domestic demand.
Apparent consumption = production – export + import.

Table 9.8 Passenger car price (Toyota Corolla)

Model change		*Specification*	*Engine size (cc)*	*Price (yen) (A)*	*Average monthly salary (yen) (B)*	*Relative price A/B*
Year	*Month*					
1966	October	Standard	1,077	432,000	40,510	10.7
1968	April	SL	1,100	557,000	52,699	10.6
1970	May	Standard/2-door	1,200	438,500	71,447	6.1
1974	April	Standard/2-door	1,200	581,000	146,464	4.0
1979	March	Standard/2-door	1,300	718,000	227,753	3.2
1983	May	DX/4-door	1,300	863,000	279,106	3.1
1987	May	Custom DX/4-door	1,300	883,000	313,170	2.8
1991	June	DX/4-door	1,300	898,000	368,012	2.4

Source: Economic Planning Agency (1976); Ministry of Labor of Japan.

Note
Cheapest model of Toyota Corolla for every model change.

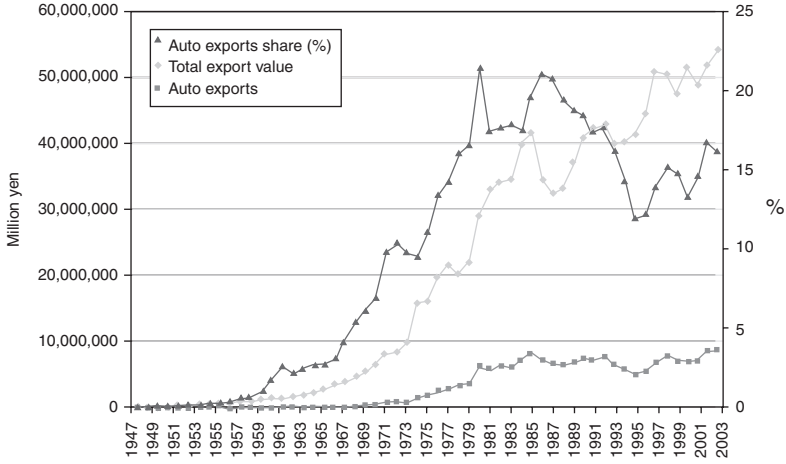

Figure 9.2 Japanese automobile exports (source: *Historical Statistics of Japan CD-ROM; Motor Vehicle Statistics of Japan 2000*, p. 47; *Monthly Statistics of Japan*).

1980, which was the peak share of Japan's auto exports. More recently auto exports make up about 15 percent of the value of total Japanese exports, meaning cars remain a major Japanese export sector.

Entrepreneurship and industrial policy

The dynamic development of the automobile industry in postwar Japan is based on the animal spirit of entrepreneurs. We derive good lessons for development policy from the anecdote on the conflict between Soichiro Honda[5] and Shigeru Sabashi of MITI.

Starting from zero: dreams and the animal spirit

The expression "starting from zero" is particularly apt when talking about the development of the Japanese automotive industry, particularly the passenger car industry, after World War II. A leading view at the time was that Japan did not need to develop a passenger car industry, as I discussed previously. Furthermore, in the early 1960s, as the domestic car industry began to flourish, both the government and private industry remained afraid of the move toward free trade. The debate over trade liberalization was critical in light of the development of Japan's automobile industry after the war. As shown in appendix table 9.A1, both Toyota and Nissan made their first passenger car exports to the United States in 1958. Even so, the quantities were extremely small: 466 Datsuns from Nissan and 30 Crowns from Toyota. To look back over the history of the years intervening between that time and today, however, with the years of friction between Japan and the United States over auto exports, the voluntary export restraints on Japanese automakers, and the advance of Japanese automakers into

overseas production bases, is to understand that the degree of change in this industry has been bewildering in its scope.

What lay behind the rapid growth of the Japanese automobile industry? First of all was the dynamism of private industry. You could also call it entrepreneurship. In the preceding section I discuss protecting infant industries, and one might say that industrial policy had a role to play in the development of the industry, but I think industrial policy was of secondary importance. The fact is, the very term "industrial policy" means different things to different people. I will explain what I understand "industrial policy" to mean.

Let us begin with some examples of entrepreneurship. In 1933, the eldest son of Sakichi Toyoda of Toyota Shokki,[6] Kiichiro Toyoda had a dream of building automobiles, so he set up an automobile manufacturing division within the company. Kiichiro Toyoda wrote immediately after World War II:

> We will charge ahead on the road to a factory dedicated to the manufacture of automobiles, giving up only when we collapse… We will build low-cost, high-quality vehicles in mass-production quantities, and we will become a company which makes products which are second to none in the world. And we will move forward with the goal of exporting our cars.
>
> (Itami *et al*. 1988a, p. 23)

As the chronology at the end of this chapter shows, in 1945 the GHQ had just given its permission for the production of trucks that September; at that time no one could have predicted when passenger cars could be manufactured again. Saying, "we will move forward with the goal of exporting our cars," was truly an expression of great ambition.

The first motorcycle (if you could call such a thing a motorcycle) made by Soichiro Honda after the war was called a "*bata-bata* (putter-putter)," and was a bicycle fitted with a second-hand engine. His first real motorcycle was the "Dream," introduced in August 1949 (Mase 1993). The name of this motorcycle reflected the dream that Soichiro Honda had for his business. Nowadays, nearly everyone in the world knows the name "Honda." Soichiro Honda's death on August 5, 1991, was reported in a front page article, complete with a photograph, in the *New York Times*. From the time of his company's infancy, Honda always said, "Think about tomorrow" (Shiroyama 1988, p. 53). From the beginning, Honda had no intention of building a motorcycle that was a copy of the best bikes of the time, which were made in Europe and the United States. He said, "I'd sooner die than imitate other people" (Honda 1990, p. 125). Takeo Fujisawa always said, "Carry the torch in your own hands!"[7] Most Japanese car companies stick to the path that has been lit by someone else carrying their own torch ahead of them. These companies depend on the company carrying the light at the head of the procession, but if the light goes out, they'll have no idea where they're going. Honda is the sort of company that carries its own torch, no matter how small the light it gives off. And Honda takes a different road from the other car makers (Okawa 1998, p. 122).

Soichiro Honda was 45 years old in 1952. He knew that Honda could never catch up to American or European companies without the latest sophisticated machines, so despite the fact that his company had only ¥60 million in capital, he imported ¥450 million worth of cutting-edge machine tools. The move may have seemed reckless from a financial point of view, but Honda was involved in high-speed pursuit, so to speak, and this strategy showed great entrepreneurship. He must have been near the end of his tether because he said, "Even if Honda Motor became bankrupt due to the huge investment, at least we'll have brought the most advanced cutting-edge machine tools into Japan and other manufactures could utilize the machine for Japan" (Shiroyama 1988, pp. 174–6).

Rent seeking and profit seeking

> There was a meeting around 1951 of people from private industry. They wanted to ask the government to prevent imports while taking steps to promote exports. I did not attend that meeting. I felt a very strong antipathy to taking the easy way out by going to the government to ask for help with exports and having them ban imports. If anything, this was an issue we had to address with technology development. If Japanese products were of superior quality, then nobody would be interested in buying imported foreign goods. And it figures that exports would increase, too, without us having to say anything. It was then that I decided to act on the notion that "good products have no national borders." With better technology, we'd build the world's best-performing engine. In so doing, we'd keep out the imports and increase exports.
>
> (Honda 1980, p. 230)

So wrote Soichiro Honda in his autobiography, *My Personal History*. This anecdote comes from the early 1950s. Honda did not even enter the four-wheel vehicle market with its T360 light truck and S500 light sports car until 1963.

Honda's full-scale entry into the four-wheel passenger vehicle market was with the N360 light vehicle in 1967 (Honda 1990, p. 128). The car sold amazingly well for a light four-wheel vehicle. It had an air-cooled, two-cylinder engine, front-wheel drive, and plenty of room for four adults. It also had as much horsepower as a compact car, and it had impact-absorbing bumpers on a par with those used at the time by Porsche and Mercedes-Benz. It cost ¥315,000.[8] Annual light vehicle sales in Japan were fewer than 60,000 vehicles before the entry of the N360. But the N360 alone sold 100,000 vehicles (Shiroyama 1988, p. 200). As shown in Table 9.8, the Toyota Corolla standard model of 1966 had a 1,077cc engine and a sticker price of ¥432,000. The light vehicles and subcompacts had some differences, but Honda's light vehicle was about 30 percent cheaper to buy.

When Honda finally did enter the market for four-wheel vehicles, it was the last company to begin four-wheel car assembly. It entered a crowded field in which 11 companies competed (Itami *et al*. 1988a, p. 25). Thus the above-mentioned Honda's argument was about motorcycles.

Soichiro Honda was the only man in his industry who advocated the importation of foreign motorcycles. He said, "Japan is behind in the motorcycle production, so we have to import these good foreign-made bikes and study them. Anyone who gropes around without a model is a fool" (Honda 1990, p. 126). Honda was the only one who argued for importing excellent foreign motorcycles. Honda's thinking is a perfect example of profit-seeking behavior.

Profit-seeking is the way companies act to make profits by increasing competitiveness through investment, augmented productivity, or technological innovation. Profit-seeking is done on an essentially level playing field. Rent-seeking is different: The "rent" in "rent-seeking" refers to the seeking of advantage through such activities as lobbying (or, as the case may be, bribes and other illegal payoffs) to secure protectionist policies favorable to one's own industry, or it may be the effort to shut out competition from imported goods, thereby extending protection of the industry.

No country, in the course of its economic development, has gone through an era that was completely profit-seeking or completely rent-seeking in character. The question is, in terms of economic management principles and corporate behavior, in which direction is the emphasis greater? With the exception of the United Kingdom, all latecomers have begun industrialization with import substitution policies. I am not arguing that policies favoring import substitution industrialization are not rational from an economic standpoint. The problem is that *prolonged* import substitution creates an environment in which rent-seeking can pervade. "Prolonged import substitution" means continued protectionism after the import substitution period during which protection is necessary for industrialization.

The Japanese automobile industry was protected in the 1950s. Given that fact, why was competition so severe? One reason was that the incentive to increase the industry's international competitiveness was powerful, even though the industry was currently protected from international competition, because the Japanese standard of living would not be improved without advancement in productivity. I believe that the industry felt great pressure knowing that they would soon be in direct competition with foreign-made automobiles as a result of import liberalization.

Import liberalization

The most important policy move in the postwar era toward liberalization was the Trade and Foreign Capital Liberalization Plan passed by resolution of the cabinet on June 24, 1960. The early 1960s was a period of many important events, including the following:

- In December 1960, the cabinet passed the National Income-Doubling Plan. (Table 10.2 lists the macroeconomic planning in postwar Japan.)
- In February 1963, Japan became the General Agreement on Tariffs and Trade Article XI country.

- April 1964 saw Japan become the International Monetary Fund Article VIII country, and its formal membership in the OECD.
- In October of 1964, the Olympics were held in Tokyo.

The Trade and Foreign Capital Liberalization Plan, an import liberalization plan framed on a product-by-product basis, categorized industries as follows: (a) products amenable to rapid liberalization (within one year); (b) products suited to near-term liberalization (within two to three years); (c) products for which liberalization would take more time (in the event that liberalization could not be achieved within three years); and (d) products for which liberalization is difficult and would take a significant period of time (for more information, see Senba 1991, pp. 208–9). Automobiles belonged to the third category.

The thinking at the time was that Japanese automobiles just could not beat foreign cars. In 1962 foreign-made automobiles were 20–30 percent cheaper than Japanese-made vehicles, a difference in price that existed across all types of automobiles (Table 9.9). Japanese vehicles were simply not cost-competitive. Factoring in quality, foreign-made vehicles were 10 percent cheaper to buy in Japan than Japanese-made vehicles, with the notable exception of 700cc class vehicles (Takahashi 1990, pp. 299–300). The political objective in joining the OECD was to attain the goal of becoming an industrial country. Toward that end, implementing and liberalizing importation was important. Up until that point, import quotas and high import tariffs of 40 percent were used to protect Japanese passenger cars from foreign competition (Takahashi 1990, p. 296). Nevertheless, as an OECD member, Japan faced a dilemma because it could not continue maintaining high tariffs after import liberalization.

As the process of rapid economic growth took off, Japanese automakers set to work on building new assembly plants in anticipation of the country's increasing demand for automobiles, and impending import and capital liberalization. Toyota started construction of its Oppama plant near Tokyo in August 1958, and automakers such as Isuzu, Hino, Nissan, and Prince followed suit by building one new plant after another as shown in Table 9.A1, which shows the trends in equipment investment by the automobile industry during this period.

In 1956, the automobile industry represented a mere 2.2 percent of total equipment investment in Japan, and four-wheel vehicles were no more than 1.1 percent. At this point, equipment investment for the manufacture of four-wheel vehicles amounted to approximately one-half of all automotive industry equipment investment. By 1961 equipment investment for the automotive industry represented 6.2 percent of the total, and equipment investment for the production of four-wheel vehicles exceeded 70 percent in the industry. As Table 9.10 clearly shows, equipment investment for the development of four-wheel vehicle production was the cause of growth in the automotive industry.

The result of these activities was growth in passenger vehicle productivity. Table 9.11 charts the number of direct staff-hours required for the production of one compact car. From the point at which the importation of foreign vehicles

Table 9.9 Price comparison between Japanese and foreign cars (1962)

Class	*Selling price*	*Selling price in Japan*				
		With a 20% margin over the present price	*Price after liberalization of imported finished car (A)*	*Price according to CKD after import liberalization (B)*	*Quality evaluation of (A)*	*Quality evaluation of (B)*
Around 2,000 cc	75	149	121	108	90	82
1,000 cc–1,500 cc	84–66	134–141	111–123	97–109	88–99	78–87
Less than 700 cc	68	157	131	115	105	92

Source: Takahashi (1990), p. 300.

Notes
Original source is a report titled "Interim Report of the Passenger Car Subcommittee" by the Heavy Industry Committee of the Industrial Structure Research Group (December 13, 1962).
Figures are the index of Japanese cars (foreign cars = 100).
CKD: complete knocked-down.

Table 9.10 Equipment investment of the automobile industry

	1956	*1961*	*1962*	*1963*	*1964*	*1965*	*1966*	*1967*	*1968*
a. Value of equipment investment (million yen)									
Total equipment investment	576,037	1,599,100	1,439,348	1,373,098	1,532,377	1,525,105	1,549,187	2,137,995	2,882,162
Electric power	154,605	350,452	351,437	326,806	301,612	352,675	366,004	399,361	493,517
Steel industry	54,618	276,174	221,349	166,833	166,630	182,925	233,099	349,871	450,415
Machinery industry	47,730	349,300	314,773	251,712	305,540	272,020	273,030	470,396	596,441
Automobile industry	12,713	98,725	89,877	95,455	150,438	145,938	142,266	250,111	301,296
Four-wheel vehicles	6,312	70,834	65,373	69,566	107,408	113,272	100,570	194,769	242,862
b. Share of equipment investment (%)									
Steel industry	8.3	21.8	21.9	18.3	19.9	17.8	17.6	22.0	20.7
Machinery industry	2.2	6.2	6.2	7.0	9.8	9.6	9.2	11.7	10.5
Automobile industry	1.1	4.4	4.5	5.1	7.0	7.4	6.5	9.1	8.4
Four-wheel vehicles/ Automobile industry	49.6	71.7	72.7	72.9	71.4	77.6	70.7	77.9	80.6

Source: Takahashi (1990), pp. 286–7.

Note
Shares are percentages relative to total of total equipment investment. However, "four-wheel vehicles/vehicles" represents the percentage of equipment investment for the production of four-wheel vehicles versus that for all automotive equipment investment.

Table 9.11 Direct labor needed to produce one compact car (hours)

	Total for compact car	*Engine*	*Chassis*	*Body/passenger compartment*	*General assembly*
1963	75.6	12.9	19.8	7.7	35.7
1964	72.7	11.0	19.8	6.3	35.6
1965	68.0	11.1	15.6	7.8	33.5
1966	57.8	11.1	12.2	8.0	26.5
1967	58.9	10.0	11.9	9.1	28.0
1968	48.4	9.7	10.7	11.2	16.9
1969	41.4	8.0	8.4	8.8	16.3
1970	37.1	7.7	6.9	7.5	15.0
1971	33.2	6.6	6.2	6.7	13.7
71/63	0.44	0.51	0.31	0.87	0.39
71/65	0.49	0.60	0.40	0.86	0.41

Source: Takahashi (1990), p. 291.

was completely liberalized in 1965 to 1971, when foreign investment was liberalized, labor productivity doubled.

Temporary Law for the Promotion of Designated Industries

Economies of scale are particularly relevant to the assembly of automobiles. The well-known Silverstone curve is derived from analysis of the economies of scale in British automobile assembly industry. The MITI specialty of industrial reorganization and formation of manufacturing groups was intended to boost competitiveness by realizing economies of scale. The prime example of this type of policy is the Temporary Law for the Promotion of Designated Industries (*Tokushin-ho*), which came up for ratification in the Diet three times, but was ultimately not enacted.

