

Exploiting the Modularity of Value Chains: Inter-firm Dynamics of the Taiwanese Notebook PC Industry

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Exploiting the Modularity of Value Chains: Inter-firm Dynamics of the Taiwanese Notebook PC Industry

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Abstract

This paper explores the inter-firm dynamics that govern the rise of capabilities of latecomer firms operating in global value chains. By extending and modifying the model proposed by Gereffi, Humphrey and Sturgeon [2005], I present a framework in which the rise of supplier capabilities is determined by interactions among the strategies of the firms. Based on a case study of the Taiwanese notebook PC industry, the paper will explore how the interactions among outsourcing strategies by lead firms from the developed countries, the learning strategies of Taiwanese suppliers, and the product strategy of powerful component vendors have driven the explosive growth of the industry after the 1990s. By so doing, the paper attempts to highlight the active roles firms play in determining the speed and direction of the rise in supplier capabilities.

Keywords: Global value chains, Notebook PC industry, ODM(original design manufacturing), Taiwan

JEL classification: F14, L23, L63.

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Introduction

Since the early 1990s, the disintegration of large multinational computer manufacturers and the rise of modular production networks for personal computers (PCs) have brought about a phenomenal growth in local manufacturers of PC-related products from East Asia (Dedrick and Kraemer [1998]). Among them, Taiwanese suppliers are by far the biggest winners to gain from the deverticalization of the industry and the subsequent growth of outsourcing markets. In 2006, Taiwanese suppliers accounted for approximately 86% and 99% of the worldwide production of notebook PCs and motherboards respectively (Market Information Center, Institute for Information Industry [2007]) mainly as ODM (original design manufacturing) suppliers who subcontract designs and manufacturing of a product sold under the outsourcer's brand.

To capture the global context underlying the dramatic rise of Taiwanese suppliers in the world landscape of the PC industry, the perspective of "global value chains" (hereafter GVCs) offers an excellent starting point. The specific configuration of GVCs in the industry, i.e. modular value chains as defined by Gereffi, Humphrey and Sturgeon [2005], has been the central key that led to the rise of Taiwanese firms as the world's dominant suppliers. The successful upgrading of Taiwanese manufacturers in terms of process, product, functions and, more recently, within different sectors (Humphrey and Schimtz [2004(a)]) is also attributable to the unique arrangement of GVCs within this industry. The PC industry illustrates the clear relevance of organizational patterns of GVCs for the growth of latecomer firms operating in the chains.

This paper explores the inter-firm dynamics that molds and formulates the possibilities for the growth of local suppliers in GVCs, with a special focus on the critical importance of strategic actions taken

by the firms in the chains. Based on case studies of the Taiwanese notebook PC (hereafter NPC) industry¹, the paper will explore how the interactions among outsourcing strategies of lead firms, the learning strategies of Taiwanese suppliers, and the product strategy of powerful component vendors have driven the explosive growth of the industry after the 1990s. By so doing, the paper presents an analytical framework that attempts to explain the rise of supplier capabilities.

The paper is organized as follows. The first section presents a framework of the study. The second section examines the characteristics of the NPC industry in terms of technology and market structure, and the configuration of its value chains. The subsequent two sections explore the outsourcing strategies of lead firms and the learning strategies of Taiwanese firms respectively. The fifth section discusses the main findings and implications of the author's case study and concludes the paper.

Framework

Among the existing GVC literature (Schmitz ed. [2004], Kimura [2007]), the paper by Gereffi, Humphrey and Sturgeon [2005] is a groundbreaking contribution that offers a formal framework to explain the determinants of GVC governance. The study identifies five types of chain governance, namely markets, modular, relational, captive and hierarchy, and explains how the combination of a high/low status of three key determinants—(1) complexity of information and knowledge transfer required for a particular transaction, (2) the extent to which this information and knowledge can be codified, and (3) capabilities of suppliers in

¹ For empirical studies on the Taiwanese PC industry, see Ernst [2000], Chen and Ku [2002] and Kishimoto [2002, 2003]. Kishimoto [2004] explores the upgrading of the Taiwanese PC cluster in global value chains.

relation to the requirements of the transaction, results in a different governance typology (see Table 1). The paper proposes a well-defined model that conceptualizes the typology of GVC governance and has a rich potential for theoretical expansion and empirical application. It is the virtue of extensibility of the Gereffi, Humphrey and Sturgeon [2005] framework that the present paper attempts to build on.

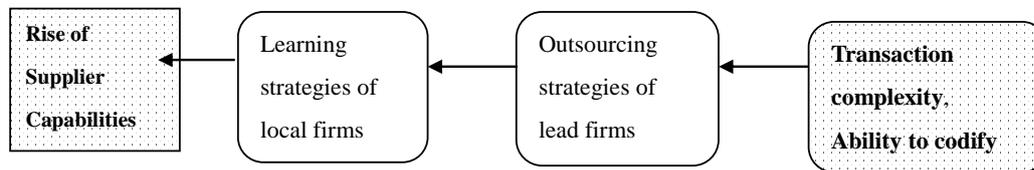
Table1: Key determinants of global value chain governance by Gereffi, Humphrey and Sturgeon [2005].

Governance type	Complexity of transactions	Ability to codify transactions	Capabilities in the supply-base	Degree of explicit coordination and power asymmetry
Market	Low	High	High	Low
Modular	High	High	High	↑ ↓
Relational	High	Low	High	
Captive	High	High	Low	↓ ↑
Hierarchy	High	Low	Low	

Source) Table1(p.87), Gereffi, Humphrey and Sturgeon[2005].

