# Changes in Firm-Specific Advantages of Japanese Companies over the Heisei era

ChungI Wang


## Abstract

The primary objective of this paper is to explore the future direction of Japanese corporate competitive strategies by examining changes in Japanese firms' firm-specific advantages during the so-called "lost 3 decades" of the Heisei era. Using 28 years of segment data from listed companies in the transportation equipment, chemical, machinery, and electrical machinery industries, we analyzed factors influencing intra-firm trade, with a particular focus on the ratio of research and development (R&D) expenses to sales. The results revealed a relative decline in the technological advantage of the electrical machinery industry over the 30 years of the Heisei era. Although the transportation equipment, chemical, and machinery industries have relatively maintained their firm-specific advantages, the significant increase in R&D expenditures in emerging economies suggests that it will be a challenge for these three industries to sustain their firm-specific advantages in the future.

To revitalize the Japanese economy, it is essential to develop new technologies while leveraging existing technological accumulation. A key challenge for the future is how to transform from "Made in Japan" to "Designed in Japan" and further to "Innovated in Japan" to create new value-added products.

*Keywords*: Market failure; Transaction costs; Firm-specific advantages; Internalization

## 1. Introduction

Since the post-war period, the Japanese economy has experienced rapid growth based on an industrial strategy that shifted from heavy and bulky industries to light and small-scale ones, coupled with aggressive exports. By the late 1980s, Japanese companies, particularly in the automotive, electronics, and machinery industries, had established a strong global competitive position through active foreign direct investment (FDI).

However, since the burst of the bubble economy in the early 1990s, the Japanese economy has faced the challenges of excessive debt, excess personnel, and excess facilities. While grappling with these issues, Japan has also experienced significant changes in the global economic environment. Over the past three decades, the emergence of East Asian newly industrialized economies, driven by the development and diffusion of IT, has significantly increased their presence in the global economy. As a result, many Japanese companies have lost their market share, and their global influence has diminished significantly (Wang, 2020b). This suggests that the firm-specific advantages of Japanese companies may have declined significantly since the collapse of the bubble economy.

Indeed, in the annual Fortune Global 500 ranking of the world's largest companies, 148 Japanese firms were listed in 1995, with six general trading companies (Mitsubishi Corporation, Mitsui & Co., Itochu Corporation, Sumitomo Corporation, Marubeni Corporation, and Nissho Iwai Corporation) ranking in the top 10. In contrast, only three Chinese companies made the list in 1995. However, in 2012, the number of Chinese companies surpassed the declining number of Japanese companies, reaching 73, and in 2020, it further increased to 124, exceeding the United States' 121 (Wang, 2020b). Particularly since the 2000s, multinational corporations (MNCs) from East Asian emerging economies have steadily grown, narrowing the gap with Japanese companies and even overtaking them in sectors such as semiconductors and electrical machinery.

Under these circumstances, Japanese companies face a wide range of challenges. Among them, the most serious is the relative decline of firm-specific advantages, which have underpinned the competitiveness of their products and services in the past. This decline is attributable to the rise of emerging market firms driven by technological innovation and globalization. Since the post-war period, Japan's economic growth has been largely driven by manufacturing. Products labeled "Made in Japan" have gained global recognition for their exceptional quality, innovative technologies, and precision craftsmanship, solidifying the nation's reputation as a manufacturing powerhouse. Japanese companies have been appreciated for their responsiveness to customer needs and have built global supply chains. However, even after the 2000s, Japan has been unable to shift away from its manufacturing-centered economic structure, and the traditional manufacturing sector, centered around companies like Toyota Motor Corporation, continues to drive the Japanese economy. The development of industries utilizing new technologies such as high-tech and digital industries lags behind that of the United States and East Asian emerging economies (China, South Korea, and Taiwan).

The primary objective of this paper is to explore the future direction of Japanese corporate competitive strategies by examining the changes in Japanese firms' firm-specific advantages over the past 30 years. This issue will be examined from the perspective of internalization theories, which emphasizes firm-specific advantages as a key characteristic of MNCs. Specifically, this paper will analyze the status of intra-firm trade among Japanese companies, using data from the Ministry of Economy, Trade and Industry's annual "Basic Survey of Overseas Business Activities." Intra-firm trade (internal transactions) is a useful transaction mode for preventing the erosion of firm-specific advantages, and numerous studies have already pointed out the relationship between intra-firm trade and a firm's specific advantages (see the next section).

This paper is organized as follows. Section 2 examines the internalization theories that emphasizes firm-specific advantages. Section 3 examines the changes in the global standing of Japanese firms over the past 30 years. Section 4 analyzes the changes in Japanese firms' transaction modes to clarify the changes in their firm-specific advantages. Finally, Section 5 presents the conclusions of this paper.

## 2. Firm-Specific Advantages, Internal Transactions, and Ownership Policy

The insights from theories related to internalization in MNCs research are often applied to explain firm-specific advantages, modes of entry, and determinants of FDI. For instance, numerous studies have examined transaction costs associated with arm's-length market transactions, internalization costs incurred when transactions are brought within the firm, and the substitutability between arm's-length and internal markets (e.g., Coase 1937, Buckley & Casson 1976, Casson 1979, Rugman 1981). Based on these internalization theories, many studies have attempted to explain firm-specific advantages, modes of entry into foreign markets, the limits of firm growth, and the transaction modes of MNCs. This section focuses on one of the key concepts related to internalization: firm-specific advantages.

### *2.1 Firm-Specific Advantages*

Internalization theories particularly emphasize the possession of firm-specific advantages by MNCs (Hymer 1976, Rugman 1981). Firm-specific advantages in the context of internalization primarily refer to managerial resources such as knowledge and technology as intermediate goods. When expanding their businesses overseas, MNCs need to possess advantages that compensate for their lack of familiarity with the host country's environment (Hymer 1976), namely, firm-specific advantages.

MNCs can develop firm-specific advantages through various means, such as conducting their own R&D or acquiring venture companies. In particular, R&D activities are a powerful tool for enhancing a firm's technological level by creating technological patents and know-how that embody firm-specific advantages. Therefore, R&D intensity (R&D expenditure/sales) can serve as a useful proxy for firm-specific advantages and technological level. Moreover, firm-specific advantages are not only a prerequisite for foreign market entry but also a significant factor that positively influences firm growth (Morbey & Reithner 1990), firm value (Chauvin & Hirschey 1993), and firm profitability (Kwon 2010).

Firm-specific advantages encompass various factors such as comparative advantages derived from specific locations, resources that are difficult for competitors to procure from the market, or assets that are difficult for others to imitate, in addition to R&D intensity. These factors significantly influence a firm's foreign market entry mode. Specifically, they include firm size (Grubaugh 1987), wage differentials (Wheeler & Mody 1992, Egger & Pfaffermayr 2005), product diversification levels (Levchenko 2007, Nunn 2007), know-how for product differentiation (Agarwal & Ramaswami 1992), and international business experience (Maskulka & Hu 1987). Furthermore, firm-specific advantages are dynamic rather than static. For instance, the accumulation of a firm's international business experience significantly impacts its subsequent foreign market entry modes (Padmanabhan & Cho 1999, Barkema & Vermeulen 1998). As firms accumulate FDI, they also accumulate international business experience. Moreover, the longer a firm has been conducting FDI, the better its FDI performance (Delios & Beamish 2001, Gong 2003, Ogasavara & Hoshino 2007).

The aforementioned factors, which compensate for the disadvantages that MNCs face compared to local firms' general advantages when entering foreign markets, serve as firm-specific advantages and resources for competing with other MNCs. Therefore, these factors are crucial components of firm-specific advantages and determinants of FDI. In other words, firm-specific advantages are a prerequisite for FDI. To prevent the leakage of knowledge, technology, and know-how related to these firm-specific advantages and to maintain their advantages while reaping the benefits, MNCs tend to prefer wholly owned FDI (creating internal markets) (Hymer 1976, Rugman 1981).

Next, we will further examine the relationship between firm-specific advantages and internalization.

*2.2 Firm-Specific Advantages and Intra-firm trade*

Since the late 1980s, Japanese manufacturing companies have been progressively relocating their production facilities to ASEAN4 countries, primarily driven by the substantial appreciation of the yen following the Plaza Accord. The 1990s witnessed a further shift of production bases to China, attracted by the country's lower labor costs and growing domestic market. These FDI have fostered complex global value chains, facilitated by substantial intra-firm trade. Such trade encompasses a wide range of products, from intermediate goods and finished products to intangible assets like technology and financial services.

As mentioned earlier, when MNCs engage in external market transactions involving knowledge and technology-related firm-specific advantages, there is a risk of these advantages being leaked and dissipated. Rugman (1981) emphasized the need for internal market transactions to avoid the risk of dissipation of firm-specific advantages. Moreover, since choosing external market transactions incurs high costs associated with contract negotiation, MNCs are likely to prefer internal transactions to market contracts (Casson 1979).