Tokushin-ho was approved by the cabinet on March 22, 1963. According to the *Tokushin-ho*, "the purpose of this law is to promote the increased sophistication of the nation's industrial structure by fostering international competitiveness in industries requiring support in light of an economic situation which is changing due to trade liberalization and other factors. By optimizing the scale of both manufacturing and management, the law aims to promote measures to increase efficiency, promote industry, and to contribute toward the development of a healthy national economy. The proposed legislation goes on:

> the "designated industries" in this law are the special steel industry (including the alloy steel industry), the four-wheel motor vehicle manufacturing industry (including the automobile tire and tube industry), the organic chemicals manufacturing industry, and other industries. This definition includes industries established and designated by government ordinance.
>
> (Arisawa and Inaba 1966, p. 402)

Reading this legislation, the reader should not be surprised that the Three Group Plan for the Automobile Industry was presented at the May 1961 Industrial Rationalization Committee. This plan called for dividing the automobile industry into three groups starting in 1963. The first group would be the mass production group, the second group would be the specialty vehicle group, and the third group would be the mini-car group. Group One was to consist of Toyota, Nissan, and Toyo Kogyo (Mazda); Group Two would be Prince, Hino, and Isuzu; and Group Three would be Fuji and Honda (Washizawa 1991, pp. 113–14). The *Tokushin-ho* was an extension of this Three Group Concept.

In the context of the *Tokushin-ho*, the feud between Soichiro Honda and then MITI's director-general Shigeru Sahashi is legendary. MITI bureaucrats thought that what they were doing was for the good of the nation (this belief is said to have been particularly true of Sahashi, who was promoted to vice-minister and was, in fact, even more influential than the then Minister of International Trade and Industry, Takeo Miki, so much so that they were called Deputy Minister Miki and Minister Sahashi). Honda believed, however, that: "Entrepreneurs make investments at their own risk in order to make something new, they do it to make the people happy" (Honda 2001, pp. 114–15). Thus, Sahashi and Honda were bound for a head-on collision.

Honda's opposition to the *Tokushin-ho* was grounded in his belief that people would be made happy by entrepreneurs acting responsibly and by corporations acting freely. As far as MITI was concerned, a Japanese auto industry consisting of just Toyota and Nissan would be fine, and doing anything differently from the way things had always been done would be a bad idea. It was outrageous for MITI to assume, however, that there was no way to beat Ford and GM. Honda expressed his philosophy about the government and his company quite clearly:

> What is this nonsense about telling us what and what not to make? Our company is free to do what it wants; it's a joint stock company. We don't operate on instructions from the government. If you've got something to say, say it after you've bought stock of the company!
>
> (Shiroyama 1988, pp. 114–15)

He also said: "There's no guarantee that the big guys are going to stay big forever," and "our company believes in freedom. We do not depend on the government, and we don't want the government meddling in our business" (Shiroyama 1988, pp. 114–15). I personally support Honda's philosophy of free corporate activity and having entrepreneurs act on their own initiatives.

What is industrial policy?

As I wrote in Chapter 8, the textbook definition of industrial policy is "the distribution of resources between a country's industries (sectors), or policies which seek to affect that country's economic welfare by intervening in the industrial system of specific industries (sectors)" (Ito *et al*. 1991, p. 4). In practical terms,

however, the nature of industrial policy itself will vary according to a number of factors (what is the goal of the attempt to influence a country's economic welfare? What are the specific industries or sectors that are subject to policy intervention?), and depending on the era, industrial policy will assume a different character depending on which segment of society is the driving force behind that policy, that is, bureaucrats responsible for the policy, private industry, manufacturers, consumers, or other forces. Moreover, the means of implementing industrial policy will vary according to the times and the economic climate.

The ways to implement industrial policy vary widely as well. The most significant policy is probably protection policy, such as import quotas, tariffs, and restrictions on direct investment. Apart from protection policy, policy financing can be used for capital investment (for example, low-interest financing from government financial institutions); export financing; preferential tax measures such as accelerated depreciation or preferential taxation for export; policy supporting technology development; and facilitation of the issuance of permits.

Individual sectors of industry, such as the automobile or electronics industries, or even individual companies, may be the focus of industrial policy. This type of policy is called "picking the winner," and the objective is to give preferential treatment to specific industries that show particular promise.

Although this reasoning may be in hindsight, Japanese industrial policy is often said to have been based on "income elasticity criterion" and "productivity increase criterion."[9] As a latecomer to industrialization, Japan was able to refer to the United Kingdom and the United States to gauge which industries were most likely to see growing demand in the future. This approach reflects the so-called "income elasticity criterion" in which industries having a degree of income elasticity of demand are promoted. On the supply side, industries having a high rate of productivity increase are promoted. Thus both demand-side and supply-side criteria help determine which industries should be promoted.

Various promotion policies were adopted by the Japanese government – such as the Temporary Law for the Promotion of Machinery Industries (1956–71); the Temporary Law for the Promotion of Electronics Industries (1957–71); the Temporary Law for the Promotion of Specific Electronics and Machine Industries (1971); and the Temporary Law for the Promotion of Specific Information and Communication Machine Industries (1978). One might not think that the designated industries for promotion are specified by these two criteria, but in reality, these criteria are simple but effective.

I believe that industrial policy is a close communication between government and private industry. In the final analysis, the main player in economic development is private industry, and the role of industrial policy should be to create an environment in which private industry can thrive. Itami *et al*. (1988a p. i) argue: "Economic growth is not the direct result of macroeconomic policy, and culture. It's something that happens because of corporate activities." I completely agree. Industrial policy must be designed and implemented with a full understanding of the goals of both government and private industry. The industrial policies and industry promotion policies that have been worked out over the years at the

desks of MITI and Ministry of Industry bureaucrats who never see factories and never listen to the opinions of people in private industry are of no use. The channels of communication between government and private industry that I'm speaking of are not just public and official forums like the Industrial Structure Council. Such public and official forums alone are inadequate. Real communication flows from a network of overlapping and private communication channels, where people in different positions of different ranks and ages can exchange ideas. Promotion policies must be designed and implemented based on this true form of communication. These policies will take a wide variety of forms, depending on the country and the stage of its development.

The car industry in particular, started by importing technology from the industrial countries as shown in Table 9.A1. By 1967 Japan had surpassed the Federal Republic of Germany as the second-ranking automaker in the world, and in 1980 Japan became the world's leading passenger car manufacturer. The result of this rise of the Japanese automobile industry was trade friction with the United States, which had previously seen Japan as a minor-league player in automobiles. With voluntary export restrictions on cars made in Japan, which went on for years, and with the yen appreciation, Japanese auto manufacturing overseas flourished.

Figure 9.3 charts overseas production by Japanese automobile manufacturers from 1985 to 2003. As of 2003, Japanese automakers produced 8.61 million vehicles overseas. In that same year, 10.28 vehicles were manufactured in Japan, so overseas production was equivalent to 84 percent of Japanese domestic production. Overseas vehicle production takes place overwhelmingly in North America and Asia.

Table 9.12 shows trends in passenger car production by Japanese manufacturers in the United States. The first Japanese manufacturer to set up a plant for four-wheel vehicles in the United States was Honda, which started operations in February 1978 and began manufacturing in November 1982. In 1982 Honda produced only about 55,000 passenger cars; in 2000, seven Japanese companies

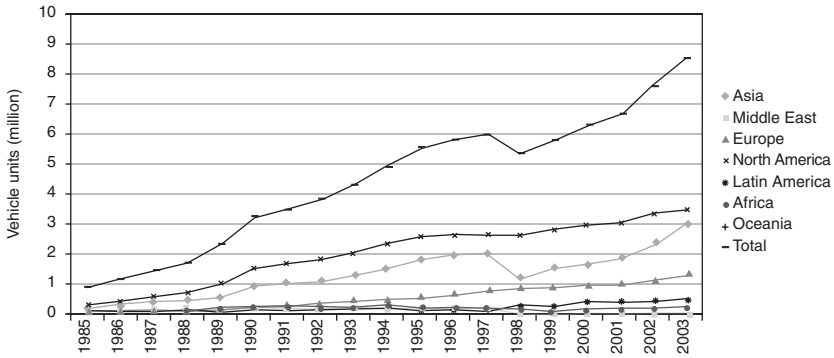

Figure 9.3 Overseas production by Japanese automobile manufacturers (source: *The Motor Industry of Japan 2004*, p. 32).

Table 9.12 Japanese automakers' passenger car production in the United States (vehicles)

	Honda	*Nissan*	*NUMMI*		*Toyota*	*Auto Alliance*		*MMMA*		*Fuji*	*Total*	*Honda's share (%)*
			Total	*(of which is for GM)*		*Total*	*(of which is for Ford)*	*Total*	*(of which is for Chrysler)*			
1983	55,335	—	—	—	—	—	—	—	—	—	55,335	100.0
1984	138,572	—	—	—	—	—	—	—	—	—	138,572	100.0
1985	145,337	43,810	64,601	na	—	—	—	—	—	—	253,748	57.3
1986	238,159	65,147	191,549	na	14,246	—	—	—	—	—	509,101	46.8
1987	324,064	117,334	143,652	na	43,726	4,200	na	—	—	—	632,976	51.2
1988	366,354	109,987	129,978	73,743	18,527	167,205	22,844	—	—	—	773,434	47.4
1989	362,274	115,584	192,235	112,111	151,150	216,200	164,975	48,829	48,829	86	1,086,358	33.3
1990	435,437	95,844	205,604	102,296	218,215	184,428	93,097	148,379	84,511	32,461	1,320,368	33.0
1991	451,199	133,505	206,066	94,927	187,708	165,314	74,245	153,936	71,818	57,945	1,355,673	33.3
1992	458,254	171,404	180,849	75,479	240,382	168,856	80,086	139,783	57,276	57,623	1,417,154	32.3
1993	403,775	292,182	207,042	84,988	234,060	219,096	103,323	136,035	38,445	47,117	1,539,307	26.2
1994	498,710	312,654	229,327	114,751	275,678	247,004	113,854	169,829	47,852	54,002	1,787,204	27.9
1995	552,995	333,234	229,553	94,441	381,445	149,562	50,653	218,161	101,943	80,660	1,945,610	28.4
1996	634,348	277,869	224,531	65,557	386,377	129,442	33,716	192,961	70,899	98,747	1,944,275	32.6
1997	648,268	279,510	209,429	60,388	404,973	100,394	9,564	189,086	78,644	102,180	1,934,290	33.5
1998	694,703	222,733	203,464	45,284	380,730	167,268	73,093	157,139	60,507	104,229	1,930,266	36.0
1999	686,043	167,742	210,726	49,967	356,840	165,143	78,078	159,702	40,654	93,070	1,839,266	37.3
2000	677,090	150,129	197,763	49,998	371,877	107,431	40,385	221,975	38,865	107,955	1,834,220	36.9

Source: *The Motor Industry of Japan*, 1990, p. 25; 1998, p. 25; 2001, p. 25.

Notes
1 NUMMI = New United Motor Manufacturing Inc., a joint venture between Toyota and GM (50:50).
2 Auto Alliance is a joint venture between Ford and Mazda (50:50).
3 MMMA = Mitsubishi Motor Manufacturing of America Inc.: a stand-alone venture by Mitsubishi Motors.

in the United States produced 1.83 million vehicles. Honda's production share, compared to all the Japanese makers in the United States, is declining, as shown in the last column of Table 9.12, and now represents about one-third of the market. Honda's production in the United States was larger than the total number of vehicles made by NUMMI (New United Motor Manufacturing, Inc.) and Toyota. The first Japanese car maker to set up production facilities in the United States was Honda, as mentioned above, and Honda developed the first engine that met environmental standards set under the Muskie Act (December 1970), with the CVCC (combined vortex-controlled combustion) engine. And I'm probably not the only one who thinks it was a good thing that Honda was not shut out of the four-wheel vehicle manufacturing business by *Tokushin-ho*.

Appendix

Table 9.A1 Chronology of the Japanese automobile industry development

Year	*Events*
1945	GHQ (Occupation Authority) allows truck production (1,500 trucks/month)
1946	Honda Technical Research established
1947	GHQ (Occupation Authority) allows production of small passenger cars of under 1500cc, 300 vehicles/year. Large vehicles (50 vehicles) can be manufactured from parts on hand
	Tokyo Electric Car (forerunner of Prince Motors) established
1948	Honda Motor Co. incorporated
1949	Honda completes its "Dream" D-type motorcycle
	GHQ (Occupation Authority) lifts ban on passenger vehicle production
1950	Governor Ichimada of the Bank of Japan argues that Japan has no need of an passenger car industry
	Toyota Motors Sales incorporated
	Labor disputes at Toyota Motor (settled in June)
	Fuji Automotive Industries established
1951	Starter manufacturing; Daihatsu Industries changes name
1952	Honda announces the "Cub" F-type motorcycle
	Prince Automotive Industries established
	Nissan signs technical transfer agreement to build Austin (U.K.) 1200cc A40 saloons in Japan
1953	Isuzu signs technical assistance agreement with Roots Motors to assemble passenger cars in Japan.
	Labor troubles at Nissan
	Fuji Heavy Industries established
	Nippon Denso and Porsche (West Germany) sign technical assistance agreement
1954	Fuji Precision Industries merges Prince Automotive
	Suzuki Loom Works changes its name to Suzuki Motor Co.
	Start of the "Financial Support to Small and Medium Enterprises for the Modernization of Equipments" for the car parts production by small and medium size enterprises
	Development Bank begins financial support of the auto parts manufacturing industry
1955	Toyopet "Crown" goes on sale

(*Continued*)

Table 9.A1 Continued

Year	*Events*
1955	MITI announces its "New Policy for Shift to Domestic Production of Japanese Automobiles"
	MITI announces its concept of a Japanese people's car
	Yamaha Starter established
1956	Nissan now able to manufacture completed Austins in Japan
	Temporary Law for the Promotion of Machinery Industries (*Kishin-ho*) promulgated; auto parts industry receives designation as a specified industry under this law
	Toyota announces its first prototype for a people's car
	MITI develops long-term plan for the automobile industry
1957	Daihatsu puts the "Midget," a light three-wheeled truck, on sale
	Hino Diesel goes over to full domestic production of the "Renault"
	Isuzu completes its first Japan-built car, the Hillman-Minx
1958	Fuji Heavy Industries announces the "Subaru 360" and puts it on sale in May
	Nissan contracts to export 466 "Datsun" models to the U.S. (first Nissan auto exports to the U.S.)
	Toyota ships 30 "Crowns" to the U.S. (first Toyota exports to the U.S.)
	Honda puts the "Super Cub C100" (50cc) on sale
	Toyota starts work on the Motomachi Plant
1959	Hino Diesel changes its name to Hino Motors
	Nissan announces the "Bluebird" and puts it on sale in August
	New Mitsubishi Heavy Industries announces a "people's car," the "Mitsubishi 500"
	Nissan ceases production of Austins
1960	Nisaan announces the "Cedric" and puts it on sale in April
	Nissan sets up Nissan America
	Daihatsu begins sales of its four-wheel light delivery truck, the "HIJET"
	Toyota announces its "people's car," the "Publica"
	Toyo Kogyo signs preliminary agreement with NSU and Wankel of West Germany for rotary engine technology
	Isuzu starts work on its Fujisawa Plant
	Hino starts work on its Hamura Plant
	Japan becomes the world leader in two-wheeled vehicle production (1.47 million vehicles)
1961	Nissan begins work on its Oppama Plant
	Prince starts construction on the Murayama Plant
	Trade liberalization for finished trucks, buses, and 2-wheeled vehicles
	MITI announces its concept of three passenger car maker groups
1962	88 percent liberalization for imports of auto parts
1965	Meishin Expressway fully open between Nishinomiya and Komaki
	Liberalization of completed passenger car imports
1966	Nissan merges with Prince
1967	Cabinet decides on basic policy for capital liberalization. Implemented in July.
	Japan displaces West Germany as world's no. 2 automaker
1968	Settlement reached in Japan–U.S. auto talks
1969	Cabinet decides on auto industry capital liberalization starting on October 1, 1971
1970	Muskie Act (U.S.)

