The Taiwanese Notebook Computer Production Network in China: Implication for Upgrading of the Chinese Electronics Industry

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YUNGKAI YANG*

Ph.D Candidate, Manchester Business School
Manchester University, UK
yyang@man.mbs.ac.uk

Personal Computing Industry Center
The Paul Merage School of Business
University of California, Irvine

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1. INTRODUCTION

China surpassed the U.S. in 2004 to become the world's largest producer of computer hardware with US$81 billion in output[1]. Yet much evidence also suggests that the contribution and value-added of indigenous Chinese firms remains low in the sector[2]. Why is this?

This paper examines a series of questions concerning the "upgrading" prospects of the domestic electronics industry in China. These questions are inspired by claims advanced by researchers and policy-makers as to the benefits of participating in a global value chain (e.g., Ernst & Kim, 2001; Humphrey & Schmitz, 2004; UNCTD, 2001), as well as by recent developments in one of the major segments of China's burgeoning electronics industry - notebook computers.

Taiwan has been a major player in the production of notebook (NB) computers for many years. In the late 1990s Taiwanese firms began to shift production to mainland China. The watershed came in 2001 when the Taiwanese government changed regulations restricting the location of strategic activities outside Taiwan. In the years immediately following, a mass exodus occurred with much of Taiwan's production capacity relocated to mainland China. This not only made notebook computers the leading electronics export,[3] it also represented a massive boost to China's position in the supply of IT hardware.

The move of such a significant segment in China's electronics industry raises the question as to the extent to which this historical shift in notebook production represents a resource and opportunity for the upgrading of China's indigenous capabilities. This paper presents preliminary findings from fieldwork carried out in Taiwan during 2005. The main sources of data were the author's interviews with managers and engineers from notebook computer companies and component suppliers (Appendix 4), industry reports, and government statistics. The main finding thus far suggests that for China, an opportunity is being missed. Few or no linkages exist between any of the major Taiwanese notebook firms and indigenous electronics firms in mainland China. This lack of linkages, in turn, raises specific questions about how we understand the relationship between global production networks (GPN) and the upgrading of domestic industrial capacities.

A key theme underlying the current literature on global production networks and economic development (e.g. Humphrey & Schmitz, 2004) is that domestic participation within such networks creates the possibility of 'localized learning' in one form or another. While GPNs may be potential 'carriers of knowledge' useful for local industrial upgrading, realizing this potential depends critically on the formation of linkages between domestic firms and foreign companies 'higher up' in the value-chain. The degree of 'openness' within the network is a critical feature affecting the nature of linkages formed and the potential for upgrading. An 'open' production network implies that local affiliates are given decision-making authority, R&D

[1]Reed (2005), Yearbook of World Electronics Data.

[2] According to China electronics Industry Yearbook 2004, the total amount of electronics products exported was $142 billion in 2003. Together, foreign wholly-owned enterprises, Foreign-Sino joint-venture enterprises, and Foreign-Sino Collaboration enterprises account for 83.7% ($ 118.9 billion) of exports. Comparatively, Chinese enterprises, including state-owned enterprises and other forms of enterprises, only account for 16.3% ($ 23.1 billion) of exports.

[3] China's export of various electronic products in 2003 (China electronics Industry Yearbook 2004): notebook computer ($11.3 billion); monitor ($9.6 billion); mobile phone ($7.4 billion); semiconductor ($60 billion).

activities take place locally, and indigenous companies are encouraged to supply inputs and enter into sub-contracting relations (Naughton, 1997). What we have found that in China is a notebook segment where production is dominated by Taiwanese original equipment manufacturers (OEMs) and especially original design manufacturers (ODMs) with no linkages to indigenous Chinese firms. In other words, the exodus of Taiwanese notebook production to China has occurred within an enclave environment that insulates these operations from the wider electronics industry in China. This suggests that the notebook segment is providing little, if any, substantive contribution to the upgrading of China's indigenous capabilities in the sector. Evidence to this effect, a preliminary interpretation as to why these developments have occurred, and future research questions to strengthen the interpretation are offered here.

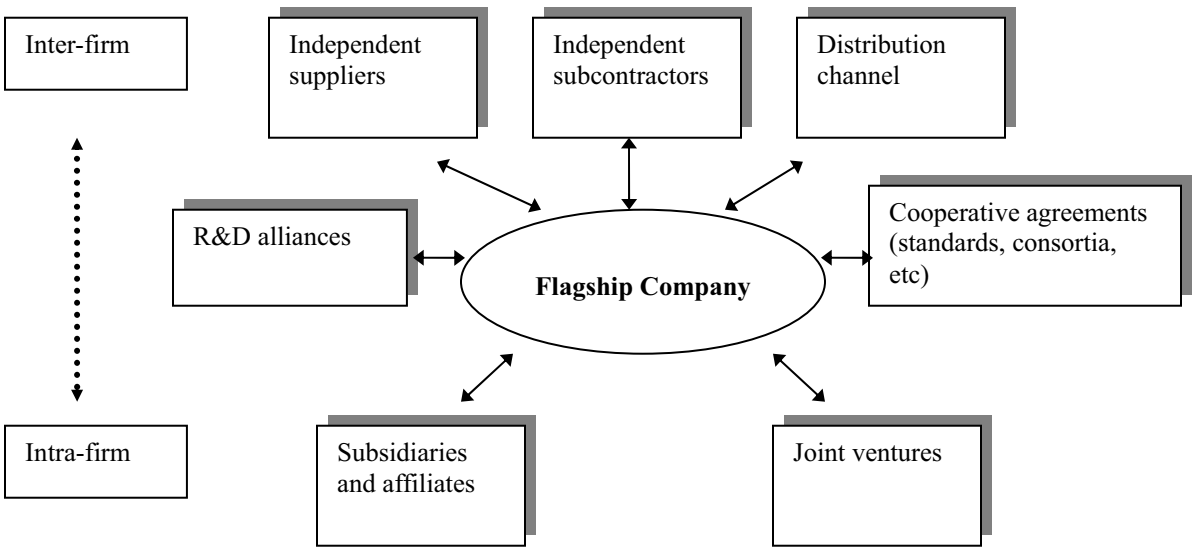
This paper is organized into six sections. Section 2 introduces the theoretical background to this research. Sections 3 and 4 document the development of the Taiwanese NB computer industry and geographical restructuring of Taiwanese NB production networks, respectively. Section 5 provides evidence as to the 'closed' nature of Taiwanese NB production networks in China, while Section 6 offers an interpretation of why this has been the case. Section 7 revisits the 'upgrading-through-linkages' thesis. It suggests that the relocation of Taiwanese notebook firms to China could contribute to indigenous upgrading, but through alternative learning channels. The upgrading would not occur through the more 'conventional' routes offered by GPNs. Localised learning need not arise from knowledge passed across organizational boundaries as is more widely conceived in the GPN literature. Rather, the benefits to Chinese capabilities may stem from learning opportunities which take place inside of Taiwanese firms. The key question here concerns the extent and nature in which the Chinese are recruited within the closed ranks of Taiwanese production networks given that, at the firm level, Chinese companies are largely excluded from participation.

2. GLOBAL PRODUCTION NETWORKS AND UPGRADING

The concept and analysis of global production networks is a relatively recent addition to the study of economic development (Gereffi, 1994; Henderson et al., 2002; Hobday, 1995).

Analyzing GPNs requires attention to both the configuration of *intra- and inter-firm relationships in a given sphere of production, as well as consideration of the forms of coordination which bind the network together. The concept is most commonly associated with the idea that production takes placed within a network of relationships organized around a flagship company with varying 'tiers' of subcontractors as well as relationships with other service providers and strategic alliances* (Ernst & Kim, 2001) (see Figure 1). One example of a GPN is Cisco, a US-owned company. Cisco only carries out new product definition and software development at its headquarters in Silicon Valley. However the bulk of more conventional R&D and significant development work on some products is done through technology and product development alliances with key suppliers such as chip, design and software firms. Instead of manufacturing products by itself, the products are assembled entirely by independent subcontractors in the U.S. and Asia. These suppliers are bound to Cisco through a variety of contractual arrangements, which typically do not involve an equity stake (Borrus et al., 2000).

