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Industrial Upgrading and Global Recession: Evidence of Hard Disk Drive and Automotive Industries in Thailand

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Abstract

This paper illustrates the upgrading experiences of the automotive and hard disk drive (HDD) industries in Thailand, chosen because of their outstanding export performance in the developing world. An understanding of their upgrading experiences can shed some light on the ongoing debate regarding the relative importance of international production networks (IPNs) and industrial clusters (ICs) and their implications for prudential industrial policy. The impact of the recent global recession is also discussed in this paper. There is evidence of industrial upgrading in both the automotive and HDD industries. Yet one primary policy challenge still remains, that is, the limited role of indigenous suppliers in the multinational enterprise (MNE) production networks. This limited role is, to a certain extent, related to the overall incentive structure. Where these two industries differ is in their mode of networking, that is, whether they are part of an IPN or an IC. In the case of the automotive industry, industrial clustering has been observed and has reached a level where the local content of a locally manufactured vehicle is approaching 100%. In the case of the HDD industry, industrial clustering has naturally occurred and reached a certain level.

Even though the current global economic crisis has severely affected each industry's production and exports, the "hollow out" scenario is unlikely to apply to either. In other words, Thailand should remain a base of production and exports for MNEs, a situation which points to the need for continual industrial upgrading. Three policy-related conclusions are drawn in this paper. Firstly, the limited linkages between MNE affiliates and indigenous suppliers point to the need for a comprehensive study probing the potentially distorting effect of the cascading tariff structure—a key theme of tariff policy for the past three decades. Despite consecutive governments' efforts since the mid-1990s to neutralize the tariff structure, it is clear that much remains to be done. Secondly, the choice between an IPN and an IC is a purely private sector decision, driven by the nature of the particular industry. There is also the possibility of coexistence between IPNs and ICs. Industrial clustering can be a developmental outcome rather than a pre-condition of technological upgrading. Finally, to promote industrial upgrading process, the government should emphasize policies that strengthen the supply-side capabilities of local firms and create an investment climate that encourages further upgrading activities.

JEL Classification: F23, O33, O53, L62, L63

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1. INTRODUCTION

Industrial upgrading (henceforth referred to as "upgrading" for brevity) has always been a major challenge for policymakers in developing economies, i.e., how can firms compete in world markets at their current stages of economic development? It is even more crucial in economies such as Thailand's, where a number of industries are established but have not yet reached the world's technological frontier and are also under severe pressure to maintain international competitiveness driven largely by low wages for unskilled workers. Upgrading is a complicated task requiring a different set of competitive assets to previous stages of development. Changes in organizational and institutional structures are required in order for Thailand to achieve its mid-term target of becoming a global player in the mid-tech industries and to compete in those technologically advanced industries where skills are complex but not cutting-edge (Amsden and Chu 2003).

How firms upgrade is related to the global economic environment. Two forms of upgrading are discussed here, namely, international production networks (IPNs) and industrial clusters (ICs), both of which are important in determining trade and investment patterns and are highly policy relevant. While the growing importance of IPNs is widely recognized, they are far more important in the East Asian region where they have played a key role in integrating regional economies over the past two decades (Athukorala and Kohpaiboon 2009). On the other hand, the concept of ICs is popular among policymakers because clustering in an industry not only implies that most of the activities in the value chain are located in the same country, it is also indicative of a level of industrial deepening. When it comes to upgrading, IPNs and ICs are to a large extent mutually exclusive. The former highlights the importance of global integration, i.e., how links with the wider world promote the learning processes of local firms with regard to how to improve production processes and attain higher product quality. The latter, on the other hand, emphasizes the importance of local-level governance as a consequence of the web of interactions between firms in the same industry, among firms in different industries, and between firms and local institutions in the areas of industrial upgrading.

Upgrading becomes even more important in the event of a global recession. Although some signs of the bottoming out of the global economic contraction have been observed, the economic forces unleashed by this crisis will probably run rampant for years. Hence, a bleak recovery is expected. In addition, there has been a growing emphasis in Asian policy circles on the need for rebalancing growth—engineering a structural shift in aggregate domestic production away from exports and towards domestic markets (Asian Development Bank [ADB] 2009). How these policies would affect upgrading remains unclear.

Therefore, this paper aims to undertake a systematic analysis by bringing both IPNs and ICs together in the context of the upgrading experience. The analysis also extends to the impact of the global recession on upgrading. The hard disk drive (HDD) and automotive industries in Thailand were chosen for the issue at hand as they seem to be, to a certain extent, upgrading success stories. Thailand has become a major producer and exporter in the global economy. While (real) wages in Thailand have continued to grow, albeit on a lower growth path since the 1997–1998 crisis (Kohpaiboon 2009: Figure 1), the global export shares of both industries have shown an upward trend for a decade. Interestingly, as argued in previous studies, these industries exhibit different paths of their development. In particular, industrial clustering has been observed in the automotive industry over the past two decades whereas the HDD industry is a classic example of the development of IPNs. A

comparison of these two industries therefore offers insights and sensible policy lessons.

The paper is organized as follows. The following section (section 2) provides the analytical framework for discussing the rationales of both IPNs and ICs. Section 3 contains a comparison of the development of Thailand's HDD and automotive industries. Section 4 discusses the upgrading experiences of both industries and Section 5 discusses the challenges related to industrial upgrading in the recent global recession. The final section offers some concluding points and formulates some policy lessons.