(*Continued*)

Table 9.A1 Continued

Year	*Events*
1971	Honda announces the low-polluting CVCC engine
	Temporary Law for the Promotion of Specific Electronics and Machine Industries (*Kiden-ho*) promulgated
	Liberalization of automobile capital implemented. Liberalization of automobiles, engines, and their components
	Modernization plan for auto parts manufacturing based on *Kiden-ho* announced
1972	Honda announces the "Civic"
1973	Exhaust gas regulations implemented for 1973 model year
1975	Hyundai of South Korea announces the "Pony"
1976	Japanese exprots of 4-wheel autos surpass steel exports
1977	Mitsubishi agrees to provide engine technology to South Korea's Hyundai
1978	Automobile import duties eliminated
1979	Honda beings operations at its motorcycle plant in Ohio
	Ford buys equity share in Toyo Kogyo (Mazda)
	Honda and British Leyland sign technology sharing agreement for compact cars
1980	Honda announces plans to build an 4-wheel vehicle plant in the U.S.
	Nissan announces plans to build small trucks in the U.S.
	Japan becomes the world leader in four-wheel vehicle production
1981	Government announces voluntary restraints on car exports to the U.S. (1.68 million vehicles in the first year)
1982	MITI decides to maintain voluntary retraints on US auto exports for a second year, holding at 1.68 millions vehicles
	Suzuki signs a joint vetnure agreement to establish a car-making company in Pakistan
	Suzuki signs agreement with Maruti of India to build and sell 4-wheel vehicles
	Honda begins manufacturing 4-wheel vehicles at its plant in Ohio
1983	Toyota and GM sign letter of understanding for joint production of vehicles in the U.S.
	1.68 million vehicles set as the limit for Japanes exports to US in 1983
	Nissan begins production at its U.S. plant (NMMC)
1984	Nissan reaches agreement with British government toward the construction of an auto plant in England.
	Toyota and GM establish a joint venture, New United Motor Manufacturing, Inc. (NUMMI), and begin production in December
	Voluntary restraints quota for exports to U.S. set at 1.85 million vehicles
	Toyo Kogyo changes its name to Mazda
1985	Mazda establishes manufacturing facilities in the U.S., MMUC
	Passenger car quota for U.S. exports set at 2.3 million vehicles for 1985
	Toyota to build auto plants in Kentucky and in Ontario, Canada
1986	MITI decides to continue voluntary restraint quotas at 2.3 million vehicles in 1986
	Full-scale production operations commence at Nissan's U.K. plant
	Suzuki and GM being work on joint venture plant in Canada
1987	MITI decides to continue voluntary restraint quotas at 2.3 million vehicles in 1987
	Agreement reached in MOSS ("market oriented sector selective") talks on auto parts

(*Continued*)

Table 9.A1 Continued

Year	*Events*
1988	MITI decides to continue voluntary restraint quotas at 2.3 million vehicles in 1988
	Honda beings imports to Japan of U.S.-made "Accord" coupes
1989	MITI decides to continue voluntary restraint quotas at 2.3 million vehicles in 1989
	Toyota announces that it will produce passenger cars in the U.K.
1990	MITI announces that it will continue voluntary restraint quotas at 2.3 million vehicles in 1989
	Suzuki Motor Corporation changes its name to Suzuki
1991	MITI announces that it will continue voluntary restraint quotas at 2.3 million vehicles in 1990
	Suzuki establishes manufacturing operations in Hungary as Magyar Suzuki
	Soichiro Honda died (August 5)
1992	First Japan–U.S. automobile summit
	MITI announces that it will continue voluntary restraint quotas at 1.65 million vehicles in 1992
	Isuzu announces that it will no longer produce passenger vehicles
	Toyota begins manufacturing operations at TMUK in the U.K.
1993	MITI announces that it will continue voluntary restraint quotas at 1.65 million vehicles in 1993
1994	MITI announces the end of voluntary restraints on U.S. auto exports, effective at the end of March
	Nissan and Samsung of South Korea sign technical assistance agreement for the manufacture and sale of passenger vehicles
	Mazda withdraws from the manufacture of light automobiles, and turns this business over to Suzuki
1995	Nissan closes down its Zama Plant
	Japan–U.S. comprehensive talks on automobiles and auto parts break down.
	U.S. government announces list of sanctions against Japan (100% duty on Japanese-made luxury cars)
	Agreement reached in Japan–U.S. automobile talks
	Four-wheel vehicle production in Japan falls below U.S. levels for the first time in 15 years
1996	Nissan agrees to set up joint venture in China for full-scale production of small trucks
	Daihatsu begins manufacture in Vietnam of light commercial vans
	Mitsubishi sets up joint venture for the manufacture of engines in China
	Toyota begins manufacturing in Argentina
	1996 auto production (10.35 million vehicles) dips below the previous year's level for the first time in six years
1997	JAMA (Japan Automobile Manufacturers Association) announces that purchases of American-made auto parts reaches $22.7 billion
1998	Honda announces that it intends to get back into Formula 1 racing by the year 2000
1999	Tie-up between Nissan and Renault
	Nissan announces that it has comulatively exported 30 million cars
	Toyota produces its 100 millionth car in Japan
2000	Renault acquires Samsung Motor of South Korea

(*Continued*)

Table 9.A1 Continued

Year	*Events*
2002	10,000,000th Toyota vehicle produced in North America
2003	Toyota announced that its cumulative U.S. sales topped 30 million units. Honda announced that its cumulative U.S. motor making reached ten million units

Source: Ueyama *et al.* (1995); *The Automobile Industry of Japan 2000*, pp. 53–9; *The Automobile Industry of Japan 2004*, p. 71; other sources.

10 Conclusion

The men who created the economic miracle

Many non-Japanese economists argue that it is the industrial policy that realized rapid growth in postwar Japan. I understand, however, that private dynamism brought about the "Japanese miracle."

The collective will of the Japanese people

The main purpose of this book is to answer the question of why Japanese manufacturing industries grew at such a high rate in the post-World War II era, and what it was that caused the economy to grow so rapidly. As I indicated in Chapter 1, I wanted to address this issue not from a macroeconomic point of view, but by applying the tools of development economics within the context of the growth of individual industries. The period of greatest interest to me is the time from Japan's recovery after the war to the country's transition point in the early 1970s, the point that marked the shift from a rapid economic growth phase to a slow growth one. Through study of the growth patterns of individual industries, I have analyzed the process by which Japan moved from its status as a developing economy to that of an industrial nation.

The background to Japan's rapid economic growth is to be found in the strong collective will of the Japanese people, who worked toward the country's quick recovery, so that Japan could become a rich and, ultimately, industrial nation. One cannot come to an understanding of Japan's rapid growth without an appreciation of this collective will, but this will or determination cannot be understood in terms of some sort of highly efficient survival-of-the-fittest process.

The Ministry of Finance of Japan, in its August 1954 Basic Economic Policy Philosophy, clearly stated its goals when it said:

> While it may seem contradictory to aim at cutting costs while expanding employment, the goal of economic policy will be to go forward in order to resolve this apparent contradiction because, while difficult, the task is by no means impossible.
>
> (Arisawa 1976, p. 384)

Kuznets' inverted "U" hypothesis is typically presented in development economics textbooks. Kuznets argued that typically a trade-off exists between the pursuit of efficiency and the pursuit of more equitable income distribution, and that at a certain stage in an economy's growth, income distribution will worsen as growth and efficiency improve. Although the inverted "U" hypothesis is, in fact, no more than a hypothesis, it is usually taken as gospel. Compelling examples of increased efficiency *and* improved income distribution can be found, however, not only in Japan, but also in other Asian economies. As the 1954 Japanese Ministry of Finance policy statement concedes, attaining both growth and equity as an economic policy goal is difficult, but hardly impossible. We must bear firmly in mind that the Japanese government had this clear policy goal in mind in the mid-1950s.

Japan immediately after the war

This section is based in part on Kohama and Watanabe (1996, chapter 2). I was born in February 1949. The new budget starting in April of that year was the so-called "Dodge Line" – a balanced budget – and an exchange rate of ¥360 to the U.S. dollar was set on April 25. This shift from multiple exchange rates to an exchange rate system marked the true start of the postwar foreign trade of Japan. After the deflation in the Japanese economy in the twenty-first century, runaway prices may be difficult to imagine, but the Dodge Line managed to tame hyperinflation.

My mother told me that in 1949, cotton swaddling clothes for an infant were hard to get. That's what things were like a half-century ago in Japan. Japanese political leaders right after the war had only one goal: to keep the Japanese people from starving to death.[1] Plenty of books show what Japan looked like after the war, and I recommend that readers turn to them to refresh their memories of how devastated the country was (see, for example, Hamashima Shoten Editorial Division 1998, p. 236; Iokibe 2001, pp. 187, 324–7; Royama 1974, pp. 33, 35; Tokyo Shoseki Editorial Division 2001, p. 217). Many Japanese readers will doubtless remember the images presented in school textbooks: the National Diet building amid the ashes; the black market; shopping trains full of people, even on the roofs; Tokyo Station's platforms open to the sky; and displaced persons returning from Japan's lost colonies. To be sure, although air raids destroyed the big buildings, the *human capital* necessary for economic recovery and development was not lost. Some six million people returning from Japan's lost colonies constituted an enormous burden on the Japanese economy at that time, but in the long run, these people contributed to rebuilding the economy, especially if we view these people through the lens of today's developing economies, with their huge pools of human capital. It was a lucky thing for Japan that the job of postwar recovery fell primarily to the younger generation, after the senior government officials and business leaders who helped bring the country to war were purged.

The largest problems facing postwar Japan were: the sharp drop in production caused by the destruction of production facilities; the loss of overseas

territories; the interruption in trade that made obtaining raw materials difficult; and the inflation this drop in production brought with it. Coupled with these issues were the problems caused by the increase in population brought on by the repatriation of demobilized soldiers and displaced persons, and the resulting over-supply of labor (Yasuba 1980, p. 157), which heightened the crisis of shortages in basic living necessities. On top of this, a terrible inflation was sparked by temporary military outlays that gave people excessive buying power. Price controls implemented to control inflation without resolving the basic cause of inflation – which is to say the delay in recovering productive capacity – only resulted in a rapid increase in the printing of money, ultimately undermining the original policy goal of reducing inflationary pressure. Although the financing of the Reconstruction Financing Fund and the price differential subsidies provided by the government played a major role in recovering production capacity, inflation accelerated too soon, before the economy had a chance to restart production.[2] Thus, relief from inflation had to wait for the Dodge Line, a policy that had a strongly deflationary effect.

War damage

The war lasted for over eight years, from the Lugou (Marco Polo) Bridge Incident in July 1937, which started the Sino-Japanese War, through the attack on Pearl Harbor in December 1941, to the end of the war with Japan's unconditional surrender on August 15, 1945. Japan spent nearly ¥150 billion on the war and suffered the loss of 1.85 million lives.[3] Japan also lost territories in the Republic of Korea, Karafuto (the Sakhalin Peninsula), Taiwan, the Ryukyu Archipelago, and Kwantung.[4] The war resulted in a loss of nearly one-quarter of the nation's wealth. Japan lost over 80 percent of its shipping, and the losses in housing, factories, transportation equipment, and so on were staggering. River routes and forests were heavily damaged and trade was cut off. The Japanese economy was effectively paralyzed after the war. Added to this state of affairs, the population was swollen with six million soldiers and displaced persons who were repatriated to Japan between the defeat and 1952, thus exacerbating food shortages and the unemployment crisis.[5]

The depression in the Japanese economy was severe, and at the time a recovery seemed to be no easy matter. For example, Figure 10.1 shows a decline in industrial production (the production index for 1934–6 was 100). The graph shows that with the start of the war industrial production rose sharply, and by 1944 registered an 80 percent increase over the base year. This rise reflects the increased use of minerals as raw materials in the production of machines, metals, and other military materiel. Conversely, the production of food, fibers, and textiles was sacrificed as the war intensified. For example, in contrast to machine production's rise to 463 over the base year, the peak year for textile production was 1937 at 114. With the interruption of exports to foreign markets, production indexes for the textile industry plummeted in 1944, down to 21 percent of the base year and, as the country awaited the end of the war, fell to below 20 percent of the prewar base year.

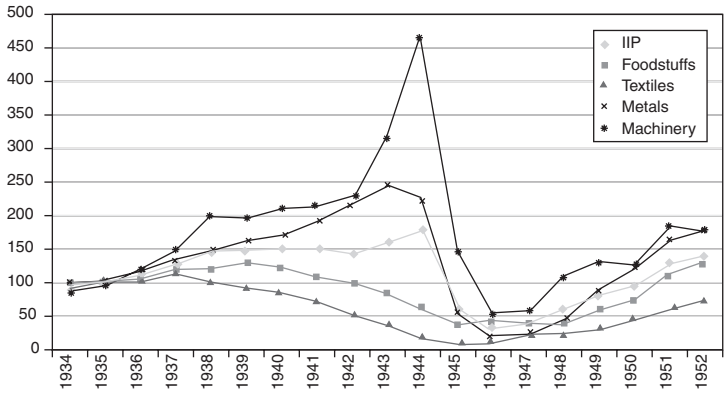

Figure 10.1 Production decline (index: 1934–6 = 100) (source: Ministry of Finance Fiscal History Section (1978), pp. 34, 90–3).

At war's end in 1945, industrial production had fallen to 60.2 percent of the prewar base year (1934–6), a level that was one-third the level of the preceding year (with production indexes falling from 178.8 to 60.2). Reflecting shortages in raw materials and equipment, manufacturing slipped even further in 1946, down to 30.7. The fall in metals production was particularly steep, with the production index down to 15.6 percent of the base year, or a mere 6 percent of 1943 levels. In the fall of that year, only three blast furnaces were in operation in the entire country (Long-Term Credit Bank of Japan 1962, p. 9).

Japan was hit with grave food shortages in 1946, and the economy was slipping into chaos. In addition to the damage inflicted on crops by the cold summer and stormy fall of 1945, wartime shortages of fertilizers had reduced fields to wastelands. Rice harvests fell to 60 percent of normal years, down to levels not seen for 30 years. Only 3.89 million tons of rice were harvested in 1946 (of which 374,000 tons were carried forward from the previous season), 69 percent of the preceding year's crop. Projections were made that as many as ten million people would starve to death. By May 1946 maintaining the already-inadequate food rations became impossible. Food deliveries throughout the country were delayed or missed altogether. Rice riots occurred on May 12 and May 19, 1946, and labor union leaders declared a so-called "Food May Day" (see Arisawa 1976, p. 256; Arisawa and Inaba 1966, p. 35).

Despite the fact that Japan's national wealth had been dealt a near-mortal blow by the war, the country's capital-stock of equipment and facilities was much higher than one might imagine, due to the massive investment during the war. Thus, even though the country had lost nearly 25 percent of its wealth, Japan's surviving plants and equipment at the war's end in 1945 were approximately equal to 1935 levels (as adjusted for prices at the end of the war). For example, notwithstanding the decline in household assets during the war, plant and equipment assets had actually increased 80 percent over 1935 levels. Electricity and gas supply facilities were up by 48 percent. Japanese industry

had undergone a profound shift during the war, moving toward heavy and chemical production.

Comparing Japanese industrial production capacities at three points in time – the start of the war in 1937, the peak year of production in the war (for example, metals in 1943, machinery in 1944), and last year of the war – iron production capacity in the peak year was up 2.2 times over 1937 levels. Machine tool production capacity was up 2.7 times; oil refining was up 1.8 times; caustic soda was up 1.9 times; and other industries also registered big gains. Conversely, with the exception of staple fibers, almost no gains were registered in fiber production capacity. Thus, the production capacity of the fiber industry was no more than 16–38 percent of the levels seen in 1937. In contrast, production capacity across the board in the chemicals and other heavy industries (with the exception of petroleum refining) was up in comparison with prewar levels. Iron, aluminum, machine tools, and caustic soda production capacities made particularly notable gains. The biggest problem for the metals and machine tools industries after the war was low usage rates because of the loss of wartime procurement orders. Moreover, since most Japanese heavy industry had been saddled with responsibility for the payment of postwar indemnities, the industry was put in the position of not being at liberty to say – in fact having to conceal – what their actual production capacities were for a time after the war.

According to the *Report on the Status of the Economy (First Economic White Paper)* issued by the Economic Stabilization Board, the December 1946 operating rates in the steel industry were 1.7–26.1 percent; they were 44.9 percent in the light metal rolling industry, 3.8–37.4 percent in the soda industry, and 22.3 percent in the cement industry. Thus, Japanese industry had considerable ability to recover after the war as operating rates increased with rising demand for basic industrial goods (see Long-Term Credit Bank of Japan 1962, p. 13; Teranishi 1993).

Tanzan Ishibashi assumed his duties as Minister of Finance in the Yoshida Cabinet, which was formed in May 1946. Ishibashi was a classic Keynesian who believed that the way to beat inflation was to expand production through deficit spending and increasing the money supply. Yet Ishibashi's budget for fiscal 1947 contained no implementation of increased production, and he was left with no choice but to frame a balanced budget (Miwa 1989, pp. 141–3). Although Ishibashi's intended strategy of conquering inflation by expanding production may in fact have had sound economic underpinning over the long term, the economic exigencies of the time may have, in fact, demanded short-term emergency measures to deal with inflation. This gap between theoretical and practical needs is a phenomenon seen often in developing countries and in countries of transition.

Postwar inflation and price controls

The Japanese economy experienced severe inflation in the three-and-a-half years between the end of the war and the issuance of the Nine Basic Rules for

Economic Stabilization (December 1948) and their specific implementation in the Economic Stabilization Plan (the Dodge Line, starting with the budget of fiscal 1949). Figure 10.2 shows the trends in prices and money supply (the index for 1934–6 was 1). The vertical axis in Figure 10.2 is logarithmic, so the tangent indicates the inflation rate and the growth rate of money supply. Consumer prices rose by nearly 200 percent in 1946, and wholesale prices actually rose in excess of 300 percent. Prices continued to rise over the next two years at rates of 100–200 percent. As a result, consumer prices increased 80-fold in the period between the end of the war and April 1949, and wholesale prices increased 61-fold.