As the author is motivated to explore the mechanism of growth of latecomer firms in the GVCs, this paper sets the rise of supplier capabilities as the dependent variable. While Gereffi, Humphrey and Sturgeon [2005] assume that the three variables jointly determine GVC governance, I argue that the determination of GVC governance is a more dynamic process in which the two variables of the Gereffi, Humphrey and Sturgeon [2005] framework, i.e., transaction complexity and ability to codify information and knowledge, regulate the rise of supply-base capabilities indirectly through the operation of two intermediate variables-----outsourcing strategies of lead firms and learning strategies of local firms. Figure 1 presents the basic structure of my model.

Figure 1. Framework.



Source) Compiled by the author.

Note) Highlighted cells indicate the three explanatory variables adopted by Gereffi, Humphrey and Sturgeon [2005].

In this framework, complexity and codifiability of transactions regulate the outsourcing strategies of lead firms, as these technological characteristics of the trade constrain the feasible options for outsourcing activities of lead firms. This in turn structures the possibilities and limitations of learning by suppliers operating in the chain, and confines the feasible options for learning strategies of suppliers. Thus, the rise of supplier capabilities is the outcome of the interactions between the two sets of firm strategies---outsourcing strategies of lead firms and learning strategies of suppliers, both governed by the complexity and codifiability of transactions.

While Gereffi, Humphrey and Sturgeon [2005] assume that the combinations of the three key variables automatically determine GVC typology, my model highlights the active roles firms play in determining the speed and direction of the rise in supplier capabilities. In this model, firms are active players with a certain latitude to boost their own capabilities or depress the growth of capabilities of their trading partners with the purpose of reaping the greatest benefits from operating in chains, though their feasible outsourcing/learning strategies are constrained by the basic characteristics of the product traded or the transaction in question.

Compared to the clear simplicity of the argument of Gereffi, Humphrey and Sturgeon [2005], the present framework deliberately introduces the uncertain causality where the strategic actions of firms and their mutual interactions determine the rise of supplier capabilities. By so doing, I intend to argue that the emergence of GVC governance is an evolutionary process in which the choices and actions of firms play critical roles in determining the speed and direction of the rise in supplier capabilities.

In the following sections, I will explore how this framework works to capture the dynamics of the rise in supplier capabilities and chain governance by studying the case of the Taiwanese NPC industry.

Configuration of the NPC Industry Global Value Chains: Technology and Market

The specific configuration of the NPC industry GVCs has been structured by two distinct dimensions of the product; the incomplete codifiability of information and knowledge required for transactions, and the strong market power held by brand-carrying companies from developed countries.

Technologically, PCs are often referred to as a typical example of modular product. Under the so-called “Wintelism” (Borras [2000]) where the focus of competition lies in setting de facto product standards rather than in final assembly of products, the technological interface between modules and parts are clearly defined, and the contracts for inter-firm transactions can be codified explicitly as detailed specifications of products and tasks.

Along with the rapid expansion of production, the NPC industry has also followed the path towards modularization, although at first it started as a rather integral product. When the product was invented by Japanese manufacturers in the mid-1980s, most of the parts were designed and manufactured in-house,

including the design of IC chips and software. The pursuit of miniaturization, weight saving and inclusion of an increasing number of functions brought about technological difficulties for new entrants and formed a barrier to entry, thus favoring Japanese manufacturers who possessed a wide variety of elemental technologies in-house.

Starting from the mid-1990s, however, the strategic promotion of CPUs and coupled chipsets supplied by Intel², as well as the growth of parts manufacturers, began to eliminate the technological difficulties of product development and fabrication of NPCs in terms of electrical engineering. Intel started to provide purchasing firms with reference designs and detailed instructions to develop products using their chips. This made product development of NPCs much easier for latecomer firms compared to the early 1990s. As far as electrical engineering is concerned, the extent to which information and knowledge related to transactions can be codified rose significantly as a result of the implementation of the strategy by the powerful chip vendor, Intel, to internalize complex functions in its products.

Nevertheless, compared with other PC-related hardware products, the NPC of today is less modularized, as it calls for a substantially integral approach in terms of mechanical engineering. Unlike desktop PCs and other PC-related products, NPCs have a larger space for differentiation in appearance and portability, and brand companies have been trying to keep room for product differentiation in terms of appearance, portability and functions to leverage the product's profitability in the industry. According to Taiwanese ODM suppliers and their customers, compared to electrical engineering, mechanical engineering of NPCs requires a rather integral approach to realize the required match of design, weight and various

² Tatsumoto [2007] explores the corporate strategy of Intel and its impacts on the PC industry in detail.

functions. For example, thermal engineering capabilities to realize the targeted goal of miniaturization, weight saving and the mounting of various heat-exhausting components on the main board requires an accumulation of experience-based knowledge by engineers and close collaboration among them. The development of appearance improvements in NPCs also calls for the understanding of market trends that requires close interactions among product planners, designers and production engineers. In sum, the NPC industry has experienced a rise in the ability to codify information and knowledge required for transactions, but the product is not as modularized as desktop PCs, and it is this incomplete modularity of the product that is the key to the outsourcing practices of brand companies that eventually mold the learning trajectory of suppliers.