Figure 1. The Nodes of a Global Production Network



Source: Adapted from Ernst and Kim, 2001.

GPNs typically consist of various hierarchical layers that range from network flagships that dominate such networks, down to a variety of usually smaller local specialised network suppliers. Conceptually, two types of global flagships are frequently identified: 1) brand leaders, such as IBM and Dell and 2) contract manufacturers, such as Solectron and Flextronics (Ernst & Kim, 2001). These contract manufacturers establish their own GPNs providing integrated global supply chain services to the 'brand leaders'. The essence of contract manufacturers is a division of labour between the "brand leaders," who design and market products, and firms which actually engage in manufacturing and the management of supply-chain functions. The relation between brand leaders and contract manufacturers is more complementary than competitive (Henderson & Phillips, 2004).

The global flagship firm is at the heart of the production network. They are frequently the brand name company which serves as the 'orchestrator' of lower tier specialised suppliers and subcontractors. They provide both strategic and organizational leadership for the production network. The power of lead firms comes from their control over critical resources and capabilities that facilitate innovation and from their capacity to coordinate transactions and knowledge exchange between the different network nodes. Flagships retain in-house activities which give them a particular strategic advantage, and outsource the ones that that do not. Some flagships focus on design, product development and marketing, and outsource volume manufacturing and related support services. Others outsource a variety of high-end, knowledge-intensive support services as well (Ernst & Kim, 2001).

There are two types of local suppliers in global production networks (Ernst, 2000). "*Higher-tier"* suppliers deal directly with global flagships and play an intermediary role between global flagships and lower-tier suppliers. Although they possess valuable proprietary assets (including technology) and specialized R&D, strategic marketing remains under the control of the network

flagships. Many Taiwanese higher-tier suppliers have their own mini-GPNs with dense linkages developed between geographically dispersed, yet concentrated and locally specialised clusters (Chen & Chen, 2001).

"Lower-tier" suppliers rarely interact directly with the global flagships; they deal primarily with local higher-tier suppliers. Lower-tier suppliers normally lack proprietary assets, are in weak financial positions, and are highly vulnerable to abrupt changes in markets and technology. Consequently, their main competitive advantages are their low cost and speed, as well as flexibility of delivery (Ernst, 2003).

The link between GPNs and upgrading is based on the notion that they may represent powerful carriers of knowledge which are deposited in the host country. One idea is that flagships need to transfer technical and managerial knowledge to the local suppliers. It is necessary to upgrade the suppliers' technical and managerial skills, so that they can meet the technical specifications of the flagships. Once a network supplier successfully upgrades its capabilities, this creates an incentive for flagships to transfer more sophisticated knowledge, including engineering, product and process development (Ernst, 2003).

Flagships transfer knowledge across borders through various mechanisms. Transfer may be mediated through the market, involving a formal contract for terms and conditions between the knowledge supplier and the knowledge buyer with payment involved. Knowledge may also be transferred informally without any payment involved. The flagship may play an active role, exercising significant control over the way in which knowledge is disseminated and used by the local supplier. Or, the flagship may play a passive role, having almost nothing to do with the way the local supplier takes advantage of available knowledge (Ernst & Kim, 2001). 'Market-mediation' together with 'the role of flagships' offers a useful two-by-two matrix that illustrates these mechanisms (see Figure 2).

Figure 2. Knowledge Transfer Mechanisms

The Role of Network Flagships

Market Mediation	Active	Passive
Market mediated	Formal mechanisms (FDI, FL, turnkey plants, technical consultancies) (1)	Commodity trade (standard machinery transfer) (2)
Non-market mediated	Informal mechanisms (flagship provides technical Assistance to local suppliers) (3)	Informal mechanisms (reverse engineering, literature) (4)

Source: Adapted from Ernst and Kim (2001)

Traditional multinationals have relied heavily on the mechanisms in quadrant 1 when setting up their plants either for the penetration of protected markets or for exploiting differential factor costs. In contrast, flagships transfer knowledge not only through mechanisms in quadrant 1 but also through mechanisms in quadrant 3. Knowledge diffusion through mechanisms in quadrant 3 illustrate that linkages with foreign firms are one of the critical strategies helping to upgrade local suppliers. In quadrant 2, machinery is a main source of process innovation for local suppliers. In this case, flagships might force local suppliers to purchase more advanced equipment for enhancing production capabilities. In quadrant 4, local suppliers acquire new knowledge through mechanisms such as reverse engineering of foreign products or observation tours of foreign firms.

Upgrading is regarded as the 'shift to higher value-added products, services and production stages through increasing specialisation and efficient domestic and international linkages' (Ernst, 2002, 2003). For others, the concept of upgrading refers to several kinds of shifts that firms or groups of firms might undertake to improve their competitive position in global value chains. It also involves insertion into local and global value chains in such a way as to maximise value creation and learning (Gereffi et al., 2001). Hence, the concept of upgrading is about local firms' insertion into the production network, learning from international firms, and then consequently moving up in position within global production networks or global value chains.

There are five types of upgrading which are not only relevant to the analysis of firms, but also to an understanding of how countries fashion development strategies to attempt to move themselves into relatively high-value, sustainable niches in the global economy (Gereffi et al., 2001). *Product upgrading:* firms can upgrade by moving into more sophisticated product lines (which can be defined in terms of increased unit values). *Process upgrading:* firms can upgrade processes by transforming inputs into outputs more efficiently through superior technology or reorganising the production systems. *Intra-chain upgrading:* involving several types of upgrading opportunities that exist within a particular value chain. Firms can acquire new functions in the chain, such as moving from production to design or marketing. Firms can also move backward or forward to different stages in a supply chain, such as moving from the production of finished goods to intermediates or raw materials. *Inter-chain upgrading*: this occurs when firms apply the competence acquired in a particular function of a chain to a new sector. For example, a company or a cluster of companies that specialise in graphite materials could move from making golf clubs and tennis rackets to racing bikes.

3. OVERVIEW OF THE TAIWANESE NOTEBOOK COMPUTER INDUSTRY

The Growing Global NB Computer Market

The size of the global NB computer market has grown five-fold between 1998 and 2004 (Table 1). This growth was driven by fierce price competition which saw the sale of NB computers increasingly replace sales of desktops. In 2005, one out of three personal computers[4] sold in the global market was a NB computer and the ratio is expected to grow[5].

[4] Personal computers include both desktop computers and notebook computers.
[5] Market Intelligence Center, 2003. 'Logistics Model of PC Industry across Taiwan and China.'

Table 1. The Taiwanese Notebook Computer Industry from 1998-2004

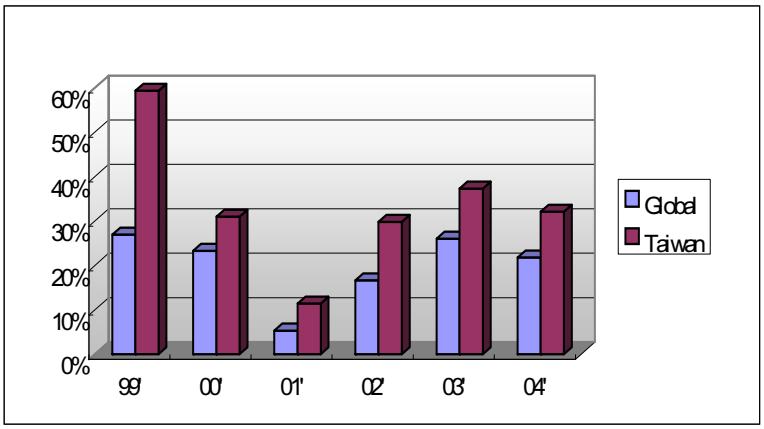
	1998	1999	2000	2001	2002	2003	2004
Volume [1]	6,088	9,703	12,708	14,161	18,380	25,238	33,340
Value [2]	$8,423	$11,073	$13,549	$12,239	$13,847	$16,809	$21,830
Average sale price	$1,384	$1,141	$1,066	$864	$753	$666	$655
Global market by volume [1]	15,610	19,816	24,437	25,747	30,033	37,857	46,110
Global market share by volume	40%	49%	52%	55%	61%	66%	72%

Source: Compiled by author from various reports of Market Intelligence Center and Economic Daily.
[1].Thousand units, [2].Million US dollars
Note: data refers to production by Taiwanese companies, both in Taiwan and offshore.