The main cause of this hyperinflation was the collapse of the balance between the supply and demand for goods. Industrial production was severely depressed, because of decreased capital stock, to the point of industrial paralysis because manufacturing was demilitarized and to the point of decreased utilization rates because of shortages in raw materials and equipment. At the same time, the economy saw increased demand pressure as the country absorbed demobilized soldiers and displaced persons from Japan's former colonies. The situation was further exacerbated by emergency military spending, savings withdrawals, war-end outlays, and reconstruction financing as discussed later.

In terms of price trends, we see that prices did not have such a pronounced increase immediately after the war when compared with money supply increase. This balance changed rapidly, however, around November 1945 when the food situation took a turn for the worse as stocks of goods hoarded during the war came to an end. By December 1945, prices had doubled since the end of the war. With the collapse of wartime systems, black market prices shot up as the food situation deteriorated, thus putting inflationary pressure on ordinary people's living expenses. The highest black market prices were many times higher than the official prices of basic commodities in October 1945: for example, rice was 132 times higher, vegetable oil 75 times, cotton thread 73 times, and soy sauce 45 times (Economic Planning Agency 1976, p. 20).

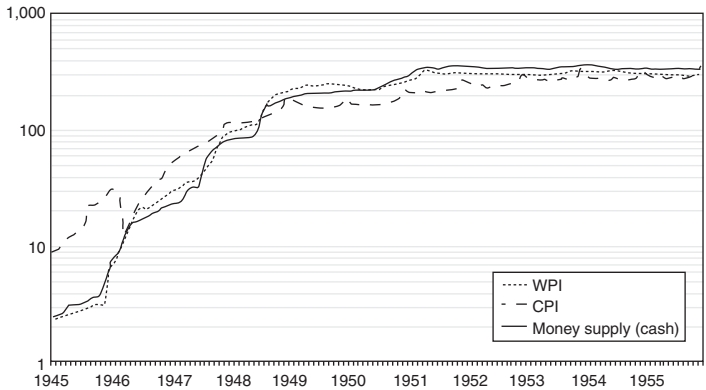

Figure 10.2 Price index and money supply (1934–6 = 1.0) (source: Katsumata (1995)).

At the same time, setting August 1945 as a baseline at 100, the industrial production index was 71 for September, 73 for October, 76 for November, and 86 for December, with no sign of recovery. Finally, in March 1946 the industrial production surpassed August 1945 levels of production based on estimates made by the Toyo Keizai Shimpo-sha (publisher of books on economics and management – they publish their own economic analysis and economic forecasts using the 1931–3 average as a base year to calculate industry production index (Ministry of Finance Fiscal History Division 1978, pp. 102–3)), but this level was no more than 120 percent of the prewar base year. Depressed production and increases in the money supply combined to drive inflation at an accelerated rate.

The Countermeasures for the Economic Emergency, announced on February 16, 1946, as a way to stem the inflationary spiral, were a collection of comprehensive anti-inflation measures that included Emergency Financial Measures promulgated on February 17, 1946. Subsumed under these measures were the Order for Deposits of Bank of Japan Bonds, the Order for Emergency Survey of Assets, the Emergency Food Measures, the Emergency Measures for Concealed Materials, the Basic Policy for Postwar Goods Prices Countermeasures, the Policy for Emergency Employment Measures, the Promotion of Industrial Production Measures, and the Control Measures for the People's Essential Goods, among others. The Emergency Financial Measures had a profound effect on people's lives because the currency was converted to the new yen, so bank accounts were frozen and depositors were forced to hold on to Bank of Japan bonds. As a whole, the policy was unprecedented and was intended to stop excess and unrealistic purchasing power in its tracks. According to these policies effective March 3, 1946, (a) the old yen would cease serving as the currency; (b) holders of old yen would receive 100 new yen per person in exchange for the former currency, any additional funds would have to be deposited in a financial institution, and those deposited funds would be frozen; (c) any subsequent salary or compensation would be limited to 500 new yen per month, and any additional payments would be frozen; and (d) persons not receiving salary or compensation would be eligible to withdraw funds from frozen bank accounts of up to ¥300 per head in the household, with an additional ¥100 per dependent per month for living expenses. Nearly all of the new yen currency was used to purchase food on the black market, so for a time the new yen ended up primarily in the hands of black marketers and farmers for example, farming and fishing villages held 48.2 percent of the new yen currency in May 1946, 32.3 percent in September 1946, and 28.5 percent in May 1947, while during the same period, ordinary consumers held 16, 6.2, and 10.1 percent of the new yen, respectively (Yoshikawa and Okazaki 1993, table 3.9). Moreover, citizens had to declare all assets during this period when bank accounts were frozen and the old yen was being exchanged for the new yen, and an asset tax was levied cumulatively on personal assets in excess of ¥100,000.

Within the context of these policies, the price control plan was essentially as follows: (a) purchaser prices for principal goods were to be held at a fixed multiple of prewar (1934–6) prices; (b) producer prices for principal goods were

calculated according to unit prices, reflecting average manufacturing costs (because this computation was based on market prices, producer prices were inevitably higher than controlled consumer prices); and (c) in the event that producer prices exceeded purchaser prices, the government would close the gap by providing subsidies for the difference (price differential subsidies). Thus the multiple applied in the March 1946 system was a factor of eight; subsequently, however, the government was left with no choice but to adjust this factor to reflect the rise in goods prices, so that by July 5, 1947, the new price system was based on a factor of 65 (and with this change, the government introduced its concept of a price stabilization range). By June 5, 1948, at the third goods price revision, a factor of 110 came into use. The irony here is that the very inflation in consumer goods prices that the government meant to control was brought about by deficit spending policies that spurred inflation by subsidizing the increasing cost of goods.

In effect, these measures, based as they were on a system of policies designed to deal with the economic crisis, only succeeded in temporarily restraining inflation, and during the initial period of priority production in the late 1946–7 period, goods prices shot up with renewed vigor. This price spike peaked at the end of 1947 and moderated after that period, but the problem of inflation was not finally dealt with until the implementation of the Dodge Line in 1949.

No doubt, stimulating manufacturing while keeping a lid on inflation was essential in the postwar period, and the priority production policy and promotion of finance by the Reconstruction Financing Fund were two of the approaches used to promote this goal. Nevertheless, no change was seen in the pace of inflation. This state of affairs was partly the result of the fact that industrial production ended its slump and got on track toward recovery as priority financing policies bore fruit. Inflation likely took hold, however, with even greater ferocity because of the indiscriminate application of government funds and promoting finance.

The priority production policy

In the fall of 1946, the stock of industrial materials on hand had bottomed out and industrial production still showed no signs of recovery. Coal and steel production, the very foundation of industry, remained severely depressed. Around this time, dire predictions were made about vanishing industrial raw materials, depressed manufacturing, and an even more virulent inflation that would set in by March 1947, the so-called "March crisis." The priority production policy was adopted as a way to head-off this crisis.

Industrial production was depressed by a deadly combination of coal shortages, caused by indiscriminate coal mining during the war, coal industry labor shortages (the number of full-time coal miners fell from 400,000 in 1944 to 300,000 in 1945), and steel shortages. In 1945 and 1946, coal production was around only 22.3 million tons and 22.5 million tons, respectively, levels of production that were less than half of the 49.3 million tons of coal produced in

1944. With the exception of coal used for railroads, collieries, and for the occupation forces, precious little coal was available to supply industry. Only 6.4 million tons of coal were provided to industry in 1946, less than 30 percent of total coal production for that year. In October 1946, government economists and officials proposed that coal production be lifted in one great push from the 23 million ton level, up to 30 million tons in order to remove what was seen at the time as the single most significant obstacle to expanded industrial production. To set this 30 million ton production goal, a coal subcommittee was formed within the Foreign Ministry. Within this committee the concept of the priority production policy was developed. Nakamura and Miyazaki (1990) are particularly informative about the events of this period.

Let us turn next to the situation in the steel industry. If we use 1944's monthly average as a baseline of 100, then pig-iron production and steel products production in September 1945 stood at a mere 2.8 and 1.4, respectively, while 1946 production volumes were still less than 10 percent of 1944 levels. The steel production capacity before and after the war were not significantly different (pig iron was 98 percent and steel products were 100–102 percent), so clearly the drop-off in production was almost entirely the result of a major decline in use rates. Wartime stocks of iron ore remained, so the reduced production of steel was primarily because of short supplies of coal (Kohama and Watanabe 1996, p. 54).

Analysts knew that increased steel production was required to boost coal production, and more coal production was necessary to increase steel production. The priority production policy was developed as an expression of economic policy to concentrate on increasing coal and steel production. The policy was approved by a cabinet vote on December 27, 1946, and was carried out by the government as a matter of public policy. The priority production policy assumed that through imports of crude oil used to produce steel, steel products would be applied to increase coal production in Japan; that increased allotments of coal would be provided to steel production; and that this action would ultimately have the reciprocal effect of increasing both coal *and* steel production. Having attained a certain level of production, coal and steel would then be supplied to other industrial sectors to effect an overall economic recovery. To realize this goal, materiel, funds, and labor would be applied in a preferential fashion to the coal and steel industries.

The Reconstruction Financing Fund was established in January 1947 to solve the financial underpinning of the priority production policy. Along with the Reconstruction Financing Fund, the money side of the priority production policy was supported by a system of price differential subsidies. As I will discuss below, although the coal industry benefited a great deal from the Reconstruction Financing Fund, the steel industry received the lion's share of support from the system of price differential subsidies, because at the time, Japanese coal mines were largely in ruins from overmining during the war years. Conversely, vast amounts of equipment investment would have been needed to bring about a recovery in the steel industry by providing subsidies to an industry that had

managed to preserve a great deal of its production capacity, war and defeat notwithstanding (Arisawa 1976, pp. 290–1).

From the end of 1948 until the time when the Reconstruction Financing Fund ended its operations, nearly ¥132 billion was provided to industry from this one financial institution, a figure that represented 23.3 percent of all financing provided by Japanese financial institutions at the time. The Japanese coal industry, which was the focal point of the Reconstruction Financing Fund lending operations, received ¥47.5 billion, representing 36 percent of all the Reconstruction Financing Fund lending. The steel industry received a mere ¥3.5 billion, only 2.7 percent. Viewed from the vantage point of the coal industry, 70.7 percent of coal's borrowings came from the Reconstruction Financing Fund, suggesting the coal industry's high degree of reliance on that institution. Apart from the coal industry, the electric power industry was also highly reliant on the Reconstruction Finance Fund (¥22.4 billion, or 17 percent of the fund's total financing). Apart from the Reconstruction Financing Fund money, the coal industry benefited from the preferential distribution of steel products and cement, living supplies and housing for its workers, and other preferential policies. This support represented an extreme example of the priority production policy in action. For example, in terms of steel and cement, while other sectors of industry received on average perhaps 20–30 percent of their minimum requirements in the form of government allotments, the coal industry received as much as 80–90 percent of its requirements.

The Reconstruction Financing Fund financing practices had several distinctive features. First, financing was concentrated on three industrial sectors: coal, fertilizers, and steel (although the fund provided more financing to the fiber industry than to the steel industry, the fiber industry's loans from the fund were small in proportion to its loans from all other financial institutions). Second, the fund paid special attention to equipment investment (71.5 percent of Reconstruction Financing Fund lending was aimed at spending on plant and equipment). The Industrial Bank of Japan (1957, pp. 726–7) reports that the fund relied on deficit lending and on loans to public corporations. Deficit financing is meant to cover corporate losses caused by the ballooning prices of goods, the vicious and paradoxical cycle of inflation spurred by the very government policies intended to keep prices under control. In other words, in the face of inflation, which causes spiraling producer prices, the government acts to control inflation by maintaining low interest rates. The result is that companies continue to lose money.

Despite the fact that the best way to deal with these losses is to provide business with government outlays and to raise prices, policies at the time were unable to respond in this way, and such assistance was far beyond the reach of ordinary financial institutions at the time, anyway. The Reconstruction Financing Fund took the task on single-handedly. Ultimately, the government used the occasion of the Three Wage Principles issued by the GHQ of the Occupation Authority on December 11, 1948, to put a halt to this kind of financing (these principles, as articulated by GHQ labor director Chester W. Hepler, banned deficit financing, price revisions, and subsidies). The various public corporations that were

responsible for implementing price controls were established on the foundation of the Public Corporation Law, which said "funds shall be borrowed from the Reconstruction Fund when operating funds are needed," (Kohama and Watanabe 1996, p. 57). So with only a few exceptions, public corporations were entirely dependent on the Reconstruction Financing Fund. As a result, at the end of March 1949, the loan balance to public corporations reached ¥18.2 billion, and 93 percent of operating funds were provided by the Reconstruction Financing Fund.

If we look at how the Reconstruction Fund obtained funds, we find that at the end of 1948, loans outstanding from the fund amounted to ¥109.1 billion, of which ¥70.3 billion was from the fund's bond (*fukkin-sai*) purchased by the Bank of Japan. This amount represented nearly 20 percent of the entire currency balance at the time, ¥314.3 billion. From the time of the Reconstruction Financing Fund's establishment at the end of January 1947 to the end of March 1949, the increase in money issuance by the Bank of Japan was ¥212.5 billion, and during that time the increase in Bank of Japan holdings of the Reconstruction Financing Fund's bond was ¥70.3 billion, representing approximately one-third of the increase in money issuance by the Bank of Japan (Reconstruction Financing Fund 1950, p. 8). In light of these circumstances, the Reconstruction Financing Fund lending obviously was a significant factor underlying increased currency issues. Strictly speaking, the Reconstruction Financing Fund bond was not a government bond; nevertheless, the fund's financing required drawdowns from the Bank of Japan, and this requirement caused inflation. Nearly two-thirds of the bond was purchased by the Bank of Japan. This fact alone illustrates how desperate the need for financing was at the time.

The price difference subsidy system, which was actually in effect during the war, was intended to achieve two goals: stabilization of prices and increases in production. The system would use straightforward accounting to supplement the difference in price when producer prices fell below official prices (purchaser prices), assuming this difference in costs and prices as government debt. After the war, however, the system ballooned within the context of the price control system. Between 1946 and 1951, when the price difference subsidy system was finally discontinued, domestic subsidies totaled ¥227.7 billion. Of this total amount, the steel industry received over 40 percent, with the coal and fertilizer industries close behind. These three industries received nearly 90 percent of domestic subsidies of the system.

Let us compare the targets and actual results in the coal industry under the priority production policy. Under the policy, production targets were very nearly met: the 1947 target for the coal industry was 30 million tons, and actual production was 29.3 million tons; the 1948 target was 26 million tons, and 34.8 million tons were actually produced. As recovery in coal industry proceeded, production in other industrial sectors gradually recovered. The index of industrial production (in 1934–6 it was 100) shows that from the January 1947 level of 30.7, production rose to 80 by April 1949. The index of mining production, including the coal industry, rose from 59.6 in January 1947, to a prewar level of 104.8 in March 1949. The index of metal industry production, including the

steel industry, stood at 17.8 in January 1947 and had recovered to 78.5 as of April 1949 (Kohama and Watanabe 1996, p. 58).

These indexes clearly indicate that industrial recovery efforts under the priority production policy showed good results. Even more important, however, the recovery owed much to the economic stimulus that resulted from U.S. changes in policy toward Japan during the period (changes toward a policy of enabling the Japanese economy to stand on its own), which included easing the demand for decentralization and lessening the burden of reparations, as well as reopening the country to international trade – policies that in turn led to improvements in daily life. More than just the priority production policy, with its reliance on the Reconstruction Financing Fund and price difference subsidies, was needed. Nevertheless, the massive investment program supported by the Reconstruction Financing Fund made the recovery of leading industries such as coal, steel, fertilizer, and electric power possible, so we must give credit to the Reconstruction Financing Fund where it is due.

Although industrial recovery was underway, a great deal of inflationary pressure remained because of the reliance on Bank of Japan's purchase of the Reconstruction Financing Fund's bond, and because of the government's burden of supporting price difference subsidies. Prices were rising. The Reconstruction Financing Fund's inflation and government debt inflation led to astonishing rises in consumer prices, making a rise in wages inevitable. Rising wages, in turn, spurred further price increases. Arisawa (1976, p. 289) notes:

> The irony is that, on the one hand, although Japan effectively accomplished the task of making a good start at rebuilding its core industries, the policies adopted had the reverse effect as far as the ultimate goal of beating inflation.

The Dodge Line

In February 1949, U.S. economic advisor Joseph M. Dodge arrived in Japan to implement economic policies based on the nine principles of economic stabilization. Dodge, a Detroit bank president, was seen at the time as an authority on postwar policy – he had experience in developing economic policy for occupied Germany. Dodge, who held with ministerial credentials, came to Japan three times between 1949 and 1952 (February 1949, October 1949, and October 1950) and served as an advisor to Douglas MacArthur on matters of fiscal and financial policies.

The economic policies developed under Dodge's guidance came to be known as the "Dodge Line." His policies, implemented from the 1949 to 1951 fiscal years, were strongly deflationary in character and can be divided into three broad categories.

