Competition and Collaboration
Between Japanese and Taiwanese Firms
In Optical Disk Industries

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Abstract: Historically, Japanese firms have been leading the optical disk industry in technological development and market development; however, Taiwanese and Korean firms are quickly catching up and have surpassed Japanese firms in terms of production volume. This paper focuses on the optical disk industry in Taiwan and analyzes the factors that have enabled Taiwanese firms to quickly catch up to Japanese firms. Our analysis show that cooperation with Japanese firms and international specialization have been the prerequisites of business activities in Taiwanese firms. This suggests that symbiotic relationships as well as competitive rivalries exist between firms in developed countries and those in developing countries that are quickly catching up.

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1. Introduction

Today, due to the worldwide popularity of optical disk drives such as CDs and DVDs, used in audiovisual devices and personal computers (PCs), the shipment volume reached about 600 million and the market scale surpassed 2.5 trillion yen in 2004. Recording media has also flourished, with CD-Rs alone becoming the largest recording media in history, with annual shipments of over 10 billion (Ogawa, 2009).

Japanese firms have been leading the world in the technological developments of optical disks. An overview of the major standard bearers in the industry begins with Sony and Philips in CD audio and CD-ROM; Sony and Taiyo Yuden in CD-R; Toshiba, Matsushita, and a number of other Japanese firms in DVD players and DVD-ROM; Pioneer in DVD-R; and Ricoh in DVD+R. Furthermore, regarding the recording media, Japanese firms such as Taiyo Yuden, TDK, Hitachi Maxell, and Mitsubishi Chemical have developed the materials and production methods and led the introduction of the product to the market.

Japanese firms have led technological developments within the optical disk field and proposed technological standards to the world. These standards have been accepted not only in the audiovisual market but also in the PC market. Thus, the technologies developed by Japanese firms have set global standards and created large markets.

Between the introduction stage and early growth stage of the product life cycle, Japanese firms had been dominant in the
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market. However, during the latter growth stage when the technologies were established as the global standard and the market began to fully grow, Japanese firms rapidly lost their market share to foreign companies.

Figure 1 summarizes the trends in shipments of optical disk drives used in PCs. It shows that the production of Taiwanese firms grew rapidly in the latter half of the 1990s, occupying a large market share. Indeed, Japanese, Taiwanese, and Korean firms have a three-way share in market for optical disk drives used in PCs.

On the other hand, in the production volume of optical disk media, the decline in the share of Japanese firms and the rise of Taiwanese firms have become evident. Figure 2 shows the trends in production of CD-Rs.

The CD-R market saw rapid growth after 1999. Taiwanese firms were responsible for much of the growth; the firms garnered a

![Figure 1. Shipment of optical disk drive for PCs](image)

Source: Techno System Research (TSR) for estimating total data, IEK (ITRI) for estimating Taiwanese data.
70–80% share of global production since 1999.

Despite the fact that Japanese firms were in control of technological development and new product introduction in the optical disk industry, how have Taiwanese and Korean firms been able to grow and even surpass Japanese firms in terms of production volume? This paper examines the factors that facilitated the rapid growth of Taiwanese firms in the optical disk industry.

We argue that the development of Taiwan’s optical disk industry was not merely a game of international competition, but it was based on cooperation with Japanese firms and international specialization. In other words, we argue that developing countries were able to catch rapidly up not only because of competitive rivalry with developed nations but also because of cooperation with them. Double sided strategy, competition and collaboration with advanced firms, is effective for catching up. International transfer of
business base supposed by Vernon (1966) could be accelerated by this strategy. Moreover, although Porter (1990) points out that domestic factors are the source of competitive advantage of nations; however, our research results indicate that the factors facilitating this creation are not limited to domestic factors.

As for the research method, the authors utilized a combination of interviews, field surveys at factories, and document surveys. In April 2004, the authors formed a research team to conduct a detail study of the optical disk industry. From April 2004 to February 2005, the team administered interview surveys to over 50 industry-affiliated persons at 23 Japanese companies. Additionally, in 2004, we conducted field surveys in China in July and October, Taiwan in September, and Korea in December. Although this paper is largely based on the survey results obtained in Taiwan, we confirm the results and supplement the data with further surveys administered to Japanese firms and other statistical data.

