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Inter-firm Dynamics in Notebook PC Value Chains and the Rise of Taiwanese Original Design Manufacturing Firms

Momoko Kawakami

1.1. Introduction

Since the late 1980s, outsourcing and offshoring by large multinational electronics hardware manufacturers have driven the formation of global value chains (GVCs) producing a wide range of products, especially in East Asia. The rise of Taiwanese notebook personal computer (PC) manufacturers is, perhaps, the most striking example. By 2008 Taiwanese contract manufacturers accounted for approximately 92% of worldwide shipments of notebook PCs (Information Industry Yearbook 2009 Compilation Team 2009). In addition to manufacturing, they have increasingly provided product design services in their role as original design manufacturers (ODMs) for brand name PC firms such as Dell, HP (Hewlett Packard), Apple, and Toshiba.

The learning process that has made the Taiwanese notebook PC industry so successful can only be understood by tracing their interactions with the two other main actors in the industry: the branded PC firms and principal central processing unit (CPU) supplier, Intel. Taiwanese ODMs were able to successfully tap into learning opportunities offered by GVCs as these other firms jockeyed for position to create an appropriate value. In this chapter I focus on two dynamics: (1) how shifting inter-firm relationships structured knowledge flow among firms in the notebook PC GVC and (2) how Taiwanese ODMs exploited these relationships to enhance their capabilities and consolidate their position as the world’s dominant suppliers of notebook PCs. By so doing,
the chapter provides an example of successful capability formation by suppliers in late-industrializing economies.

The chapter is organized as follows. Section 1.2 presents the research framework of the study. Section 1.3 traces the development of the Taiwanese notebook PC industry. Sections 1.4 and 1.5 divide inter-firm dynamics of the industry into two periods: before and after the early 2000s, and explore the process of capability development by Taiwanese ODM suppliers in each of these periods. The final section summarizes the study’s findings.

1.2. Research framework

To trace the growth of Taiwanese suppliers, I employ the GVC perspective (Humphrey and Schmitz 2004; Gereffi et al. 2005). The GVC approach focuses on the organization and spatial distribution of value-added in the global economy. It offers a conceptual starting point to explore how industry structure and the character of inter-firm linkages affect the flow of inter-firm knowledge, and in turn the opportunities for learning by firms from late-industrializing economies.

1.2.1. Global value chain analysis

As global economic integration proceeded and market competition intensified during the last few decades, vertical intra-industry trade across different parts of the world has expanded rapidly (Arndt and Kierzkowski 2001; Jones et al. 2005). One of the driving forces of accelerated global integration has been the search for lower costs by powerful firms from developed economies (Fröbel et al. 1980). The result is an international division of labor that increasingly includes suppliers from developing economies.

The GVC perspective highlights the organizational configuration of this type of cross-border trade. It explores the way in which “lead firms”—largely from developed economies—organize the vertical sequence of value-adding activities in global production networks. They do this by selecting suppliers and setting and enforcing the parameters and specifications related to product definition, quantity, quality, and delivery to which suppliers—from both developed and developing countries—must adhere (Humphrey and Schmitz 2004: 96–98). Recent GVC studies have sought to understand this “governance” process by focusing on the specifics of how this coordination is achieved. Arrangements in notebook PC GVCs clearly fit the basic patterns found
In these studies: lead firms from developed countries such as Dell, HP, and Toshiba coordinate value-adding activities by setting and enforcing parameters for outsourced transactions. As the “chain” metaphor indicates, the GVC perspective highlights sequences of bilateral relationships between powerful lead firms and less powerful suppliers (Gibbon et al. 2008). It explores the determinants for different patterns of chain governance and the asymmetric power relationships that tend to exist between the two parties. However, a simple application of the GVC framework to the notebook PC industry would fail to capture a critical dimension of the industry: the emergence of powerful “platform leaders” and their pivotal role in driving and structuring inter-firm dynamics in the industry. Here, the term “platform leader” refers to companies that provide the core components and technologies on which other companies build products or offer services (Gawer and Cusumano 2002: 6). As Gawer and Cusumano argue, Intel and Microsoft are considered platform leaders in the PC industry (2002: 15–16). While some have attributed this role to historical accident, or a single strategic misstep by IBM, which chose to outsource the CPU and operating system for its original PC in 1981, Intel and Microsoft have in fact devoted extensive resources to developing the ecosystem based on the “Wintel” platform and preserving their leadership position within the industry. Intel, in particular, has been extremely effective in this regard (Tatsumoto et al. 2009). Today, Intel microprocessors are found in a range of products, even in PCs that do not use the Microsoft operating system, such as Apple Macintosh computers.