The first category was the formulation of a balanced budget and the cessation of the activities of the Reconstruction Financing Fund. The budget for the 1949 fiscal year was built on healthy fiscal policies. It mandated a balanced budget, not only in general accounting terms, but also in terms of special accounts,

regional financial policy, and all government-related financial institutions. The elimination of subsidies was the main method of slashing government deficits, and among these were the price differential subsidies. The Dodge Line also called for an end to lending activities by the Reconstruction Financing Fund, which was a significant cause of inflation, and stepped up efforts for repayments. In addition to the obvious cutting of long-term debt, severe restrictions were also placed on short-term borrowing from the Bank of Japan. Policies were implemented to facilitate repayment of government bonds, the Reconstruction Financing Fund's bond, and other loans. The result of these and other efforts was that overall balances, which had been ¥141.9 billion in the red in fiscal 1948, jumped to ¥157.7 billion in the black in 1949.

The second category of Dodge Line policies involved improvements in a highly inefficient system characterized by corporate dependence on subsidies. The objective was to return to corporate independence in a market economy. Dodge recommended that U.S. support of Japan be accounted for in a special way: a so-called "counterpart funds system" was created to find the most economically efficient ways to make use of U.S. support of the Japanese economy (the funds obtained from selling goods in Japan that had been provided through U.S. assistance were called "counterpart funds" – in accordance with agreements with the United States, the Japanese government used these funds to rebuild the domestic economy). The Dodge Line not only sought to achieve a balance for the central government budget through a halt of subsidies, drawing a bright line between government and finance and by reducing or eliminating subsidies, it also aimed at an across-the-board reduction of governmental involvement in the economy. By normalizing the economy in this way, the road was cleared for Japan to make the transition from a controlled economy to a free economy. This era saw shrinking and rationalizing of the public entities that had exercised control over prices and goods. This process began in March 1949, and by March 1951 all of these public corporations had been eliminated. Effective on April 1, 1952, the Provisional Law for the Adjustment of the Supply and Demand of Goods was invalidated.

The third principle of the Dodge Line was the setting of a single exchange rate. Although international trade was under national control after the war, the Japanese domestic and overseas price structures were completely separate. All calculations for exchange rates could only be made on an ex post facto basis according to whether the particular transaction was for import or for export, and it varied according to the goods in question. In effect, no uniform exchange rate existed. Export exchange rates were between ¥160 to ¥600 to the U.S. dollar, whereas import exchange rates were spread between ¥37 and ¥636 to the U.S. dollar (see Table 10.1). Effective on April 25, 1949, a unified exchange rate of ¥360 to the U.S. dollar was adopted, effectively normalizing the relationship between Japanese domestic prices and international prices. Up until that point, export exchange rates had been based on a weaker yen; now many exporters could not turn a profit as a result of the new fixed exchange rates, and imports, whose prices had been set according to a strong yen exchange rate, suddenly became costly at ¥360 to the U.S. dollar, stirring renewed fears of inflation.

Table 10.1 Multiple exchange rate (as of January 28, 1949)

Import items	*Yen/U.S.$*	*Export items*	*Yen/U.S.$*
Paraffin	636	Fat glass, mirror, celluloid ware, ceramic ware	600
Dyestuff	610		
Diesel oil	595	Aluminum	580
Heavy oil (B)	284	Radio, cotton carpet, pencils	550
Manila fiber (third class)	220	Light bulbs	540
Anthracite coal, manila fiber (second class)	182	Cast metal	530
		Toys, dyestuff, ceramic plate, camera	500
Coking coal	178		
Wheat	165	Bicycles, tire tube	470
Bauxite	158	Bamboo goods, clocks, chicken wire	430
Rubber, phosphate rock	154		
Soybean	132	Raw silk	420
Iron ore	125	Artificial silk, cotton products, galvanized iron	410
Raw hide	120		
Salt	103	Fertilizer, tire	390
Manila fiber (First class)	101	Vegetables, seamless pipe	340
Potassic fertilizer	82	Tea, barbed wire	330
Raw cotton for spinning	81	Cement, spun rayon	320
Raw cotton for milling	76	Silk fabrics	315
Pig iron	67	Canned food	300
Feedstuff	51	Other silk products	270
Bean cake	37	Crude drug, spun rayon yarn, cotton yarn	250
		Artificial silk yarn, steel bar	240
		Sodium hydroxide	200
		Agar	160

Source: Arisawa and Inaba (1966), pp. 77–8.

By stabilizing the economy with the Dodge Line and by establishing a single fixed exchange rate, Japan was able to do business in the world market. Perhaps the most significant outcome of the Dodge Line was that, in removing the boundaries imposed by the controlled economy, the economy made the transition to a system in which companies could act freely. Nevertheless, under the strictures imposed by the extremely balanced budget, the cessation of lending activities by the Reconstruction Financing Fund, and the reduction or elimination of government subsidies, Japanese companies were compelled to undertake the rationalization of their operations. As companies strove to reorganize themselves by cutting personnel, by increasing plant and equipment use rates, and by cutting out inefficient corporate divisions, unemployment and bankruptcies of small- and medium-sized enterprises both increased.

Macro or micro?

In 1955, average U.S. income was nine times that of Japan. By 1970, this gap had narrowed to 2.5 times (see Table 2.1). This rapid catching-up to the United

States took place in the context of the period of rapid economic growth from the late 1950s to the early 1970s. In the 1960s Japan achieved annual growth rates as high as 12 percent (Figure 10.3). Now, in the twenty-first century, we hear about the so-called "East Asian Miracle," and we may wonder what is so remarkable about 10 percent growth rates. We should remember, however, that around 1970, the period of Japan's rapid growth in the 1960s seemed nothing short of miraculous to the world (see two articles of *The Economist* in the 1960s: "Consider Japan," September 1 and 8, 1962, and "The Rising Sun," May 29 and June 3, 1967). Not only was the rate of growth extraordinary at the time, but equally impressive were investment rates of as much as 35 percent.

Japanese government announced the Income-Doubling Plan in December 1960. The rapid growth in the 1960s shown in Figure 10.3 illustrates that Japan's income level rose remarkably. Japan's per capita GDP in constant yen in 1970 was more than 2.4 times that of 1960 (WDI CD-ROM 2004). The Japanese government implemented a series of indicative macroeconomic plans as listed in Table 10.2.

Figure 10.4 compares the planned and realized economic growth rates for the macroeconomic plans 1 to 12 listed in Table 10.2. Both planned and realized growth rates have declining trends. The realized growth rates for plans 1 to 5 (1956–71) are higher than the planned rates. The Japanese economy entered the low-growth phase in the mid-1970s. After the mid-1970s, realized growth rates for plans 9 and 10 were slightly higher than planned rates. The period of 1956–71 was a dynamic era of Japanese economy.

The Japanese economy was very vigorous in the late 1950s and the 1960s, but the country faced balance of payments difficulties in this period. Figure 10.5 shows the cyclical pattern of surplus and deficit of the balance of payments. Maintaining the balance of payments was crucial for the government at that time.

Let us examine the factors behind this remarkable growth from the macroeconomic perspectives of demand and production. The Japanese economy

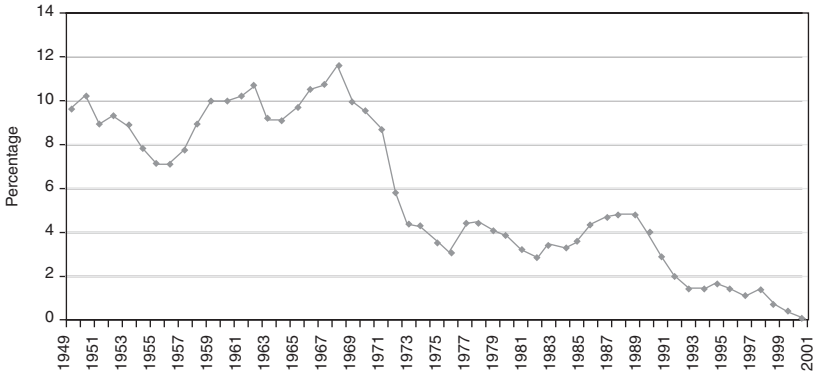

Figure 10.3 Economic growth rate in postwar Japan (5-year moving average) (source: *WDI-2004 CD-ROM*; *Handbook of Japanese Economy 2004 CD-ROM; Monthly Statistics of Japan*).

Table 10.2 Macroeconomic plans in postwar Japan

Plan		*Plan period (fiscal year)*	*Aims of plan*
1	Five-year Plan for Economic Support	1956–60 (5 years)	Self-support of the economy Full employment
2	New Long-range Economic Plan	1958–62 (5 years)	Maximization of growth Living standard improvement Full employment
3	National Income–Doubling Plan	1961–70 (10 years)	Maximization of growth Living standard improvement Full employment
4	Medium-term Economic Plan	1964–8 (5 years)	Improvement of imbalances
5	Economic and Social Development Plan	1967–71 (5 years)	Balanced and steady economic and social development
6	New Economic and Social Development Plan	1970–5 (6 years)	Construction of admirable society through balanced economic growth
7	Basic Economic and Social Plan	1973–7 (5 years)	Promotion of national welfare Promotion of international cooperation
8	Economic Plan for the Second Half of the 1970s	1976–80 (5 years)	Stable economic development Richer national life
9	New Economic and Social Development Seven-year Plan	1979–85 (7 years)	Shift to stable economic development path Richer national life Active contribution to the global development
10	Outlook and Guidelines of Economy and Society in the 1980s	1983–90 (8 years)	Formation of peaceful and stable International relations Creation of the economy with vitality Ensuring secure and affluent life
11	Economic Management within a Global Context	1988–92 (5 years)	Reducing massive current account surplus Creating better quality of life Development without regional imbalances
12	Five-year Plan for Quality of Life	1992–6 (5 years)	Reform for quality of life Coexistence with global community Improvement of infrastructure
13	Economic and Social Plan for Structural Reform	1995–2000 (6 years)	Creation of free and dynamic economic society Creation of affluent and stable society Active participation to the global community Soft and hard infrastructure development Administrative and fiscal reform
14	Ideal Socioeconomy and Policies for Economic Rebirth	1999– (10 years or so)	Creation of knowledge-based society Response to the low-birthrate and aging society Response to globalization Harmonization with environmental restrictions

Source: Economic Council (www5.cao.go.jp/98/e/keikaku/keizaikeikaku.html).

experienced an "investment spurt" during the rapid growth era (Ohkawa and Kohama 1989, chapter 5). Table 10.3 tracks the degree to which investment contributed to growth (the ratio of the increments of investment to the increments of gross national expenditure) and the trend in investment rates from 1955 (immediately prior to the period of rapid growth) to 1976 (after the

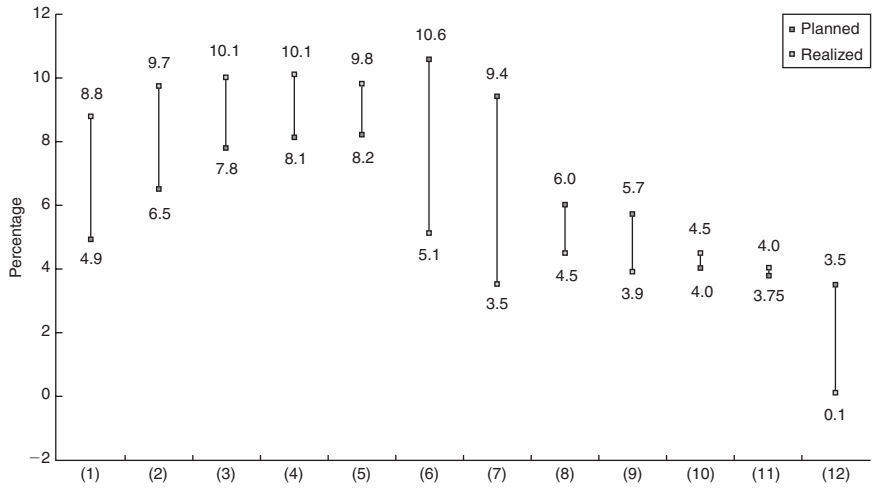

Figure 10.4 Planned and realized growth rate (macroeconomic plan 1–12 in Table 10.3).

economy entered the period of slow growth in the wake of the oil crisis). Investment rates (the ratio of gross fixed capital formation to gross national expenditure) in the second half of the 1950s averaged approximately 25 percent. By the 1960s the rates topped 30 percent per year, with a peak in 1973 of just under 37 percent, a high rate of investment never before seen in any country. Most countries that enjoyed subsequent rapid development have had extremely high rates of investment.

Typically, fluctuations in rates of investment are larger than those for variations in overall economic activity, but even in terms of the contribution of investment to growth (the ratio of increments of investment to increments of gross national earnings), for seven years this rate surpassed 40 percent. No doubt

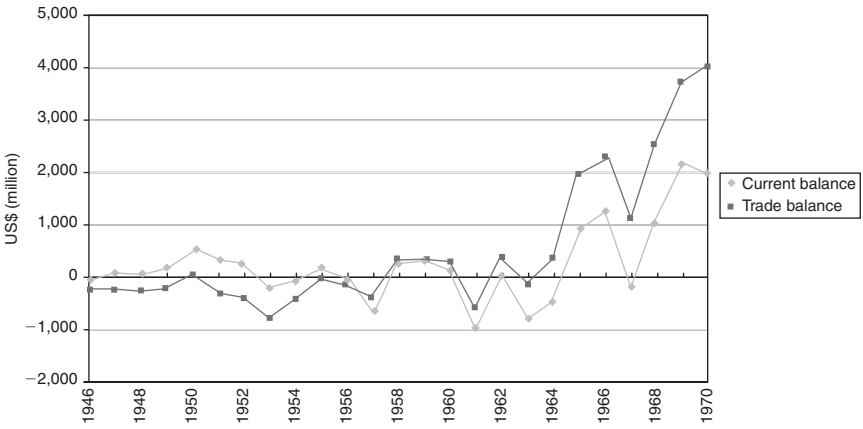

Figure 10.5 Balance of payments in postwar Japan: 1946–70 (source: Bank of Japan).

Table 10.3 Investment spurt (billion yen, %)

	GNE	*GFCF*	*Private equipment investment*	*Growth contribution*		*Investment ratio*	
	(A)	*(B)*	*(C)*	*ΔB/ΔA*	*ΔC/ΔA*	*B/A*	*C/A*
1946	474	74	37			15.6	7.8
1947	1,309	219	95	17.4	6.9	16.7	7.3
1948	2,666	443	212	16.5	8.6	16.6	8.0
1949	3,375	557	289	16.1	10.9	16.5	8.6
1950	3,947	694	390	24.0	17.7	17.6	9.9
1951	5,444	1,035	610	22.8	14.7	19.0	11.2
1952	6,261	1,276	721	29.5	13.6	20.4	11.5
1953	7,059	1,554	862	34.8	17.7	22.0	12.2
1954	7,829	1,696	911	18.4	6.4	21.7	11.6
1955	8,622	1,703	888	0.9	–2.9	19.8	10.3
1956	9,725	2,289	1,373	53.1	44.0	23.5	14.1
1957	11,082	2,948	1,856	48.6	35.6	26.6	16.7
1958	11,520	2,939	1,718	–2.1	–31.5	25.5	14.9
1959	12,926	3,435	2,019	35.3	21.4	26.6	15.6
1960	15,487	4,670	2,909	48.2	34.8	30.2	18.8
1961	19,125	6,370	4,102	46.7	32.8	33.3	21.4
1962	21,203	7,140	4,238	37.1	6.5	33.7	20.0
1963	24,475	7,886	4,453	22.8	6.6	32.2	18.2
1964	28,917	9,389	5,388	33.8	21.0	32.5	18.6
1965	31,954	9,764	5,086	12.3	–9.9	30.6	15.9
1966	36,821	11,344	5,834	32.5	15.4	30.8	15.8
1967	43,569	13,968	7,575	38.9	25.8	32.1	17.4
1968	51,599	17,333	9,689	41.9	26.3	33.6	18.8
1969	59,670	20,919	11,995	44.4	28.6	35.1	20.1
1970	70,708	24,771	14,236	34.9	20.3	35.0	20.1
1971	79,272	27,214	14,805	28.5	6.6	34.3	18.7
1972	90,651	31,298	15,950	35.9	10.1	34.5	17.6
1973	111,091	40,658	21,182	45.8	25.6	36.6	19.1
1974	132,362	45,236	23,482	21.5	10.8	34.2	17.7
1975	145,654	44,870	20,650	–2.8	–21.3	30.8	14.2
1976	164,420	48,755	22,104	20.7	7.7	29.7	13.4

Source: *Historical Statistics of Japan (1868–1985) CD-ROM*.

Notes
1946–51 = Fiscal year.
GNE = gross national expenditure.
GFCF = gross fixed capital formation.

this jump in investment rates drove the economy's rapid growth. Naturally, if we consider the so-called dual nature of investment, more than an expansion in demand was needed to boost the economy. We must not neglect the increases in production capacity and the incorporation of the latest technologies into the capital goods of Japanese corporations.

Let us turn next to the production factors underlying the rapid growth of the

economy. Table 10.4 shows the relative contributions to growth by types of economic activity during the period of rapid growth in the 1960s.[6] Japan's GDP went from ¥16 trillion in 1960 to ¥72 trillion by 1970, an increase by ¥56 trillion (nominal value). The manufacturing sector made the largest contribution to growth, in excess of one-third of overall growth. Other leading sectors in economic growth were wholesale and retail (15 percent) and the service sector (10 percent) as shown in Table 10.4.