2. Taiwanese Governmental Supports

The Industrial Technology Research Institute (ITRI), established in 1973, and Taiwan’s Ministry of Economic Affairs supported the meteoric rise of Taiwan’s optical disk industry. ITRI is Taiwan’s national research organization, and is involved in the transfer of research results to private corporations to nurture the industry’s growth. ITRI has been involved in all of Taiwan’s major electronic industries including, semiconductors, PCs, and liquid crystal display.

The role of ITRI is extremely important in Taiwan, where there are many small venture firms. This is because small firms do not have the wherewithal to invest the capital for basic R&D.

Optical disk research within ITRI began with the establishment of the Opto-Electronics Research Center in 1987. The Opto-Electronics
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and Systems Laboratories was established in 1990 as a successor to the Opto-Electronics Research Center. The Opto-Electronics and Systems Laboratories initially endeavored to spur the start-up of the hard disk drive industry, but the attempt ended in failure.\textsuperscript{1} Therefore, they turned their attention to CDs by researching basic CD technology beginning in 1992, and begun to transfer the results to private corporations from 1994, thus contributing to the start-up of the optical disk industry. ITRI gave technological supports to private firms and even its technicians transferred to these private firms in some cases. Those include over 10 optical disk drive companies like LITE-ON IT, the major disk companies such as Ritek and CMC and the chipset company like MediaTek.

On the other hand, the policies implemented by the Ministry of Economic Affairs were of significant financial help to Taiwanese firms. The Ministry selects some industries for strategic development area and allots incentives to companies within the selected industries. The optical disk industry was selected as one of these strategic industries in the latter half of the 1990s. Companies were able to reduce corporate tax and accelerate the depreciation of facilities (Mizuhashi, 2001).

The technological aid and industrial development policies by the government, such as the economic incentives mentioned above, were not the only factors contributing to the rise of Taiwan’s optical disk industry. These policies functioned very effectively in terms of attracting firms during the industry’s introduction stage.

\section*{3. Three Stages of Development in Taiwanese Optical Disk Drives}

Taiwanese firms have experienced remarkable growth in both optical disk drives and media. In this section, we analyze the process

\footnote{Refer to Mizuhashi (2001, pp. 77–78) for a history of the efforts and failures of the hard disk drive industry in Taiwan.}
of this development, focusing on the optical disk drive industry. The period of our analysis is from the early 1990s to mid-2000s, during which Taiwan’s optical disk drive industry was flourishing. In 2000–2005, Taiwanese firms maintained an estimated 25–35% of world optical disk drive production. In this section, we provide a three-fold description to the development of Taiwan’s optical disk drive industry and discuss the factors that facilitated the rapid growth of Taiwanese firms and the problems they currently face.

(1) Subcontractor of foreign firms (early 1990s)

The first period is that of subcontracted production for overseas firms prior to 1995. Around this time, PCs were becoming popular due to the advent of Macintosh and Microsoft Windows based PCs. As standard equipment in PCs, CD-ROM drives became the driving force that ushered in a period of rapidly increased demand within the optical disk industry.

During this period, Taiwanese firms were involved in assembling CD-ROM devices as subcontractors for Japanese and European firms. This was a simple job of assembling the parts supplied from overseas firms, with only a slim profit margin for the Taiwanese firms. However, Taiwanese firms gradually accumulated competence in assembly through these subcontracting opportunities. BenQ and LITE-ON IT realized the rapid growth of the optical disk drive industry would accompany the popularization of PCs, and subsequently, began production of disk drives: Ben Q from December 1994 and LITE-ON IT from December 1995.