2. ANALYTICAL FRAMEWORK

In this study the definition of upgrading is, to a large extent, in line with that used in previous studies, such as Waldner (1999), Gereffi (2005), and Doner (2009). Upgrading is defined as the activities undertaken by firms to maintain or increase income in the face of increasing competitive pressures. This can be done by either increasing the skill content of their activities or by moving into market niches which have entry barriers and are therefore shielded from competitive pressures. According to this definition, upgrading includes both product and functional upgrading. The former refers to moving into more sophisticated product lines, defined in terms of increased unit values, whereas the latter is about acquiring new functions to increase the overall skill content of activities. Note that the role of local content is treated as one feature of upgrading in this study. This is different to Doner (2009) where local content is treated as one of three components necessary for upgrading.[1]

International production networks (IPNs) refer to the globally organized nexus of interconnected functions and operations by firms and non-firm institutions through which goods and services are produced, distributed, and consumed (Coe, Hess, and Yeung 2004). Such networks not only integrate firms (and parts of firms) into international structures, but also integrate national economies in ways that have enormous implications for economic development. As a result of the increasing importance of IPNs, national and regional boundaries are being cut through in highly differentiated ways and traditional organizational boundaries blurred through the development of diverse forms of equity and non-equity relationships. Multinational enterprises (MNEs) have played a pivotal role in linking the countries in the Asian region to regional and global production networks.

While a consensus regarding the precise definition has not reached (Cortright 2006), an "industrial cluster" (IC) usually refers to a geographic concentration of interconnected companies and institutions in a particular field.[2] The idea of industrial clustering was very influential, especially among policymakers, throughout the late 1980s and 1990s as it was seen as a crucial step for industrial upgrading and deepening.

[1] The other two are shifting from lower-value to higher-value economic activities and producing at levels of price, quality, and delivery demanded by global value chains.

[2] This definition of cluster is, to a certain extent, in line with the concept proposed by Porter (1990). The reason Porter's definition is used here is simply because it is the most influential definition in policy circles (Yeung 2008). In fact, it is not widely accepted among academics. For example, Martin and Sunley (2003) argue that such a definition is vague and ambiguous and its policy implications very risky, given its one-size-fits-all approach to understanding clustering.

The potential effects of both IPNs and ICs on the success of upgrading have been highlighted in previous studies.[3] Each of them emphasizes the role played by non-market relationships in the coordination of economic activities. Such coordination can generate new ideas and knowledge diffusion, all of which makes upgrading successful. To a certain extent, the two approaches have different and mutually exclusive views on the role of coordination. The IC literature emphasizes the importance of local-level governance as a consequence of interactions between firms and local institutions. Crucial inputs for the upgrading process come primarily from the locality[4] and there are also various production inputs from the locality. Pioneered by Marshall (1920) in his *Principles of Economics,* clustering can help enterprises, small ones in particular, to compete, as the agglomeration of firms engaged in similar or related activities generates a range of localized external economies that lower costs for clustered producers. Such advantages include a pool of specialized inputs and services and the quick dissemination of new knowledge, all referred to as "external economies." Yet there is the conscious pursuit of joint action working over and above the so-called "Marshallian external economies" (e.g., Brusco 1990; Cooke and Morgan 1998; Humphrey and Schmitz 1998; Rabellotti 1997; Schmitz and Nadvi 1999). The results of studies in regional science, innovation studies, and endogenous growth (e.g., Lundvall 1993; Freeman 1995; Edquist 1997; Braczyk, Cooke, and Heidenrich 1998; Otsuka, 2006), strengthen the argument for promoting ICs insofar as clustering creates a conducive environment for innovation systems.

The importance of the links between local ICs and the wider world have not been recognized until recently.[5] For example, the extensive literature on Italian industrial districts (e.g., Pyke, Becattini, and Sengenberger 1990; Pyke and Sengenberger 1992; Cossentino, Pyke, and Sengenberger 1996) point to the importance of external relationships, especially among the export-oriented clusters. However, the relationships are characterized explicitly or implicitly by arm's length transactions, which is far different to those which occur within the IPN's quasi-hierarchical structure. Overall, the resources needed for industrial upgrading are found mainly within the improved organization that results from the concentration of interaction and effort within the cluster.

IPNs, on the other hand, take a very different view of inter-firm linkages. IPNs are also concerned with upgrading but the knowledge required for it flows through the chain. Particular attention has been given to the role of multinational enterprises (MNEs), as owners of capital and proprietary know-how that comes to constitute entry barriers for other firms. These MNEs also play an important role in determining the upgrading opportunities available to the firms from developing countries that participate in their production network. This occurs irrespective of firms' locations or whether they are affiliates or independent subcontractors. Firms in IPNs place more emphasis on learning from MNEs about how to improve their production processes, attain consistently high quality, and improve response times. This is very important for countries that already have basic industries, but find they are coming up against the global technological frontier and facing severe pressure to ensure profits are driven largely by low wages for unskilled workers . Learning from MNEs is in line with

[3] For example, Grossman and Helpman (2002), Helpman (2006), Athukorala (2008), Athukorala & Kohpaiboon (2009), Cawthorne (1995), Nadvi (1999), Schmitz (1995), Knorringa (1996), Rabellotti (1997), Sandee (1995) and Visser (1999).

[4] In a study of the connection between national exports and local industry clusters, Storper (1997) found that US strength in science-based high-tech exports and Italy's strength in design-intensive exports could be traced to regional industry clusters and the continuous, localized interactions between buyers and sellers which result in product-based technological learning.

[5] Yet from the beginning most cluster analysis has addressed the question of how a localized concentration of firms can compete effectively in global markets (Piore and Sabel 1984; Porter 1990).

the concept of "organizational succession," referred to in the literature on global value chains (e.g., Gereffi 1999). The finished product is made to the precise specifications of particular MNEs. Thus, to obtain the desired finished product, intensive inter-firm cooperation is needed (Hobday 1995; Hobday 2000). As a result of this, MNEs can considerably influence the business operations and technological capabilities of host country subcontractors. In general, MNEs (the principal contractors) provide technical know-how and services to ensure that subcontracting firms can produce quality components that meet specifications. Host country subcontractors need to demonstrate their potential to deliver the final goods, which requires that firms possess a certain level of production skill and technological capability. Usually, MNEs take part in the selection of capital equipment and the training of managers, engineers, and technicians, as well as give advice on production, financing, and management (Hobday 1995). This eventually raises the technological capabilities of host country subcontractors.