Numerous studies have examined the relationship between internal transactions and knowledge and technology. Specifically, many studies have shown that firms with higher technological levels tend to have a higher proportion of internal transactions (Lall 1978, Helleiner 1979, Helleiner & Lavergne 1980, Davidson & McFetridge 1984, Slenwaegen 1985, Cho 1990, Kobrin 1991, Wang 2016, etc.). That is to say, to maintain their firm-specific advantages, firms with high technological levels are more likely to establish their own production bases and utilize their knowledge and technology in subsidiaries to produce products, rather than outsourcing production to external firms. In other words, FDI based on the parent firm's firm-specific advantages leads to an increase in intra-firm trade between the parent and subsidiaries (Andersson & Fredriksson 2000). MNCs increased transnational integration, namely, the increase in overseas subsidiaries through FDI, has led to an increase in intra-firm trade related to technology, raw materials, components, and finished products (Kobrin 1991).

In addition to R&D intensity related to knowledge and technology, many studies have identified numerous other factors (at both the country and firm levels) that promote internalization. These include firm size (Helleiner 1979, Helleiner & Lavergne 1980), capital intensity (Helleiner 1979, Helleiner & Lavergne 1980, Antràs 2003, Wang 2016), advertising intensity (Kobrin 1991), product value-added (Feenstra & Hanson 2005), product diversification levels (Levchenko 2007, Nunn 2007), the strength of governance over contractual agreements (Bernard, Jensen, Redding, Schott 2010), greenfield

FDI (Andersson & Fredriksson 2000), differences in tariff rates (Feinberg & Keane 2001, Yi, 2003, Wang 2013) , corporate tax rates (Hanson et al., 2005, Wang 2013), and wage differentials (Egger & Pfaffermayr, 2005). These firm-level factors can be considered firm-specific advantages. These firm-specific advantages have the effect of increasing internal transactions and promoting FDI.

As mentioned earlier, MNCs tend to prefer wholly owned FDI to maintain their firm-specific advantages and reap the benefits. In other words, firm-specific advantages that promote internalization also influence the ownership mode of FDI.

*2.3 Ownership, Firm-Specific Advantages, and the Evolution of IT*

As previously mentioned, Japanese companies have been actively investing directly in Asia since the late 1980s. Table 1 presents the ownership ratios of overseas subsidiaries established by Japanese manufacturing companies in Asia. While the proportion of wholly owned subsidiaries in Asia increased from approximately 20-30% in the 1990s to around 60% in 2020, the rate of wholly owned overseas subsidiaries expansion during the late 1990s and early 2000s, when emerging Asian economies (ASEAN4 and NIE3) were experiencing rapid growth, was only around 30-40%. This is largely attributed to the strict foreign investment regulations imposed on foreign companies in these emerging economies during that period. In the 2020s, emerging economies have significantly relaxed their regulations on foreign investment ownership ratios, but some restrictions remain. The Laotian government has enacted regulations governing foreign investment in the chemical manufacturing sector, with a specific focus on the production of therapeutic drugs and medicines. These regulations stipulate a maximum foreign ownership limit of 49%[1]. China stipulates that the Chinese equity ratio in Sino-foreign joint

1 Japan External Trade Organization (JETRO). (2016). Laos Investment Guidebook (Business Development Division, Business Development Department, p. 17).

Table 1

Ownership Ratios of Overseas Subsidiaries of Japanese Manufacturing Companies in Asia

| Region/Year | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|---|
| Asia | 30.5 | 32.0 | 35.9 | 46.1 | 54.0 | 59.5 | 62.2 |
| | 56.3 | 63.4 | 69.7 | 78.5 | 83.4 | 85.5 | 87.3 |
| China | | 22.9 | 34.4 | 50.0 | 60.3 | 66.4 | 69.0 |
| | | 66.6 | 72.6 | 81.6 | 85.6 | 87.1 | 88.7 |
| ASEAN4 | 23.7 | 27.5 | 35.1 | 40.9 | 46.5 | 50.5 | 52.1 |
| | 52.2 | 57.2 | 69.1 | 77.1 | 83.4 | 85.6 | 86.3 |
| NIE3 | | | 42.1 | 47.3 | 47.9 | 49.5 | 55.1 |
| | | | 68.5 | 74.8 | 76.3 | 76.3 | 79.8 |
| ASEAN10 | | | | | 52.0 | 56.8 | 59.2 |
| | | | | | 85.1 | 87.4 | 88.4 |
| All Regions | 46.3 | 45.6 | 50.2 | 55.7 | 60.5 | 64.0 | 66.3 |
| | 68.3 | 71.4 | 77.0 | 82.6 | 85.9 | 87.4 | 88.9 |

Note: The upper row represents the ratio of 100% ownership, while the lower row (shaded) indicates the Majority Ownership Ratio (51-100%).
*Source*: Ministry of Economy, Trade and Industry, Basic Survey of Overseas Business Activities (each year).

ventures for complete automobiles and motorcycles must exceed 50%[2]. While the ratio of wholly owned subsidiaries in ASEAN 10 reached 59.2% in 2020, this figure stands at 69% in China. Consequently, many MNCs are compelled to opt for joint ventures. As a result, numerous Japanese companies have contributed to the economic development of host countries through joint ventures with local companies, facilitating technology transfer, job creation, and capital accumulation. However, their unique competitive advantages in host countries are gradually diminishing.

Recent advancements and penetration of IT have enhanced firms' information gathering and dissemination capabilities, significantly reducing information asymmetry. Consequently, transaction costs, emphasized in internalization theories, have decreased to some extent. In other words,

2 People's Republic of China. (2004, May 21). Order No. 8 of the National Development and Reform Commission of the People's Republic of China. [Original language]

market failures related to knowledge and technology have been mitigated by IT advancements. While firm-specific advantages promote internalization of transactions, IT advancements can also facilitate externalization (Rangan & Sengul 2009, Banalieva & Dhanaraj 2019). Industries with easily codable production specifications are particularly likely to engage in market transactions through IT adoption (Chen & Kamal, 2016).

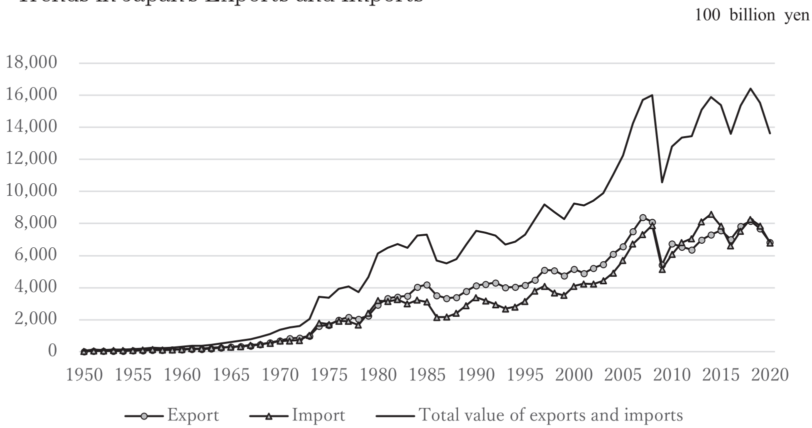
Therefore, although MNCs continue to encounter transaction costs due to market failures in foreign expansion, the imperative to expand internationally as a means of mitigating these market failures (by creating internal markets) has diminished. This is because the advancement of IT means that internationalization and internalization are not always closely linked (Rangan & Sengul, 2009). Furthermore, the spread of IT has likely weakened the general advantages of local firms that possess local information and connections compared to the pre-IT era.

In other words, as IT increases the integration of the global market, the costs arising from market failures due to insufficient integration will decrease. Consequently, the diminishing marginal returns associated with internalizing transactions to mitigate market failures pose a significant challenge for MNCs. To counter this trend, MNCs must proactively adopt IT as a strategic tool to capitalize on their unique competitive advantages. The proliferation of IT-enabled platforms, including those in logistics, supply chain management, e-commerce, and artificial intelligence, offers MNCs valuable opportunities to complement their existing capabilities and secure long-term profitability (Wang, 2020b).

In Section 3, we will examine the changes in the presence of Japanese companies in the global economy during the Heisei era. In Section 4, we will statistically verify the changes in the firm-specific advantages of Japanese MNCs by examining the relationship between the R&D intensity and intra-firm trade of Japanese companies during the Heisei era.

Figure 1

Trends in Japan's Exports and Imports




*Source* : Based on the Ministry of Finance import and export statistics (https://www.customs.go.jp/toukei/suii/html/nenbet.htm).

## 3. Changes in Japanese Companies over the Heisei era

### *3.1 Changes in the Position of Japanese MNCs in the Global Economy*

After experiencing rapid economic growth and a period of stable growth in the postwar era, Japan emerged as one of the world's leading economic powers. In the 1980s, Japan overcame the high yen recession triggered by the Plaza Accord and rapidly globalized through economic activities such as international trade and FDI. Particularly in the late 1980s, Japanese companies further enhanced their global presence during the bubble economy. However, in the 1990s, the Japanese economy entered a prolonged recession, known as the "lost 3 decades," following the collapse of the bubble economy. This section examines the changes in the global presence of Japanese companies over the Heisei era.