(2) Division of labor between products and components (late 1990s)

The second stage is the period of rapid growth for Taiwanese companies due to specialization in modular and finished products in the latter half of the 1990s. The typical products of this period were recordable CD-R/RW drives. These were markedly more difficult to
develop than read-only CD-ROM drives. Fine-tuning of laser power, minute control technology for focusing and tracking, and compatibility with media from different companies were all required. Taiwanese companies, the late entrants, were able to achieve such rapid growth during this period, despite the high level of technological requirements, because they had advanced product modularization capabilities. This high-level technological know-how was encapsulated into key components such as optical pickups and chipsets. Drive makers were able to design and produce cutting-edge products by purchasing these key components from component makers. As with the PC industry, the product architecture was modularized, and the industry structure of specialization became the norm in the optical disk drive industry.

In the first stage (the era prior to 1995), Japanese and European firms were overwhelmingly dominant in core components. Hence, Taiwanese firms could not independently control the timing of new product introduction. However, in the latter half of the 1990s, Taiwan’s MediaTek entered the business of chipsets for use in optical disk drives. In addition to learning from overseas companies, MediaTek engaged distinguished engineers into large-scale development design and gradually increased their design competence. Furthermore, MediaTek adopted the supply strategy of bundling drive function control software, which had traditionally been designed by drive makers. These bundled chipsets by MediaTek greatly facilitated to enter the drive production.

(3) International joint ventures with advanced companies (early 2000s)

The third stage occurred between 2000 and 2005. This stage witnessed business expansion facilitated by joint ventures between Taiwanese firms as well as Japanese and European companies, which coincided with the advent of recordable DVD drives becoming major products. The leading factor that brought such changes was
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patent licensing fees. During this time, patent holders (European and Japanese companies) intensified their collection of these patent royalties. Because the DVD patent royalty payment was fixed per unit, the ratio of the royalty payments increased as the decreasing price due to price competition. Therefore, companies that had to pay royalties found themselves at a distinct disadvantage to patent holders that did not have to pay much royalty payments. Patent holders signed cross-licensing contracts with each other. Hence, royalty payments were an extremely heavy burden on Taiwanese firms.

The second factor inspiring the change was technological capability. DVD capacity is 4.7 GB. With CD capacity at 650 MB, a DVD can hold over seven times the information of CDs. A high level of technological capability was required for the development of drives capable of writing data to disks of such high density. Taiwanese firms were not producing key components and lacked technological capability in DVD. Partnerships with companies that had accumulated technological capabilities became essential in supplementing their lack of technological resources.

Against this background, Taiwanese firms began to establish joint ventures with Japanese and European companies to introduce DVD drive. Similar to those in Taiwan, Korean companies also established joint ventures with Japanese companies.

The cross-licensing contracts signed between patent holders included subsidiary clauses that enabled subsidiaries to use licenses under the same conditions as parent companies. Accordingly, Taiwanese and Korean firms established joint ventures wherein the patent-holding Japanese and European companies held 51% of the equity. Undertaking production as a joint venture allowed them to avoid the payment of licensing fees.

In addition, they had access to the supply of leading-edge core components from their Japanese and European
partners. Furthermore, they were able to transfer technology inbound in certain areas.

On the other hand, Japanese and European firms were able to take advantage of the benefit afforded by the low cost assembly competence of Taiwan and Korea. For Japanese firms that were engaged both in the core components and in the finished product business, the sale of components to Taiwanese firms might damage their finished product business. However, by partnering with major players in Korea and Taiwan, Japanese businesses were able to procure self-branded finished product at a low cost, in addition to increasing sales of components.

The pioneer of this business model was Hitachi-LG Data Storage (hereinafter referred to as HLDS), which was formed in November 2000. HLDS leveraged Hitachi’s patents with the large-scale production competence held by Korea’s LG, expanding their optical disk drive business and occupying the world’s top spot by market share in 2003. Later, Taiwanese firms formulated similar joint ventures: LITE-ON IT allied with Japan Victor (JVC) in 2001, forming JVC-Liteon Manufacturing & Sales (hereinafter referred to as JLMS), and BenQ partnered with Europe’s Philips in 2003 to form Philips BenQ Digital Storage (hereinafter referred to as PBDS). Moreover, in 2004, Toshiba and Samsung formed Toshiba Samsung Storage Technology (hereinafter referred as TSST).