3. OVERVIEW OF THE HDD AND AUTOMOTIVE INDUSTRIES IN THAILAND

In this section, the two industries are briefly compared with regard to three aspects, namely, the surrounding policy environment, the role of MNEs, and past economic performance. The policy environment is discussed first, with an emphasis on examining the incentive structures that firms have faced over the past three decades. This is followed by a discussion of the role of MNEs in linking the countries within the region to regional and global production networks. The final section compares the economic performance of these two industries.

3.1 Policy Environment

When assessing the policy environment, this paper focuses on trade policy, which has acted as a major influence on the allocation of resources across industries over the past three decades in Thailand. There have been completely different trade policies affecting these two industries. The automotive industry is situated at one end of the protective policy spectrum, where since the early 1970s the Thai government has been heavily involved in creating a policy-derived incentive structure to promote local assembly activities. The HDD industry lies at the other end of the spectrum, where the policy environment has always been liberal.

With regard to the automotive industry, in its early stages the Thai government, along with other developing countries, enacted high levels of border protection against the import of completely built-up (CBU) vehicles and imposed local content requirements with the aim of creating linkages between various local supporting industries. Such a policy package is in line with the argument about the protection of infant industries. Promotion of the automotive industry can lead to the expansion of numerous complementary investments by auto parts firms, thereby laying down the basis for broad-based industrial growth. Since the early 1990s, however, policy measures towards the automotive industry have become more liberal (Table 1).[6] Despite the 1997 economic crisis, in 1998 the Thai government confirmed that it would honor its World Trade Organization commitment to abolish local content requirement (LCR) policies on schedule in January 2000. While protection of the automotive industry

[6] For example, the Ministry of Commerce replaced passenger-car import restrictions with tariff measures. Tariff rates for CBU passenger vehicles over 2,400 cc were reduced to 68.5% in 1992, from 300% prior to 1991.

remains high compared to other industries, absolute protection has been considerably reduced for the auto assembly industry since the early 1990s.

Table 1: Tariffs on Completely Built-Up (CBU) and Completely Knocked-Down (CKD) Vehicles

(%)

	Before 1992	1992	1999	2000–present
Completely built-up (CBU) vehicles				
Passenger cars over 2,400 cc [a]	300	68.5	80	80
Passenger cars under 2,400 cc [a]	180	42	80	80
Pick-up trucks	120	60	60	80
Completely knocked-down (CKD) vehicles				
Passenger cars over 2,400 cc [a]	112	42	20	33 (30) [b]
Passenger cars under 2,400 cc [a]	112	42	20	33
Pick-up trucks	72	20	20	33

[a] Prior to 1992, the classification of a passenger vehicle was 2,300 cc

[b] The number in parenthesis is the 2005 tariff

Source: Official Document from Ministry of Finance, Thailand (2009).

During the 1990s, when there was evidence that a number of carmakers had decided to export vehicles from Thailand, the Thai government focused on promoting supporting industries, particularly the mold and die industry. The indigenous suppliers in these industries were presumed to have a comparative advantage and the ability to intensively collaborate with MNE affiliates. Examples of some of the initiatives instituted by the government are the establishment of: the Thailand Board of Investment (BOI) Unit for Industrial Linkage Development (BUILD) (1991); the National Supplier Development Program (1994); the Metal Industries Development Agency (1995); the Automotive Development Institute (1999); the National Institute of Molds and Dies (2003); and the Automotive Human Resources Development Project (AHRDP) (2006). All of these initiatives reflect the market-friendly orientation of policy design over the past three decades (Kohpaiboon 2006a) and the policymakers' ideological conviction that the assemblers would become the key drivers for the industry's development path and that inter-linkage with MNE affiliates would open a channel of technology transfer to indigenous suppliers. However, these policy efforts have not achieved much thus far, due to small budget allocations and the country's general problems when it comes to policy implementation (Doner 2009). This conclusion is consistent with the interview results reported in Kohpaiboon (2009b), in which neither automakers nor suppliers assigned much importance to policy.

In the HDD industry, tariffs related specifically to this industry (both intermediate and final goods) were lower, generally speaking, than average rates throughout the period 1995–2006. However, the tariff structure is somewhat distorted, as the tariffs on intermediate goods are consistently higher than those on final goods (Table 2). Nonetheless, the distortion resulting from such a tariff structure is offset by the presence of various tariff exemptions/rebate schemes. Since most of the HDD makers and their parts' suppliers are foreign-owned and export-oriented (McKendrick, Doner, and Haggard 2000), they are eligible for the investment

privileges offered by Thailand's Board of Investment (BOI), some of which are the tariff exemptions that started to be offered in 1983.[7]

Table 2: Tariff Structure in the Hard Disk Drive Industry 1995–2006

(%)

	1995[a]	2002	2003	2006
Hard Disk Drive HS 847170)	9.8	0	0	0
Inputs				
1. Wafers (HS3818)	11	0	0	0
2. Printed Circuit Boards PCBs) (HS8534)	14	8	4	0
3. Integrated Circuits (HS8542)	14	0	0	0
4. Semiconductors (HS8541)	14	1	1	0
5. Motors	14	9	8	8
5.1 Finished Motors (HS8501)	14	8	7	7
5.2 Parts for Motors (HS8503)	14	10	10	10
6. Ball Bearings HS848210)	10	10	10	1
7. Aluminum Plates HS 7601)	19	1	1	1
8. Media (HS 852390)	14	9	7.4	0
Average Manufacturing Tariffs	21	14.3	13.3	11.1

Tariffs for the period 1995 are proxied by the corresponding HS at 2 digit. For example, tariff of HS847170 in 1995 is proxied by the average tariff of HS 84.

Source Office of Fiscal Economics, Ministry of Finance, Thailand

In the new millennium, the policy emphasis with regard to both industries has shifted away from protectionism and tax incentives and toward strengthening the supply-side capabilities of firms, and indigenous suppliers in particular, for e.g., by promoting human capital development, financially supporting research and development (R&D) projects, and strengthening linkages between MNEs and indigenous enterprises. There are several government agencies involved, such as the National Electronics and Computer Technology Center, the Ministry of Science, the Offices of Industrial Economics, the Ministry of Industry, and the BOI. Most of the policy measures are the result of close consultations with the private sector. For example, many of the R&D projects initiated by the private sector are co-financed by the government. The proportion of the government's financial contribution is dependent on whether the project's outcomes will remain proprietary or become common knowledge. The more common the knowledge created by the projects, the larger the government contribution.