Table 2 shows the global ranking of companies by market capitalization at the peak of Japan's bubble economy. As shown in Table 2, of the top 20

Table 2

Global Market Capitalization Ranking (End of May 1989)

| Rank | Company | Market Capitalization (USD billion) | Nationality | Rank | Company | Market Capitalization (USD billion) | Nationality |
|---|---|---|---|---|---|---|---|
| 1 | NTT | 164 | Japan | 11 | Toyota Motor | 54 | Japan |
| 2 | The Industrial Bank of Japan | 72 | Japan | 12 | GE | 49 | USA |
| 3 | Sumitomo Bank | 70 | Japan | 13 | Sanwa Bank | 49 | Japan |
| 4 | Fuji Bank | 67 | Japan | 14 | Nomura Securities | 44 | Japan |
| 5 | The Dai-Ichi Kangyo Bank | 66 | Japan | 15 | Nippon Steel | 41 | Japan |
| 6 | IBM | 65 | USA | 16 | AT & T | 38 | USA |
| 7 | Mitsubishi Bank | 59 | Japan | 17 | Hitachi, Ltd. | 36 | Japan |
| 8 | Exxon Corporation | 55 | USA | 18 | Matsushita Electric | 36 | Japan |
| 9 | Tokyo Electric Power | 54 | Japan | 19 | Philip Morris | 32 | USA |
| 10 | Royal Dutch Shell | 54 | UK | 20 | Toshiba | 31 | Japan |

*Note*: The data for 1989 is from The Business Week Global 1000 (July 17, 1989, issue).

companies in the world in 1989, 14 were Japanese, 5 were American, and 1 was British. Although stock prices were likely detached from the real economy during this period, which was at the peak of the bubble economy, Japan's total exports and imports recovered rapidly from the high yen recession caused by the Plaza Accord and reached a record high of 75.3 trillion yen in 1990 (Figure 1).

Furthermore, Japanese corporations during the bubble economy period not only pursued expansion strategies and engaged in high-risk financial activities with massive capital procurement but also actively invested in fixed assets, driving up their performance. However, the Bank of Japan's shift in monetary policy in 1991 led to the collapse of the bubble economy, leaving many Japanese corporations grappling with the aftermath of their expansionary strategies: excessive debt, excess capacity, and overemployment. As a result, the burst of the bubble economy in the early 1990s triggered the bankruptcy of major financial institutions such as Yamaichi Securities and Hokkaido Takushoku Bank, forcing numerous companies into bankruptcy and layoffs. Moreover, Japan experienced a prolonged recession, often referred to as the

Table 3

Trends in Top 20 Japanese Companies Ranked in the Fortune Global 500

| 1995 | | | 2000 | | | 2005 | | |
|---|---|---|---|---|---|---|---|---|
| World ranking | Company name | Founded | World ranking | Company name | Founded | World ranking | Company name | Founded |
| 1 | Mitsubishi Co. | 1950 | 6 | Mitsui & Co., Ltd | 1947 | 7 | Toyota Motor | 1937 |
| 2 | Mitsui & Co., Ltd | 1947 | 7 | Mitsubishi Co. | 1950 | 18 | NTT | 1985 |
| 3 | Itochu Co. | 1949 | 8 | Toyota Motor | 1937 | 23 | Hitachi, Ltd. | 1920 |
| 4 | Sumitomo Co. | 1919 | 10 | Itochu Co. | 1949 | 25 | Matsushita Electric Ind. | 1935 |
| 6 | Marubeni Co. | 1949 | 12 | Sumitomo Co. | 1919 | 27 | Honda Motor | 1948 |
| 9 | Nissho Iwai Co. | 1968 | 13 | NTT | 1985 | 29 | Nissan Motor | 1933 |
| 11 | Toyota Motor | 1937 | 14 | Marubeni Co. | 1949 | 47 | Sony Co. | 1946 |
| 13 | Hitachi, Ltd. | 1920 | 20 | Nissay | 1889 | 56 | Nissay | 1889 |
| 14 | Nissay | 1889 | 23 | Hitachi, Ltd. | 1920 | 72 | Toshiba Co. | 1904 |
| 16 | NTT | 1985 | 24 | Matsushita Electric Ind. | 1935 | 90 | Tokyo Electric Power | 1951 |
| 17 | Matsushita Electric Ind. | 1935 | 25 | Nissho Iwai Co. | 1968 | 96 | NEC | 1899 |
| 18 | Tomen Co. | 1920 | 30 | Sony Co. | 1946 | 98 | Dai-ichi Life Ins | 1902 |
| 23 | Nissan Motor | 1933 | 33 | Dai-ichi Life Ins | 1902 | 99 | Fujitsu Ltd | 1935 |
| 24 | Nichimen Co. | 1892 | 34 | Honda Motor | 1948 | 112 | Aeon Co., Ltd. | 1926 |
| 25 | Kanematsu Co. | 1889 | 36 | Nissan Motor | 1933 | 113 | Meiji Yasuda Life Ins | 1881 |
| 26 | Dai-ichi Life Ins | 1902 | 38 | Toshiba Co. | 1904 | 142 | Nippon Oil Co. | 1888 |
| 32 | Tokyo Electric PWR | 1951 | 45 | Fujitsu Ltd | 1935 | 145 | Ito Yokado | 1920 |
| 35 | Sumitomo Life Ins | 1926 | 47 | Sumitomo Life Ins | 1926 | 147 | Sumitomo Mitsui FG | 2002 |
| 36 | Toshiba Co. | 1904 | 48 | Tokyo Electric PWR | 1951 | 148 | Mitsui & Co., Ltd | 1947 |
| 43 | Sony Co. | 1946 | 51 | NEC | 1899 | 149 | Mitsubishi Co. | 1950 |

| 2010 | | | 2015 | | | 2020 | | |
|---|---|---|---|---|---|---|---|---|
| World ranking | Company name | Founded | World ranking | Company name | Founded | World ranking | Company name | Founded |
| 5 | Toyota Motor | 1937 | 9 | Toyota Motor | 1937 | 10 | Toyota Motor | 1937 |
| 6 | Japan Post Co. | 2006 | 38 | Japan Post Co. | 2006 | 39 | Honda Motor | 1948 |
| 31 | NTT | 1985 | 44 | Honda Motor | 1948 | 42 | Mitsubishi Co. | 1950 |
| 47 | Hitachi, Ltd. | 1920 | 59 | Nissan Motor | 1933 | 60 | Japan Post Co. | 2006 |
| 51 | Honda Motor | 1948 | 65 | NTT | 1985 | 62 | NTT | 1985 |
| 63 | Nissan Motor | 1933 | 89 | Hitachi, Ltd. | 1920 | 72 | Itochu Co. | 1949 |
| 65 | Panasonic | 1935 | 92 | JX HD | 2010 | 83 | Nissan Motor | 1933 |
| 69 | Sony Co. | 1946 | 110 | Soft Bank G | 1981 | 94 | Soft Bank G | 1981 |
| 75 | Nissay | 1889 | 116 | Sony Co. | 1946 | 106 | Hitachi, Ltd. | 1920 |
| 89 | Toshiba Co. | 1904 | 125 | Marubeni Co. | 1949 | 115 | Aeon Co., Ltd. | 1926 |
| 119 | Dai-ichi Life Ins | 1902 | 131 | Panasonic | 1935 | 122 | Sony Co. | 1946 |
| 124 | Seven & i HD | 2005 | 132 | Mitsubishi Co. | 1950 | 123 | ENEOS HD | 2010 |
| 126 | Mitsubishi UFJ FG | 2001 | 138 | Nissay | 1889 | 130 | Nissay | 1889 |
| 127 | Aeon Co., Ltd. | 1926 | 142 | Dai-ichi Life Ins | 1902 | 153 | Panasonic | 1935 |
| 128 | Tokyo Electric Power | 1951 | 147 | Aeon Co., Ltd. | 1926 | 161 | Mitsubishi UFJ FG | 2001 |
| 136 | JX HD | 2010 | 157 | Toshiba Co. | 1904 | 165 | Dai-ichi Life Ins | 1902 |
| 138 | Fujitsu Ltd | 1935 | 161 | Tokyo Electric PWR | 1951 | 172 | Mitsui & Co., Ltd | 1947 |
| 146 | Mitsubishi Co. | 1950 | 184 | Seven & i HD | 2005 | 173 | Marubeni Co. | 1949 |
| 158 | Meiji Yasuda Life Ins | 1881 | 201 | Mitsubishi UFJ FG | 2001 | 177 | Toyota Tsusho | 1948 |
| 164 | Mitsui & Co., Ltd | 1947 | 204 | NSSMC | 1950 | 178 | Seven & i HD | 2005 |

*Source*: Compiled by the author based on data from Fortune Global 500.

"Lost Decade," exacerbated by subsequent events such as the 2008 Lehman Brothers crisis and the 2010 Great East Japan Earthquake.

Table 3 presents the trends of the top 20 Japanese companies ranked in the Fortune Global 500 from 1995 to 2020. The Fortune Global 500 is a ranking of the world's largest companies based on their revenues. Revenue is generally considered a measure of a company's size, and larger companies are often assumed to have greater market power. Consequently, size is believed to enhance a company's profitability and market influence (Ravenscraft 1983, Buzzell & Gale 1987, Samiee & Walters 1990, Geringer et al., 2000). In other words, the Global 500 is considered a representation of the capabilities of MNCs worldwide and the global economic landscape.