Another characteristic of the NPC industry is the disproportionate concentration of market demands in developed countries. In 2003, the U.S., Japan and West Europe accounted for 36%, 28% and 16% of worldwide shipments of NPCs respectively (Market Information Center, Institute for Information Industry [2004]). This overwhelming share of developed countries as the final market has led to the strong market power of brand-carrying companies specializing in marketing activities in developed countries. Thus, the most feasible way for the suppliers from developing countries, including Taiwan, to enter the world market of NPCs was to trade with these powerful multinationals, namely Dell, HP and Apple from the U.S., Toshiba and others from Japan³.

This is in contrast with the case of the mobile handset industry studied by Imai and Shiu (Imai and

³ Kimura [2007] calls this type of strategy, in which a latecomer firm attempts to upgrade its supplier status step-by-step in the intermediate goods market, an “upgrading strategy” and contrasts it with the “catch-up strategy” in which a latecomer firm attempts to succeed in the finished product market (pp. 34-35).

Shiu [2007]), where the relatively low price of the product and the strong need for telecommunications in late-industrializing economies have created huge local markets in developing countries, and led to the rise of a number of local brand-carrying companies in China and other emerging markets.

Outsourcing Strategies of Brand-carrying Companies

Now let us turn to an exploration of the outsourcing strategies of brand-carrying companies. Gereffi, Humphrey and Sturgeon [2005] argue that when complexity and codifiability of transactions are high, either “modular” or “captive” value chains arise depending on the capabilities of suppliers. When supplier capabilities are low, lead firms are required to make great efforts and interventions to instruct and monitor suppliers in the completion of the tasks allocated. Lead firms also tend to lock-in suppliers to exclude other firms from reaping the benefits of their efforts. Meanwhile, when suppliers have sufficient capability to supply full packages and modules, hard-to-codify information can be internalized within firm boundaries, and modular value chains arise. In this type of value chain, the necessity for lead firms to directly monitor and control suppliers is low, but there is certain information flow between trading partners beyond mere information about prices (Gereffi, Humphrey and Sturgeon [2005: pp.86-87]).

In the early years, both modular chains and captive chains co-existed in the NPC industry. Compaq, one of the most powerful American brand companies in the 1990s, preferred to nurture quasi-exclusive suppliers of their own, and such Taiwanese suppliers as Inventec and Arima Computer remained quasi-exclusive suppliers of Compaq until 2001, when the latter was merged into HP. For those Taiwanese manufacturers, becoming quasi-exclusive suppliers of Compaq was a promising strategy, as the latter was

one of the largest and most celebrated PC companies at the time.

Even in the early years, however, captive value chains remained rather exceptional. The availability of integrated chips and reference designs supplied by Intel, technology support offered by various parts makers, and the accelerated process of learning by Taiwanese suppliers, as we will see later, all worked to remove the technological barriers and difficulties for development and fabrication of NPCs. This encouraged brand-carrying companies to subcontract out not only production, but also product development, to firms from emerging countries, while they concentrated their own resources in marketing activities, the most critical domain of their activities. As the focus of inter-firm competition shifted from the quality and uniqueness of product development to such aspects as price, time-to-market of product release, and variety in product line-up, trading with exclusive partners came to be costly and inflexible, and captive chain governance became less effective. Instead, creating switchability of suppliers came to be crucial, as sticking to inefficient suppliers seriously damages the competitive edge of the outsourcer in the final market. The explosive growth of the market also encouraged brand companies to trade with multiple manufacturers to avoid the risk of supplier failure.

All these developments promoted the emergence of a modularized practice of subcontracting by brand companies. Such brand companies as Dell boosted their position in the market by successfully managing outsourcing relationships with multiple suppliers, creating competition pressure among suppliers and lowering costs. Japanese brand companies also followed suit after the mid-1990s. They started subcontracting activities by allocating low- to middle-end products to Taiwanese suppliers, while keeping production of high-end models in-house. Since their sourcing strategies were cost-oriented, Japanese PC

companies preferred to maintain competitive pressure by trading with multiple suppliers rather than nurturing loyal suppliers.