These policy measures contribute, to a certain extent, to the increased local content ratio observed nowadays.[8] For example, the imported content of HDDs had dropped from 90% in the early 1990s to about 50% in 2006, whereas the local content of vehicles is virtually 100% (Kohpaiboon 2009a; Kohpaiboon 2009b). As argued in Kohpaiboon (2009c), the nature of product fragmentation is different in both industries and this gives rise to the observed differences in local content.

[7] It is worth clarifying the difference between tariff exemptions granted by the BOI and alternative schemes. While tariff exemptions and tax rebate schemes are administered by the Department of Customs, the BOI scheme constitutes a prior exemption scheme that is less cumbersome than the two existing schemes. After receiving approval from the BOI, export-oriented included firms are automatically allowed to access their imports without a delay to calculate and pay levies. This reduces customs procedures which before 1997 were considered unusually cumbersome and imposed costs on importers (European Commission [1999] and United States Trade Representative [1999] cited in Warr 2000).

[8] See the increased local content in Section 3.3

The largest remaining policy challenge is the weak link between MNE affiliates and indigenous suppliers. MNE affiliates in these industries have virtually operated in an enclave. Interestingly, the limited link with indigenous suppliers has also been observed in other export-oriented industries such as the garment industry, in which export-oriented garment firms working in enclaves rely more on imported fabrics (Kohpaiboon 2009c). Local textile producers manufacture different kinds of fabrics not really used for garment exports. The limited link occurs regardless of the design of industry-specific policy. It has also been observed in other industries in Southeast Asian economies such as Malaysia's (Yusuf and Nabeshima 2008) and Indonesia's (Athukorala and Santosa 1997; Narjoko 2007). While it is beyond the scope of this paper to provide a satisfactory explanation for this phenomenon, we suspect it is related to the dualistic trade policy—popular in the region since the early stages of implementation of export-oriented industrialization strategies—whereby both tariffs and tariff exemptions/rebate schemes are used extensively. Under this dualistic trade policy it is unlikely that export-oriented firms would create backward linkages to local suppliers given that there are tariffs on locally manufactured inputs whereas imported inputs are eligible for tariff exemption/rebate schemes.

3.2 Patterns of Multinational Enterprise Involvement

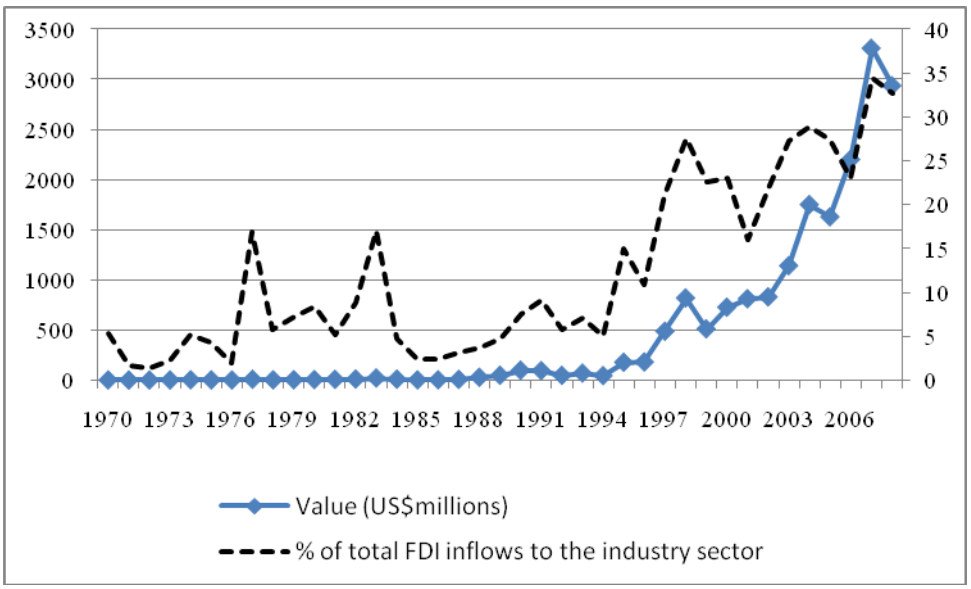
Both industries share a common feature, that is, that multinational enterprises (MNEs), especially from developed countries, play a dominant role. These enterprises are in leading positions in terms of research and development, as well as marketing, distribution, and post-sale services. Interestingly, their involvement occurs in the form of equity participation. This is in contrast to traditional labor-intensive products, like footwear and clothing, in which MNEs participate through their buyer links (Gereffi and Memedovic . 2003; Kohpaiboon 2006a).

MNEs have become increasingly involved in the Thai automotive industry since the mid-1980s. Figure 1 illustrates foreign direct investment (FDI) inflows of machinery and transport equipment—in both dollar terms and as a percentage of total industry sector FDI inflows—for the two industries between 1970 and 2008. FDI inflows were more or less unchanged from 1970 to 1985, with annual inflows amounting to less than US$5 million. Machinery and transport equipment's share of total manufacturing FDI inflows was around 5% except for spikes in 1977 and 1983 due to "protection-jumping" FDI in automotive industry.[9] After this, the annual average value of FDI inflows increased dramatically to US$37 million and US$87 million for the periods 1986–1990 and 1991–1995 respectively. After the 1997 crisis, FDI inflows continued to increase. Their value reached its peak in 2007 at US$3.3 billion and then declined slightly, `to around US$2.9 billion in 2008. The dramatic increase in FDI inflows reflects the extensive development of the manufacturing sector, which accounted for 26.6% of total FDI inflows between 2000 and 2008.