As I will discuss later, the evolution of the notebook PC industry has been structured by the interactions of the three major actors: (1) Intel, the industry’s most powerful component vendor and platform leader, governs the distribution of value-added among firms in the chain; (2) brand-carrying firms in the United States and Japan control access to final markets, and (3) Taiwanese ODM firms control detailed design, production, and the coordination of final assembly and the purchasing of non-core components. These firms occupy different positions in the PC GVC, not only in terms of the vertical sequence of value-added, but also in terms of geographic location. This study shows how Taiwanese ODMs took advantage of the strategic interplay among these different GVC actors to exploit learning opportunities in ways that have created both opportunities and limits for their future development.
1.2.2. Knowledge flow in global value chains and learning strategies

The inter-firm flow of resources and knowledge is a critical, yet little explored, topic in GVC analysis. Gereffi (1994: 97) defined governance of chains as the authority and power relationships that determine how various types of resources flow within a chain. Sturgeon (2001: 11) defined lead firms in GVCs as “firms that initiate the flow of resources and information through the value chain by developing and marketing final products.” These definitions suggest that the strategies and actions of lead firms configure the chains and shape the flow of resources. Other studies of global production networks in the electronics industry pay special attention to the role of network “flagship” firms in transferring knowledge and the formation of capabilities by local suppliers as well (Ernst and Kim 2002).

For firms from late-industrializing economies, one of the central motivations for participating in GVCs lies in the potential to acquire the strategic resources, including technological knowledge and market information, that can lead to the formation of the “dual-faceted” competences needed to generate rent (profits) as well as bargaining power within GVCs (Kimura 2007: 50–52). Put more simply, firms from developing economies can capture knowledge flowing from lead firms by participating in GVCs. If they are able to consolidate and build upon the knowledge they acquire over time, their relative position within GVCs can be improved. As will become abundantly clear from the case study presented in this chapter, this process is far from certain or automatic.

1.3. Industry background: rise of Taiwanese ODM manufacturers

Before proceeding to the analysis, I present a brief history of the rise of the Taiwanese notebook PC industry. Japanese and American firms started to develop portable PCs from the earliest days of the PC industry and offered the first “laptop PCs” in the mid-1980s. However, the true technological breakthrough in PC miniaturization came with the advent of “notebook PCs” developed and mass-produced by Toshiba and NEC in Japan in 1989. In developing the new product, both companies designed and manufactured key components and sub-systems in-house or in cooperation with closely linked parts
suppliers. These included semiconductors, software, displays, floppy disk drives, and hard disk drives. They used their intimate knowledge of component and sub-system technologies to miniaturize the product through the integration of key technologies that were proprietary and in-house. Because the technological hurdles associated with developing and mass-producing this sophisticated product were high, Japanese firms continued to dominate the notebook PC market until the mid-1990s.

Starting in the mid-1990s, however, the entry barriers to the notebook PC industry began to decline. First, the technological know-how associated with mechanical engineering became more mature, as we will see later. Second, and even more important, strategic moves by Intel aimed at establishing platform leadership began to dissolve the product development barriers facing new entrants, including Taiwanese ODMs. These technological changes created opportunities for Taiwanese firms by triggering a massive inflow of orders from US-based computer producers eager to increase their market share, not least by undercutting the prices charged by Japanese producers. As competition intensified, American and Japanese firms outsourced more notebook PC models to Taiwanese contract manufacturers, and began accepting design input from them on a growing range of models. By the late 1990s, notebook PC production and exports from Taiwan had swelled dramatically (see Figure 1.1).

Figure 1.2 shows that the worldwide share of notebook PC shipments by Taiwanese firms rose constantly during the past decade, reaching 92% in 2008. At the same time, contract manufacturing's share of total production by Taiwanese firms, including both original equipment manufacturing (OEM) contracts, where the lead firm provides the design, and ODM contracts, where contractors carry out some or all of the design work, increased from about 80% of 2.6 million units in 1995 to 95% of 112 million units in 2008 (see Table 1.1). While the flood of new contracts decreased the relative importance of Taiwan-branded PCs in the production mix, as almost all of this work was for foreign lead firms, even Taiwan-branded notebook PC companies such as Acer were using contract manufacturers by the early 2000s. Clearly, the rise of Taiwanese contract manufacturers as the world’s dominant producers of notebook PCs was directly related to lead firm strategies to increase global outsourcing.

Another critical factor behind the dramatic rise in the share of Taiwanese firms’ global notebook PC production was the successful relocation of production sites to Shanghai and adjacent areas in China after the turn of the century. The Taiwanese government had prohibited
Figure 1.1  Quantity of Taiwan’s production and exports of notebook PCs
Source: The Internet Information Search System, Department of Statistics, Ministry of
Economic Affairs, R.O.C.

Figure 1.2  Worldwide Notebook PC shipments by Taiwanese firms and their
share of the world total
Source: Information Industry Yearbook, MIC, Institute for Information Industry, various
years.
the relocation of notebook PC production to China during the 1990s. In 2001 the government decided to lift the ban, and notebook PC suppliers, facing rising labor and land costs in Taiwan, rushed to set up production capacity in China. The ratio of Chinese production rose from 5% in 2001 to 54% in 2003 and to 99% in 2008, showing an almost complete relocation of the industry in seven years.