As Table 3 shows, the top 20 Japanese companies ranked in the Global 500 in 1995 were among the world's top companies. All six major Japanese general trading companies were ranked among the top 10 globally, and major Japanese manufacturers such as Toyota Motor Corporation, Nissan Motor Co., Ltd., Matsushita Electric Industrial Co., Ltd. (now Panasonic), Sony Corporation, and Hitachi, Ltd. ranked between 11th and 43rd globally. While the global economy experienced significant transformation driven by technological advancements, particularly in the IT sector, the composition of Japan's leading corporations remained remarkably stable between 1995 and 2020. Traditional industries, such as general trading, automotive, electronics, and finance, continued to hold a dominant position in the corporate hierarchy.

Upon examining the establishment years of these companies, it may appear that firms reorganized through mergers and acquisitions (such as Seven & I Holdings, ENEOS Holdings), general trading companies dissolved under GHQ directives and later reestablished, or privatized corporations (such as Japan Post and NTT) have relatively short histories. However, the parent companies or predecessors of these firms are, in fact, long-established enterprises, having been founded predominantly before the war or in the immediate postwar period. Moreover, many of these companies were ranked among the top 20 in terms of global market capitalization in 1989. In other words, the driving force behind the Japanese economy has been long-established companies such as Toyota Motor Corporation, Sony Corporation, and Hitachi, Ltd. in the automotive and electronics industries, as well as general trading companies like Mitsubishi Corporation and Itochu Corporation, which supported the Japanese economy both before and after the war. Over the 30 years of the

Heisei era, the only "new" company to join the Global 500 and drive the Japanese economy was the ICT company SoftBank Group. That is to say, the current situation is that no new industries or companies have emerged to lead the Japanese economy in the last 30 years.

For the past 30 years, the companies ranked in the Global 500 and driving the Japanese economy have remained largely unchanged, and there has been no emergence of new companies capable of competing in the global market. Therefore, unless these long-established companies can adapt to the rapidly changing global environment by leveraging their accumulated management resources and create new competitive advantages, they will be unable to compete with emerging companies appearing worldwide. As illustrated in Table 3, with the exception of a few automotive manufacturers like Toyota Motor Corporation and Honda Motor Co., Ltd., most Japanese companies have experienced a decline in their global rankings over time. As previously noted, numerous studies have established a correlation between firm size and market power, as well as profitability. Over the past three decades, many Japanese companies have witnessed an erosion of their market power. In essence, many of the traditional stalwarts of the Japanese economy have struggled to adapt to the evolving global landscape, potentially leading to a decline in their comparative advantage relative to international competitors.

Many previous studies have demonstrated that the firm-specific advantages contributing to a company's growth, competitiveness, and profitability are closely related to its R&D activities (Rugman 1980, Dunning 1981, Morbey & Reithner 1990, Chauvin & Hirschey 1993, Kwon 2010). The following section will specifically examine the R&D activities related to the technological superiority of Japanese manufacturing firms, which excel in Monozukuri (craftsmanship and production).

Table 4

Trends in Total R&D Expenditure in Major Industrial Countries

billion yen (1990=100)

| Year | Japan (OECD estimate) | | USA | | Germany | | China | | South Korea | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1990 | 11,295 | 100 | 25,842 | 100 | 6,531 | 100 | 1,137 | 100 | 877 | 100 |
| 1995 | 11,719 | 104 | 27,659 | 107 | 6,611 | 101 | 1,733 | 152 | 1,783 | 203 |
| 2000 | 13,789 | 122 | 37,151 | 144 | 8,189 | 125 | 4,119 | 362 | 2,317 | 264 |
| 2005 | 16,008 | 142 | 40,281 | 156 | 8,522 | 130 | 9,625 | 847 | 3,517 | 401 |
| 2010 | 15,865 | 140 | 45,797 | 177 | 10,104 | 155 | 21,551 | 1,895 | 5,708 | 651 |
| 2015 | 17,436 | 154 | 51,164 | 198 | 11,806 | 181 | 37,878 | 3,331 | 7,959 | 908 |
| 2020 | 17,294 | 153 | 67,480 | 261 | 12,947 | 198 | 58,285 | 5,126 | 10,671 | 1,217 |

*Note*: The left-hand side shows the total R&D expenditure (in real terms based on 2015 prices, converted using OECD purchasing power parities), while the right-hand side shows the values indexed to 100 in 1990. While the data for each country is generally based on the OECD manuals, there are differences in data collection methods, scope, and other aspects.

*Source*: Based on the Science and Technology Indicators 2022 published by the National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology, and processed by the author.

*3-2 Changes in the Technological Capabilities of Japanese Companies*

Table 4 illustrates the trends in total R&D expenditures among major industrial countries. As shown in Table 4, when the total R&D expenditure for each country in 1990 is set to 100, the values for Japan, the United States, and Germany in 2020 are 153, 261, and 198, respectively. In contrast, the figures for China and South Korea are 5,126 and 1,217, respectively. Notably, China's total R&D expenditure has increased 50-fold over the 30-year period up to 2020. China surpassed Germany in 2005, Japan in 2009, and has continued to increase, nearing the level of the United States in 2020. While Japan's R&D expenditure remained relatively stagnant with only a slight increase over the 30 years of the Heisei era, South Korea, which has aggressively invested in the IT industry, including semiconductors, saw its R&D expenditure increase more than 10-fold.

The next issue to consider is the results of these R&D activities. Patents, which indicate novelty and technological innovation, are generally regarded as reflecting the results of a company's R&D activities, though this also depends on the technological content of the patents. Table 5 presents the number of patents obtained under the Patent Cooperation Treaty (PCT) by major industrial countries. As shown in Table 5, as of 2023, China, the United States, and Japan are global leaders in patent acquisition. In particular, China has seen a rapid increase in the number of patents since the late 2000s. China surpassed South Korea in 2010, Germany in 2013, and Japan in 2017 in terms of patent acquisition. By 2019, China had overtaken the United States, and by 2023, the gap had widened further. This trend is likely a reflection of the sharp increase in China's R&D expenditure during the 2000s, as seen in Table 4. Similarly, South Korea, which lagged significantly behind advanced economies like Germany in the 1990s, saw substantial growth in patent acquisition from the late 2000s onward, surpassing Germany in 2020. Since the 2000s, emerging countries like China and South Korea have driven technological innovation across various fields, with the results reflected in the number of patents obtained.

These patents are applied in various industries and exported as products. In other words, patents and related products embody a firm's unique capabilities, including knowledge and know-how, that have been realized through R&D activities. This unique capability significantly influences the trade balance of related industries. Table 6 shows the trends in the trade balance ratio for high-tech (HT) and medium-high-tech (MHT) industries in major industrial countries[3]. Japan's trade balance ratio in both HT industries

3 HT (High Technology) includes industries such as Pharmaceuticals, Computer, electronic and optical products, and Air and spacecraft and related machinery. MHT (Medium-High Technology) encompasses industries such as Weapons & ammunition, Motor vehicles, trailers & semi-trailers, Medical and dental instruments, Machinery and equipment, Chemicals and chemical products, Electrical equipment, and Railroad, military vehicles & transport (OECD, STAN Bilateral Trade in Goods by Industry and End-use (BTDIxE), ISIC Rev.4).

Table 5

Number of Patents Acquired under the PCT in Major Industrial Countries

Number of patents

| Year | Japan | USA | Germany | China | South Korea |
|---|---|---|---|---|---|
| 1995 | 2,692 | 16,568 | 4,948 | 102 | 192 |
| 2000 | 9,467 | 37,941 | 11,976 | 584 | 1,523 |
| 2005 | 25,115 | 44,577 | 16,232 | 2,344 | 4,010 |
| 2010 | 31,382 | 45,157 | 17,403 | 12,352 | 9,269 |
| 2015 | 44,082 | 57,312 | 18,027 | 29,274 | 14,336 |
| 2020 | 50,274 | 58,755 | 18,643 | 68,459 | 19,834 |
| 2021 | 49,810 | 59,271 | 16,770 | 71,307 | 20,934 |
| 2022 | 51,465 | 56,675 | 17,454 | 66,849 | 22,163 |
| 2023 | 48,904 | 56,749 | 17,449 | 72,595 | 22,070 |

*Source*: 1995 data from the OECD Patent Statistics database; subsequent data compiled by the author from The World Intellectual Property Organization (WIPO) Statistics Database.