[9] In 1978, high tariffs on completed built-up (CBU)vehicles were replaced with an import ban and import tariffs on completed knock-down (CKD) kits were raised to 80 per cent. The new high local content requirement at 50 per cent was set to achieve by 1983. See detail in Kohpaiboon (2006a).

Figure 1: FDI Inflows in Machinery and Transport Equipment in Thailand 1970–2008

(US$ million, % of total FDI inflows to industry sector)



Note: The data for 2008 is preliminary only

Source: Official data provided by Bank of Thailand

The huge increase in FDI inflows was a result of both incumbent firms' capacities for expansion and the entry of new firms. In the automotive industry, MNE involvement increased at a phenomenal rate in the mid-1990s. Not only did Japanese affiliates upgrade their production, the US big-three MNEs (i.e., Ford, General Motors, and Chrysler) re-entered the market in the mid-1990s, just before the 1997 crisis. Some MNE parts suppliers followed their carmaker customers and their number increased from around 30 firms in 1971 to 312 firms in 1985 (Kohpaiboon 2006a: 199). Incumbents also expanded their existing activities and introduced new parts.[10]

MNE involvement in the HDD industry started after Seagate Technology shifted its head-stack assembly (HSA) operation, the most labor intensive part of the HDD production process, out of Singapore and into Thailand in 1983. From then on, the HDD industry began to form a clustering pattern. Seagate expanded their existing HSA capacities, commenced high-volume operations in head-drive assembly (HDA) in Thailand in 1987, and began manufacturing spindle motors in 1994. This shifting of HDD production to Thailand produced net gains over other HDD firms. In addition, Seagate Technology trained numerous technical workers and thereby enlarged the availability of skilled labor (McKendrick et al. 2000). This, in turn, created a magnetic effect, enticing other key players such as IBM (1991), Fujitsu (1991), Western Digital (2001), Hitachi Global Storage (2004), and Toshiba (2008) to set up operations in Thailand.[11]

Many MNE parts suppliers like NMB Technologies (1988), T.P.W. (1989), Nidec (1989), KR Precision PCL (1988), and Magnetric (1992) also established operations in Thailand. The number of firms operating in the HDD industry increased from 5 firms in the period 1981–1985 to 74 firms in the period 2001–2006 (Table 3). The industrial clustering observed in both industries in Thailand supports the argument

[10] See Kohpaiboon (2009b), Figure 5, for the experience of Denso (Thailand).

[11] In 2008, Toshiba started producing HDDs in Thailand, using Fujitsu's production facilities. This arose as a result of a joint investment made by the two companies for manufacturing HDDs.

that there is a general tendency for MNE affiliates to become increasingly embedded in host countries the longer they are present and the more accommodating the overall investment climate of the host country becomes over time (Rangan and Lawrence 1999).

Table 3: The Number of Enterprises in the Hard Disk Drive Industry in Thailand 1981–2006

	1981–1985	1986–1990	1991–1995	1996–2000	2001–2006
Number of enterprises *	5	18 (13)	36 (18)	51 (15)	74 (23)
Name (year of commencement of operation) - operation	1. Seagate (1983) - HSA 2. GSS Arrays (1985) - HSA 3. Fujikara (1985) - Actuators 4. NMB (1985) - Bearings and spindle motors 5. GSS (1985)- PCBs	1. Seagate (1987) - Disk assembly 2. KR Precision (1988) - Suspension 3. Seagate (1989) - HGA 4. Micropolis (1988) - HSA 5. IBM/Saha Union (1989) - HSA 6. Read-rite (1989) - HSA 7. Seagate (1986) - Spindle Motors 8. NMB (1988) - Spindle Motors 9. Nidec (1989) - Spindle Motors 10. Elec & Eltek (1988) - PCB 11. SCI (1988) - PCB 12. TPW (1989) - Base plates 13. Magnetric (1990) - HGA	1. Fujitsu (1991) - Disk assembly 2. Avatar Peripherals (1995) - Disk assembly 3. IBM/Saha Union (1991) - HGA 4. Read-rite (1991) - HGA 5. Minibear (1994) - HGA 6. Fujitsu (1991) - HSA 7. Magnecomp (1992) - Suspension 8. Fujitsu (1994) - Actuators 9. TDK (1992) - Voice coil magnets 10. Hana (1993) - Voice coil magnets 11. NHK (1994) - Bearings 12. Seagate (1994) - Magnets 13. Daido (1995) - Magnets 14. Seagate (1994) - PCBs 15. Hana (1993) - PCBs 16. Boron (1995) - Flex circuits 17. Wearnes Precision (1994) - Housing and base plates 18. NHK Precision (1993) - Housing/base plates	1. IBM-SPT (1997) - Disk assembly 2. Fujitsu (1999) - HGA 3. Maxtor (1996) - HSA 4. IBM-SPT (1997) - HSA 5. Boron (2000) - Flex suspension 6. Eng Precision (1999) - Actuators 7. Fujitsu (1994) - Actuators 8. Measuren (1998) - Actuators 9. Habiro (1995) - Hubs & O-rings, sleeves, brackets 10. Nippon Super (1996) - Hubs & O-rings, sleeves, brackets 11. Advanced Magnetic Materials (1998) - Magnetic powder 12. Ad Flex (1996) - Flex circuit and suspension assembly 13. Asahi Komag (1996) - Polished substrates 14. Arrow mizutani (1998) - Heat sinks 15. G.D.P. (1998) - General machining	1. Benchmark Electronics (2007) - Flex suspension 2. Comp Part Precision (2003) - Arm coils 3. Innoven (2002) - Printer Flex 4. Innoven (2005) - PCBs 5. LCET (2006) - Coil assembly 6. LCET (2005) - Membrane switch circuit assembly 7. LCET (2004) - Write-Read Heads 8. PCTT (2007) - PCBAs 9. PCTT (2006) - FPCBs 10. PCTT (2003) - FPCBs multi layer 11. Intreflex (2006) - Metallic parts 12. Cal Comp electronics (2007) - Semi-PCBA 13. Star microelectronics (2005) - PCBAs 14. Beyonic Technology (2002) - Base plates 15. Single point parts (2006) - Ring motors, sleeves, shafts 16. Chin-ed Su Magnetic (2006) - Voice coil motors 17. MPN technology (2005) - Base plates 18. World Precision (2004) - Base plates 19. Altum Precision (2006) - Base plates 20. Silatic (2004) - PCBAs 21. Prem Star (2006) - PCBAs 22. Prem star (2006) - electronic micro assembly

FPCB = Flexible printed circuit board; HSA = Head-stack assembly; HDA = Head-drive Assembly; HGA= Head-gimbals Assembly PCBAs = printed circuit board assembly;

Note:* The numbers in parentheses in the number of enterprises row indicate the number of additional establishments from the preceding period.