This transition involved more than simple relocation of existing factories. First, capacity was increased to accommodate a nearly ten-fold increase in output, from 14 million to 112 million units (Figure 1.2). Second, the shift to China prompted an industry shakeout. Figure 1.3 shows the change in the number of portable PC manufacturers in Taiwan,

Table 1.1 Share of OEM/ODM contracting in the total production of notebook PCs by Taiwanese firms (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>1995</th>
<th>1997</th>
<th>1999</th>
<th>2001</th>
<th>2003</th>
<th>2005</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contracting ratio</td>
<td>79</td>
<td>81</td>
<td>87</td>
<td>92</td>
<td>96</td>
<td>96</td>
<td>95</td>
<td>95</td>
</tr>
</tbody>
</table>

Source: Information Industry Yearbook, MIC, Institute for Information Industry, various years.

Figure 1.3 Change in the number of notebook PC manufacturers in Taiwan
Source: TEEMA (Taiwan Electrical and Electronic Manufactures’ Association) member lists, various years.
declining from about 40 firms in the early 1990s to only 19 in 2008. In recent years, consolidation has proceeded even further, with the top five suppliers, Quanta, Compal, Inventec, Wistron, and Asustek, accounting for more than 70% of total production (Information Industry Yearbook 2007 Compilation Team 2007: 9–2). Among them, the largest supplier, Quanta, produced approximately 29% of the world’s notebook PCs in 2008.

The simultaneous scale up and absolute geographic shift of companies working in a product area undergoing continual innovation and pressure for price reduction, last-minute configuration, and rapid delivery represent a managerial achievement of significant proportions. In the following sections I will discuss some of the learning processes that enabled this extraordinary transformation.

1.4. Inter-firm relationships and the flow of knowledge: the late 1990s

In this and the following section, I employ a three-step approach in my analysis. First, I examine the inter-firm relationships among the three major actors that comprise the industry’s value chains—platform leader(s), brand-carrying firms, and Taiwanese ODM contract manufacturers—and then analyze how the relationships among them have evolved over time. Second, I highlight how the knowledge flow among these three actors was structured by their inter-firm relationships. Third, I analyze the strategies used by Taiwanese firms to exploit the learning opportunities of GVCs. The discussion in these two sections is based on in-depth interviews with managers of companies acting in all three roles. I conducted 49 interviews with Taiwanese ODM firms, brand-carrying firms, and Intel during 2004–2008. My questioning centered on the evolution of inter-firm relationships and the degree and character of information and knowledge sharing among firms. The evolution of the industry’s inter-firm relationships can be divided into two phases, that is, before and after the early 2000s, with the turning point around the period 2001–2002. In this section, I examine developments prior to 2001 and in the next section I summarize the changes since.

1.4.1. Dynamics of inter-firm relationships: consolidation of platform leadership by Intel

In the late 1990s, a complex dynamic of cooperation and competition developed between Intel and brand-carrying (lead) firms (Figure 1.4). On one hand, the two sides cooperated closely in developing new chips
and system-level products based on their joint interest in cultivating PC markets. For Intel, lead firms were the indispensable agents for delivering the company’s “Intel Inside” branded components to consumers. They also provided Intel with valuable market information to help their “roadmap” for future products and applications. Intel also depended on feedback from experienced PC manufacturers during the course of product development for the verification of new chips and chip-sets (Figure 1.5). Conversely, brand-carrying firms depended on Intel. Access to the details of Intel’s technology roadmap and advance technical information about newly developed products were critical for PC firms’ own product strategies.

On the other hand, intensifying competition in the notebook PC industry in the late 1990s led to conflict between the two parties over the appropriation of value-added. As already mentioned, brand-carrying firms—especially Japanese lead firms—dominated the market and enjoyed high profits in the early days of the notebook PC industry. Their in-house capability to develop chip-sets (packages of semiconductors combining Intel CPUs with other system elements) formed the core of their competitive advantage, along with their ability to verify chip-sets developed by third-party vendors, which sometimes contained a large number of errors.

However, beginning in the mid-1990s Intel started to challenge the dominant position of Japanese lead firms. Following the successful
strategy it had employed to dominate and extract high profits from the desktop PC industry, Intel began to promote its own notebook PC chip-sets, launched “mobile modules” that integrated its Pentium brand CPUs, coupled chips and second-level cache memory on a single board as a turnkey solution for latecomer firms, and kept the internal structure of its products as a proprietary black box (Tatsumoto et al. 2009; Ogawa 2007). In this way Intel was able to encapsulate more value chain functions, knowledge, and capture more value by integrating proprietary technical knowledge within its chip-sets, just as MediaTek later did in the mobile phone industry (see Chapter 2 of this book). In addition, the rapid spread of 3D-CAD systems for developing molds and dies and the launch of thermal modules as heat treatment solutions by Japanese parts suppliers removed additional technological barriers facing latecomer producers.