Growing Faster Than the Global Market

Global demand for NB computers has increasingly come to be supplied by the Taiwanese NB computer industry (Table 1). By 2002, Taiwanese companies had taken more than half of the global market share by volume, reaching over 70% in 2004. In fact, the rate of growth of the Taiwanese NB computer industry has been constantly higher than the volume growth rate of the global market since 1999 (Figure 3), which strongly suggests an influential position for the Taiwanese NB industry in the world.

Figure 3. Volume Growth Rate of Global Notebook Market and Taiwanese Company Production, 1999-2004

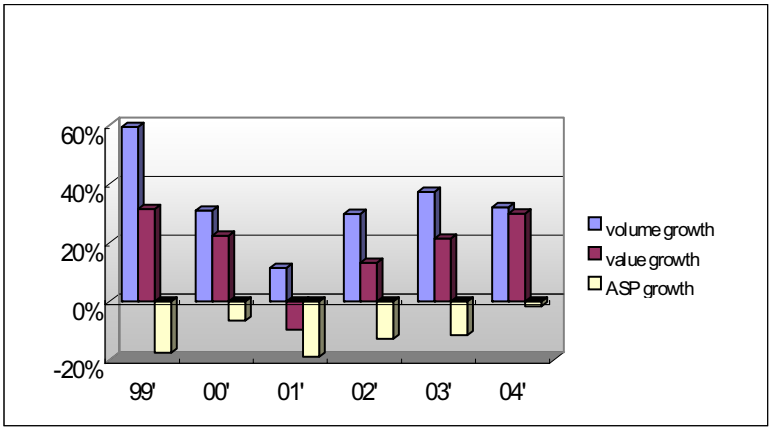


Source: Data from Table 1 in this article.

Growing in Volume but Not in Added Value

In spite of the fact that the Taiwanese NB computer industry keeps growing in volume every year since 1999, its 'average sales prices' (ASP) has been growing negatively ever since (Figure 4). Two reasons help explain this phenomenon: firstly, low price products introduced by flagship companies such Dell and HP since 2000; secondly, compared to Korean OEM/ODM companies, namely Samsung and LG, Taiwanese producers focus more on low- and middle-end products with lower added-value.

Figure 4. Volume/Value/ASP Growth Rate of Taiwan NB Production, 1999-2004

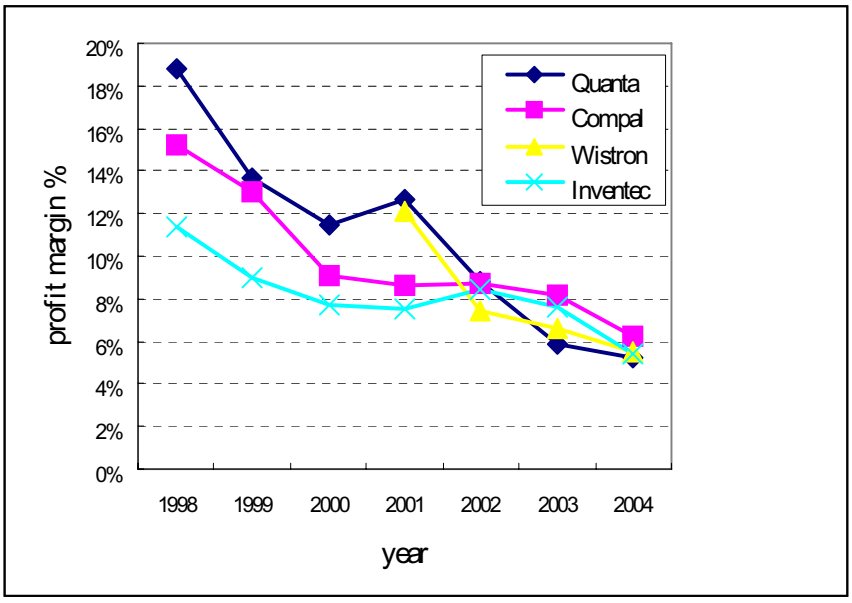


Source: Data from Table 1 in this article.

Strategies of Growing in both Volume and Added Value

A gradual decrease of the average sales price per unit has made NB computers made by Taiwanese companies a "commodity" product. The main Taiwanese producers have been struggling to maintain profit margins above five percent in the face of declining profit margins over recent years (Figure 5).

Figure 5. Profit Margin of Four Main Taiwanese NB Companies, 1998-2004



Source: Annual reports from companies. *Wistron data is only available after 2001, when it was spun off from Acer.

In response, several strategies have been adopted by Taiwanese companies for growing not only in volume, but in value. The first strategy is relocating manufacturing sites to countries with lower production costs, first in Southeast Asia but now almost entirely in China. Second is vertically integrating key manufacturing components in order to ensure stable components supply, and a higher profit margin. One source of profit for Taiwanese NB companies used to be purchasing components on behalf of flagship companies. However, as flagship companies have taken over procurement of more procurement components, the Taiwanese lose the profit earned from purchasing components. Thus, some began to build up their own factories producing components such as LCD-panels and DVD-ROMs so that flagship companies could buy components from Taiwanese NB companies instead of from a third party. The third strategy is to upgrade to the marketing function in the value chain. Most Taiwanese NB companies do not have their own brand products (see next section). In other words, most of them only focus on the manufacturing function of the NB computer value chain. However, companies such as Acer, Asus, and BenQ choose to expand their territory into the marketing area, and choose to develop their own brand products.

Three Types of NB Companies

There are three types of companies in the Taiwanese NB computer industry:

1) *Own-brand manufacturer (OBM).* A company whose products are sold under its own brand name. Companies in this category include Acer and BenQ. Acer was formerly one of main Taiwanese first-tier suppliers producing various computer-related products for international buyers. To deal with the conflict between own-brand business and OEM[6] (Original Equipment Manufacturer) business within an organization, the decision was made to separate OEMs from own-brand businesses. After the separation, Acer solely focused on marketing and R&D activities and outsourced manufacturing activity to OEM companies. BenQ is an Acer spin-off company and likewise, BenQ also outsources manufacturing activity to other OEM companies.

2) *Pure OEM business company.*[7]: A company of this type merely focuses on producing NB computers for flagship companies. In total, there are seven companies in this category. Among them, Quanta and Compal are the two largest with more than five million units ahead of others. Wistron is a spin-off company of Acer. Mitac and Inventec also produce NB computers for industrial and military use. FIC and Uniwill are also in this category (see Appendix 1 for company profiles).

3) *Mix of own-brand and OEM business.* Companies of this category not only produce NB computers for flagship companies through OEM or ODM contract arrangements, but also sell products with their own-brand name on them. A difference among companies of this type is how they are organized for own-brand businesses. Companies like Arima, Clevo, Elite,

[6] An OEM supply relationship refers to a contractual arrangement in which the contract manufacturer provides manufacturing services based on the product design, specification, quality, standard, and in some cases, designated components furnished by the outsourcing firm (Lee & Chen, forthcoming).