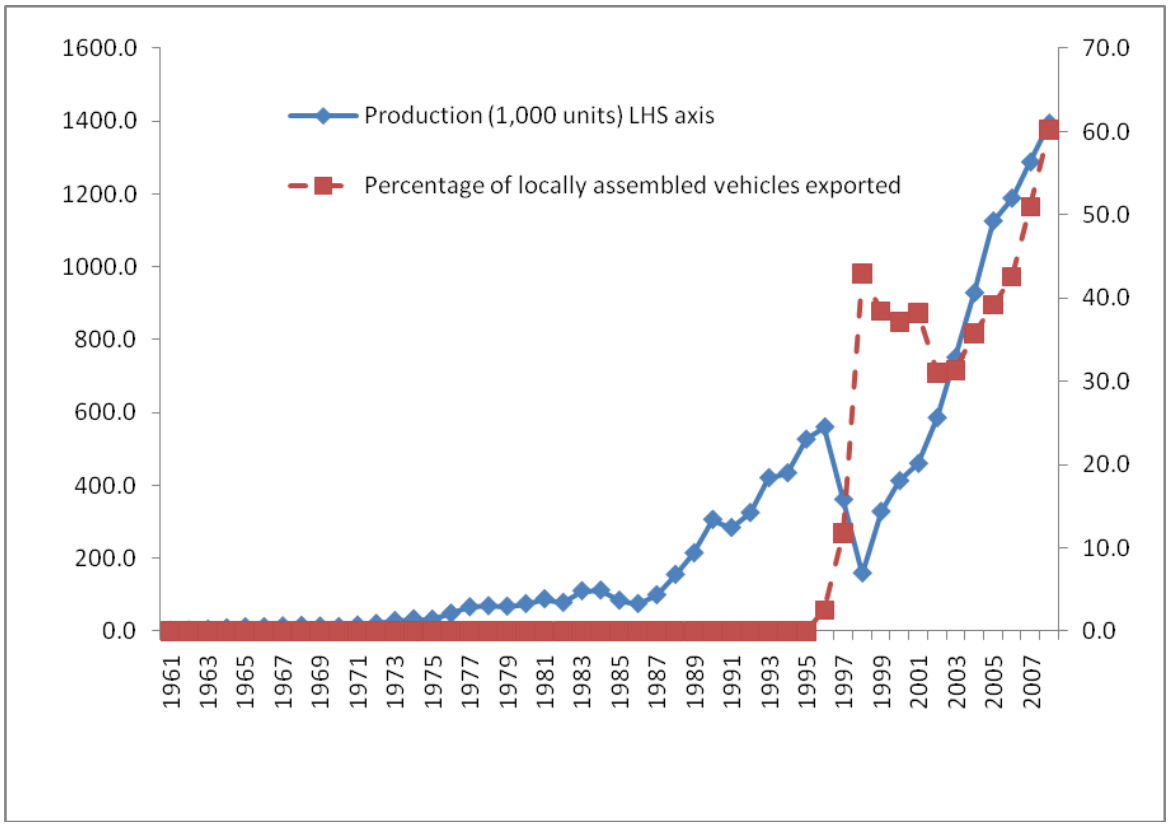
Sources: Data for 1981–2000 are from McKendrick et al. (2000) and data for 2001–2006 are from Kohpaiboon (2009a)

3.3 Economic Performance

Both the HDD and automotive industries are part of Thailand's leading export-oriented sector. Initially geared toward import-substitution, the Thai automotive industry has been shifting toward an export orientation since 1996. The industry's export-output ratio surpassed 50% in 2005 (Figure 2). Its export value increased from about US$1 billion in 2000 to US$5 billion in 2007—largely the result of the CBU vehicle becoming the industry's major export item. The predominant role of parts, which accounted for the lion's share of the industry's exports prior to 1996, has been replaced by that of CBU vehicles. As indicated in Figure 3, the export value of auto parts grew moderately, with average annual growth of around 10% during the period 2000–2007. Its growth performance was far behind that of CBU vehicles. As a result, the share of parts in the industry's exports declined sharply from around 80% during the first half of the 1990s to around 52% in the period 2000–2007.

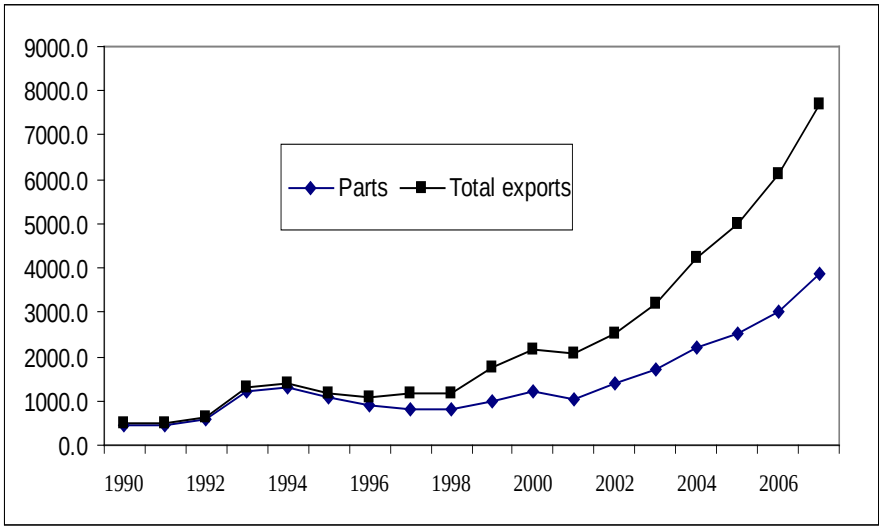
Figure 2: Volume of Vehicle Production and Share of Vehicles Exported 1961–2008