When we see the growth contribution by demand-side components, investment was the largest contributor to the rapid growth in the 1960s. Conversely, the manufacturing sector was the main actor for rapid growth by economic activities. This fact is crucial as the starting point for any discussion of the period of rapid growth, but we still need to consider the most basic of questions, such as, why did this spurt in investment occurr? And why did the manufacturing sector grow so rapidly?

Most IMF economists would probably argue that macroeconomic stabilization and liberalization are the causes of rapid growth (see letters of intent at the IMF website: www.imf.org). I understand that macroeconomic stabilization is a necessary condition of economic growth, but it is not sufficient. Japan is an example of an economy in which high growth rates were attained, despite the protectionism of industrial policy and delayed market liberalization. As I noted

Table 10.4 Value added and growth contribution by economic activities (billion yen)

	Value added		*Value added increments 1960–70*	*Growth contribution by economic activities (%)*
	1960	*1970*		
Private economic activities	15,413.8	68,959.9	53,546.1	95.9
Agriculture, fishery	2,137.0	4,404.7	2,267.8	4.1
Mining	235.1	601.4	366.4	0.7
Manufacturing	5,568.0	25,602.6	20,034.6	35.9
Construction	880.6	5,484.0	4,603.4	8.2
Electricity, gas	418.5	1,563.6	1,145.1	2.1
Wholesale and retail	1,893.1	10,167.3	8,274.2	14.8
Financing, security	600.6	3,197.7	2,597.1	4.7
Real estate	1,223.2	5,956.6	4,733.4	8.5
Transportation, communication	1,226.4	4,956.1	3,729.7	6.7
Service	1,231.3	7,036.8	5,805.5	10.4
Government Service	1,028.5	4,671.2	3,642.7	6.5
Non-profit private service	141.3	740.4	599.1	1.1
GDP	16,118.7	71,960.4	55,841.7	100.0

Source: Economic Planning Agency (1996).

Notes
Value added figures are three-year averages in current prices.
Growth contribution by economic activities is the ratio of the increments of sectors to the increments of GDP.

in Chapter 9, citing Itami *et al*. (1988a, p. i), Japan's rapid economic growth was the result of neither macroeconomic policy nor the Japanese culture. It happened because of corporate activity. No doubt in the broadest terms, corporate activities are supported by the economic base, culture, and educational factors. In the most direct sense, however, the growth of Japanese companies brought about economic growth. Without companies such as Matsushita and Sony, growth in the Japanese home appliance industry would not have happened. What was the contribution to Japan's automobile industry and, by extension, to the Japanese economy as a whole, by companies such as Toyota and Honda? These companies first made Japan into an international competitor, and they played the largest role in Japan's rapid growth. The role of macroeconomic policy, like interest rate policy, was not the major cause of rapid growth.

I am convinced that the growth of Japanese companies brought about economic growth. Note, however, that hard-working entrepreneurs will not necessarily create a thriving economy in every time and place. If that were in fact the case, then countries would not differ from one another in terms of economic development performance. Even in postwar Japan, neither agriculture nor the finance sector have seen increases in productivity; to the contrary, these sectors showed no increase in international competitiveness. In fact, as I have argued in this book, the Japanese manufacturing sector has succeeded in international markets, even though the leading players in manufacturing may have changed from time to time. Is there some difference between manufacturing and agriculture or banking? In a sense, this question is the most important one in development economics.

Industrial policy or entrepreneurship?[7]

Industrial policy and international competitiveness

Many foreign observers argue that the Japanese government, and in particular MITI, played a decisive role in the rapid industrialization and expansion of Japanese exports during the postwar era of rapid growth. This premise is the source of the so-called "Japan, Inc. argument." Although the government, and especially MITI, implemented a wide range of industrial and export promotion policies, MITI did not always have the leading role in industrialization. Furthermore, private industry certainly did not always respond as MITI thought it would. The most important factor in the rapid growth of the Japanese economy was not industrial policy; it was the dynamism of the private sector. The secret to Japan's rapid postwar development, however, lies in industrial policy that nurtured that dynamism in the private sector, which is to say, policies that enabled the economy to attain levels of greater efficiency based on fundamental market mechanisms.

The arguments that intervention in markets by industrial policy and market protectionism give rise to economic distortions and inefficiency represent a static, naïve, and incorrect line of reasoning. Economic development is a long-term

process of structural change, and to the extent that the factors ensuring competition in the private sector are in place and corporate entrepreneurs possess a strong inclination to increase productivity, government support and promotion of these factors through long-term development policies is the rational thing to do. Japan's industrial policy essentially attached a great deal of importance to corporate activities and initiatives. Industrial policy advanced Japan's transformation into an industrial society in response to situational needs. Many times, however, private industry did not heed the government or did not respond as MITI thought it should. The anecdotes I discuss below in an examination of the relationship between Japan's postwar development industries and government industrial policy contain valuable lessons for today's developing countries as they consider industrial policy.

After World War II, many people believed that Japan had little need for an automobile industry, particularly a passenger car industry, and that the country could get by with vehicles imported from the United States as I discussed in Chapter 9. The Japanese auto industry would likely not be what it is today if MITI's plans for Japan's postwar industrialization had been carried out. Soon after the war, and with no orders in hand, both Toyota and Nissan applied for loans from the Reconstruction Financing Fund – the very same Toyota that today is famous for carrying no debt on its books. If it had been up to industrial policy, of which the government was the primary architect, no loans likely would have been made, given the severe limitations on funds at the time. Sure enough, some directors of the Reconstruction Financing Fund were said to be firmly opposed to providing financing to the auto industry. In the end, however, the fund provided loans to Toyota and Nissan, an action that can probably be interpreted as an example of how, in the reconstruction period immediately after the war, the Japanese government respected and supported the initiatives of private companies.

The role of the Reconstruction Financing Fund and the Japan Development Bank was to provide funds to Japan's basic industries: electrical, coal, shipping, and steelmaking. At the same time, the banks were to promote industries using new technologies, of which Sony is a good example. Most private sector banks were not interested in providing credits when Sony began development of the transistor. Furthermore, the flexible tax regulations were used as a means to promote new industries such as transistor radios, televisions, and photographic film. For example, during the first two years of the transistor's development, the industry was exempt from goods taxes.

Let us examine the government policy in the machine tool industry in the period when Japan was shifting from imports to machines made in Japan, an issue I discussed in Chapter 6. Industrial development depends on securing a supply of industrial machines, especially the so-called "mother machines" that are used to build other machines. At the beginning of their industrial development, countries have no choice but to depend on imports of these industrial and machine tools from the more industrial countries. As industrialization goes forward, the import substitution of industrial machines starts while imports of machine tools continue. With further industrialization, the domestic manufacture

of machine tools begins. In Japan immediately after the war, MITI was aware that promoting the machine tool industry was essential to promote industrial development and that first-class machine tools would be required to achieve that goal. Thus MITI put in place the 1951 Machine Tool Import Subsidy Policy, with its aim of promoting imports of high-quality machine tools. This subsidy system was very costly, and the government picked up half the cost of designated high-quality, foreign-made machine tools imported into Japan. This subsidy policy, designed to spur the importation of high-quality machine tools, was introduced in 1951.

Although this import subsidy policy may have been a fine thing for machine tool users who were able to use first-class foreign-made tools at half-price, the policy would have done nothing to prevent the drain of foreign-exchange, or to encourage improvements in domestically manufactured machine tools had the policy continued for very long, so after the Machine Tool Import Subsidy Policy, MITI implemented a new subsidy policy to support the production of high-performance machine tool prototypes. In this policy as well, half the cost of making machine tool prototypes was subsidized. Although the goal – securing a supply of well-made machine tools – was the same as for the earlier subsidy policy, the idea here was to shift from subsidizing imports to subsidizing prototype production. Thus, this new subsidy policy represented a major contribution to improving the efficiency of the Japanese machine tool industry in light of Japan's future import liberalization.

Here are some examples of confrontation between the thinking of the Japanese government and private industry's reaction. In the steel industry, for example, two integrated steelmakers (companies that made steel from scratch using coke ovens, blast furnaces, and so on) existed: Nippon Steel and Nippon Kokan (NKK). After the war, three Osaka-region steelmakers, Sumitomo Metals, Kawasaki Steel, and Kobe Steel, made the transition from making steel with the open-hearth method (starting with scrap metal), to the blast furnace (starting with iron ore).[8] The confrontations between the new players and the existing integrated steelmakers and the government are legendary in the history of the Japanese steel industry. The story is well-known about Kawasaki Steel in the summer of 1950 (see Chapter 4), at a time when the government and the existing steelmakers put up fierce opposition to Kawasaki's announcement that it was going to build an integrated steel works in Chiba, next to Tokyo. The governor of the Bank of Japan at the time, Hisato Ichimanda, threatened that if the company tried to build a steel mill at the site in Chiba, he'd see that it got planted over in weeds. By June 1953, however, Kawasaki Steel started the operations at Chiba Works in the midst of the First Steel Industry Rationalization Plan. Chiba Works production capacity was 700 tons per day, but Kawasaki announced only 500 tons per day publicly. This story is an excellent example of how a private company's vigorous determination to invest in plant and equipment enabled it to emerge as an integrated steelmaker over the strong opposition of both the government and industry.

Next is the Sumitomo Metals incident of 1965 in which Sumitomo Metals,

MITI, and the other steelmakers fought over reductions in crude-steel production. At the time, Japan had very little in the way of foreign-exchange, and increasing its exports was imperative. Steelmakers were even required to earmark a portion of their steel production for export. In that year, Sumitomo Metals surpassed its required quota of steel exports, but MITI determined the steel production quota according to the total of steel produced for domestic use and steel for export. If a company wanted to increase its exports, it had to do so at the cost of reducing its shipments into the Japanese domestic market. Sumitomo went head-to-head with MITI because Sumitomo's actions ran counter to the larger goal of increasing steel exports. MITI applied all sorts of pressure to Sumitomo, including refusing to allow the company to obtain more than the share of imported coking coal commensurate with the company's official steel production quota. In the end, however, MITI bowed to Sumitomo and gave them a special export quota. This story is an example of how the government was unable to adopt a policy that seemed to go against the goal of increasing exports.

Another example of the disparity between MITI policy and private industry, one that is somewhat different from the examples taken from the steel industry, relates to the so-called 300,000 ton ethylene policy discussed in Chapter 5. In the petrochemical industry, which uses economies of scale, ethylene is the core stock. In June 1967, the Petrochemicals Coordinating Council (MITI and the industry body charged with coordinating capital formation in the industry) announced a policy in which the Japanese petrochemical industry would cut costs and build the international competitiveness through economies of scale. At the same time, Japan simply did not have enough gigantic companies that could support the kind of massive investment needed to build enormous petrochemical plants. The goal here was to achieve the 300,000 ton ethylene policy. The achievement of this goal required, among other things, constructing new ethylene plants capable of having in excess of 300,000 tons of annual production capacity, planning for appropriate derivative products, securing a stable supply of naphtha from plants within petrochemical industrial zones, and creating centralized corporate industrial parks that were internationally competitive.

At the outset, MITI thought perhaps two or three companies would come on board for the 300,000-ton requirement as I discussed in Chapter 5. In fact, more than ten companies came forward, an indication that private industry's desire to invest in plant and equipment was very strong (see Table 5.6). This standard was all about optimizing production technology so the production target could be achieved with the minimum facilities necessary. No limit was placed on the number of companies that could participate.

Within MITI, some believed that limiting the number of companies was necessary, and as we saw in the Temporary Law for the Promotion of Designated Industries, the pendulum swung back and forth between promoting industry through free competition and what was, in a certain sense, the opposing philosophy of government intervention to limit the number of players in a given industry. The more the government intervened, the more pronounced the shift by

entrepreneurs from profit-seeking behavior (seeking profits by increasing productivity and international competitiveness) to rent-seeking behavior (in which companies improve their bottom line through regulation and protectionism) became.

For example, when Honda, which had been a manufacturer of scooters and motorcycles exclusively, entered the four-wheel vehicle market, MITI moved to set up the Temporary Law for the Promotion of Designated Industries to prevent excessive competition caused by the arrival of new players in the industry, ostensibly to promote the development of a domestic Japanese automobile industry. Honda's founder, Soichiro Honda bitterly criticized MITI's policies. Honda went ahead to become a manufacturer of four-wheel vehicles and went on to take the lead from Toyota and Nissan in terms of its anti-pollution technology and overseas production strategy.

Even prior to its entry into four-wheel vehicle production, as a motorcycle manufacturer, Honda had a philosophy of aggressively capitalizing on competition with foreign manufacturers. Around 1950, Japanese motorcycle companies asked the government to restrict imports of foreign motorcycles. Honda, for its part, believed that the entry of high-quality foreign motorcycles into the Japanese market would serve as an invaluable stimulus to Japanese manufacturers. By freeing up imports, domestic motorcycle makers would be driven to develop their own manufacturing capabilities, so Honda was vehemently opposed to import restrictions (see Chapter 9). Soichiro Honda's thinking was absolutely clear on this score: Japan was behind in this area and needed to learn from good products. They needed samples, so allowing imports was seen as a good thing. Japan's rapid industrialization owes a great deal to this kind of activity on the part of private business leaders.

These examples make clear that severe competition between companies and the strong desire by private industry to pursue investment in new plant brought about Japan's rapid industrialization, notwithstanding alternating periods of harmony and conflict between MITI and private industry. Of course, in comparing Japan with today's developing countries, many differences must be accounted for, including differences in the respective sizes of domestic markets and changes in the international economic environment. Nevertheless, today's developing economies can learn much from Japan's experiences. Japan maintained strong competition in the manufacturing sector while directing the economy to increased levels of efficiency to attain high rates of economic development, all the while pursuing the larger goals of expanding exports and working toward future import liberalization. All the experiences of cooperation and conflict between government and private industry have relevance for the contemporary developing countries.

Debate continues about whether Japan's rapid postwar economic growth was driven by exports or not. If we examine the role of export expansion in the demand-side components of Japanese national accounts, we see that the relative fraction attributable to exports hardly grew at all during Japan's period of rapid economic growth, a pattern that is manifestly different from that seen, for

example, in Korea. Figure 10.6 compares the exports-to-GDP ratio of Japan and Korea over the period from 1960 to 2002. We observe the rising trend for Korea, but the ratio has been stable for Japan. From the standpoint of development policy, however, talking about whether growth is export-led or not is virtually meaningless. The important things are: (a) Japan worked very hard to improve efficiency and strengthen international competitiveness while moving toward export expansion; and (b) that the structure of the Japanese market brought this circumstance about. Japanese corporate leaders applied their companies vigorously to technological innovation and to the importation of new technologies. With trade and capital liberalization just around the corner, the latent competition with foreign companies was sure to be severe, and that competitive pressure drove Japanese companies to redouble their efforts at technological innovation and increased production efficiency.

Textbooks teach us that protecting only infant industries is economically rational. In terms of policy design, however, identifying an infant industry from appearances is very difficult. Governments risk dragging out protectionist policies for too long in the interest of fostering import substitution. This phenomenon is clearly in evidence in Latin America. In the immediate postwar period, Japanese industries were heavily protected. As I have taken pains to point out, however, most Japanese knew that trade and capital liberalization had to happen in the near future.

I believe that at times, from a development standpoint, adopting policies that protect domestic industries is indeed economically rational. Nevertheless, the decisive factor here is that such protective policies must promote the efficient operation of the domestic market. Such policies must take into account the degree of competition in various industries and the speed of improvements in attaining international competitiveness, and the people must be told exactly

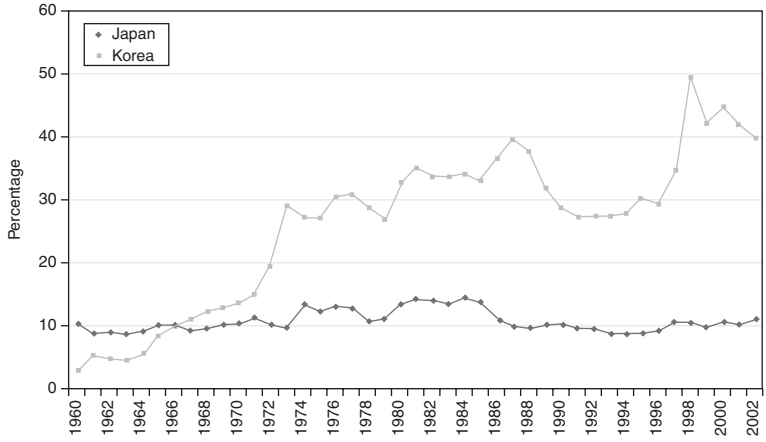

Figure 10.6 The ratio of exports of goods and services to GDP: Japan and South Korea (source: *WDI 2004 CD-ROM*).

when trade liberalization is going to come into force. Furthermore, when this schedule of liberalization is announced, policymakers must stick to it. Liberalization is something that should be introduced in a steady, gradual, and consistent way. Under these conditions, and with the blessings of the government, companies will do what they need to do to survive, making every effort to increase productivity and make themselves competitive in international markets.