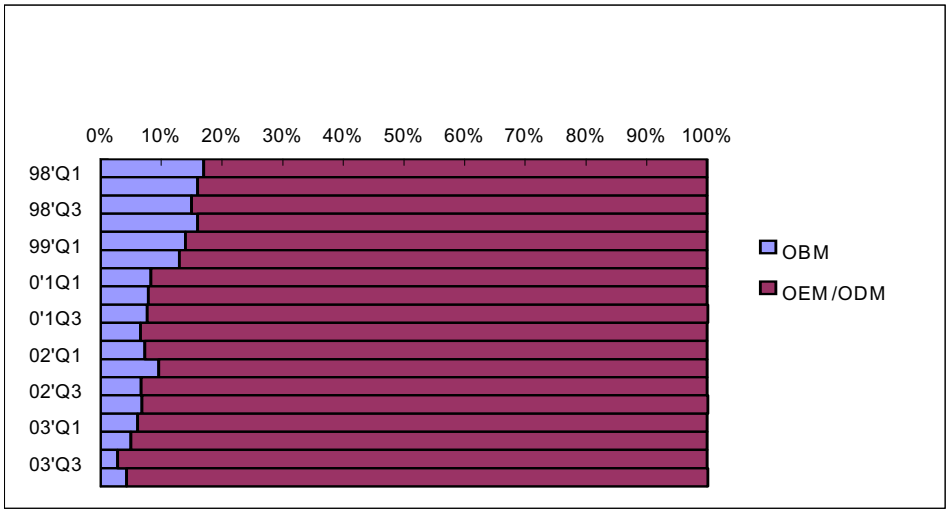
[7] If a supplier can provide product design and manufacturing outsourcing services, we may call this type of contractual arrangement ODM (own design, development and manufacturing) supply (Lee & Chen, forthcoming).

Twinhead have own-brand and OEM businesses placed within the same organization. In contrast, Asus' OEM business is allocated to its wholly-owned subsidiary. Thus, its own-brand and OEM business enjoy higher independence from each other compared to other companies. Sales and marketing of own-brand products for these companies tend to be rather small and limited in the Taiwan market, except for the fact that Asus has overtaken Acer as the number one brand in Taiwan, and continues to gradually expand in the overseas market.

OEM/ODM as Main Business

The Taiwanese NB industry is largely based on OEM/ODM business The proportion of OEM/ODM business is constantly higher than 80% and has reached as high as 95% in recent years (Figure 6). Due to the substantial proportion of OEM/ODM business, the Taiwanese NB computer industry has been particularly governed by flagship companies in aspects of price, volume and product strategy.

Figure 6. Volume Proportion between OBM and OEM/ODM Business, 1998-2004.



Source: Compiled by the author from various MIC reports.

Collaboration and Competition between Supplier and Flagship Company

Flagship companies usually have two or three first-tier NB computer suppliers (Table 2). Advantages of multiple suppliers include reducing risk in supply chain management and bargaining with different suppliers for a better price. As buyer-supplier relationships may change because of competition dynamics, there is a static relationship between flagship companies and Taiwanese NB suppliers (Table 2).

Table 2. Proportions of Outsource Manufacturing of Leading NB Companies in 2002

Company	Proportion of Outsourcing	Outsourcing to Taiwan	Outsourcing to Korea	Taiwanese Supplier
HP	100%	87%	13%	Inventec, Arima, Quanta
Dell	100%	95%	5%	Quanta, Compal, Wistron
Toshiba	24%	24%	0%	Compal, Inventec
IBM	40%	25%	15%	Wistron, Quanta

Source: Strategies of Global Leading NB Companies, MIC, 2003a.

It is argued that the upgrading effort of suppliers may be deterred by global buyers (Humphrey & Schmitz, 2000). This is true for the Taiwanese NB computer industry in terms of moving up to OBM production. When some Taiwanese OEM/ODM firms attempt to start their own-brand business by leveraging various resources and capabilities (Lee & Chen, forthcoming), at least two sorts of conflicts of interest occur: 1) Flagship companies' design and technology might leak to suppliers and then be used for developing suppliers' own-brand products; 2) Consequently, as the own-brand products of buyers and suppliers compete head to head in the market, their relationship then changes from buyer versus supplier to competitor versus competitor. Thus, flagship companies are less willing to give contracts to companies with own-brand business because of the worries of losing technology and cultivating a competitor.

There are several options for suppliers to avoid or minimize this conflict of interest. First, instead of developing own-brand products, suppliers can merely focus on OEM business, which is the choice of half of the Taiwanese NB companies. Second, suppliers can upgrade to pure own-brand business and allocate OEM business to a spin-off company. Until now only Acer has succeeded in using this strategy. Thirdly, suppliers can place OEM business in a subsidiary so that the level of conflict of interest decreases, which is what has been adopted by Asus.

4. OFFSHORE MANUFACTURING IN CHINA

Investment Regulations

Due to the political tension between Taiwan and China, Taiwanese investment activities are regulated by the Taiwanese government in terms of product, industry, amount of capital and technology transferred. The NB computer industry was categorized as a restricted industry by the Taiwanese government and was not allowed to invest in China until the end of 2001.[8] However, if an investment project in China was over 20 million US dollars, specific project reviewing is required for companies. Otherwise, only a general review process is needed[9].

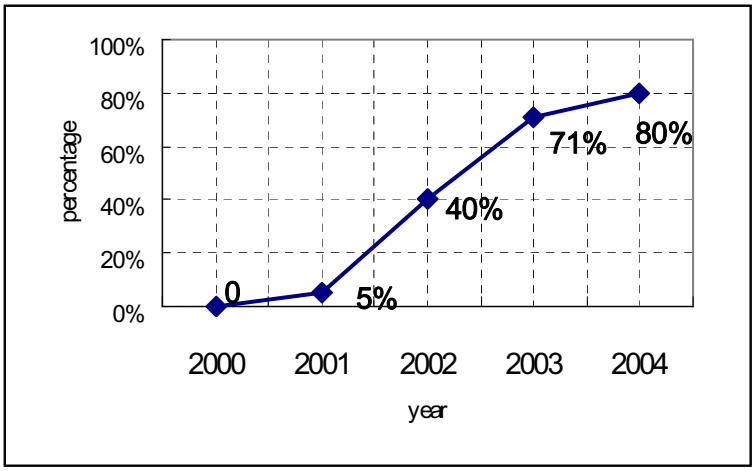
[8] NB computers were removed from the restricted investment list at the end of 2001. 'The influence of Taiwanese notebook computer industry investment in China" published by Market Intelligence Centre, 2003.

[9] More details about investment regulations could be found in 'Investment Commission, Ministry of Economic Affairs, www.moeaic.gov.tw

Offshore Manufacturing in China

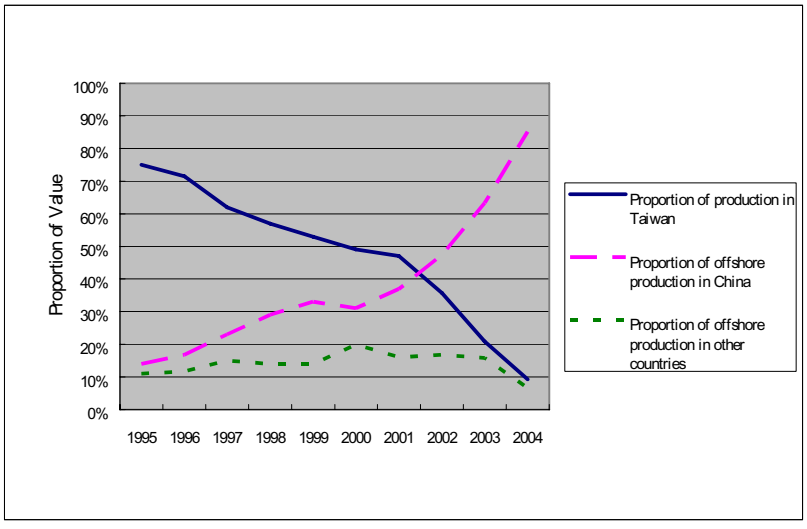
After the relaxation of investment regulations in November of 2001, the percentage of Taiwanese NB computers produced in China increased dramatically. By early 2004, the percentage of Taiwanese NB computers produced in China reached as high as 70% (Figure 7). The growing percentage of offshore manufacturing, either in China or other countries, does not only occur within the Taiwanese NB computer industry. By the end of 2004, more than 85% of Taiwanese information technology (IT) hardware manufacturing is done in China and relatively, less than 10% is done in Taiwan (Figure 8). Thus the exodus of the Taiwanese NB industry represents a widespread cross-strait geographic reconstruction happening in the Taiwanese electronics industry.

Figure 7. Percentage of Taiwanese NB Computers Produced in China, 2000-2004



Source: Compiled by the author from MIC reports.