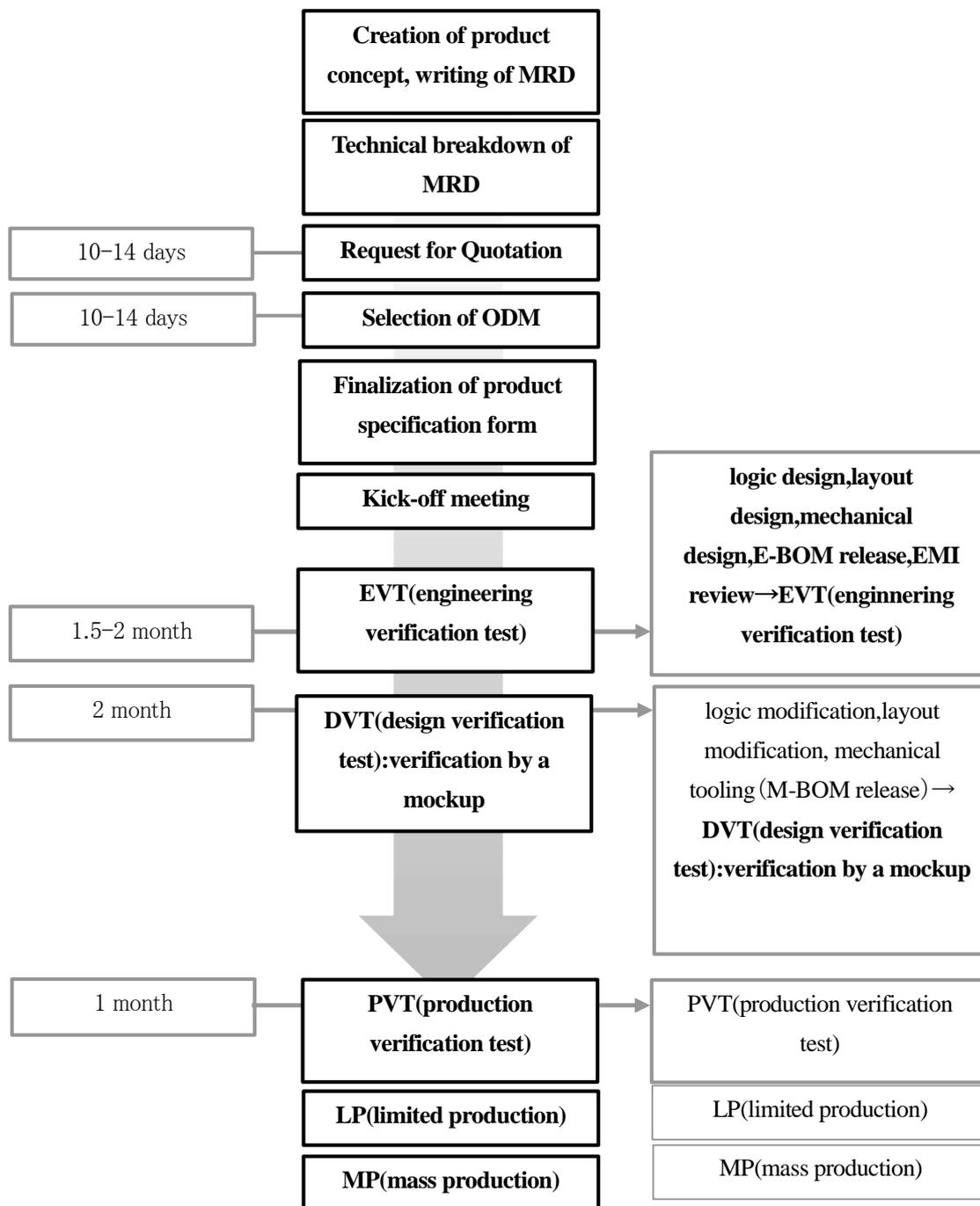
In this way, the value chains in the NPC industry converged into modular chains. Brand-carrying companies now exploit the modularity of value chains to retain inter-firm competition among suppliers, and leverage their bargaining power vis-à-vis their suppliers.

Special attention is due here to note that the rise of modular value chains in the NPC industry, as we have seen above, has been the result of the strategy of one powerful component supplier, Intel. The turn-key solution and the coupled reference design provided by the company lowered technological barriers in terms of electrical engineering, and eventually raised the supply-base capabilities in relation to the requirements of customers. This spurred on the rise of modular value chains, where brand-carrying companies trade with multiple suppliers simultaneously and occasionally switch partners.

On the other hand, what is peculiar to NPCs is that the remaining element of partial non-modularity, or incomplete modularity, calls for “thick” information flow between trading partners⁴. In the case of high-end products, outsourcers and subcontractors need to interact closely over the course of a project cycle that lasts approximately six to eight months (see Figure 2), in order to realize the targeted match of functions, thinness, weight and battery life. They discuss and work out various technological problems together, and exchange information on new developments of parts and elementary technology. Mutual trust and close collaboration are critical to the effective management of the time schedule of the project.

⁴ In their comparative case study of Taiwan and North American electronics contract manufacturers, Sturgeon and Lee [2005] identify those suppliers that seek to limit interdependence with specific customers and build up generalized assets and “thick” customer interfaces as turnkey suppliers.

Figure 2. Flowchart of ODM Business.



Note) MRD stands for “market requirement document.”

Source) Based on interviews by the author.

Thus, the outsourcing strategies by brand companies in the NPC industry are dual-faceted, in the sense that the information flow between trading partners is relatively “thick”, while brand companies cautiously retain the possibilities of switching trading partners occasionally in order to maintain inter-firm competitive pressure.