All these developments negated the originally scarce and valuable engineering expertise that Japanese-branded PC firms had accumulated in earlier years (Ogawa 2007). The emergence of ready-made technological solutions with well-defined external interfaces encapsulated the know-how needed to deal with a host of potential electrical engineering problems within Intel’s design infrastructure (Tatsumoto et al. 2009). Together with better codification across most PC system elements, Intel’s strategic move increased the modularity of the product, lowering entry
barriers for developing and mass-producing notebook PCs. With few alternatives available, this wrested value from incumbent firms rapidly created a field of low-cost competitors that could expand the consumer marketplace with a myriad of low-cost products with superficial variations that competed away profits.

Lead firms were affected by this change in different ways. American firms like Dell, Gateway, and Compaq responded positively to the emergence of Intel’s new notebook PC platforms. Exploiting the increased modularity of the product, the firms quickly increased outsourcing to Taiwanese firms to reduce costs, while concentrating their efforts on product conception, marketing, and distribution. Taiwanese firms became adept at the recursive and relatively superficial work of product design. Rapid product life cycles and intense competition justified outsourcing the most detailed aspects of design and redesign to Taiwanese ODMs.

Conversely, Japanese lead firms that had based high profitability on superior Research and Development (R&D) and production capabilities were negatively affected by the commoditization of the product. Toshiba, the world’s leading notebook PC company in 1997, faced not only a decline in market share but also reduced profits from its notebook PC unit. NEC, the world’s second-largest notebook PC brand at the time, and other Japanese firms suffered similarly.

It was the strategic move by Intel to leverage its position as a platform leader in the notebook PC GVC, and the brand firms’ reaction to it, that opened up critical learning opportunities for Taiwanese suppliers. Brand firms started to focus more on product conception, brand marketing, supplier management, and negotiations with suppliers of core components (most notably Intel), while outsourcing detailed product design, mass production, logistics, and after-sales service to contract manufacturers. By successfully embracing this role, Taiwanese ODMs soon came to dominate world production of notebook PCs.

1.4.2. Inter-firm flow of knowledge: intensive technical training and knowledge transfer

As we have seen, a mix of cooperation and competition between a powerful platform leader and brand-carrying lead firms over the division of value-added in the notebook PC industry provided a critical opportunity for Taiwanese contract manufacturers. As brand firms transferred value-adding activities step by step to Taiwanese firms, an intensive flow of knowledge from lead firms to Taiwanese suppliers took place. Figure 1.6
conceptualizes the inter-firm knowledge flow among firms in the late 1990s.

As they moved toward outsourcing production to Taiwanese firms in the late 1990s, American and Japanese lead firms sent teams of engineers on to monitor and train their ODM suppliers in the realms of R&D, parts procurement, production management, and other activities (Kawakami 2009). Production engineers from one Japanese firm trained line workers at its Taiwanese supplier by asking them to assemble and disassemble products again and again, taught them how to avoid making small scratches on exterior surfaces, and reminded them of how demanding consumers can be. An even more intensive transfer of technology and know-how took place when lead firms started to ask for product development services. Engineers from lead firms were stationed at or made frequent visits to Taiwanese suppliers to teach design engineers how to solve various technical issues and analyze data. Even after this initial transfer of knowledge, engineers from buyer and suppliers communicated with each other frequently to solve various problems. These interactions helped to expand and consolidate ODMs’ R&D capabilities.

When build-to-order and configuration-to-order systems were put in place at the end of the 1990s, Taiwanese manufacturers again received intensive training from their customers. Implementing these systems was difficult for Taiwanese firms, especially as volumes soared and product variety increased dramatically over the years. They required
the formation of new management capabilities to handle a multitude of products and components and to configure, finish, package, and ship highly differentiated products. Intensive assistance from lead firms allowed “no-touch shipments,” in which products are shipped directly from factories to retailers and individual end users without going through the customers’ intermediate warehousing or distribution systems. HP was a fast mover in this regard, helping its suppliers to introduce the system. In the case of Quanta Computer, the first customer to launch the “direct shipment” was Apple Computer, Inc. In 1998 Quanta, in cooperation with Apple, brought in consultants and logistics vendors to help form a project team to introduce the direct shipment system (Kawakami 2009).

As their role in the industry grew, Intel started providing Taiwanese ODMs with reference designs that included detailed instructions on how to develop PCs based on their chip-sets, and helped them to solve various technological issues that tend to arise during product development. The growth of Taiwanese contractors was a desirable development for the company because it lowered the cost of PC products and thereby expanded Intel’s market.