Figure 8. Offshore Production of Taiwanese IT Hardware, 1995-2004



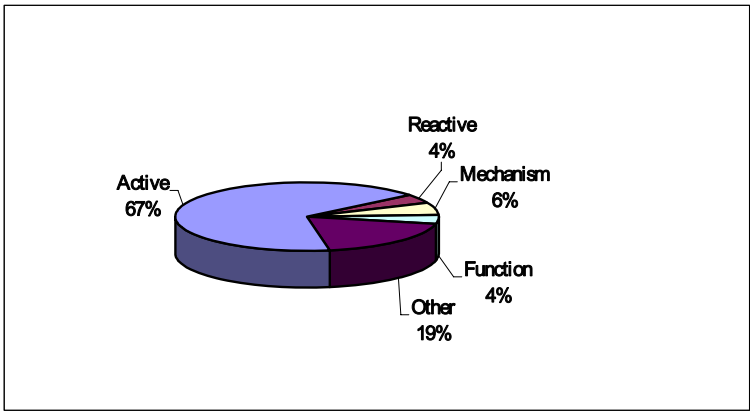
Source: Compiled by the author from MIC reports and China Times, 2004.

Why Leave Taiwan----Cheaper in China and Ability to Make More Profit?

Cost-savings is one of the main purposes of investing in China for many foreign firms, particularly those from other Asian countries (Gaulier et al., 2005). Nevertheless, from the case of the Taiwanese NB computer industry, it is clear that if the cost of logistics was included, offshore manufacturing in China does not make too much of a cost difference. Apart from that, relocation to China does not save the Taiwanese NB computer industry from decreasing profit margins.

Components for NB computer manufacturing can be divided into five categories: 1) Active components (i.e. LCD panel, CUP, chipset, memory); 2) Mechanism components (i.e. PCB, connector and switch); 3) Reactive component (i.e. capacitance, resistance and adaptor); 4) Function component (i.e. power supply, speaker, battery); and 5) Others (i.e. CD/DVD-ROM, hard disk (modulized component), case, keyboard (non-electronics component)). Taiwanese NB companies not only buy most of their active components but also CD/DVD-ROMs and hard disks from Japanese, Korean and US companies (Kuo, 2002), which means that there is about 70% to 80% of components purchased from other countries (Figure 9).

Figure 9. Cost Structure of NB Components



Source: Adapted from "Competition of NB Computer Components between Taiwan and China," Industrial Economics and Knowledge Center, Taiwan.

Normally these components are purchased with so called 'global prices', which means that the purchase price is not related to the location of manufacturing. Consequently, the difference of manufacturing in China and Taiwan in the components aspect would only derive from the price difference contributed by Taiwanese suppliers making components in China. Thus, production in China saves about 1% of component costs (6 U.S. dollars) per NB computer (Table 3, component subtotal). Combining the cost difference of components together with cost saved in items such as labour and electricity, offshore manufacturing in China is about 3% (21 U.S. dollars) lower per unit than in Taiwan. However, if cost of flight is added, the cost advantage of manufacturing in China decreases to 1.8% (12 U.S. dollars) of total cost.

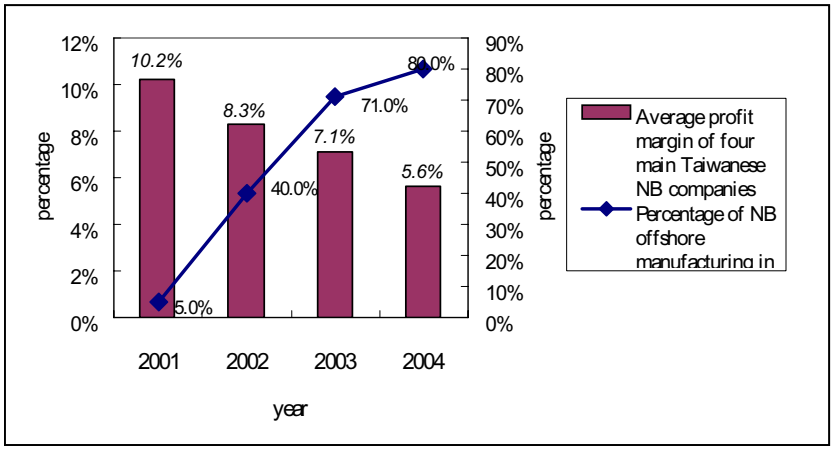
Table 3. Cost Difference between Taiwan and China

Item \ Location	Taiwan	China
CPU	170	170
LCD Panel	125	125
HDD	80	80
OS	65	65
Battery	32	30
DVD-ROM	35	35
Memory	30	30
Adaptor	19	18
Others	68	65
Component subtotal	*624*	*618*
Labour, electricity, etc.	30	15
Component and labour subtotal	*654*	*633*
Flight	8x3kg=24	11x3kg=33
Total	*678*	*666*

Source: MIC, 2003b, MIC presentation, 2005.
Note: Unit: US dollar. These prices are based on NB computer with 15" monitor, Intel Pentium M CPU, 256MB RAM and 40G hard drive.

Indeed, offshore manufacturing in China saves some cost for the Taiwanese NB companies. However, such relocation did not solve the profit margin squeeze. From 2001 to 2004, the percentage of offshore manufacturing in China grew every year, but the profit margin of four main Taiwanese NB companies decreased steadily during the same period (Figure 10).

Figure 10. Comparison of Average Profit Margin and Percentage of Offshore Production in China, 2001-2004



Source: Figures 5 & 6 of this paper.

5. CLOSED TAIWANESE PRODUCTION NETWORKS IN CHINA

Ownership Aspect of Investment Strategies

It has been suggested that joint-ownership of companies would be a channel for Chinese companies to learn from Taiwanese companies. As shown in Table 4, there is no evidence of a joint-venture company being established by Taiwanese NB companies and local companies. This means there has been no learning through the joint-venture channel for the Chinese electronics industry.

Table 4. Taiwanese NB Computer Company's Investment in China[10]

Company	Percent of Ownership	Location	Company	Percent of Ownership	Location
Quanta	100%	Shanghai	Compal	100%	Kunshan
Inventec	100%	Shanghai	Wistron	100%	Kunshan
Asus	100%	Suzhou	Twinhead	100%	Kunshan
Uniwill	100%	Suzhou	Mitac	100%	Kunshan
Arima	100%	Wujiang	Clevo	100%	Kunshan
FIC	100%	Wujiang	Elite	100%	Kunshan

No Chinese Suppliers in the Production Network

The Yangtze River Delta area has become the center of NB computer manufacturing because of the 'co-location' of twelve Taiwanese NB companies and five NB companies from other countries (Appendix 2, Table 5). Such an agglomeration of NB companies has provided local Chinese companies the opportunity for inter-organization learning through interaction with members of cluster (Bell & Albu, 1999).

However, as shown in Table 6, there are no local Chinese companies supplying Taiwanese NB companies. Thus, the prospect of Chinese companies learning through 'linkages' with the Taiwanese NB production network is gloomy for the local industry. For Taiwanese NB companies, components are sourced only from Taiwanese suppliers or suppliers from third countries such as Japan and the U.S. Components made by local Chinese suppliers are rarely purchased; at most only packing material such as boxes are sourced from Chinese suppliers[11]. Hence, this strongly suggests that the Taiwanese NB computer production network is a 'closed' production network with foreign companies operating in an enclave environment in China.

[10] Direct investment in China is restricted by the Taiwanese government. Taiwanese NB companies have to set up investment companies in a third country such as the British Virgin Islands and then invest in China through its investment company. See more details of related regulations in 'Investment Commission, Ministry of Economic Affairs'. www.moeaic.gov.tw.

[11] Interview 1, 3, 5, 7 & 9. (For a list of Interviews, see Appendix 4).

Table 5. Computer Manufacturers in the Yangtze River Delta Area

Taiwanese Company			Chinese Company			Other Countries		
Name	**City**	**Product**	**Name**	**City**	**Product**	**Name**	**City**	**Product**
Arima	Wujiang	NB	Lenovo	Shanghai	DT	Samsung	Suzhou	NB
Clevo	Kunshan	NB	TCL	Wuxi	DT	Toshiba	Shanghai	NB
Elite	Kunshan	NB				Sony	Wuxi	NB
Inventec	Shanghai	NB				HP*	Shanghai	DT+ NB
Quanta	Shanghai	NB				NEC	Shanghai	DT+ NB
Twinhead	Kunshan	NB						
Asus	Shuzhou	NB						
Compal	Kunshan	NB						
FIC	Wujiang	NB						
Mitac	Kunshan	NB						
Uniwill	Wuxi	NB						
Wistron	Kunshan	NB						

Source: Compiled by author.
*HP coordinates OEM/ODM manufacturing in China.