Learning Strategies of Taiwanese ODM Suppliers⁵

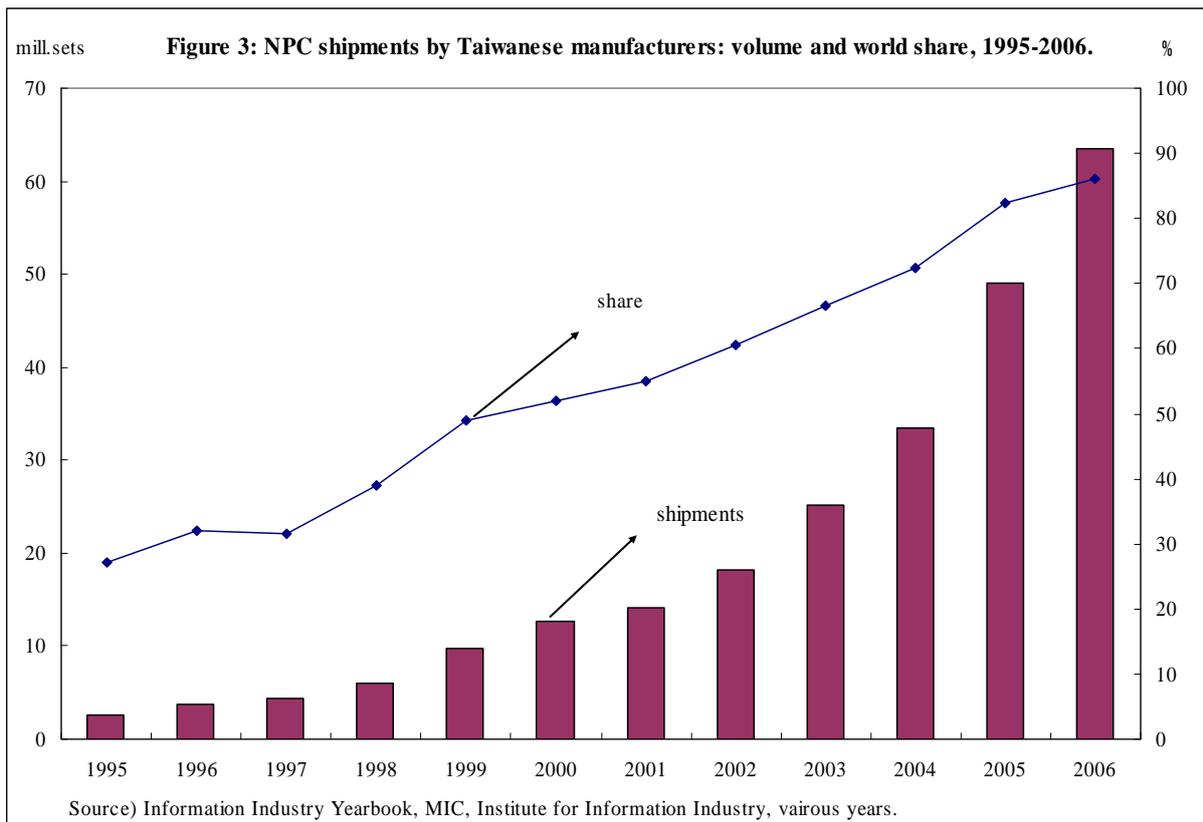
The rise of modular value chains in the NPC industry has benefited outsourcing firms by allowing them to trade with multiple suppliers concurrently, thus retaining flexibility and competitiveness in their product sourcing activities. However, it was the latecomer suppliers that benefited more substantially from the rising modularity of the chains coupled with the remaining element of non-modularity. Let us now turn to an exploration of the learning mechanism of Taiwanese ODM suppliers, and see how the suppliers have exploited the learning opportunities embedded in the outsourcing strategies of brand companies.

Figure 3 shows the change in share of Taiwanese firms in the world-wide production of NPCs. The share of Taiwanese firms has rapidly increased from 27% in 1995 to the overwhelming share of 86% in 2006. Interestingly, the expansion of outsourcing of production by brand companies has resulted in the disproportionate concentration of subcontracting orders in the hands of Taiwanese manufacturers. This is attributable to a number of factors including the long history of Taiwanese PC industry since the early 1980s (Kawakami [1996], Chen and Ku [2002]), the resultant agglomeration of PC assemblers and parts manufacturers (Kishimoto [2002, 2003]), and the strategies of Taiwanese firms to specialize in ODM

⁵ This section is partially based on Kawakami [2007].

business. Among the small number of gigantic suppliers that emerged from the severe competition for survival after the mid-1990s, Quanta Computer, Compal Electronics, Wistron Corporation, Inventec Corporation and Asustek Computer are the representative manufacturers. The first two companies jointly supply approximately 56% of the world's total production of NPCs, with the former producing 33% and the latter 23%, followed by Wistron (13%), Inventec (12%) and Asus (8%) respectively in the last quarter of 2007 (Data source: IDC, *Economic Daily News*, D5, February 21st, 2008).

How has this overwhelming dominance of Taiwanese ODM suppliers in the world landscape of the industry been accomplished? What kind of learning strategies did these suppliers pursue to rise to such a dominant position? The author's interviews with Taiwanese NPC manufacturers and their customers from Japan and the U.S. revealed that it was the strong learning effects of interacting with multiple customers simultaneously that accelerated the process of the rise of Taiwanese ODM suppliers. To understand this process, it is helpful to divide the learning process of Taiwanese firms into two consecutive phases, before and after the turn of the century, and to see how the same learning strategies of interacting with multiple customers have resulted in the accumulation of different types of resources.



Learning to catch-up: the late 1990s

The former phase, the late 1990s, was basically the stage of catch-up. During this period, Taiwanese ODM suppliers absorbed different types of technology, know-how and information related to manufacturing and product development from their customers, and gradually rose to become “turn-key suppliers” (Sturgeon [1997]) that develop and fabricate products upon the receipt of a product concept from the customer.

A study by this author (Kawakami [2007]) revealed that brand companies started subcontracting simple manufacturing to Taiwanese firms around 1993-1995, and gradually moved on to assigning them electrical and mechanical design, as well as testing functions.