Table 6

Trade Balance Ratios of High-Tech and Medium-High-Tech Industries in Major Industrial Countries

| Year | Japan | | USA | | Germany | | China | | South Korea | |
|---|---|---|---|---|---|---|---|---|---|---|
| | HT | MHT | HT | MHT | HT | MHT | HT | MHT | HT | MHT |
| 1990 | 3.59 | 4.24 | 1.10 | 0.80 | 0.96 | 2.06 | - | - | 1.38 | 0.49 |
| 1995 | 2.45 | 3.90 | 0.91 | 0.86 | 0.98 | 1.90 | 1.00 | 0.47 | 1.42 | 0.85 |
| 2000 | 1.76 | 3.66 | 0.88 | 0.72 | 0.95 | 1.82 | 0.93 | 0.70 | 1.46 | 1.22 |
| 2005 | 1.40 | 3.43 | 0.77 | 0.68 | 1.07 | 2.02 | 1.14 | 0.83 | 1.77 | 1.52 |
| 2010 | 1.05 | 3.34 | 0.73 | 0.85 | 1.04 | 1.87 | 1.31 | 0.98 | 1.93 | 1.59 |
| 2011 | 0.98 | 3.02 | 0.73 | 0.83 | 1.07 | 1.84 | 1.31 | 1.02 | 1.74 | 1.77 |
| 2015 | 0.75 | 2.64 | 0.73 | 0.70 | 1.18 | 1.79 | 1.29 | 1.42 | 1.66 | 1.84 |
| 2020 | 0.74 | 2.50 | 0.55 | 0.63 | 1.15 | 1.55 | 1.20 | 1.51 | 1.54 | 1.56 |

*Note*: Trade balance ratio = Total exports / Total imports

*Source*: Based on the Science and Technology Indicators 2022 published by the National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology, and processed by the author.

(pharmaceuticals, computers, electronics, optical equipment, and aerospace) and MHT industries (automobiles, machinery, chemical products, electrical equipment, and seven other industries) has been declining consistently since the 1990s, and in particular, for HT industries, it fell below 1 in 2011, resulting in a trade deficit. The United States has shown a similar trend. In contrast, the trade balance ratio for HT industries in Germany, China, and Korea has been gradually increasing, and has generally exceeded 1 since the 2000s. In addition, the trade balance ratio for MHT industries in Korea and China has been consistently rising since the 1990s when they had trade deficits, and they achieved trade surpluses in 2000 and 2011, respectively.

In the OECD statistics, HT industries encompass three sectors: “Pharmaceuticals,” “Computer, Electronic and Optical Products,” and “Air and Spacecraft and Related Machinery.” In most countries, the “Computer, Electronic and Optical Products” industry accounts for a significant proportion of HT industries, exceeding 90% in Japan[4]. As is widely known, since the 1990s, many Japanese electronics companies have relocated their production bases to China and other emerging Asian economies. Consequently, a large portion of electronic products is now manufactured and exported from emerging countries such as China, Taiwan, and South Korea. Therefore, a trade balance ratio below 1 does not necessarily indicate a loss of technological superiority in Japan’s HT industries. However, because of producing HT products for over 30 years, the technological capabilities of these emerging countries, which serve as the manufacturing bases for Japanese companies, have significantly improved. In certain industries—such as the computer, electronics, and semiconductor industries—the gap between emerging economies and advanced countries has narrowed, or in some cases, emerging economies have surpassed advanced ones.

In fact, major global semiconductor manufacturers such as NEC, Toshiba, Hitachi, and Fujitsu withdrew from the semiconductor industry after the late 2000s. As evident from Table 7, companies from South Korea, Taiwan, and the United States account for over 80% of the revenue among the Top 20

4 National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology. *Science and Technology Indicators 2022*, No. 318, p. 172.

Table 7

Major Global Semiconductor Companies (2022)

Million USD

| Rank | Company Name | Type | Country/Region | Revenue |
|---|---|---|---|---|
| 1 | Samsung Electronics | IDM | South Korea | 77,097 |
| 2 | TSMC | Foundry | Tiwan | 75,851 |
| 3 | Intel Corporation | IDM | USA | 61,534 |
| 4 | Qualcomm | Fabless | USA | 36,722 |
| 5 | SK Hynix | IDM | South Korea | 29,922 |
| 6 | Broadcom | Fabless | USA | 26,333 |
| 7 | Micron Technology | IDM | USA | 25,637 |
| 8 | Nvidia | Fabless | USA | 24,503 |
| 9 | AMD | Fabless | USA | 23,601 |
| 10 | Texas Instruments | IDM | USA | 18,993 |
| 11 | MediaTek | Fabless | Tiwan | 18,506 |
| 12 | Apple | Fabless | USA | 17,824 |
| 13 | ST Microelectronics | IDM | Switzerland | 16,128 |
| 14 | Infineon Technologies | IDM | Germany | 15,776 |
| 15 | NXP Semiconductors | IDM | Netherlands | 12,954 |
| 16 | Analog Devices | IDM | USA | 12,388 |
| 17 | Renesas Electronics | IDM | Japan | 11,318 |
| 18 | Kioxia | IDM | Japan | 10,595 |
| 19 | SONY | IDM | Japan | 9,858 |
| 20 | UMC | Foundry | Tiwan | 9,362 |

*Note*: Fabless refers to semiconductor companies that do not own manufacturing plants but focus on design, development, and sales. Notable examples include Qualcomm, NVIDIA, and AMD. Foundry refers to semiconductor companies specialized in manufacturing, which produce semiconductors on behalf of fabless companies. TSMC is a leading example. IDM (Integrated Device Manufacturer) refers to semiconductor companies that handle all processes in-house, from design to production.

*Source*: Compiled by the author based on publicly available company data and TechInsights.

global semiconductor companies in 2022. Among these, two South Korean companies and three Taiwanese companies represent around 20% each of the Top 20.

Next, we turn our attention to the trade balance ratios of MHT industries, with a particular focus on sectors such as automotive and machinery. In advanced economies like Japan, the United States, and Germany, there has been a consistent decline in these trade balance ratios. While the United States has experienced a trade deficit in these sectors since the 1990s, with a ratio falling below 1, both Japan and Germany have managed to maintain a trade balance ratio above 1. In Germany, the trade balance ratio decreased from 2.06 in 1990 to 1.55 in 2020, while in Japan, the ratio significantly dropped from 4.24 in 1990 to 2.50 in 2020. This decline likely reflects the increased number of overseas production bases due to the international expansion of MHT industries. In Japan, exports in the MHT sector are dominated by the transportation equipment industry, which accounts for approximately 30–40% of total exports. In 2020, this sector represented 37.3% of total MHT exports[5]. The transportation equipment industry is the most crucial industry sustaining Japan's economy and trade balance. Additionally, exports from the transportation equipment industry not only include physical products but also play a significant role in technology exports. In fact, when looking at the technology export trade value by Japanese companies, the "Manufacture of Transport Equipment" industry consistently recorded the highest technology export figures. Over the 20 years leading up to 2020, this industry accounted for approximately 50% to 60% of total technology exports. In 2020, the transportation equipment sector achieved a technology export value of 1.3662 trillion yen, comprising 63% of all technology exports across industries[6].

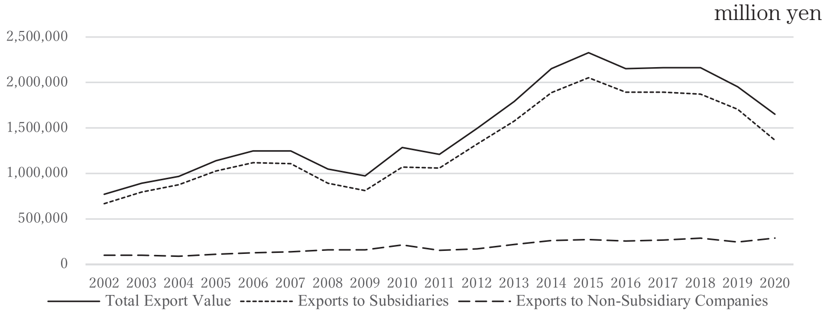
Figure 2 illustrates the technology export values of the transportation equipment industry. As shown in Figure 2, the technology export values in this industry began rising in the 2000s and peaked in 2015, after which they started to decline. Most of these technology exports are intra-firm trades, primarily between parent companies and their subsidiaries, accounting for more than 80% of the total export value. Exports to external companies,

5 *Ibid.*, *p.* 253.

6 *Ibid.*, *p.* 165.

Figure 2

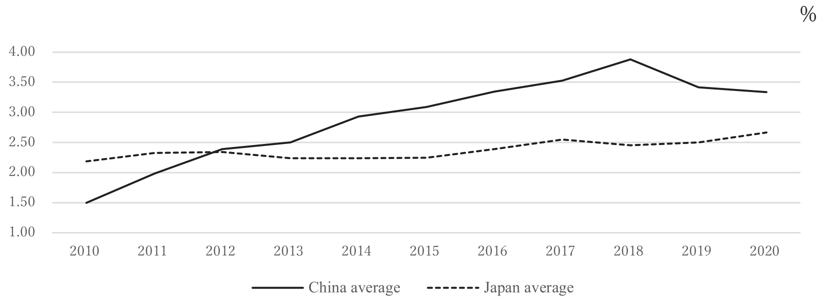
Technology Exports in the Transportation Equipment Industry




*Source*: Based on the Science and Technology Indicators 2022 published by the National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology, and processed by the author.

Figure 3

R&D intensity for Major Japanese and Chinese Transportation Equipment Companies




*Source*: Compiled by the author based on the securities reports of Japanese and Chinese companies.

outside the parent-subsidiary relationship, constitute only about 10% of the total. Moreover, technology exports to external firms have remained flat or have shown only modest increases over the past 20 years, up to 2020.