Table 6. Component Procurement Sources of Taiwanese NB Computer Companies by Volume

	Place of Production					
Item	**Taiwan**		**China**			**Others**
	Taiwanese company	**3rd Country Company**	**Taiwanese company**	**Chinese Company**	**3rd Country Company**	
CPU		2%				98%
LCD Module	30%		15%		55%	
Hard Drive						100%
Case	30%		30%		10%	30%
CD/DVD ROM	10%		10%		80%	
Chipset	25%					75%
Adaptor			70%		10%	20%
Fan	20%		20%			60%
Speaker	10%		10%		80%	
Microphone		80%			20%	

Source: Material given by analyst in MIC during interview, data was collected in 2003.

6. REASONS FOR BEING A"CLOSED" PRODUCTION NETWORK

Relocation of Whole Production Network

Linkage Permanence of NB Companies and Taiwanese Suppliers

Linkage permanence of Taiwanese NB companies and their Taiwanese suppliers stems from the nature of NB computer products development.

Normally suppliers provide customized components to NB companies. In some cases, collaborative-design takes place between Taiwanese NB companies and components suppliers[12]. Therefore, for some components, instead of changing suppliers in order to have cheaper components, NB companies prefer to work together with existing suppliers to improve cost and quality. As stated by a manager:

> '…We have some long-term collaboration with component suppliers because components are more customized. We have to start from the beginning if we use a new supplier. So we seek long-term collaboration to improve quality. It is not necessarily a good thing to change suppliers often. In principle, we work together with existing suppliers to improve quality; changing suppliers is our last resort'[13]

Flagship Companies' Quality Assurance System

Poor quality is the main reason why Taiwanese NB companies are reluctant to use components produced by Chinese suppliers.[14] This decision is due to the fact that the penalties for product defects make it financially risky to use unreliable components.

Product quality is highly regarded by flagship companies, so that comprehensive quality assurance systems are adopted to ensure quality of products bought from OEM companies. There are generally three levels of auditing in a quality assurance system. 1) System audit: focuses on OEM companies' business scale, customer base, supplier base, quality management system (ISO system), and security management system. 2) Process audit: focuses on engineers' experience and know-how, engineer testing equipment, routine manufacturing report checking, and engineering change management. 3) Final product audit: on-site account manager from flagship companies conduct OOB (out of box) sample checking. Prior to shipment of final products, on-site account managers check product's appearance, function and appliances as if they were the customer making the purchase.[15]

For OEM manufacturers, product quality is critical for winning contracts and maintaining relationships with flagship companies. A 'penalty agreement' is usually signed between OEM

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[12] Interview 9
[13] Quote from interview with a NB company manager in Yang & Hsia, 2004.
[14] Interviews 1,3, 5, 7 & 9
[15] Interview 5

manufactures and flagship companies. OEM manufacturers have to compensate flagship companies when defects occur. Though the amount of compensation is unknown, it is surely to be avoided by Taiwanese NB companies since their profit margin has been as low as 5%-6%. As a result of that, Taiwanese NB companies are cautious in choosing qualified components in order to keep the possibility of product failures to a minimum.

The Missing Link--- Business Norms and Practices

Flexibility and speed of Taiwanese NB companies mainly stem from their 'informal' agreements and interactions with Taiwanese suppliers, which is why trust is a critical element. The special business norms and practices of Taiwanese companies, compared to others, can be seen in the following statement given by a manager in a NB company:

> 'They (*suppliers*) know that you *(NB company)* are the boss so they listen to you. If you do business with foreign companies you have to sign many agreements. For Taiwanese companies, you just ask them to do what you want them to do. Because they know that you are a leader in the industry and they will have prosperity as long as they follow you. Thus, they do not talk about contract, agreement or terms & conditions with you. Things can be changed immediately if you want them to, it is very flexible'[16]. *(Italics added by the author).*

Instead of official legal arrangements, agreements are reached by oral promises so that Taiwanese NB companies can avoid rigidity and delays caused by extra administrative work. Taiwanese NB companies find it difficult to work with Chinese suppliers which not only have different business norms and practices, but a different mentality.[17] In fact, without business norms and practices, flexibility and speed are hard to achieve, which suggests a loss of competitive advantage.

Consequence of China's Trade and Industrial Policy

Domestic Market Quota Policy Promotes Vertical Integration

Though only one case was found during fieldwork, it is noteworthy that China's domestic market quota policy indirectly encourages vertical-integration of Taiwanese NB companies. Sales to China's domestic market are imposed with quotas for Taiwanese companies investing in China. Quotas are decided by the central government on the basis of criteria such as number of employees, wage level, and difference of value between imports and exports. The quotas policy does not seem to bother large companies because of the scale of their operations. However, it is difficult to get quotas for Taiwanese component suppliers since the majority of them are small and medium companies. Consequently, to supply Taiwanese NB companies, they need to export and then import components, which apparently not only delays suppliers' delivery time, but also complicates buyers' supply chain management. Therefore, in order to shorten supply

[16] Interview 9
[17] Interview 1

chain lead time, a company may choose to integrate its suppliers into the organization.

Small and Medium Enterprise is Neglected because of National Champion Policy

While more than 80% of electronics companies in China are small and medium enterprises (SMEs) (Table7), industrial policy which greatly favours large enterprises has undermined the development of the SMEs.

Table 7. Numbers of Large, Medium, and Small Enterprise in China, 2001-2003[18]

	2001	2002	2003
Large enterprise	499 (16.3%)	803 (8.9%)	824 (7.8%)
Medium enterprise	580 (18.9%)	873 (9.7%)	1017 (9.6%)
Small enterprise	1983 (64.8%)	7330 (81.4%)	8755 (82.6%)
Total	3062 (100%)	9006 (100%)	10596 (100%)

Source: China Electronics Industry Yearbook , 2004.

In the 1990s, a key theme of China's industrial policy was 'grasp the large, let go of the small', which aimed to develop a number of large enterprises to be the backbone of the Chinese economy and to be able to participate in international competition (Nolan, 2001). For the electronics industry, the goal was set in the 'Ninth Five-Year National Development Plan' to develop two or three domestic microcomputer manufacturers into enterprises with an annual production capacity of over 1 billion U.S. dollars (Kraemer & Dedrick, 2002 and 2001).

In the context of promoting large enterprises, Chinese SMEs face various obstacles. Among these obstacles is a lack of financial support from the government, which particularly limits the development of Chinese SMEs. Unlike other governments, which set up enterprise development funds specifically providing loans to the SMEs, China's government does not have such financial policies that practically target the SMEs. Meanwhile, the loan policy of Chinese banks is substantially in favour of large enterprises. As result, the town-village enterprises, which account for majority of Chinese SMEs, only represent 7%-8% of total loans in China (Lin & Wei, 2001).

Given that it is difficult to get loans from banks, self-accumulation is a main source of investment capital for Chinese SMEs. According to a 1998 survey, 81% of all Chinese SMEs self-fund more than half of their fixed assent investment. In contrast, only 10% of all SMEs in China use loans for more than half of fixed asset investment. Slow progress and a limited amount of self-accumulation capital constrain Chinese SMEs' capability of improving product quality and innovation. Lack of innovation capability and poor product quality naturally limit their opportunities of being a supplier for foreign companies.

[18] Companies are categorized into super-large, large, medium, and small companies according to their sales income and assets. If both sales income and assets are between 50 and 500 million RMB, it is categorized as a medium company. If sales income and assets are less than 50 million RMB, it is categorized as small company (Lin & Wei, 2001).