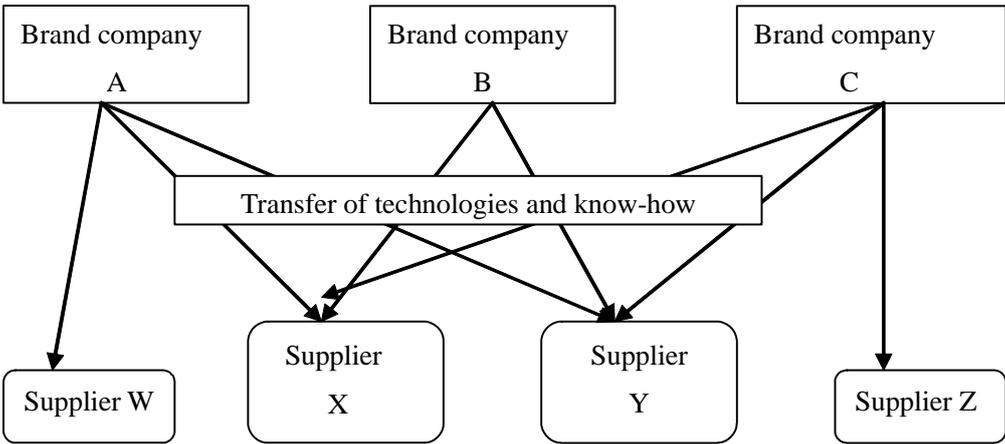
As seen from Figure 2, over the course of the ODM business flow, lasting approximately six to

eight months, brand-carrying companies and Taiwanese suppliers engage in close interaction. When a brand company allocates a new function to a supplier, the former provides substantial technological assistance to the latter. Trading with multiple brand firms from different markets concurrently accelerated the process of acquiring different types of technology and resources effectively. One Taiwanese manufacturer acknowledges the positive impact of having customers from different national backgrounds and states:

American customers are innovative in transferring functions to Taiwanese. Also they are very document-oriented. They emphasize the analysis of testing data, and our company learned from them the technique associated with verification of design and liability. In contrast, the Japanese really care about production lines. They send in a team of engineers to start up SMT lines and assembly lines. They've trained our workers. (ODM company A)

Another ODM company admits that there is a substantial difference in the emphasis that American and Japanese customers have placed on their interactions. For instance, Japanese companies are more demanding concerning process control as they have a long experience of in-house manufacturing, while trading with first-tier American brand companies requires strong management capabilities to deal with mass production with short delivery times. The wide customer base of these ODM companies has allowed them to absorb diversified types of technology, knowledge and information, and by consolidating these resources, Taiwanese firms transformed themselves into turn-key suppliers (Figure 4). On the other hand, suppliers that remained in “captive” trade relationships with brand companies had to face a slower pace of accumulation of technological resources.

**Figure 4. Absorbing resources through multiple customer interactions:
the late 1990s learning mechanism.**



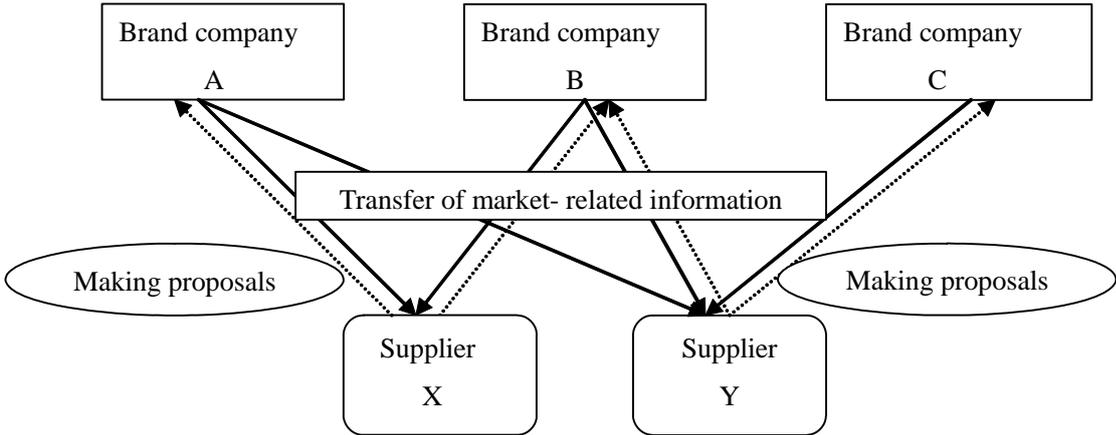
Source) By the author.

Learning to create information superiority: after the early 2000s

The author’s interviews revealed that by the late-1990s, Taiwanese ODM firms had completed catching-up in terms of acquiring the required technological capabilities as turn-key suppliers, and their product development and testing capabilities had become mostly stable and mature. From around the turn of the century, trading with multiple customers began to have different outcomes for the Taiwanese firms’ learning. As Taiwanese firms repeated the transactions with brand companies from all over the world, they came to accumulate abundant information about their customer’s customers, i.e. the final market. By leveraging this information pool, they started to bring forward various proposals for future model design, product line-up, and arrangement of logistics to customers. These proposals often turn out to be effective and

valuable for customers, as they reflect the rich information concerning market trends accumulated by the gigantic suppliers trading with most of the top-tier brand customers. Individual brand companies, interestingly, do not have access to all of this information. All these factors have favored the further growth of ODM suppliers with a wide customer base, and thus have accelerated the concentration of orders in the hands of a small number of top-tier manufacturers. The dominance of a small number of large-scale Taiwanese ODM suppliers is closely associated with this learning mechanism (Figure 5).

Figure 5. Exploiting the information pool: after the 2000s.



Source) By the author.