(Production units 000's, % share of vehicles exported)



Source: Thai Automotive Association

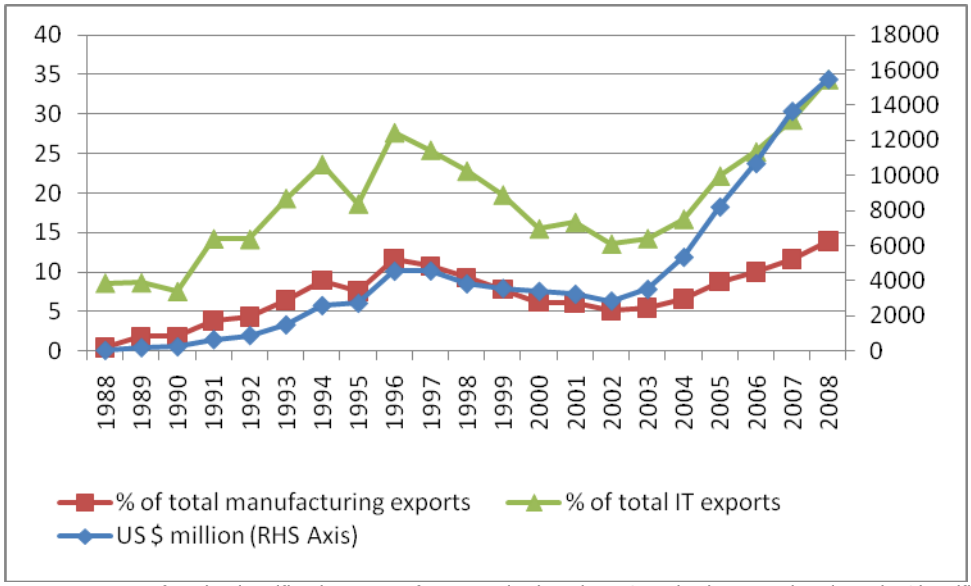
Figure 3: Export Values of Thai Automotive Industry 1990–2007 (US$ million)



Source: Kohpaiboon (2009b)

Conversely, the HDD is one of the most important of Thailand's electronics exports and the industry has always been export-oriented. Its export value increased from US$37 million in 1988 to US$4.5 billion in 1996–1997 (Figure 4). Between 1999 and 2003, there was a slight downward trend in export value as a consequence of the global crisis in the information technology (IT) industry. The HDD industry's export value dropped to an average of US$3.4 billion over the period 1999–2003. Since then, HDD exports have grown at a phenomenal rate, reaching values of US$8.2 billion in 2005 and US$15.5 billion in 2008. Consequently, HDD exports accounted for 45% of Thailand's total IT exports and 15% of Thailand's total exports in 2008.

Figure 4: Thailand's HDD Exports 1988–2008 (%, US$ million)



Notes: In terms of trade classifications, IT refers to United Nations Standard International Trade Classification (SITC) 75–77. Manufacturing refers to SITC 5–8 less 68 (metals) and HDD refers to HS 847170 (computer data storage units).

Sources: Author's compilations based on data from UN Comtrade database, available at http://comtrade.un.org/db/

Thailand is one of the world's major producers of both vehicles and HDDs. Table 4 shows the distribution of vehicle production around the world over the period 2000–2008. While the majority of vehicles are still manufactured in developed countries, developing countries, notwithstanding the three developing countries with enormous domestic markets, i.e., the People's Republic of China (PRC), India, and Russia, are still of relative importance. Interestingly, production capacity is concentrated in only the handful of developing countries that participate in production networks. Nine of the developing countries listed in Table 4 (Brazil, Mexico, Thailand, Ukraine, Czech Republic, Poland, Slovakia, Argentina, and Indonesia) accounted for 33% of the total vehicle production that took place in developing countries in 2008. This share increased from 13% in 2000. In Southeast Asia and Oceania, Thailand was the major hub for vehicle production and accounted for about 12% of total vehicle production in developing countries.

Table 4: World Vehicle Production 2000–2008

(Millions of units, % of total vehicle production)

4.1 All Types of Vehicles

	2000	2005	2006	2007	2008
Total vehicle production	58.4	66.5	69.2	73.2	70.5
% of total vehicle production					
Developed countries	74.9	64.2	61.0	57.7	53.9
India	1.4	2.5	2.9	3.2	3.3
People's Republic of China	3.5	8.6	10.4	12.1	13.3
Russia	2.1	2.0	2.2	2.3	2.5
Major Hubs in the Developing Countries - total	10.1	11.7	14.5	15.8	17.1
Brazil	2.9	3.8	3.8	4.1	4.6
Mexico	3.3	2.5	3.0	2.9	3.1
Ukraine	0.1	0.3	2.4	2.4	2.3
Thailand	0.7	1.7	1.7	1.8	2.0
Czech Republic	0.8	0.9	1.2	1.3	1.3
Poland	0.9	0.9	1.0	1.1	1.3
Slovakia	0.3	0.3	0.4	0.8	0.8
Argentina	0.6	0.5	0.6	0.7	0.8
Indonesia	0.5	0.8	0.4	0.6	0.9
Other developing countries	8.1	11.0	8.9	9.2	9.8

(Cont.)