This trend suggests that Japanese companies are not actively transferring their technologies to external firms, likely to preserve their technological advantage. Technology transfers from parent companies to their subsidiaries within the transportation equipment sector have experienced a decline since 2015. A contributing factor to this trend, particularly evident in the Chinese market, is the shift from a period of sustained high economic growth to a phase of lower growth. China's GDP growth rate in 2015 marked a 25-year low, signaling a significant change in its economic trajectory. This deceleration in China's economic growth has coincided with a reduction in technology transfer activities within the transportation equipment industry.

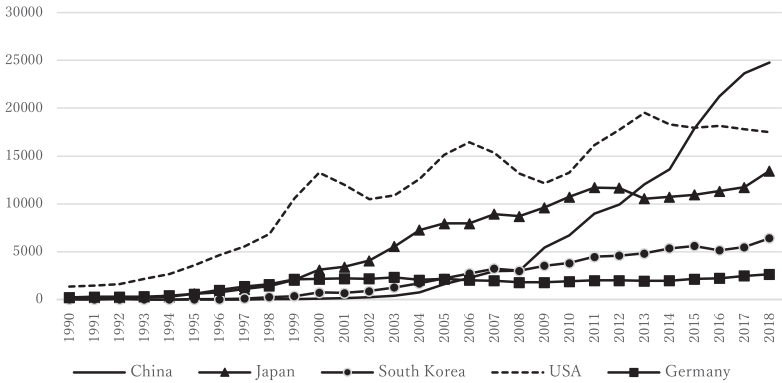
As is well-known, since the late 2000s, countries worldwide have been promoting the transition from fossil fuel-powered vehicles to electric vehicles (BEVs, PHEVs, HEVs, and FCEVs) as part of their efforts to combat climate change. Consequently, numerous automotive companies and their suppliers have been investing heavily in R&D to adapt their existing technologies to electric vehicles or develop new ones.

Figure 3 presents a comparison of the R&D intensity for publicly listed transportation equipment companies in Japan (90 companies) and China (58 companies). While direct comparisons may be limited, it is evident that the R&D intensity of Chinese transportation equipment companies has been increasing at a faster pace than their Japanese counterparts, surpassing Japan in 2012. Although Japan's transportation equipment industry, the core of its MHT industry, still maintains a leading position, the differential growth rates in R&D intensity suggest that China could potentially overtake Japan in this sector.

Moreover, to accelerate the transition to electric vehicles, the transportation equipment industry must efficiently develop not only hardware components such as platforms, motors, and batteries but also the software to control them. Consequently, many companies are actively adopting ICT. Numerous

Figure 4

Number of PCT Patents in ICT for Major Industrial Countries




*Source*: OECD, Patents by main technology and by International Patent Classification (IPC), OECD Patent Statistics database (OECD Science, Technology and Innovation Scoreboard), Figure created by the author.

studies have demonstrated a strong positive correlation between ICT capital and productivity (Siegel 1997, Barua & Lee 1997, Stiroh 2002, Matteucci et al. 2005, Dahl et al. 2011, Commander et al. 2011). Especially since the 2000s, many emerging MNCs in East Asia have adopted advanced ICT technologies from developed countries, further accelerating their R&D efforts and developing unique products and services (Wang 2020b). In fact, many companies related to the HT and MHT industries have been introducing ICT-related technologies to enhance their productivity.

Figure 4 illustrates the number of ICT patents in major developed and emerging countries. As shown in Figure 4, ICT patent numbers were primarily concentrated in the United States by 2000. Japan rapidly caught up from the late 1990s, and by around 2010, Japan and the U.S. held most of the world's ICT patents. However, in emerging economies, South Korea surpassed Germany in ICT patent numbers in 2005, and China's ICT patent numbers increased sharply in the late 2000s, surpassing Japan in 2013 and the U.S. in 2016. As of 2018, ICT technologies are concentrated in Japan, the U.S., and

China.

As our analysis has shown, since the burst of the bubble economy in the early 1990s, the presence of Japanese companies in certain industries such as semiconductors and electronic devices has significantly declined. The number of Japanese companies ranked in the Fortune Global 500 has decreased significantly, and they have been overtaken by emerging economies in terms of R&D expenditures and the number of patents, including ICT patents. Moreover, as many Japanese companies have relocated their production bases overseas, and with the economic development and technological advancement of emerging countries, Japan's HT industries have shifted to a trade deficit, while exports in MHT industries have also declined.

As mentioned earlier, Japan overcame the high yen recession of the late 1980s and rapidly globalized. Japanese companies particularly enhanced their global presence during the bubble economy. However, with the shift in Japan's monetary policy in 1991, the bubble economy burst, and many companies faced the problems of excessive debt, overcapacity, and overemployment, leading to the "lost decade" that extended to three decades. Even today, the major companies and industries that once drove Japan's economy have remained largely unchanged since the 1980s. Not only have industries such as semiconductors and electrical machinery lost their competitive edge, but Japan has also failed to cultivate new companies or industries to replace them, which presents a significant issue. In fact, when focusing on technological development, emerging economies such as China and South Korea have significantly increased their R&D expenditures, along with a rapid rise in the number of patents acquired. This is considered one of the key factors contributing to the decline in Japan's trade balance in the HT and MHT industries.

Furthermore, the number of patents related to ICT has also increased in emerging economies, with China surpassing Japan and the United States, indicating a shift in the driving force of technological advancement and development from traditional major countries to emerging economies. In the transportation equipment industry, which has been a driving force of the Japanese economy, the technological advantage of Japanese companies may significantly decline as the global trend shifts towards electric vehicles.

In the next section, we will empirically examine the changes in firm-specific advantages, with a particular focus on changes in intra-firm trade among Japanese companies.

## 4. Empirical Analysis on Changes in Firm-Specific Advantages of Japanese Companies

As discussed previously, Japan has been surpassed by China in terms of R&D expenditures and the number of patents, including ICT patents. Moreover, not only the trade balance of the HT industry has shifted to a trade deficit, but also exports in the MHT industry have continued to decline. The firm-specific advantages of industries such as semiconductors and electrical machinery are believed to have significantly deteriorated. Additionally, many studies (e.g., Wang 2023) have suggested that the decline in information asymmetry due to ICT advancements may reduce the internalization incentives of MNCs.

As discussed in Section 2, firm-specific advantages are a critical feature of MNCs. MNCs tend to internalize transactions to preserve their firm-specific advantages. Conversely, if the firm-specific advantages of MNCs decline relatively, they may have less incentive to internalize transactions and may prefer to utilize external markets. As discussed in Section 3, the specific advantages of Japan’s semiconductor and electrical machinery industries may have significantly declined. Furthermore, ICT advancements may reduce firms’ internalization incentives. Considering these factors, Japanese firms may have a decreased incentive to engage in internalized transactions.

In the following analysis, we focus on Japanese public companies in four industries representative of HT and MHT sectors—chemicals, machinery, electrical machinery, and transportation equipment—which have actively engaged in FDI. We examine the relationship between intra-firm trade and firm-specific advantages in these four industries. The analysis period is from 1994 to 2021, a period often referred to as Japan's "lost decades".

Data for the analysis will be drawn from the Nikkei NEEDS-Financial QUEST database of listed companies, compiled by Wang (2020a). Specifically, we will utilize the 28-year (1994-2021) segment information of listed companies in the four industries to analyze factors affecting intra-firm trade, with a particular focus on the R&D intensity. Given that not all companies disclose data every year, making time-series data unavailable, we employ pooled OLS and robust OLS with White (1980) standard errors using cross-sectional data of sample firms.

In our analysis, the dependent variable is the intra-firm trade ratio (IFTR). The independent variables include "firm size (ln_Sales)," " R&D intensity (R&D)," and "overseas sales ratio (OSR)," which have been recognized as determinants of intra-firm trade in previous empirical models by Wang (2016, 2020a).