Thus, as the industry evolved, the learning effect associated with a variety of customers came to the fore, and the capabilities acquired through this learning mechanism shifted from those required as cost-competitive subcontractors to those required as strategic partners of brand-carrying companies. More specifically, these suppliers started to assume a much more critical role for their customers as the source of

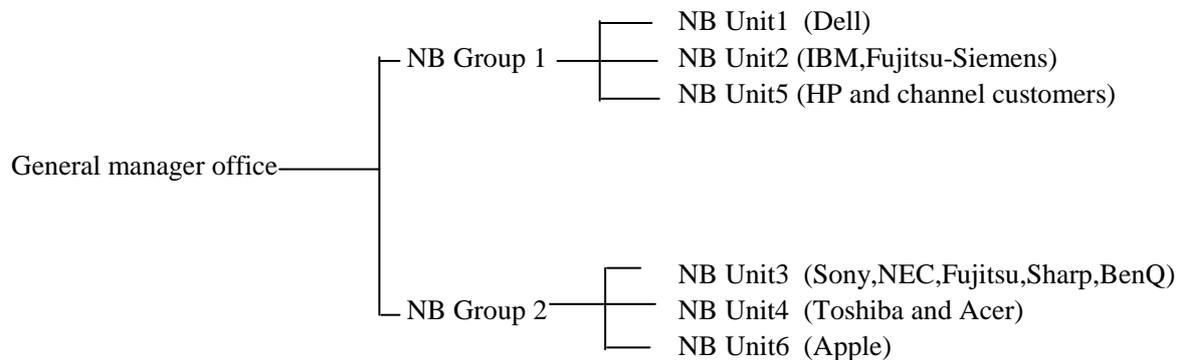
various proposals and suggestions. Taiwanese ODM firms have thus exploited the learning opportunities structured in the modular-type outsourcing practices by brand companies, and have successfully upgraded within the chains.

Special attention should be given here to the fact that Taiwanese firms have strategically organized an intra-firm system of information sharing and learning. Figure 3 is the organization chart of Quanta Computer prepared from data obtained by the author in an interview with the company. The company consists of several business units that accommodate specific customers with independent R&D teams, sales managers, and factories⁶. In a sense, an ODM company is a kind of a collection of several exclusive subcontractors trading with Dell, HP, Apple, and Japanese customers respectively.

Clearly, this organizational configuration aims to set up firewalls between divisions that trade with different customers in order to dispel anxiety on the part of customers that their confidential information might be leaked to competitors through intra-firm contact within the shared supplier. However, the author's interviews revealed that in spite of the adoption of such an organizational structure, a certain amount of information leveraging activities and intra-firm technology spillover does in fact occur in these ODM companies. Such first-tier Taiwanese manufacturers as Quanta Computer and Compal Electronics successfully leverage information and technology acquired from one customer to another customer in order to make attractive proposals to these customers. On the other hand, their customers admit that they also benefit from the improved abilities of their suppliers to make proposals. Thus, the fruit of supplier learning by interacting with diversified customers benefits both subcontractors and outsourcers.

⁶ Where a business unit covers more than one customer, an independent account is devoted to each customer.

Figure6. Organization chart of Quanta Computer.



Source) Company report of Quanta Computer and interview by the author.

Note) Company names in parenthesis are main customers of business units. NB stands for notebook PC.

In sum, Taiwanese firms have successfully exploited the mixed nature of the value chain configuration of the NPC industry. On the one hand, the remaining component of non-modularity has created a thick information flow from brand companies to subcontractors. ODM suppliers have significantly benefited from this aspect of the value chains, as it has allowed Taiwanese firms to absorb various types of resources from customers. On the other hand, they have exploited the modularity of value chains that allow them to trade with multiple customers. This has accelerated the learning process and spurred the rise of Taiwanese firms into competitive turn-key suppliers. Thus, Taiwanese firms have effectively leveraged the learning opportunities structured in the outsourcing strategies of the PC companies from developed countries.

Discussion

Based on a case study of the NPC industry, this paper has explored the inter-firm dynamics that govern the rise of capabilities of latecomer firms operating in GVCs. While Gereffi, Humphrey and Sturgeon [2005] argue that the three variables of complexity of transaction, codifiability of information and

knowledge required for a transaction, and supply-base capabilities jointly determine GVC governance, I have presented a framework which indicates that the rise in supplier capabilities is determined by interactions among the strategies of the firms trying to reap the greatest benefits from the chains. Complexity of transactions and their codifiability structure the outsourcing activities of brand companies and learning strategies of suppliers, thus molding the trajectory of the growth of suppliers.

By examining the development of the NPC industry and the dramatic rise of Taiwanese ODM suppliers within the chain, I have highlighted the critical roles firms play in shaping the GVC governance typology. As seen from the case of the NPC industry, the emergence of modular value chains in this industry was an evolutionary process, where the strategic actions of individual actors interacted with each other to result in this specific pattern of GVCs. In the context of the NPC industry, the strategy of a powerful component vendor to promote its turn-key solution chips triggered the emergence of modular-type subcontracting activities. This provided Taiwanese firms with precious opportunities for acquiring various types of resources from diversified trading partners concurrently, accelerating their learning processes, and resulting in the further modularization of the value chains. Further, organizational efforts on the part of Taiwanese manufacturers to attract multiple top-tier customers resulted in the successful exploitation of the learning opportunities embedded in these trading relationships.

The argument of this paper also calls for a revisit to the concept of “lead firms”. The existing literature has defined lead firms as those *buyers* that set the critical parameters which define what is to be done by suppliers, i.e., what/how/when and how much is to be produced (Humphrey and Schmitz [2004(b)], pp.96-97). This definition of lead firms leads us to specify those brand-carrying companies such as Dell, HP,

Apple, Toshiba, Sony and other brand-carrying PC companies as lead firms.