1.4.3. Learning strategies of Taiwanese firms: leveraging the diversified customer base

In winning new orders and absorbing the associated flow of knowledge, Taiwanese ODMs were by no means passive actors. By consolidating the flow of technologies and expertise transferred from various notebook PC firms and Intel, Taiwanese manufacturers acquired multifaceted product development, mass production, and logistics capabilities that underpinned their rise as full service “turn-key suppliers” (Sturgeon 2002). The intense competition among contract manufacturers to win larger and more profitable orders drove the pace of this learning process.

As the market expanded, the fastest-growing Taiwanese contractors were soon serving a large and diverse customer base. As the learning process unfolded, the diversity of this customer base came to assume strategic importance. Serving different types of customers from different markets (the United States, Europe, Japan, etc.) and product segments (low-end and gradually higher-end product categories) exposed ODMs to a wide variety of technologies and market information, demanded that they accommodate different types of requirements, and accelerated the pace of their learning.
The significance of diversified customer base was especially high for two ODM suppliers, Quanta Computer and Compal Electronics, firms that have outpaced other contractors in Taiwan in the realm of ODM contract manufacturing (Figure 1.7). The two companies aggressively pursued customer diversification during the 1990s, whereas some other companies (e.g., Inventec and Arima) chose to become quasi-captive suppliers to powerful buyers. By interacting with multiple customers, Quanta and Compal gained access to additional market information and acquired a wider range of technological capabilities.

Nevertheless, at this stage ODM supplier capabilities remained “contestable” and not “unique” to them (Langlois and Robertson 1995: 7). The knowledge transferred to and consolidated by Taiwanese suppliers during this period remained largely “substitutable” and “imitable” (Barney 1991) for their customers, and did not result in capabilities that would generate high levels of rent or bargaining power. As a result, horizontal competition between contractors was extremely intense.

Figure 1.7  Sales of major Taiwanese notebook PC manufacturers
Note: Arima Computer was merged with Flextronics International in 2008.
Source: Annual company reports.
1.5. Inter-firm relationships and the flow of knowledge: after the early 2000s

1.5.1. Change in the dynamics of inter-firm relationships: shift to overlapped long-term partnerships

In the early 2000s, an industry shakeout took place on the ODM side, and a small number of large Taiwanese suppliers came to dominate the notebook PC contract manufacturing business. This led to several new features in the inter-firm relationships described below.

The main factors behind these changes were the following. First, the policy change by the Taiwanese government in 2001 to approve investment by Taiwanese notebook PC manufacturers in China spurred the shakeout in the industry because smaller firms did not have the resources to scale up production in China. The suppliers who had enhanced their capabilities in the late 1990s by trading with multiple customers surged ahead of competitors in this investment rush. More specifically, Quanta and Compal stretched their lead over their competitors, leveraging their rapid pace of learning further (see Figure 1.7). Second, the launch of the low-power Centrino platform by Intel in 2003 further increased the modularity of the industry by integrating even more functions within the chip-set, including wireless internet connection, power management, and a host of other functions. The further encapsulation of value-added by the platform leader intensified the price competition among branded firms, and raised the importance of scale economies. It thus spurred the concentration of contract manufacturing orders in fewer suppliers, leading to further consolidation in the supply base. Third, by lowering prices and improving notebook PC functionality (e.g., enhanced internet connectivity and longer battery life) the launch of the Centrino platform boosted demand for mobile PC products and triggered a new round of notebook PC competition. To embrace the growing market, lead firms further expanded outsourcing, but since the number of ODM firms had decreased and scale economies had become ever more important this new business was funneled to the same small set of huge ODM suppliers.

As a result, branded notebook PC firms came to rely on the same set of contractors. In 2006, nine of the world’s top ten notebook PC brands were trading with Quanta Computer, the largest supplier of notebook PCs in the world.

The overlapping of trading partners for both outsourcers and contractors triggered several important changes in the industry, as summarized in Figure 1.8. First, brand firms began to compete with each other...
to secure the attention of ODM suppliers. In other words, lead firms with the most bargaining power sought to strategically “capture” the resources possessed by their suppliers. They began to require ODM suppliers to create dedicated business units with distinct product development and mass-production capabilities. Furthermore, the largest lead firms asked their suppliers to allocate the “best” engineers and other staff to their projects, and to open financial accounts devoted to each customer, so that the returns from the customer’s investments in the relationship could be monitored and the benefits from production scale economies captured bilaterally.

Taiwanese contractors responded to these requests, but only to a degree. The largest customers received their own divisions while smaller customers were sometimes grouped together (see the example of Quanta Computer in Figure 1.9). While it appears that this would be a burden to the ODM contractors, it is unclear how thoroughly operations are segmented among customers over the long term. Production equipment for core processes like circuit board assembly and material handling is highly generic, and can be moved between divisions. Warehouse space can also be re-assigned, as can personnel.

Second, as a response to the strategies by lead firms to capture supplier capabilities, the largest ODM firms started, after the early 2000s, to discriminate against smaller customers by offering higher pricing, lower R&D and production quality, and slower delivery responsiveness.
In other words, capabilities were distributed according to the buyer’s market power.