In short, the vitally important lesson for developing countries is that the Japanese experience emphasized management of the Japanese economy in such a way as to promote efficiency; that protection was used, yet severe competition within the oligopolistic Japanese domestic market was allowed; and that Japanese companies were ultimately able to compete with foreign companies in international markets.

The dynamism of private industry and entrepreneurship

The Trade and Foreign Capital Liberalization Plan played an important role in the rapid development of postwar Japan. The Trade and Foreign Capital Liberalization Plan was approved by the cabinet on June 24, 1960, setting basic trade liberalization policy, countermeasures, and liberalization specifics for each product. According to the plan:

> Through the implementation of this plan, where the economy had been 40 percent liberalized (that is, the percentage of freely-imported goods the total imports), as of April 1960, the targets will be an increase to approximately 80 percent after three years, and approximately 90 percent in case of the liberalization of oil and coal imports.
>
> (Arisawa and Inaba 1966, p. 372)

The plan divided products into four categories for liberalization as mentioned in Chapter 9: (a) products that could be quickly liberalized (within one year); (b) products that could be liberalized in the near future (two or three years); (c) products that needed more time for liberalization (three years or more); and (d) products that would be difficult to liberalize, even given a substantial period of time.

The principles for dividing products into these four categories were as follows: (a) raw materials needed for manufacturing, which should be liberalized early to bring down their costs; (b) Japanese-made goods that are already sufficiently competitive on international markets; (c) industries that can be liberalized according to the degree of progress they have made in streamlining their operations and which have benefited from improved technology (*History of Trade and Industrial Policy Vol. 8*, pp. 208–9). As it turned out, the plan for 80 percent liberalization after three years was further compressed in the promotion of Trade and Foreign Capital Liberalization Plan of September 1960, which required liberalization of 90 percent after two years.

This kind of import liberalization policy can be seen in many developing countries today. The question here becomes whether the liberalization schedule announced is the one that is ultimately adhered to. In many cases liberalization enjoys general support in principle, but faces opposition in details. The result is that any backbone that the liberalization plan may originally have had is removed.

Japan's move toward trade liberalization was directly occasioned at the time by strong demands for Japan to open its markets. These demands were made at the IMF annual meeting in September 1959 and at the General Agreement on Tariffs and Trade meeting held in Tokyo that October. Details of these debates are contained in *History of Trade and Industrial Policy, Vol. 8*, (pp. 179–84). The background of the debate at the time was the demand for liberalization by the United States, which was suffering from a worsening international balance of payments and an outflow of dollars, as well as the rapid move by the European economies toward trade liberalization. Within Japan itself, however, some were calling for trade liberalization, including the following:

- The May 28, 1959 "Determination and Resolutions Concerning Basic Requests for Trade Liberalization" from the Federation of Economic Organizations (*Keidanren*).
- The August 7, 1959 "Joint Statement on Liberalization" signed by eight individuals, including Hiromi Arisawa, Ichiro Nakayama, and Yoshizane Iwasa.
- The October 19, 1959 "Statement on Trade and Capital Liberalization" issued by the Japan Association of Business Executives (*Keizai Doyukai*).

All of these individuals and groups strongly called for free trade. On the philosophy of the *Keidanren* chairman of the time, Taizo Ishizaka, Nihachiro Hanamura says "It wasn't the government that brought in capital and trade liberalization; it was Taizo Ishizaka's strong leadership that did it" (Nikkan Kogyo Shimbun-sha 1995, p. 26). Sohei Nakayama says, "As *Keidanren* chairman at the time, Mr. Ishizaka, said of liberalization, 'We should liberalize immediately. It's sheer overprotectiveness to delay it any longer'" (Nikkan Kogyo Shimbun-sha 1995, pp. 36–7).

The entrepreneurs in the manufacturing sector were well aware of strong competition. They knew that even in a protected, oligopolistic market (think, for example, of the Japanese steel industry in the 1950s), they had to press forward with improvements in productivity and international competitiveness to be prepared for the coming trade and capital liberalization. The situation was one of latent competition with foreign companies. Dependent as they were on the Liberal Democratic Party, heavily protected agriculture and banking sectors under the traditional convoy system felt no such pressure.

In the end, however, whether we are talking about latent this or that, no entrepreneur escapes competitive pressure. This axiom was true of Honda's Soichiro Honda and of Sony's Masaru Ibuka and Akio Morita (Nikkan Kogyo Shimbun-sha 2001).

Now, in more detail, I show Soichiro Honda's recounting of the postwar motorcycle import story to which I have alluded earlier (Honda 1990).

——— So, you finally set up shop in Tokyo in 1950? I've heard that you had already posted a sign or something in the company saying that the company aimed to be number one in the world.

HONDA: I always said, if it's something a person can do, then it's something *I* can do. What is there that a person can do that I *can't* do? That's what I always said.

——— In those days, I guess that in the motorcycle business, it was mostly foreign-made bikes, right?

HONDA: Yeah. American Harleys and Indians.

——— But there were dozens of Japanese manufacturers. Were these mostly copycats?

HONDA: There were about 200 companies. They were all making copies of European or American bikes. I thought about making copies once, too, but I'd sooner die than imitate other people, so we did things in our own way. That's why we had to work so hard! Because we didn't imitate.

——— Were any of the copycat companies making bikes that performed as well as the real thing?

HONDA: None. And there aren't any left now.

——— I guess a copy is always worse than the original.

HONDA: It's a copy, so there's no doubt that the thing is good enough for that time…

——— I've heard that at the time you argued Japan should import foreign motorcycles, and that you had quite an extraordinary confrontation with MITI.

HONDA: That's right. In those days, people thought you were supposed to do what the officials told you to do. I said, let the foreign bikes in. If you didn't let the bikes in, you wouldn't know what you were up against … Let them in from overseas, and we'd find out just what kind of bikes they were. And then, why not send our bikes over there? I said, give them the go-ahead to import! So that's why people were ornery and angry at me. Everyone was against it. The industry was also against it. And MITI, they said we had to have import restrictions in order to expand domestic manufacturing. But that's a mistake. I just wouldn't give in, no way.

We had to study and learn because Japan was behind. But to try to get ahead, feeling our way left and right without any samples: I was saying that's a stupid way to do things. So, what's wrong with imports? The imports wouldn't mean much, because in those days Japan was pretty much broke. They wouldn't have been able to sell too many motorcycles! It was a whole lot more important just to eat.

So, it wouldn't be any problem to let the imports in. But after all kinds of folks got real mad at me, some bikes started coming in. Let me tell you, it's a good thing they did. It was because the foreign bikes started coming in that the backward-minded Japanese made progress.

Let the goods in, and that's how you'll make Japanese industry prosper.

Let them import! I was the only one to make that argument. The industry, everyone was against me.

——— At the time, Tadashi Kume represented the younger engineers who completely defied you, arguing for water-cooled engines. But Kume went on to become Honda's third president … It almost never happens that people stand up to the president and founder of a company. Didn't it leave a bad taste in your mouth to have these confrontations?

HONDA: Not at all. You know, if the guy couldn't stand up to me, I wouldn't entrust him with the business.

Japanese manufacturing has been sustained by people like Soichiro Honda, by Masaru Ibuka and Akio Morita, by the famous and the not-so-famous. We may note here that the difference in the wages paid by Japanese manufacturers and banks has always been enormous. No one would say anything about high salaries in the banking sector, if banking and manufacturing were competing on the same ground. However, Japanese banks, traveling in convoy together as they do, have been cut-off from international competition, and the high salaries they pay represent a kind of moral hazard. The banks are not dealing in good faith and have provided misleading information about their assets, liabilities, or credit capacity. The funny thing is that manufacturing companies have to struggle to cut their production costs in increments of ¥1 – or less! The prerequisites for winning in the world market are technological innovation and lower costs. I said earlier that Japan's high rates of postwar economic growth were, at least from the demand side, not export driven. Nevertheless, from the point of view of the way Japan has competed in the world market, Japanese manufacturing industry essentially owes its success to its increased international competition.

A Japanese model: policy implications for the developing countries

Based on the above analysis, I will summarize the major lessons of Japan's postwar industrial development experiences from the standpoint of policy implications for the developing countries.

Japan's economy was not fully developed

We can derive some policy implications from the development experiences in postwar Japan. I understand Japan's economy was not fully developed until around 1960. This view is based on the fact that Japan passed the turning point of the labor market around 1960. Japan was a country with cheap labor in the 1950s. Textiles were major exporting goods in the 1950s, as shown in Table 2.4.

Japan's economy performed rapid catching-up as we discussed in Chapter 2. At the beginning of the 1950s, the income level of the United States was more than ten times that of Japan. U.S. income was more than six times in 1960. But now, Japan's income level is as high as the U.S. income level.[9] Japan experienced remarkable structural changes in the process of high growth. For

example, the export share of textiles was about 40 percent in 1954, but it declined to 1 percent by 2006. Machinery exports are the leading export of Japan, which shows about 70 percent of Japan's total exports.

Japan faced balance of payments difficulties. Until around the mid-1960s, Japan experienced cyclical balance of payments deficits and surplus as shown in Figure 10.5. Thus export promotion was an important policy in those days.

Common target to become rich

Japan was poor as mentioned previously. Becoming rich was a common target of Japanese people at that time. In line with this desire, Japan wanted to join the OECD. However, various conditions such as trade and capital liberalization should be cleared for membership of the OECD. When Japan joined the OECD, Japanese manufacturers would need to compete with foreign companies because Japan would have to liberalize imports, which was one of the prerequisites for joining. Future competition with foreign companies was a strong incentive for Japanese manufacturers to improve international competitiveness. Therefore, Japanese manufacturers made every effort to enhance productivity and technology level.

Growth and equity

"Growth and equity" is a big issue for development policy. Are there trade-offs between growth (efficiency enhancement and equity aspect of development which includes income) and asset distribution and employment. Governments should consider the equity aspect for social stability. In spite of Kuznets' inverse U-shape hypothesis, efficiency enhancement and equity pursuit do not always contradict each other. We observe the concurrent increase in efficiency and equity in some East Asian countries. The Japanese government announced a policy philosophy on growth *and* equity in 1954. It said that although simultaneous pursuit of both growth and equity was very difficult, Japan pursued both targets at the same time. Such a clear statement of policy philosophy is very important in understanding Japan's high growth alongside social stability.

Confidence in the government and the continuity of policy directions

Economic development should be based on the cooperation of a private sector and a government. In a process of economic development, a government has its own role and a market has its own role. This is a so-called "market-friendly" approach which was first clearly stated in *World Development Report 1991*. In order to realize the merit of a market-friendly approach, private sector's confidence in a government is crucial. For this the continuity of development policy directions is very important, because economic development is a long process of structural change.

Industrial policy and fierce competition

I understand industrial policy played a certain role in rapid industrialization in postwar Japan. This is partly because the Japanese bureaucrats were capable and clean as suggested in the *East Asian Miracle* report (World Bank 1993). But as I stated previously, the private sector was the main actor for high growth in postwar Japan. Competition is crucial for the improvement of international competitiveness. Potential competition, i.e. contestability, can explain the fierce competition among private manufacturers even in the protected and oligopolistic markets.[10]

I mentioned that the private sector was the main actor in the high growth of postwar Japan. I am not saying all private sectors were competitive and contributed to the high growth in postwar Japan. Mandelbaum (2002, pp. 314–16) clearly stated that the Japanese economy was divided into two parts. One part was exports, which operated based on market principles. The other part was comprised of distorted, inefficient sectors, which were created by competition-restricting policies.

Generally speaking, the manufacturing sector was competitive, while agriculture, banking and other service sectors were less so, due to heavy protection by the government. Even among manufacturing subsectors, some, such as the chemical industry, were less competitive when compared to other subsectors such as electronics and car industries.

Notes

1 Introduction: Japan as a developing economy

1 Long-term economic statistics that lend themselves to international comparisons are extremely rare. For example, according to the figures presented in Maddison (1995, table D.1), in 1930 Japan had a per capita GDP of U.S.$1,780 versus Argentina's U.S.$4,080 (1990 Geary–Khamis dollars). In fact, visiting Buenos Aires today and seeing the streets and the city's magnificent Teatro Colón persuades one that Argentina was at one time a developed country, but that it somehow took a wrong turn and became a backwater.

2 The Korean economy provides an example of this pattern. The early 1970s represented a turning point in the Korean labor market, but analysts and policy planners had expected that transition to take place at the end of the 1960s. Based on that expectation, the Korean government instituted the third five-year plan in 1972 in order to shift the leading industries in the economy from light industry to the heavy and chemical industries (Inoue *et al*. 1993).

2 Economic development as structural change

1 Industrial classification is sometimes revised according to changes in industrial structure. In 2002, the electric machinery manufacturing industry encompassed the total of manufacture of electrical machinery, equipment and supplies (industrial classification code 27), manufacture of information and communication electronics equipment (industrial classification code 28), and manufacture of electronic parts and devices (industrial classification code 29).

2 When I speak of "macroeconomics" here, I do not refer to Japan as a whole, but to whole prefectures. I have in mind here a micro approach, accounting for the development of local industries like Oita's "One village, one product" movement. Productivity improvement is based on the improvement in productivity of individual towns and companies. Some years ago, I visited a town in Oita with students from developing countries. We learned that two foreigners were working at the town hall as regular employees, and that all adult residents of the town carried passports. There was slogan at one time, "Let's plant the peaches and chestnuts and go to Hawaii!" In other words, plant or make things that are profitable and go off to Hawaii on vacation. This anecdote has an important implication for the incentives to improve productivity.

3 The fact that per capita income figures do not necessarily reflect an economy's stage of development can be easily seen, for example, in a country that has a small population and abundant natural resources. Countries such as Brunei or the United Arab Emirates come to mind. These countries have higher per capita incomes than, for example, Great Britain.

4 The revised Small and Medium Enterprise Basic Law raised the capital requirement for a small and medium manufacturing enterprise from ¥100 million to ¥300 million. Specifically, the law changed the definition of an SME from an enterprise with "capital of ¥100 million or less and 300 or fewer employees" to one with "capital of ¥300 million or less and 300 or fewer employees" (Small and Medium Enterprise Agency 2000, pp. 425–6). For a critique of this revision, see Itose (2000, pp. 33–7).
5 See Kohama (1999a, tables 2 and 3). *Census of Manufactures 2002* reports statistics for enterprises with one to three employees only for specified years (years ending in 0, 3, 5, 8); otherwise reporting is done only for specific industries (for years ending in 8, see *Census of Manufactures 1998*, pp. 448–83). *The Census of Manufactures 1997* estimated figures for enterprises with one to three people (pp. 505–16). For specific industries, see appendix table 1 in "Precautions in using the data" of *the Census of Manufactures 1997*. *The Census of Manufactures* used here is the "Report by Industry"; they are not based on establishment-based figures, but on corporate-based statistics.
6 I became aware of this table because it was quoted in Kiyonari *et al*. (1996, p. 56). It is an interesting table and has icons illustrating the shapes of the various products in the original. I have looked at all of the Small and Medium Enterprise White Papers from 1978 to the present, but have never seen the same kind of information anywhere else.
7 *Keiretsu* refers to a conglomerate or industrial group, such as Mitsubishi, Mitsui, or Sumitomo. Business transactions tend to take place within the confines of the *keiretsu* group.
8 Allegedly, managing directors and other ordinary members of the board said absolutely nothing at Long Term Credit Bank board-of-directors meetings (see "The Silent 30 Directors," *The Yomiuri Shimbun*, June 10, 1999, p. 3.). It isn't only the financial industry that is ridiculous in this way: it is said that in days gone by, faculty elders at Japanese universities would brook absolutely no dissent from faculty "youngsters."
9 Kimura (2000, pp. 219–28) argued that most of the Bank of Japan (Central Bank of Japan) staff do not make substantial discussions on monetary policy with their colleagues, especially with senior colleagues. It is not only due to the Japanese culture. An obedient attitude to senior colleagues is good for an employee's promotion in the Bank of Japan. Kimura pointed out that such an attitude was one of the reasons for the monetary policy failure in the 1990s.
10 Naturally, it isn't necessarily a good thing to defy one's superiors. The story goes that in response to Soichiro Honda, who said, "If the CVCC engine succeeds, this is our best chance to stand up to the Big Three," his subordinates countered, "Countermeasures for tailpipe emissions are not really the job of the company; it's a societal problem which is the responsibility of the automobile industry" (NHK "Project X" Production Staff 2000, p. 257).

3 The textile industry: a leading industry in developing countries

1 Cross-country regression analysis results for 68 countries using data obtained in 1996 are as follows. The textile industry share is the fraction of added value contributed by the textile industry to all manufacturing industries (WDI CD-ROM 2000). For other years, statistically significant negative correlations exist.

Textile industry share = 17.0724 – 0.0004123 per capita GNP
(11.992) (–4.5078)

* *t*-value are in parentheses.