Therefore, we employ the following equation to examine the determinants of intra-firm trade in the four industries of chemicals, machinery, electrical machinery, and transportation equipment:

$$IFTR(i) = C(i) + \beta_1 ln\_Sales(i) + \beta_2 OSR(i) + \beta_3 R\&D(i) + \varepsilon(i)$$

Table 8 presents the descriptive statistics of the sample firms. Table 9 shows the correlation matrix among the variables. As is well-known, multicollinearity, which occurs when there is a high correlation among independent variables in OLS analysis, can undermine the reliability of the

Table 8

Descriptive Statistics of Sample Companies

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Transportation Equipment (1994~2021) | | | | | |
| ln_sales | 1,268 | 12.262 | 1.876 | 8.034 | 17.224 |
| OSR | 1,215 | 46.852 | 22.951 | 0.970 | 90.480 |
| R&D | 1,155 | 2.682 | 2.086 | 0.010 | 12.490 |
| IFTR | 1,268 | 11.056 | 7.991 | 0.000 | 40.560 |
| Chemicals (1994~2021) | | | | | |
| ln_sales | 1,351 | 11.370 | 1.446 | 7.645 | 14.890 |
| OSR | 1,249 | 31.356 | 16.896 | 0.150 | 89.160 |
| R&D | 1,203 | 3.379 | 2.515 | 0.010 | 21.830 |
| IFTR | 1,351 | 6.367 | 6.118 | 0.000 | 52.630 |
| Machinery(1994~2021) | | | | | |
| ln_sales | 2,038 | 10.833 | 1.351 | 7.615 | 15.032 |
| OSR | 1,902 | 43.776 | 21.518 | 0.590 | 99.980 |
| R&D | 1,785 | 2.545 | 1.837 | 0.010 | 16.060 |
| IFTR | 2,038 | 13.225 | 10.460 | 0.000 | 47.940 |
| Electronic Goods (1994~2021) | | | | | |
| ln_sales | 2,442 | 11.262 | 1.704 | 6.430 | 16.234 |
| OSR | 2,389 | 45.161 | 20.479 | 0.720 | 99.840 |
| R&D | 2,071 | 4.795 | 3.615 | 0.010 | 33.620 |
| IFTR | 2,442 | 20.105 | 12.877 | 0.000 | 59.590 |

Table 9

Correlation Matrix Among Variables

| *Transportation Equipment* | *ln_Sales* | *OSR* | *R&D* | *IFTR* |
|---|---|---|---|---|
| *ln_Sales* | *1.000* | | | |
| *OSR* | 0.507 | 1.000 | | |
| *R&D* | 0.399 | 0.127 | 1.000 | |
| *IFTR* | 0.447 | 0.561 | 0.303 | 1.000 |
| *Chemicals* | | | | |
| *ln_Sales* | 1.000 | | | |
| *OSR* | 0.225 | 1.000 | | |
| *R&D* | -0.052 | 0.157 | 1.000 | |
| *IFTR* | 0.086 | 0.436 | 0.298 | 1.000 |
| *Machinery* | | | | |
| *ln_Sales* | 1.000 | | | |
| *OSR* | 0.190 | 1.000 | | |
| *R&D* | 0.051 | 0.175 | 1.000 | |
| *IFTR* | 0.093 | 0.615 | 0.201 | 1.000 |
| *Electronic Goods* | | | | |
| *ln_Sales* | 1.000 | | | |
| *OSR* | 0.168 | 1.000 | | |
| *R&D* | -0.023 | 0.044 | 1.000 | |
| *IFTR* | 0.112 | 0.573 | 0.013 | 1.000 |

results. Table 10 presents the results of the multicollinearity test. As shown in Table 10, since the Variance Inflation Factor (VIF) of all variables is less than 4, it can be concluded that there is no multicollinearity among these variables. Table 11 presents the results of the test for homoscedasticity. As shown in Table 11, the null hypothesis of homoscedasticity is rejected for all industry data, indicating that the error terms are not homoscedastic. Therefore, to address this issue of heteroscedasticity, we employ a robust test using White (1980) standard errors, which corrects for heteroscedasticity.

Table 12 presents the results of the analysis. First, *(ln_Sales)* is not statistically significant for the *(IFTR)* in the three industries of chemicals, machinery, and electrical machinery, except for the transportation equipment industry. The *(OSR)* is found to have a statistically significant positive impact on the *(IFTR)* in all four industries. Moreover, *(R&D)* is found to be a significant determinant of *(IFTR)* in three industries: transportation equipment, chemicals, and machinery, except for electrical machinery.

These findings suggest that intra-firm trade is more influenced by the overseas sales ratio than by firm size, except in the transportation equipment industry. Additionally, R&D intensity, which is considered a proxy for firm-specific advantages, remained a significant factor influencing intra-firm trade in the transportation equipment, chemicals, and machinery industries throughout the 30-year period. This indicates that firms in these three industries likely prefer internalization to preserve their firm-specific advantages. However, no significant relationship was found between firm-specific advantages and internalization in the electrical machinery industry. As previously mentioned, since the late 1980s, many Japanese electronics companies have shifted their production bases to China and other emerging Asian countries, leading to significant improvements in the technological capabilities of these countries. The results of this analysis suggest that the relative technological advantage of Japan's electrical machinery industry has declined over the past 30 years.

Table 10

Test for Multicollinearity

| | *Transportation Equipment* | | *Chemicals* | | *Machinery* | | *Electronic Goods* | |
|---|---|---|---|---|---|---|---|---|
| *Variable* | VIF | 1/VIF | VIF | 1/VIF | VIF | 1/VIF | VIF | 1/VIF |
| *ln_Sales* | 1.59 | 0.6294 | 1.06 | 0.9417 | 1.04 | 0.9634 | 1.03 | 0.9708 |
| *OSR* | 1.36 | 0.7365 | 1.09 | 0.9209 | 1.07 | 0.9363 | 1.03 | 0.9694 |
| *R&D* | 1.20 | 0.8331 | 1.03 | 0.9672 | 1.03 | 0.9690 | 1.00 | 0.9971 |
| *Mean VIF* | 1.38 | | 1.06 | | 1.05 | | 1.02 | |

Table 11

Test Results for Homoscedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

| | *Transportation Equipment* | *Chemicals* | *Machinery* | *Electronic Goods* |
|---|---|---|---|---|
| | chi2(1)=19.53<br>Prob>chi2=0.0000 | chi2(1)=92.28<br>Prob>chi2=0.0000 | chi2(1)=384.42<br>Prob>chi2=0.0000 | chi2(1)=145.31<br>Prob>chi2=0.0000 |
| Result | Reject Null Hypothesis | Reject Null Hypothesis | Reject Null Hypothesis | Reject Null Hypothesis |
| Model | Robust | Robust | Robust | Robust |

*Note*: We test the null hypothesis of homoscedasticity in the error terms using the Breusch-Pagan test.

Table 12

Analysis Results

*Linear regression (Robust)* *Dependent variable: IFTR*

| | *Transportation Equipment* | *Chemicals* | *Machinery* | *Electronic Goods* |
|---|---|---|---|---|
| *ln_Sales* | 0.571 | 0.036 | -0.203 | 0.196 |
| | (5.20)a | (0.28) | (-1.22) | (1.52) |
| *OSR* | 0.167 | 0.144 | 0.298 | 0.365 |
| | (17.07)a | (10.89)a | (25.04)a | (25.45)a |
| *R&D* | 0.731 | 0.544 | 0.547 | -0.040 |
| | (9.44)a | (8.59)a | (4.32)a | (-0.75) |
| *Constant* | -5.927 | -0.374 | 1.176 | 1.620 |
| | (-4.83)a | (-0.23) | (0.66) | (1.05) |
| *Adj R-squared* | 0.381 | 0.244 | 0.387 | 0.329 |
| *F-Stat.* | 190.98 | 81.81 | 230.44 | 229.81 |
| *Samples* | *N=1,112* | *N=1,112* | *N=1,665* | *N=2,022* |

*Note*: a: Significant at 1%. t-values adjusted for heteroscedasticity using White (1980) are in parentheses.

In contrast, the statistical significance of firm-specific advantages as a determinant of intra-firm trade in the transportation equipment, chemicals, and machinery industries indicates that these industries have maintained their relative advantages.

## 5. Conclusion

The primary objective of this paper is to explore the future competitive strategies of Japanese companies by examining changes in firm-specific advantages during Japan's so-called "lost 3 decades" of the Heisei era. Specifically, the study analyzes factors affecting intra-firm trade, particularly the R&D intensity, using 28 years of segment information from publicly listed companies in the transportation equipment, chemical, machinery, and electrical equipment industries. The analysis reveals that only the electrical equipment industry does not show a statistically significant relationship between the R&D intensity and the intra-firm trade ratio. This suggests that the technological superiority of the electrical equipment industry has relatively declined over the 30 years of the Heisei era.

As the results indicate, the transportation equipment, chemical, and machinery industries have seemingly maintained their firm-specific advantages. However, given the significant increase in R&D expenditures in emerging economies, the question of how these three industries will continue to sustain their competitive advantages remains a critical issue. In fact, many companies from the West and emerging markets have rapidly grown by integrating ICT technologies. To remain competitive against these firms, Japanese companies must allocate more resources to R&D than ever before. Furthermore, the introduction of AI alongside advancements in ICT is expected to significantly boost productivity across various industries. Therefore, how Japan's traditionally leading sectors—transportation equipment, chemicals, and machinery—adapt to these transformations will be a major challenge.

As previously mentioned, even in the 2020s, the Japanese economy has been unable to break away from its economic structure centered around long-established companies. The Japanese economy continues to be driven by traditional long-established companies such as Toyota Motor Corporation, which were founded before or after the war. Industries utilizing new technologies such as high-tech and digital industries have yet to emerge. To revitalize the Japanese economy, it is necessary to develop new technologies while leveraging existing technological accumulation. A key challenge for the future is how Japan can transform from "Made in Japan" to "Designed in Japan" and ultimately to "Innovated in Japan," creating new value-added products.

## References

1) Agarwal, S., & Ramaswami, S. N. (1992). Choice of foreign market entry mode: Impact of ownership, location, and internalization factors. *Journal of International Business Studies*, 23(1), 1-27.