Relationships between Intel and Taiwanese firms also changed after the early 2000s. During the 1990s, lead firms collaborated closely with Intel to solve the technological problems faced by their contractors during product development. More recently, as lead firms have been retreating from the time-consuming and strategically dubious process of working closely with their suppliers to solve technological problems related to Intel’s chips, they have encouraged such problems to be hammered out directly with Intel (see Figure 1.5). Faced with deteriorating profitability, Japanese-brand firms also reduced the human resources devoted to the notebook PC business, and began relying more on Taiwanese ODMs for design. As their relationships with Intel matured, Taiwanese ODMs began to assist Intel in debugging newly developed chips. While Intel still provided lead firms with access to market forecasts and retained the practice of negotiating chip availability and pricing with brand-carrying firms, the degree of technological collaboration between engineers of Intel and lead firms decreased. In contrast, Taiwanese ODMs used their ties to Intel to accelerate their
pace of learning and consolidate their new, more important position in notebook PC GVCs.

1.5.2. Inter-firm flow of knowledge in the early 2000s: shift to a bidirectional knowledge flow

Figure 1.10 shows the inter-firm flow of knowledge after the turn of the twenty-first century. As the capabilities of Taiwanese manufacturers in terms of R&D, production, and logistics matured, lead firms gradually retreated from providing intensive training and assistance to their suppliers. As a result, the inflow of knowledge regarding product development, mass production, and deployment of global logistics from lead firms to contract manufacturers decreased substantially.

In this period, the formation of new inter-firm linkage patterns and the creation of deep pools of information within Taiwanese ODMs took place as shown in Figure 1.10. First, more stable trading relationships allowed engineers and managers from both parties to forge closer relationships in which in-depth information is exchanged bilaterally. With longer-term partnerships and the protection of strategic information assumed, lead firms started to share more details about their product strategies and market observations with the ODM engineers that work (more or less) exclusively for them.
This allowed Taiwanese suppliers, especially those with a wide customer base, to accumulate extensive knowledge about the requirements and preferences of various customers and end users. Exploiting the information pool created by the close interactions with lead firms, Taiwanese ODM firms began to prepare more prototypes and designs tailored to specific customers—especially for their top-priority customers. Taiwanese ODM firms also started to bring forward proposals for entire product lineups, including the design of new products, selection of functions, adoption of new parts, arrangement of logistics, and other issues of strategic importance to their most important customers. Although Taiwanese suppliers had been creating product roadmaps and raising various proposals earlier, lead firms have only recently come to seriously consider their proposals, and even to rely on them.

Over time the exchange of information and knowledge between the lead firms and ODM contract manufacturers in the notebook PC industry has become thicker as well as bidirectional. The two parties started to exchange more in-depth knowledge, experiences, and observations about final markets and the latest technological developments. In this way, what were highly “modular” value chains, where the contracts for inter-firm transactions were highly codified in the form of detailed specifications, have become more “relational” (Gereffi et al. 2005). More tacit and hard-to-codify information is being exchanged between trading partners that are less substitutable. Paradoxically, the rise in the modularity of the product has led to the sharing of in-depth knowledge and mutual reliance between trading partners in co-creating the value-added in the industry. Furthermore, the relatively standard design parameters of notebook (and other) PCs allow ODMs to pool design knowledge in ways that are not possible with products with less design modularity (Sturgeon 2009). Still, the high modularity of the product allows lead firms to keep strong bargaining power vis-à-vis the ODM firms by switching orders among trading partners, as we will see later.

1.5.3. Strategy of learning: consolidating the information and knowledge pool

In this final section I explore the learning process underpinning the acquisition of new capabilities by Taiwanese firms starting from the early 2000s. In this period, consolidating and leveraging the intra-firm information pool within leading Taiwanese ODMs, created by serving multiple customers, became an effective device for accelerating learning.
By setting up divisions assigned to different customers, ODM firms created an organization that allowed them to learn from multiple customers simultaneously (see Figure 1.9). In spite of informational “firewalls” between divisions, Taiwanese manufacturers do in fact leverage information and technologies acquired and, in essence, transfer what they have learned from one customer to another. Although proprietary customer information is protected, lessons learned in one division can be shared company-wide. Detailed sharing of customer information and data among divisions is restricted, but inter-division interaction at the senior management level provides a mechanism for diffusing more general market and technology information. Also, generic knowledge is shared across different business units, such as those regarding product verification and production management. So, in practice, ODM firms have been able to utilize a rich information and knowledge pool about final market and technological trends across their entire business. It is

![Figure 1.11 Ratio of gross margin to net sales: comparisons of Intel, Dell, and Quanta](source)

Source: Intel and Dell, from Annual Report Form 10-K, various fiscal years. Quanta, from annual reports, various years.
these information pools that enable them to make increasingly valuable and unique proposals and suggestions to their customers.16