2 Raw silk is made from spun silkworm cocoons, so it can be thought of as an industrial, primary product. In the case of iron, iron ore as well as steel are traded internationally. Iron ore is a primary product, but steel is an industrial product. Tin, however, is traded internationally almost exclusively as a metal, but tin ingot is

handled as a primary product. For these reasons, the boundary between primary and secondary products tends to be vague.

3 Japan's industrial classification code was revised for 2002 (*Census of Manufactures 2002*).

4 In contrast to Japan, garment-making factories in China, Vietnam, and other countries may be housed in four- to five-story buildings where there may be different apparel companies on each floor. This arrangement may seem a little strange to Japanese eyes at first, because Japan's factories are generally one-story buildings.

5 Although this observation is unrelated to the textiles industry, the difference is enormous between the conventional image of the plantation as taught in textbooks as a large-scale agricultural operation located in the tropics, and the reality of plantations. For instance, the traveler coming from the airport to the center of Kuala Lumpur sees rubber and palm oil plantations spread out all around the outskirts of the city. These are real plantations.

6 Obtaining capital-stock data is difficult, even on a macroeconomic basis, and obtaining data about capital-stock or tangible fixed asset balances on an industry basis is even more difficult. One must start from estimates of total industrial capital-stock to arrive at not only the ratio of industry capital-stock-to-labor measures, but total factor productivity (TFP), as well.

7 Strictly speaking, "labor inputs" should be calculated in man-hours, and not by the number of workers because the amounts of overtime, plant shifts, and so on, vary according to the business climate. Any figures concerning developing countries must be debated as the accuracy of such data is open to question.

8 Chemical fibers are included in the textiles industry here. In Table 2.3, chemical fibers are included in the chemical industry.

4 The steel industry: a typical industry of semi-industrial countries

1 Arcelor was created by a merger of Aceralia, Arbed and Usinor. Arcelor officially launched on February 19, 2001, and the merger became effective on February 18, 2002 when the Arcelor share was listed on several stock exchanges (www.arcelor.com/index.php?page=73&lngId=1).

2 POSCO received an enormous boost through the leadership of Korean President, Park Chung-Hee, who acted in the face of strong opposition from Korean and foreign economists and other experts. POSCO is now the world's most efficient steelmaker, a good example of a politician being more correct than the "experts" (It goes without saying that technocrats are not always wrong and politicians not always right). For the history of POSCO, see www.posco.co.kr/en/company/overview05_01.html.

3 Total crude-steel production in the Commonwealth of Independent States was 105.9 million tons in 2003 (www.worldsteel.org/csm_archive.php).

4 Integrated steelmaking companies that begin with raw materials (that is, coking coal and iron ore), and use blast furnaces to produce pig iron, which is refined and/or alloyed with alloying materials in steel converter facilities (such as the LD converter), into molten steel. The molten steel is then cast into a variety of semi-finished steel products, which in turn are rolled or forged into finished steel products, or are cast in molds to produce finished steel products.

5 There were no complaints to the author, despite strong protests lodged by *Keidanren* and *Tetsuren* directors to the Institute of Developing Economies. I suppose Japan still does not have a culture which is friendly to discussion and debate.

6 The Japanese term *gorika* is typically translated "rationalization," but in the present context, the term suggests "restructuring and modernization," although it may, more colloquially, also suggest the "streamlining" (for example, layoffs, plant closings, and consolidation of business units, etc.) of industries that are less viable than they once had been.

5 The chemical industry: a huge and heretical industry

1 Please recall some junior high school math:. the volume of a sphere is proportional to the radius raised to the power of three, while the surface area of a sphere is proportional to the radius raised to the power of two. Thus, the surface area of a sphere would be raised to the power of two-thirds even if the volume was doubled.
2 It is similarly absurd today for the upper classes in developing countries, comfortably ensconced as they are in air-conditioned homes, waited on by servants, to put a higher priority on environmental protection than on economic development, thereby demonstrating their flagrant disregard for the lives of poor people. See Kusano (1997, p. 153) on this issue.
3 See Itami (1998, p. 240, figure 8.1) for data about trends in the net export ratio. The net export ratio is defined as (exports − imports)/(exports + imports), and its value varies between −1 and +1. The larger this ratio, the greater a country's international competitiveness is said to be; increases in the number are said to show a country's growing competitiveness in world markets.
4 Relative export share = (export share)/(value of shipments share). Exports are a gross value, and do not represent the share of value added. Thus, exports are divided by the value of shipments, which is a gross value.

6 The general machinery industry: from import substitution to export

1 Table 6.A1 shows *Census of Manufactures 2002* industrial classification for the general machinery industry. See Table 6.A2 for the products by machine type.
2 The total value added of the manufacturing industry in 2002 was ¥97 trillion in Table 6.1, which is slightly different from the national accounts statistics. Discussion here is based on the national accounting statistics by the Cabinet Office of Japan (www.esri.cao.go.jp/jp/sna/h16-nenpou/16annual-report-j.html).
3 *Japan's Industries* (Industrial Bank of Japan 1997, p. 141) contains a graph that clearly shows the correlation in growth between corporate capital spending and growth in the production of general machines.
4 I recommend that the reader go to the FANUC website (www.fanuc.co.jp/eindex.htm), and see products and factory video (www.fanuc.co.jp/en/profile/production/video/index.html).
5 I recommend that readers go on plant tours to understand industries. As a development economist, I have frequent occasion to visit developing countries. Although I go to confer with politicians, bureaucrats, economists, and members of the business communities of these countries, I also seek every opportunity to find and tour local factories. When I visit local factories, it is useful to compare them with the various Japanese factories I have seen. I once toured the Fuji plant of FANUC with Argentinean officials. The plant was fascinating, but it was hard to tell the difference between the robots being manufactured from the robots doing the manufacturing. See the factory video of FANUC at their website (www.fanuc.co.jp).
6 See Ministry of Economy, Trade, and Industry, machine statistics (www.meti.go.jp/statistics/data/h2d3103j.html). The time series comparison needs close scrutiny because of the changes in industrial classification.
7 Sewing machines for home-use are durable consumer goods, while industrial sewing machines are capital goods.
8 Machine exports were 13.5 percent of total exports for Japan in 1954 (Table 2.4). Sewing machines represented 14.2 percent of all machine exports that year. Sewing machines earned 1.9 percent of Japan's foreign-exchange in 1954.
9 Japan adopted a multiple exchange rate system immediate after the war, and used no uniform rate. Separate rates for imports and exports were used, and rates were calculated after the fact according to the yen price and foreign currency price of the

products in question. According to the product, export exchange rates varied between ¥160 and ¥600 to the dollar, and import exchange rates ranged from ¥37 to ¥636 to the dollar. A fixed exchange rate of ¥360 to the dollar was adopted on April 25, 1949. In so doing, import and export prices were brought into line with international prices. In December 1971, the Smithsonian Accord raised the exchange rate to ¥308, and in February 1973, the currency was converted to a floating exchange rate system.

10 I will not touch on arguments that maintain that the concept of international competitiveness is vague from the standpoint of economic theory.

7 The electrical and electronics industries: from low tech to high tech

1 I am writing this book using a Macintosh, but for some people a computer is a nuisance, and they would rather write using a dedicated word processor. Other people feel that accessing the Internet from a computer is too much of a bother, but they would be happy to do so using a high-tech television if all they needed do was turn it on. Today is the age of Windows, but who knows? In another ten years, which operating system one is using may not matter, and mixing and using application software freely, enjoying complete compatibility, may be possible. Although nearly inconceivable ten years earlier, in 1999 more personal computers were shipped in Japan than color television sets (*Asahi Shimbun*, May 10, 2000, p. 13).

2 Figures for computers were first presented as an independent category in *the Census of Manufactures 1967*, but separate data for semiconductor elements can be obtained from 1955 onward. Separate data for integrated circuits also became available in 1967. These statistics appear to be for only one company, however, and statistics were not more widely available until 1969.

3 There are people in industrial countries who become obsessed with the notion of working very hard precisely to acquire durable consumer goods. Shiono has written critically of leftist intellectuals:

> These people, they have everything, yet they preach to people in developing countries and tell them to go back to their aboriginal ways of life. Meanwhile, the people in developing countries work day and night just because they want a refrigerator, a washing machine, and a car. Have these leftist intellectuals ever stopped to think of how much a refrigerator or a washing machine can ease the burden on women?
>
> (Shiono, 1998, pp. 499–500)

4 Here is a story about a mistake I made a number of years ago: I was escorting a dozen or so young businessmen on a tour through a Sony television factory in Vietnam. I asked the plant manager how different the Vietnam-made Sony's were from the ones made in Japan in terms of quality. The plant manager grew angry, and said, "We are selling Sony-brand TVs and it doesn't matter where they are made in the world, whether it's Vietnam or Japan. The quality is the same." Setting aside the question of whether or not the television sets are indeed identical in quality, the pride a manufacturer takes in what he makes is essential.

5 Konosuke Matsushita (1894–1989) is a founder of the Matsushita electric companies. In 1918 he opened a small electric shop in Osaka, where he succeeded in developing small bicycle lamp batteries. He reorganized it as Matsushita Electric Industrial Co., Ltd, in 1935. Matsushita developed a series of home electrical appliances and established mass-production systems and a sales network. Since then Matsushita has become one of the leading home electrical appliances manufacturers.

6 Masaru Ibuka (1908–97) is a founder of the Sony Corporation. Ibuka established Tokyo Tsushin Kogyo (Sony's predecessor) in 1946 with Morita Akio and others. They developed the first tape recorders produced in Japan in 1950. In 1953 Ibuka acquired the patent rights on transistors from Western Electric Co. of the United States and began developing transistor radios, which Sony started exporting to the world in

1955. Ibuka developed small-sized televisions, video-cassette recorders, and many other highly successful new products.

7 For Shuji Nakamura's research, go to his homepage (www.cnsi.ucla.edu/faculty/nakamura_s.html) and the University of California, Santa Barbara (www.engineering.ucsb.edu/Announce/nakamura.html). An article in the August 2000 issue of the *Scientific American* ("Shuji Nakamura Beat the Titans to Blue Leds and Lasers, Potentially Revolutionizing Lighting and Data Storage" by Glenn Zorpette) is also helpful to understand his research (www.sciam.com/article.cfm?articleID=000A2624-E2ED-1C73–9B81809EC588EF21).

8 Naturally, one must not overlook the fact that even imitating something can be quite an achievement. Kikuchi (1992, p. 78) writes:

> You could say that even being able to copy the transistor was an impressive feat … The ability to copy a piece of revolutionary technology in and of itself requires a very high degree of ability and latent power in the society.

This ability to imitate technology is highly suggestive of how late-starting countries catch up to the advanced countries, of the latecomers' advantage described by Gerschenkron, and of societal capacities in general. I already touched on these issues in Chapter 4, section 2, but interested readers are directed to Watanabe (1985, chapters 1 and 2), Ohkawa and Kohama (1989, pp. xiv, 82–4, 204–15), and Kohama and Watanabe (1996, pp. 97–8), among others.

9 Japan's per capita income in 1965 was U.S.$917, which was about ¥330,000. See Table 2.1.

10 Elpida (www.elpida.com/en/) is a joint venture company formed by NEC and Hitachi on December 20, 1999 and has been in operation since April 2000.

11 See the website for Elpida: www.elpida.com/en/news/2004/06–16.html.

12 MITI originally considered forming a strategic national company in which the government would be a 50 percent investor, but the Ministry of Finance did not go along with this way of thinking (K. Nakamura 1992b, pp. 213–14).

8 The shipbuilding industry: the dilemma of industrial adjustment

1 In terms of 2002 shipment value (figures for establishments having more than four workers), 57 percent of the "other transportation equipment" category is generated by the shipbuilding industry (*Census of Manufactures 2002*).

2 Other measures apart from "gross tonnage" (GT), such as "net tonnage" (NT), "deadweight tonnage" (DW or D/W), or "displacement tonnage" are used to represent the size of a ship. See, International Convention on Tonnage Measurement of Ships, (1969) (www.imo.org/Conventions/mainframe.asp?topic_id=259&doc_id=685).

3 Flag-of-convenience: an expedient method used by Japan and other countries to reduce taxes on ships by setting up a subsidiary company in a country with lower tax rates and registering the ship in that country.

4 Wooden-boat building and boat repair industry data are not available in *Census of Manufactures 2002*.

5 Statistical information on small establishments (one to three workers) is not readily available.

6 Permits are required in order to build a ship. See the table "Permits for new ship production" in *Statistical Handbook of Japan's Shipbuilding Industry 2004* (pp. 12–15). The industry is still subject to a permit process.

9 The automobile industry: entrepreneurship and government intervention

1 Nissan produced 1.47 million cars and sold 825,000 cars in Japan in 2003 according to the JAMA (the Japan Automobile Manufacturers Association), active matrix database system (jamaserv.jama.or.jp/newdb/eng/index.html).

2 Consider also that most people at the time believed that "Only about two carmakers – Toyota and Nissan – would be likely to survive trade and capital liberalization as we get into the 1960s." (Udagawa 1992, p. 228). Times certainly have changed.
3 The following is based on Arisawa (1966, pp. 396–9) and on Ueyama *et al.* (1995).
4 "Import liberalization" usually means the elimination of quantitative restrictions for imports. High import tariffs are usually implemented immediately after the removal of quantitative restrictions for imports. In today's debate in the World Trade Organization, however, trade negotiations on importing rice into Japan are an exception, and a distinction must be made between quantitative restrictions for imports and quotas. When people talk about "liberalizing rice imports," they really mean the setting of import quotas, since the whole debate begins with the complete ban on rice imports into Japan. Japan made a small deregulation on the rice import ban policy, but still has a very high tariff for rice imports.
5 Soichiro Honda (1906–91) was a founder of Honda Motor Co., Ltd. He was an aggressive and innovative engineer. Honda organized Honda Motor in 1948 and revolutionized the motorcycle industry. He succeeded in developing a series of powerful new motorcycle models, and exporting throughout the world. Honda Motor entered the four-wheeled vehicle market in 1963. Honda succeeded in a series of innovations of car manufacturing technologies, such as the low-pollution engine called CVCC (combined vortex-controlled combustion) which first cleared the U.S. Clean Air Act (so-called Maskie Act).
6 Today's Toyota Motor Corporation, initially a manufacturer of textile looms.
7 People often say that Soichiro Honda's area was technology and engineering, while Fujisawa's was sales and management, and that Honda as an automaker would not exist today without both of them. Both men share the spotlight. They met in August 1949. See, Fujisawa (1998), Honda (1980, p. 220), and Okawa (1998).
8 Japan's per capita gross national income was ¥122,000 in 1967 (*Handbook of Japanese Economy 2004*). See also Table 9.8 for the average worker's monthly salary.
9 According to Baba (1988, p. 468), this philosophy was first articulated in a 1960 paper by Miyohei Shinohara. In 1972, MITI's then vice-minister Yoshihisa Ojimi spoke about Japan's industrial policy at the OECD (Ojimi 1975).

10 Conclusion: the men who created the economic miracle

1 Tokyo residents could eat only 1,352 calories a day at that time, and the ration was 775 calories per day. The shortfall had to be made up by home production and the black market (Iokibe 2001, p. 291). Today, Japanese daily food intake is approximately 2,000 calories a day (*Statistical Yearbook of Japan 2001*, p. 657).
2 Most of the capital underlying the Reconstruction Financing Fund's bonds was purchased by the Bank of Japan. This move was essentially financing by printing money.
3 In total, 1,854,793 people died in the war (1,555,308 of the dead were soldiers or persons affiliated with the military, and 299,485 people died on the home front). An additional 678,232 people were wounded or missing (309,402 of these were soldiers affiliated with the military, and 368,830 were on the home front) (Ministry of Finance, Fiscal History Division 1978, pp. 22–3). According to T. Nakamura (1986, p. 148), nearly three million people were lost in the war, but in any event, obtaining precise figures is hard or impossible.
4 Japan lost 45.8 percent of its total territory, including colonies.
5 At the end of the war, 3,280,000 troops were overseas; 2,892,531 were repatriated from 1945 to 1949. Exact figures for the number of troops overseas at the end of the war are unknown, but estimates run to 4.24 million. The Ministry of Finance uses a figure of 2.69 million persons prior to May 1947 (Ministry of Finance, Fiscal History Division 1978). As of the end of 1946, the total number of repatriated soldiers and

civilians is 5,096,323, and a cumulative total of 6,251,439 people as of the end of 1952 (Industrial Bank of Japan 1957, p. 641).

6 Figures for 1960 and 1970 are three-year average nominal values. The 1960 figures are a three-year average from 1959–61, and 1970 is an average from 1969–71. Although figures in constant prices should be used for these calculations, the value added figures by type of economic activity in constant prices are available only from 1970 in Long-term National Accounts of Japan (Economic Planning Agency 1996).

7 This section is based in part on Kohama and Watanabe (1996, chapter 5) and Ohkawa and Kohama (1989, chapter 8).

8 Nippon Kokan and Kawasaki Steel merged in 2002 to form JFE steel (www.jfe-steel.co.jp/en/).

9 Japan's GNI per capita was U.S.$38,950, while U.S. income level was 43,560 in 2005 (WDI 2007).

10 Announcement of the import liberalization schedule in 1960 was one of the factors to explain the potential competition.

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