While JVC and LITE-ON IT eventually dissolved their relationship, the other three companies mentioned above continued their joint ventures. After dissolving its relationship with JVC, LITE-ON IT entered a cooperative relationship with another Japanese company.²

Figure 3 shows the global share of optical disk drives as of

² Refer to Ogawa, Shintaku, and Yoshimoto (2005), Shintaku, Ogawa, and Yoshimoto (2006), Tatsumoto, Ogawa and Shintaku (2011) for more information regarding the business model of firms from developing countries partnering with Japanese companies.
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4. Conclusion: Future Challenge of International Division of Labor

While not mentioned in this paper, a pattern similar to the drive industry is also observed in the optical disk recording media industry. More specifically, Taiwanese media producing companies Ritek and CMC have achieved the first and second rankings, respectively, in global market share within a mere 3–4 years. They were able to do so by relying on Japan’s advanced companies for core materials and production equipment and by focusing their businesses into media producing activities (Nakagawa, 2006, 2011; Ogawa, 2009).

While this type of business model enabled a quick startup for

![Figure 3. World market share of optical disk drives in 2003. Source: TSR (2004)](image-url)
Taiwanese firms, at the same time, it is quite easy for other companies to imitate. Any company can produce the same products if they are able to procure key components. The questions facing Taiwanese firms is how will they manage and what they will make of their core competitiveness after Chinese companies begin production by procuring components. In China, Chinese companies grow rapidly in industries where modularization has progressed (Ge & Fujimoto, 2004; Shintaku, Kato, & Yoshimoto, 2004; Yasumoto & Shiu, 2007; Yoshimoto, 2009).

The accumulation of basic technologies and development of key components is not accomplished in the short time. Japanese companies have been developing optical disk technology since before 1980 and have continued R&D in CD-ROM drives even after the entry of Taiwanese firms. Is it plausible that such a technological difference exists between Japanese and Taiwanese firms in core component fields? In addition to becoming a source of competitiveness for Japanese companies, the fierce competition with Taiwanese firms lasting over a decade has also become a hindrance to the Taiwanese firms that have procured their key components.

Perhaps it is necessary here to discuss the pros and cons of ITRI. As touched upon in Section 2, ITRI functioned superbly as an incubation center for the plentiful Taiwanese venture firms, and became the seedbed for firms such as LITE-ON IT (Sonobe & Otsuka, 2004). On the other hand, it is also conceivable that the more success that ITRI has as a R&D organization, the less incentive Taiwanese firms have to undertake R&D on their own.

The role of ITRI is the introduction of advanced technology into Taiwan through the development of human resources. To this end, Taiwanese firms are able to readily introduce technology by head-hunting ITRI research personnel. In addition, as seen with LITE-ON IT and BenQ, there are many Taiwanese firms that have achieved rapid growth through the introduction of technology from
foreign companies. These success stories have been deeply ingrained into Taiwanese companies. At the very least, the stance of LITE-ON IT and BenQ regarding next-generation DVDs (Blu-ray drive) is not concentrated on the development and formulation of standards, but rather on the plan of catching up through alliances with and component procurement from European and Japanese companies.

The strength of Taiwanese firms in the optical disk drive industry lies in their assembly competence. These firms have succeeded because of this competence and their rapid absorption of technology developed by Japanese companies through the external procurement of key components. They have garnered large profits by launching price wars and pushing Japanese companies toward higher-end products and the subsequent implementation of catch up strategies. However, as the industry as a whole matures, fierce price competition ensues. The real abilities of companies are called into question, and this will reveal Taiwan’s lack of technological capability. Furthermore, the business model of Taiwanese firms is relatively easy to imitate and contains the flaw of a tendency toward cost competition with new entrants, such as Chinese companies.

The business model of Taiwanese firms is relatively easy to imitate and contains the flaw of a tendency toward cost competition with new entrants, such as Chinese companies. To solve these problems, some Taiwanese firms may try to develop related optical disk technology and key components, but that is not easy. It will be interesting to see how Taiwanese firms undertake to resolving these issues.

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