Following Langlois and Robertson (1995: 7) we can say that during this phase, Taiwanese firms began to possess an “intrinsic core,” valuable resources that are hard to imitate. However, it should also be noted that the profitability of ODM suppliers has declined over time (see Figures 1.11 and 1.12), as lead firms have started to put ever greater pressure on their suppliers to reduce prices under threat (and practice) of switching orders between suppliers. Apparently the formation of an “intrinsic core” by Taiwanese suppliers has not provided them with enough power to raise prices and increase profitability.17 On the contrary, lead firms have started to purchase more and more components in advance (known in the industry as component “consignment”), in addition to the CPU chip-sets and other high-value components that they have always purchased to assure supply, to prevent Taiwanese suppliers from earning profits by marking up parts prices, one of the few areas of the business where they have control over pricing. To the extent that Intel’s highly integrated platform has raised the homogeneity of products, the economic returns to the “intrinsic core” of Taiwanese

![Graph showing ROA of major Taiwanese notebook PC manufacturers](image)

**Figure 1.12** ROA of major Taiwanese notebook PC manufacturers

*Note: Arima Computer was merged with Flextronics International in 2008.*  
*Source: Annual company reports.*
firms are limited because they remain substitutable, albeit among a small number of highly capable players.

1.6. Conclusion

This chapter has explored the process by which Taiwanese notebook PC manufacturers developed their supplier capabilities, focusing on inter-firm dynamics with the global division of labor that characterizes GVCs in the electronics industry. Specifically, I have employed a three-step approach in which I studied (1) the inter-firm relationships of competition and collaboration among the three major actors of the notebook PC value chains; (2) the knowledge flow among these three actors; and (3) the strategy on the part of Taiwanese suppliers to exploit learning opportunities that have arisen from the changing configuration of knowledge flow in the industry's value chains. I divided the evolution of inter-firm dynamics of the notebook PC industry into two phases, approximately before and after the turn of the century, and explored the above three topics in both periods.

To wrest value from brand-carrying lead firms, Intel launched a platform strategy in the late 1990s that encapsulated, within its chip-sets, scarce and valuable expertise possessed by leading branded notebook PC firms in Japan. This resulted in price declines and reduced profitability for firms that had previously enjoyed lucrative returns based on their in-house product development and production capabilities. After a period where Intel’s encapsulation strategy lowered entry barriers for following firms, a similar dynamic played out, to a lesser extent, for lead firms based in the United States. As the product price declined, notebook PC firms outsourced more and more product development and mass production to Taiwanese firms. In the early stages, lead firms trained Taiwanese suppliers, but as the latter’s capabilities in product development and mass production matured, these efforts became unnecessary.

After 2001, lead firms sought to capture the best resources of their suppliers for their own use, leading to a deeper level of interaction between buying and selling firms. While the effort to block information sharing within suppliers was only partly effective, the exchange of information and knowledge between the two parties became denser and increasingly bidirectional as the 2000s progressed. Through this process, Taiwanese firms came to possess an information pool and capabilities that may seem, given their relational nature, difficult to imitate and substitute by other actors in the chain. However, because these capabilities are applied
to the development and production of products based on modular architecture, with a core module with a very high level of functionality, they remain largely substitutable.

In conclusion, three agendas need to be addressed in future research. First, the case of the notebook PC industry poses a challenge to the concept of “chain governance” used in the existing GVC literature. As Gibbon et al. (2008) point out, GVC studies tend to begin with the inter-firm linkages at a specific node in the chain—the lead firms and their first-tier suppliers—when exploring GVC governance. In the PC industry, however, it is the platform leader, Intel, that has the most important role in controlling the distribution of value-added among value chain actors. Intel possesses the power not only to set standards but also to drive the chain dynamics by redistributing the value-added in its favor. As a result, the learning process that has made the Taiwanese notebook PC industry so competitive can be understood only by tracing the evolution of inter-firm relationships among the three major actors in this GVC. This insight extends GVC governance theory beyond the dyadic relationship between lead firms and suppliers. Thus, we should seriously contemplate how to conceptualize “chain governance” and “lead firms” to incorporate the complex and diverse value chain dynamics that are common in the contemporary IT hardware industry.

Second, the economic conditions that facilitated the rise of Taiwanese firms should also be examined. The emergence of a large number of manufacturers swarming into the fabrication of notebook PCs and the resulting intense competition among these firms spurred active learning in the case of Taiwan, but not every late-industrializing economy has local manufacturers with this level of entrepreneurial vigor. We must therefore consider seriously the economic and social conditions and institutions that enable, or inhibit, firms from late-industrializing economies to successfully exploit the learning opportunities offered by GVCs.