Table 8. Capital Sources of Fixed and Current Assent Investment

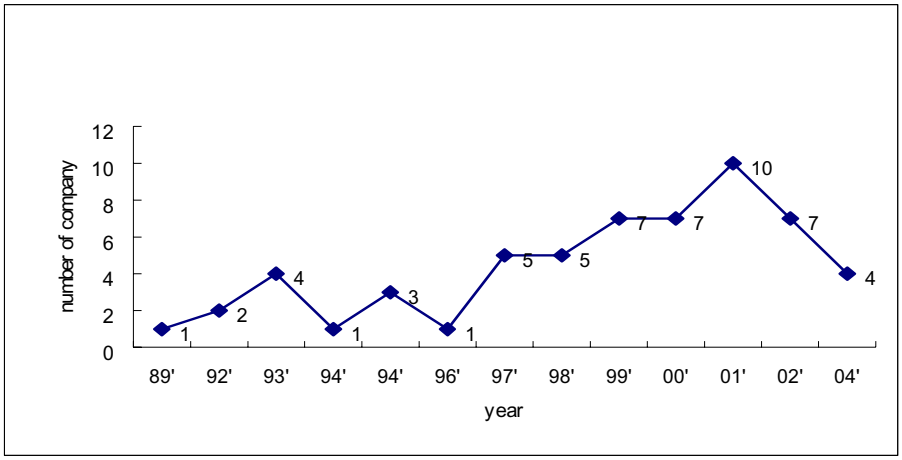
Proportion of Investment	Fixed Asset Investment			Current Asset Investment		
	Self-own (%)	Loan (%)	Others (%)	Self-own (%)	Loan (%)	Others (%)
0.0	8	77	84	9	67	81
0.1-49.9	11	13	7	12	20	10
50.0-99.0	14	7	5	24	10	5
100.0	67	3	4	55	3	4
total	100	100	100	100	100	100

Source: Lin, 2003

Taiwan Government's Involvement

Evidence suggests that a considerable number of Taiwanese suppliers had already established their operations in China (Figure 11)[19] prior to the relaxation of investment restrictions in 2001. Given that there are 11 companies which had no investment in China until 2004, 36 out of 57 main Taiwanese component suppliers had invested in China before 2001. Since there were many Taiwanese component suppliers available in China already, Taiwanese NB companies were less willing to find local Chinese ones.

Figure 11 . Number of Taiwanese Component Suppliers' Investment in China, 1989-2004



[19] List of main Taiwanese NB components suppliers are taken from the report 'Competition across the Strait in NB computer component industry' published by Industrial Technology Research Institute, Industrial Economics and Knowledge Center, Taiwan in 2002. Year of first investment in China is identified in company annual reports. For non-public companies, the year is identified in by the company websites.

7. DISCUSSION AND CONCLUSION

Governance Power in the Taiwanese Production Network

Governance power could be found in at least three aspects in the case of Taiwanese production networks: components assignment; quality assurance, and inventory risk sharing. As far as components assignment is concerned, most key components are assigned by flagship companies to first-tier suppliers; non-key components are assigned in some cases as well. Second-tier suppliers are also required by first-tier suppliers to only use components approved by them. By assigning components, flagship companies not only ensure the quality of final products, but also comprehend the cost structure of their suppliers, which gives them advantage for bargaining prices with suppliers. Therefore, the characteristics of the so called 'Taiwanese production networks' are rooted in the decisions of flagship companies from the U.S. and Japan. While Taiwanese NB companies have similar principles and practices as flagship companies in managing their suppliers (second-tier suppliers), the governance pattern is further extended from the relationship between the flagship company and first-tier supplier to the one between first-tier supplier and second-tier supplier.

Governance power could also be found in quality assurance and inventory risking sharing systems in the Taiwanese NB production network. In the principles of the 'quality assurance system,' suppliers have to be either assigned or approved by buyers. Failures in quality of products and components can cause penalties for suppliers. Both the flagship company and first-tier supplier prefer to use someone who is reliable with regard to quality and has a good reputation in the industry. First-tier suppliers also prefer second-tier suppliers which are financially capable of sharing penalty risks with them (i.e. being able to pay a penalty if poor quality occurs).

'Inventory risk sharing' is done by shifting part of the inventory risk, if not all, to upstream suppliers. Inventory risk is shifted from flagship companies to first-tier suppliers via the build-to-order (BTO) practice. The BTO practice is adopted to replace the traditional way of building to stock. This practice requires Taiwanese NB companies to produce products according to orders that are collected instantly on the Internet and then the product is shipped to designated places on time (Chen, 2003). Thus, inventory pressure and risk are transferred from flagship companies to Taiwanese NB companies. BTO is especially welcomed by flagship companies when the demand of the market is highly unpredictable.

Inventory risk is shifted from first-tier suppliers to second-tier suppliers via 'vendor managed inventory' (VMI)[20] supply chain management. VMI represents a common denominator in various industrial contexts where firms want to hold less inventory in the supply chain (Hines et al., 2000). What has been found from fieldwork studies is that suppliers are ordered to deliver components to warehouse hubs set up by NB companies. Prior to the use of components, they

[20] A working definition of VMI is 'a collaborative strategy between a customer and supplier to optimise the availability of products at minimal cost to the two companies. The supplier takes responsibility for the operational management of the inventory within a mutually agreed framework of performance targets which are constantly monitored and updated to create an environment of continuous improvement' (Hines et al., 2000).

are regarded as suppliers' inventory. At the end of an agreed upon period, NB companies only pay for units used, regardless how many are left in the warehouse. NB companies even charge suppliers for using their warehouse facilities. The suppliers incur increased inventory costs with a negative impact on liquidity and cashflow (Hines et al., 2000).

Some Explanations of No Linkages and Alternative Channels of Learning

The presence of foreign direct investment by Taiwanese NB companies does not promote linkages with local (Chinese) suppliers because the governance system raises both the quality and finance thresholds of those participating in global production networks. Given that 'quality assurance' and 'inventory risk sharing' are both norms in the Taiwanese NB production network, to be able to participate in global production, suppliers are compelled to have sufficient financial strength in order to share risk with other network members. Regrettably, finance capability is a weakness of small and medium Chinese enterprises. Therefore, an explanation of why linkages between the Taiwanese NB production network and local Chinese suppliers do not exist is that, besides poor quality, the weak financial strength of Chinese suppliers leaves them unable to share risks with other network members. In other words, instead of contributing to process and product upgrading (Humphrey & Schmitz, 2004), the governance system of global production networks could be an adverse element to wider participation in global economic activities for companies in less developed countries. For local suppliers in less developed countries to participate in global production networks, there are not only technology issues that need to be tackled, but also financial ones.

The findings of this research project also bring the notion of learning through global linkages into question. It would be pointless to discuss how dispersal of global production organization is advantageous to the local economy if linkage never exists. For that reason, we not only need to study when and how local suppliers could benefit from linkages with various networks and chains (ex. Ernst & Kim, 2001; Humphrey & Schmitz, 2004) but also *ask why linkages may or may not occur in the first place*. Apart from that, the GPN and development literature need to begin thinking more about what and how local suppliers could learn within a 'closed network.'

In spite of the fact that the Taiwanese NB production network has a limited contribution to the upgrading of the Chinese electronics industry through external linkages, it is conducive to the upgrading of the Chinese electronics industry in two alternative ways. Firstly, benefits could be reaped from R&D activities conducted in China. The process of producing a NB computer includes five phases: design, engineer verification test (EVT), design verification test (DVT), pilot verification test (PVT), and mass production (Appendix 3). Not long ago, design and all testing tasks were done in Taiwan and then passed to production sites in China for mass production. Today, not only is almost all of the PVT done by sites in China; DVT and EVT tasks have also been gradually taken up by engineers in China.[21]. Apart from testing tasks, software development is also carried out in China in some companies. One advantage of conducting software development in China is that one task could be divided into many small tasks and handled by many engineers at the same time. This way, the process of software development is sped up.[22].