From the viewpoint of growth and the well-being of local suppliers in GVCs, however, the real concern is the agent that holds the ultimate—or the strongest—power to affect the distribution of the value added among actors, thus structuring the upgrading paths of local manufacturers, as well as how that actor regulates and governs the conditions for competition and value distribution within the chain. In the case of PCs, we should contemplate seriously whether those that govern the value chains are such buyers as Dell, HP, Toshiba and other brand-carrying companies, or those powerful component suppliers that set *de facto* standards, control the conditions of competition among brand companies, and eventually capture the highest ratio of profit, such as Intel.

From the viewpoint of fieldworkers in East Asian economic development, the recent theoretical advancement of the GVC perspective seems to have been attained at the expense of the weaker relevance of development studies. The sharp focus on governance typology has shifted the main agenda away from the discussion of the rise in supplier capabilities, power asymmetry between lead firms and suppliers, and the distribution of value added among various players in the chains. In order to link the GVC literature to the primal concern of development studies, we should reposition local suppliers—the most critical agents of late industrialization in East Asia in GVCs and explore the roles they play in the formulation of GVC governance. This paper is only the first step towards that goal.

References

- Borras, Michael [2000] "The Resurgence of US Electronics: Asian Production Networks and the Rise of Wintelism," in Michael Borras, Dieter Ernst and Stephan Haggard eds., *International Production Networks in Asia: Rivalry or Riches?* London and New York: Routledge: 57-79.
- Chen, Tain-Jy and Ying-Hua Ku[2002] "The Development of Taiwan's Personal Computer Industry," Working Paper Series Vol.2002-15, The International Center for the Study of East Asian Development, Kitakyushu.
- Dedrick, Jason and Kenneth L. Kraemer [1998] *Asia's Computer Challenge: Threat or Opportunity for the United States and the World?* New York and Oxford: Oxford University Press.
- Ernst, Dieter [2000] "What Permits David to Grow in the Shadow of Goliath? The Taiwanese Model in the Computer Industry," in Michael Borras, Dieter Ernst, and Stephan Haggard eds., *International Production Networks in Asia: Rivalry or Riches?*, Routledge; London: 110-140.
- Gereffi, Gary, John Humphrey and Timothy Sturgeon [2005] "The Governance of Global Value Chains," *Review of International Political Economy*, 12(1), 78-104.
- Humphrey, John and Hubert Schmitz [2004(a)] "Chain Governance and Upgrading: Taking Stock," in H.Schmitz ed.[2004].
- Humphrey, John and Hubert Schmitz [2004(b)] "Governance in Global Value Chains," in H.Schmitz ed.[2004].
- Imai, Ken and Shiu Jingming [2007] "A Divergent Path of Industrial Upgrading: Emergence and Evolution of the Mobile Handset Industry in China," IDE Discussion Paper, No.125.
- Kawakami, Momoko [1996] "Development of the Small- and Medium-sized Manufacturers in Taiwan's PC Industry," *Discussion Paper Series* No.9606, Taipei: Chung-hua Institution for Economic Research.
- Kawakami, Momoko [2007] "Competing for Complementarity: Growth of Taiwanese Notebook PC Manufacturers as ODM Suppliers," Yukihiro Sato and Momoko Kawakami eds., *Competition and Cooperation among Asian Enterprises in China*, Chosakenkyu-Hokokusho, IDE-JETRO: 91-118.
- Kimura, Seishi[2007] *The Challenges of Late Industrialization: The Global Economy and the Japanese Commercial Aircraft Industry*, Palgrave Macmillan: New York.
- Kishimoto, Chikashi[2002] "The Taiwanese Personal Computer Cluster: Trajectory of its Production and Knowledge Systems," DPhil dissertation, Institute of Development Studies, Sussex University.
- Kishimoto, Chikashi [2003] "Upgrading in the Taiwanese Computer Cluster: Transformation of its

- Production and Knowledge Systems,” *IDS Working Paper* 186, Brighton: Institute of Development Studies.
- Kishimoto, Chikashi [2004] “Clustering and Upgrading in Global Value Chains: the Taiwanese Personal Computer Industry,” in Schmitz ed.[2004].
- Market Intelligence Center (MIC), Institute for Information Industry, *Information Industry Yearbook*, various years.
- Schmitz Hubert ed.[2004] *Local Enterprises in the Global Economy: Issues of Governance and Upgrading*, Cheltenham: Edward Elgar.
- Sturgeon, Timothy J.[1997] “Turnkey Production Networks: a New American Model of Industrial Organization?” BRIE Working Paper 92A, University of California, Berkeley.
- Sturgeon, Timothy J. and Ji-Ren Lee[2005] “Industry Co-Evolution: a Comparison of Taiwan and North American Electronics Contract Manufacturers,” in Suzanne Berger and Richard K. Lester eds., *Global Taiwan: Building Competitive Strengths in a New International Economy*, Armonk: M.E.Sharpe: 33-75.
- Tatsumoto, Hirofumi [2007] “PC no basu a-kitekucha no hensen to kyoso yui: Naze Interu ha prattofo-mu ri-da-sippu wo kakutoku dekitaka (Bus Architecture of PCs and Comparative Advantage: Why could Intel consolidate Platform Leadership?),” in Japanese, MMRC Discussion Paper Series. No.171.