Third, the notebook computer case presented in this chapter does not represent the capstone of technological learning and GVC upgrading by Taiwanese firms. Rather, it sets the stage for an unfolding GVC dynamic that will be analyzed in ongoing research. For example, Taiwanese firms have recently become very active in a convergent set of new product areas, built around new platform technologies such as Intel’s ATOM chip-set and Google’s Android operating system, that includes very low-cost “netbook” portable computers, “smart” mobile phone handsets, and personal navigation devices (Sturgeon and Kawakami 2010). The
recent rise of Acer and Asustek as successful brand-carrying suppliers of netbook PCs deserves special remarks too. The discussion of this development remains a future research topic.

Notes

1. The demand for notebook PCs is heavily concentrated in the developed markets. In 2008 the United States, Japan, and West Europe accounted for 30%, 8%, and 33% of worldwide shipments of notebook PCs, respectively (Information Industry Yearbook 2009 Compilation Team). This overwhelming share of the final market held by the developed countries has led to the strong market power of brand-carrying companies from the United States and Japan, although the multiplicity and intense competition among brand firms have weakened their bargaining power vis-à-vis Intel.

2. A part of this section is based on the author's interviews with executive officers of Kohjinsha, Co., Ltd, former senior engineers of NEC and Panasonic Communications Co., Ltd. Existing literature on the Taiwanese PC industry includes Dedrick and Kraemer (1998), Ernst (2000), Kishimoto (2002, 2004), and Sturgeon and Lee (2005).

3. TEEMA member lists are compiled based on the self-reported data. Partly due to this, the figure suffers from inexactness.

4. Wistron was formerly the design, manufacturing, and services division of Acer. Acer is one of the few Taiwanese firms that have continuously pursued an original brand manufacturing strategy. In the early 2000s, the company split its brand business from its original design manufacturing activities and established two independent companies. This reorganization proved successful and Acer has risen to be one of the world's largest sellers of notebook PCs. Asustek Computer Inc. followed the same strategy and split its design and manufacturing division to establish an independent company in 2008.

5. A part of this section and the next one are based on Kawakami (2009).

6. The Taiwanese ODM companies interviewed were Quanta Computer, Compal Electronics, FIC, Arima Computer, Wistron, and Uniwill Computer (acquired by Elitegroup Computer Systems in 2006). The interviewed brand-carrying companies included NEC, IBM, Toshiba, Fujitsu, and Hitachi. I made multiple visits to most of these firms. In addition, interviews were also conducted with former executive managers of the Taiwan procurement office of Dell and HP.

7. In the mid-1990s Intel started to define and promote various types of technological standards and interfaces for desktop PCs, and included these standards in their own chips. The company promoted them as technological "platforms" upon which PC makers could easily develop products. For a detailed examination of Intel's platform strategy, see Gawer and Cusumano (2002) and Tatsumoto et al. (2009).

8. Intel kept the internal structure of its products proprietary while making their external interface specifications widely available (Gawer and Cusumano 2002: 13). By so doing, Intel succeeded in lowering the price of PC systems over time while it maintained the profitability of its chip products (Tatsumoto 2007).

10. In 2000 the share of outsourcing to Taiwanese suppliers in the total shipments of notebook PCs for Dell and Compaq reached 61% and 76% respectively, while the figure for Toshiba remained 16% (Chien 2001).

11. Nevertheless, Japanese firms were more reluctant to turn to outsourcing compared with their American competitors during this period. Smaller branded firms were more active in outsourcing, but Toshiba and Sony continued to retain a high proportion of in-house fabrication until the early 2000s.

12. Sturgeon and Lee (2005) point out the strong learning effects associated with a shared supply base where a number of lead firms that compete head-to-head in final product markets trade with groups of suppliers.

13. I did not include Wistron in Figures 1.7 and 1.12, as the company’s key products are diversified compared with other ODM firms shown in these figures.

14. Only the mobile PCs that contain Pentium M, the coupled chip-sets and wireless LAN chips—all of which are supplied by Intel—are allowed to use the “Centrino” brand.

15. The average selling price of notebook PCs dropped from US$1827 in 2001 to US$1065 in 2006 (Topology Research Institute 2005: 47; 2008: 12). In response to the intensified price competition, Japanese firms started to rely more heavily on subcontracting. For example, Toshiba changed its in-house production policy and started to outsource all of their low-cost models from Taiwanese firms in 2003.

16. At the same time, customers also benefit from access to the information pools of their suppliers who sometimes know even better than the customers themselves about the overall development of the world notebook PC market, and they enjoy the improved product development capabilities of their suppliers.

17. Based on a teardown report of a specific HP model (HP nc6230), Dedrick et al. (2010) calculate the value captured by the firms participating in the value chain; according to their calculation of gross profit along the value chain, HP captures 28%, and Microsoft and Intel jointly capture 15% of the wholesale price of the product, whereas the Taiwanese ODMs are only 2%.

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Note: The letters ‘f’, ‘n’ and ‘t’ following the locators refer to figures, notes and tables respectively.

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