[21] MIC, 2003 "logistics Model of PC industry across Taiwan and China.
[22] Interview 11

Secondly, personnel localization provides opportunity for learning managerial-related skills for Chinese locals. Personnel localization is favoured because the limited number of expatriates from Taiwan is not sufficient to sustain operations in China. This is exacerbated by the fact that operations in China are normally larger than their counterparts in Taiwan. In addition to limited availability of expatriates, lower wage level is also a reason why local Chinese managers are favoured by Taiwanese NB companies.[23]

Although the extent to which R&D activities will be allocated to China and the extent of future personnel localization in China is open to question, surely Chinese employees, both in managerial and engineering positions, could gain beneficial experience and skills from the training and education provided by their Taiwanese employers.

Further Research Issues

Given the empirical evidence found thus far, there are some issues that need further investigation for a more comprehensive understanding of the dynamics of global production networks.

Risks of inventory and quality failure are shared among product network members in order to survive in a highly volatile market. Risks are shifted from flagship companies to first-tier suppliers and then to second-tiers suppliers via practices such as BTO and VMI. In the end, who actually shares most of risk in global production networks? Who shares what kind of risks? What is the relationship between 'risk' and 'governance power' in global production networks? Does the one who shares more risk enjoy greater governance power in a global production network, in other words is the amount of shared risk equivalent to the amount of governance power? If not, why is the one who shares more risk but enjoys less governance power willing to stay in a global production network?

The lack of financial support and linkage-promoting policies create barriers that are hard to overcome between the Taiwanese NB production network and local Chinese suppliers. Nevertheless, China's national champion policy has encouraged another format of linkage between Taiwanese companies and Chinese companies, which is Taiwanese suppliers and Chinese branded PC makers. Yet, it is claimed that Chinese brand-name companies are poor in technology capability.[24] Questions posed here include: How critical is it to be technologically advanced in order to be a leader of a production network? How critical is it to have manufacturing capability or technology knowledge in order to upgrade to own-brand business in a production network? If there is a technological capability gap between Chinese brand-name companies and other flagship companies, what would be the distinction of Sino-Taiwanese production network and Anglo/Japan-Taiwanese production network in terms of operation modes and governance power? If Chinese buyers indeed learned from Taiwanese suppliers (reverse learning), it provides a contrary case to the literature often claiming that suppliers should learn from buyers.

[23] Interview 9
[24] Interview 1

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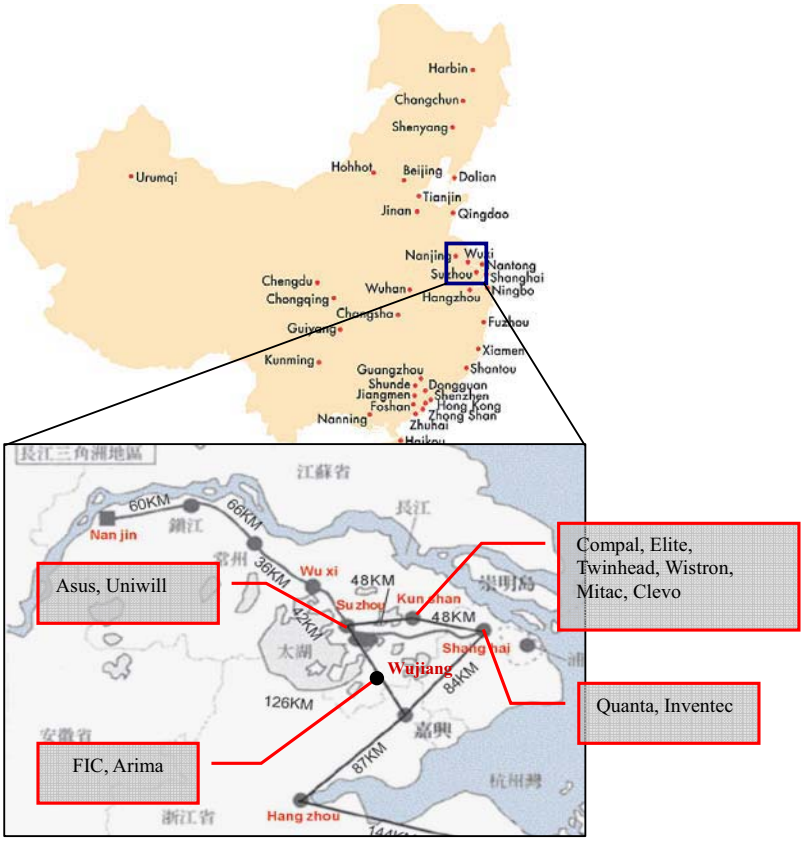
Appendix 1. Profiles of Taiwanese NB Companies

Name	*Product (proportion of income)*	*Number of Employees*	Main Customer	Proportion of sales income by region	Notebook Computer Sales Volume	Share of Taiwan's Export / of World market *
Arima,	Notebook Computer (78%) Components (23%)	1140	HP NEC Compaq	America (62%) European (4%) Asia (32 %)	838,512	3.3% / 2.2%
Asus	Notebook Computer (29%) Motherboard (32%) Multimedia (18%)	7036	Sony	North America (14%) Asia (42%) European (42%)	691,617	2.7% / 1.8%
Clevo	Notebook computer, LCD PC, Tablet PC (95%) Others (5%)	942	TCL	European (48%) Asia (36%) America (14%)	About 510,000	2.0% / 1.4%
Compal	Notebook computer Monitor Mobile communication	4360	Dell, HP, Toshiba, Fujitsu-Siemens, Acer, Apple	European (34.5%) Asia (34.3%) America (29.2%) Others (2.0%)	8,000,000	31.1% / 21.3%
Elite	Notebook computer (39.7%) Motherboard (48%)	3340	Apple, PC Wave	Asia /America/European	706,253	2.8% / 1.9%
FIC	Notebook & Desktop computer Motherboard	1798	NEC, Hitachi	*Not available*	*Not available*	*Not available*
Inventec	Notebook computer & Server (64%) Others (36%)	2119	HP, Toshiba, Compaq	Asia America European	*Not available*	*Not available*
Mitac	notebook computer (95%) Industry notebook computer (3%)	636	NEC, Sharp	*Not available*	961,885	3.7% / 2.6%
Quanta	Notebook computer (82%) Mobile Phone (5%)	4979	HP, Dell, Fujitsu-Siemens, IBM, Acer, Sony, NEC, Apple	America (39%) Asia (20%) European (33%)	9,677,000	37.6% / 25.8%
Twinhead	Notebook computer (95%) Others (5%)	330	Sotec, Trigem computer, Itronix	*Not available*	230,875	0.9% / 0.6%
Wistron	Notebook computer (62%) Desktop computer (11%) Other (27%)	3703	Acer, Dell, Fujitsu-Siemens, Hitachi	European (8%) Non-European & America (92%)	1,782,342	6.9% / 4.8%

Source: Year 2003 annual reports & *Business Times* (Taiwan) *The numbers in this column are calculated by author. Volumes of NB global market and Taiwan's export are adopted from 'Report of global NB Market 2004', published by MIC. Volume of global market in 2003 is 37,500,000; Taiwan's export volume was 25,710,000.

Appendix 2



Appendix 3

NB Manufacturing Process

Design	*EVT*	*DVT*	*PVT*	*MP*
Architecture design Product feature list	Basic function testing Parameter and specification setting	Temperature, anti-shock testing ect.	Small scale production and testing	Mass Production

Lead Time 3 months → 1.5 months → 1.5 months

Source: Logistics Model of PC Industry across Taiwan and China, MIC, (2003)

Appendix 4: Company Interviews

Interview	Date	Company/Institute	Interviewee
1	03/01/2005	Notebook computer company	Vice Senior Manager
2	03/08/2004	Marketing Intelligence Center	Senior Industry Analyst
3	04/10/2005	Notebook computer company	Product Manager
4	04/18/2005	Notebook computer company	Product Manager in International Procurement Office
5	04/28/2005	Notebook computer company	Senior Manager in Global Quality Assurance Office
6	05/03/2005	Notebook computer company	Vice-General Manager
7	05/11/2005	Notebook computer company	MIS engineer
8	05/18/2005	Notebook computer company	Internal Auditor
9	05/28/2005	Notebook computer company	Product Manager
10	06/21/2005	Notebook computer company	Senior Sales Manager
11	06/30/2005	Notebook computer company	R&D manager