2) Andersson, T., & Fredriksson, T. (2000). Distinction between intermediate and finished products in intra-firm trade. *International Journal of Industrial Organization,* 18(5), 773-792.

3) Antràs, P. (2003). Firms, Contracts, and Trade Structure. *Quarterly Journal of Economics*, 118, 1375-1418.

4) Banalieva, R. E., & Dhanaraj, C. (2019). Internalization theory for the digital economy. *Journal of International Business Studies*, 50(8), 1372–1387.

5) Barkema, H. G., & Vermeulen, F. (1998). International expansion through

start-up or through acquisition: A learning perspective. *Academy of Management Journal,* 1, 7–26.

6) Barua, A., & Lee, B. (1997). The information technology productivity paradox revisited: A theoretical and empirical investigation in the manufacturing sector. *International Journal of Flexible Manufacturing Systems*, 9, 145–166.

7) Bernard, A. B., Jensen, J. B., Redding, S. J., & Schott, P. K. (2010). Intra-Firm Trade and Product Contractibility. *American Economic Review*, 100(2), 444-448.

8) Buckley, P. J., & Casson, M. C. (1976). *The future of the multinational enterprise*. London: Macmillan.

9) Buzzell, R. D., & Gale, B. T. (1987). *The PIMS principles*. New York, NY: Free Press.

10) Casson, M. C. (1979). *Alternatives to the Multinational Enterprise*. London: Macmillan.

11) Chauvin, K., & Hirschey, M. (1993). Advertising, R&D expenditures and the market value of the firm. *Financial Management*, 22, 128-138.

12) Chen, W., & Kamal, F. (2016). The impact of information and communication technology adoption on multinational firm boundary decisions. *Journal of International Business Studies*, 47(5), 563-576.

13) Cho, K. R. (1990). The Role of Product-Specific Factors in Intra-Firm Trade of U.S. Manufacturing Multinational Corporations. *Journal of International Business Studies*, 21(2), 319-330.

14) Coase, R. (1937). The Nature of the Firm. *Economica*, 4(16), 386-405.

15) Commander, S., Harrison, R., & Menezes-Filho, N. (2011). ICT and productivity in developing countries: New firm-level evidence from Brazil and India. *Review of Economics and Statistics*, 93(2), 528-41.

16) Dahl, C. M., Kongsted, H. C., & Sørensen, A. (2011). ICT and productivity growth in the 1990s: Panel data evidence on Europe. *Empirical Economics*,

40(1), 141-164.
17) Davidson, W. H., & McFetridge, D. G. (1984). International Technology Transactions and the Theory of the Firm. *Journal of Industrial Economics, Wiley Blackwell*, 32(3), 253-264.
18) Delios, A., & Beamish, P. W. (2001). Survival and profitability: The roles of experience and intangible assets in foreign subsidiary performance. *Academy of Management Journal*, 44(5), 1028-1038.
19) Dunning, J. H. (1981). Explaining the international foreign direct investment position of countries: Towards a dynamic or development approach. *Weltwirtschaftliches Archiv*, 117, 30–64.
20) Egger, P., & Pfaffermayr, M. (2005). The Determinants of Intra-Firm Trade: In Search for Export-Import Magnification Effects. *Kiel Working Paper No. 1247*, Kiel Institute for World Economics (Germany).
21) Feenstra, R. C., & Hanson, G. H. (2005). Ownership and Control in Outsourcing to China: Estimating the Property-Rights Theory of the Firm. *The Quarterly Journal of Economics*, 120, 729-761.
22) Feinberg, S. E., & Keane, M. P. (2001). U.S.-Canada Trade Liberalization and MNC Production Location. *The Review of Economics and Statistics*, 83(1), 118-132.
23) Geringer, J. M., Tallman, S., & Olsen, D. M. (2000). Product and international diversification among Japanese multinational firms. *Strategic Management Journal*, 21, 51-80.
24) Gong, Y. P. (2003). Subsidiary staffing in multinational enterprises: Agency, resources, and performance. *Academy of Management Journal*, 46(6), 728-739.
25) Grubaugh, S. G. (1987). Determinants of direct foreign investment. *Review of Economics and Statistics*, 69, 149-152.
26) Hanson, G. H., Mataloni, R. J., Jr., & Slaughter, M. J. (2005). Vertical production networks in multinational firms. *Review of Economics and*

*Statistics*, 87, 664–678.

27) Helleiner, G. K., & Lavergne, R. (1980). Intra-Firm Trade and Industrial Exports to the U.S. *Oxford Bulletin of Economics and Statistics*, 41, 297-311.

28) Helleiner, G. K. (1979). Transnational Corporations and Trade Structure: The Role of Intra-Firm Trade. In H. Giersch (Ed.), *On the Economics of intra-Industry Trade* (pp. 159-181). Tiibingen.

29) Hymer, S. H. (1976). *The International Operations of National Firms: A Study of Direct Foreign Investment.* Doctoral dissertation, MIT Press.

30) Kobrin, S. J. (1991). An Empirical Analysis of the Determinants of Global Integration. *Strategic Management Journal*, 12, Special Issue: Global Strategy, Summer, 17-31.

31) Kwon, Y. C. (2010). Market orientation of Korean MNC subsidiaries and their performance in the Chinese and Indian markets. *International Marketing Review*, 27(2), 179-199.

32) Lall, S. (1978). The Pattern of Intra-Firm Exports by U.S. Multinationals. *Oxford Bulletin of Economics and Statistics*, 40, 209-222.

33) Levchenko, A. A. (2007). Institutional Quality and International Trade. *Review of Economic Studies*, 74(3), 791–819.

34) Maskulka, J. M., & Hu, M. Y. (1987). Bankers' responses to the ETC Act: Attitudes and the degree of international involvement. *Journal of Business Research*, 15, 191–200.

35) Matteucci, N., O'Mahony, M., Robinson, C., & Zwick, T. (2005). Productivity, workplace performance and ICT: Industry and firm-level evidence for Europe and the US. *Scottish Journal of Political Economy*, 52, 359-386.

36) Morbey, G., & Reithner, R. (1990). How R&D affects sales growth, productivity, and profitability. *Journal of Engineering and Technology Management*, May–June, 11-14.

37) Nunn, N. (2007). Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade. *Quarterly Journal of Economics*, 122, 569-600.
38) Ogasavara, M. H., & Hoshino, Y. (2007). The impact of ownership, internalization, and entry mode on Japanese subsidiaries' performance in Brazil. *Japan and the World Economy*, 19(1), 1–25.
39) Padmanabhan, P., & Cho, K. R. (1999). Decision-specific experience in foreign ownership and establishment strategies: Evidence from Japanese firms. *Journal of International Business Studies*, *30*(1), 25–41.
40) Rangan, S., & Sengul, M. (2009). Information technology and transnational integration: Theory and evidence on the evolution of the modern multinational enterprise. *Journal of International Business Studies, 40*(9), 1496-1514.
41) Ravenscraft, D. J. (1983). Structure-profit relationships at the business and industry level. *The Review of Economics and Statistics, 65*(2), 214-224.
42) Rugman, A. M. (1981). *Inside the multinational*. Croom Helm.
43) Samiee, S., & Walters, P. G. P. (1990). Influence of firm size on export planning and performance. *Journal of Business Research*, *20*(3), 235-248.
44) Siegel, D. (1997). The impact of computers on manufacturing productivity growth: A multiple indicators-multiple causes approach. *The Review of Economics and Statistics*, *79*(1), 68-78.
45) Slenwaegen, L. (1985). Monopolistic advantages and the international operations of firms: Disaggregated evidence from U.S.-based multinationals. *Journal of International Business Studies*, *16*(1), 125-133.
46) Stiroh, K. (2002). Information technology and the U.S. productivity revival: What do the industry data say? *American Economic Review*, 92(5), 1559-1576.
47) Wang, C. I. (2013). An empirical analysis of the induced effects of inter-regional intra-firm trade. *The Commercial Review of Seinan Gakuin University, 59*(3-4), 55-83.
48) Wang, C. I. (2016). Empirical research on the determinants of intra-firm

trade: Evidence from Japanese and Korean firms. *The Commercial Review of Seinan Gakuin University, 62*(3-4), 231-261.

49) Wang, C. I. (2020a). The determinants of Japanese foreign direct investment in EPA partner countries. *Journal of East Asian Studies, Japan Society of East Asian Studies, 27*, 23-42.

50) Wang, C. I. (2020b). The new order of world economy and the rise of emerging multinational corporations. *East Asia Studies, Japan Society of East Asian Studies, 28*, 1-17.

51) Wang, C. I. (2023). Changes in transaction types and their determinants of multinational corporations. *The Commercial Review of Seinan Gakuin University*, *69*(3-4), 153-182.

52) Wheeler, D., & Mody, A. (1992). International investment location decisions: The case of U.S. firms. *Journal of International Economics, 33*(1-2), 57-76.

53) White, H. (1980). A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity. *Econometrica, 48*(4), 817-830.

54) Yi, K. M. (2003). Can vertical specialization explain the growth of world trade? *Journal of Political Economy, 111*(1), 52-102.