4.2 Commercial Vehicles

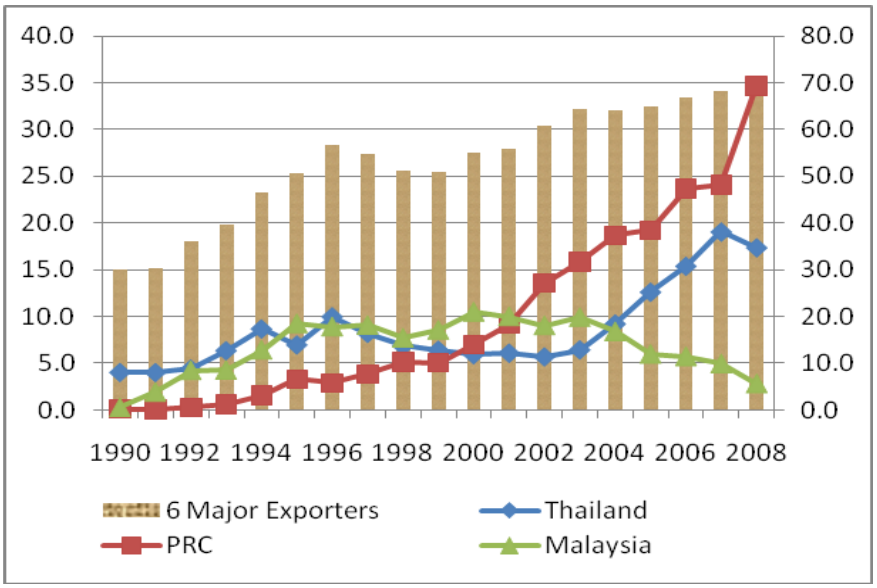
	2000	2005	2006	2007	2008
Total vehicle production millions of units	17.2	19.6	19.3	20.1	17.9
% of total vehicle production					
Developed countries	74.6	66.9	63.3	61.1	55.1
India	1.7	1.8	2.8	3.0	2.7
People's Republic of China	8.5	13.4	10.1	12.4	14.6
Russia	1.4	1.4	1.7	1.8	1.8
Major Hubs in the Developing Countries – total	8.7	12.9	14.8	15.2	18.3
Brazil	1.9	2.6	2.7	2.9	3.7
Mexico	3.8	3.5	4.9	4.4	5.3
Ukraine	0.1	0.1	1.1	1.1	1.1
Thailand	1.8	4.3	4.6	4.8	5.5
Czech Republic	0.2	0.0	0.0	0.1	0.1
Poland	0.1	0.4	0.4	0.4	0.6
Slovakia	0.0	0.0	0.0	0.0	0.0
Argentina	0.6	0.7	0.9	1.0	1.1
Indonesia	0.2	1.3	0.2	0.5	0.9
Other developing countries	5.1	3.4	7.2	6.4	7.5

Notes: Developed countries include Australia, Austria, Belgium, Luxemburg, Canada, Denmark, Finland, Germany, France, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States. Other developing countries are the world net of the developed countries, India, People Republic of China, Russia, and major hubs in the developing countries.

Source: Kohpaiboon (2009c: Table 5.12)

Figure 5 shows the world market shares of the major exporters of HDDs between 1990 and 2008. Thailand was the second largest HDD exporter, accounting for 17% of the global export market in 2008, behind only the PRC with its 35% share. Interestingly, Thailand's market share has been continually increasing since the start of the new millennium, except in 2008. The growth in Thailand's market share has kept pace with that of the PRC.

Figure 5: World Market Shares of Major HDD Exporters 1990–2008



Note: The six major exporters are the People's Republic of China (PRC), Thailand, Malaysia, Singapore, Ireland, and the Philippines

Sources: Author's compilations based on data from UN Comtrade database, available at http://comtrade.un.org/db/

4. THE UPGRADING EXPERIENCES OF THE AUTOMOTIVE AND HDD INDUSTRIES IN THAILAND

This section reviews both the historical development and upgrading experiences of firms in the automotive and HDD industries in Thailand, in other words, how these firms have arrived at their current stages of development. The data used in this section is drawn heavily from Kohpaiboon (2006a), Kohpaiboon (2009b), and Kohpaiboon (2009c) for the automotive industry, and Kohpaiboon (2009a) for the HDD industry, and all is derived from interview-based evidence.

4.1 The Automotive Industry

Industrial upgrading has been observed in the automotive industry since the late 1980s and is the result of changing business strategies on the part of MNE carmakers. In the past, when automotive industries in developing countries were highly protected by cross-border trade protection policies, these MNEs set up assembly facilities in each individual country in order to access the highly-protected domestic markets and earn economic rent. Driven by both increased global competition in the automotive industry starting in the late 1980s and promising growth prospects for vehicle sales in emerging market economies, car assemblers changed strategy and started to pursue national specialization in each region. That is, in each region (for e.g., North America, Latin America, Southeast Asia etc.), there would be a few production bases (countries) that specialized in producing and exporting certain types of vehicle models. Vehicles manufactured within a certain production base would be sold mainly within that region. The exception would be the pick-up truck, which is more or less a world-wide model that consists of a few region-specific features, such as product design and/or safety features. Consider the national specialization strategy of Toyota in Southeast Asia, Oceania, and the Middle East. Toyota uses Thailand as a production and export base for small to medium passenger cars (Vios, Altis, and Camry) as well as one-ton pick-ups (Hilux and Tiger). In the meantime, the company uses its production base in Indonesia for other family vehicle models, such as the Avanza and Inova, and orders for these models within the region are supplied by Toyota affiliates in Indonesia.

Other companies are pursuing more or less the same strategy, although their trade, investment, and production patterns are not necessarily the same. Another example is the Ford and Mazda network which uses Thailand as a base for manufacturing one-ton pick-ups (e.g., Ford Ranger, Ford Everest, and Mazda Fighter) and the Philippines for producing passenger cars (Ford Laser, Ford Escape, Mazda Protégé, and Mazda Tribute). Cost competitiveness is a basic factor determining which models/parts are produced at which locations (countries) and for which markets. This is in sharp contrast to the past, when local assembly facilities manufactured whatever vehicles they could to earn economic rent in local markets under the border protection rules that prevailed.

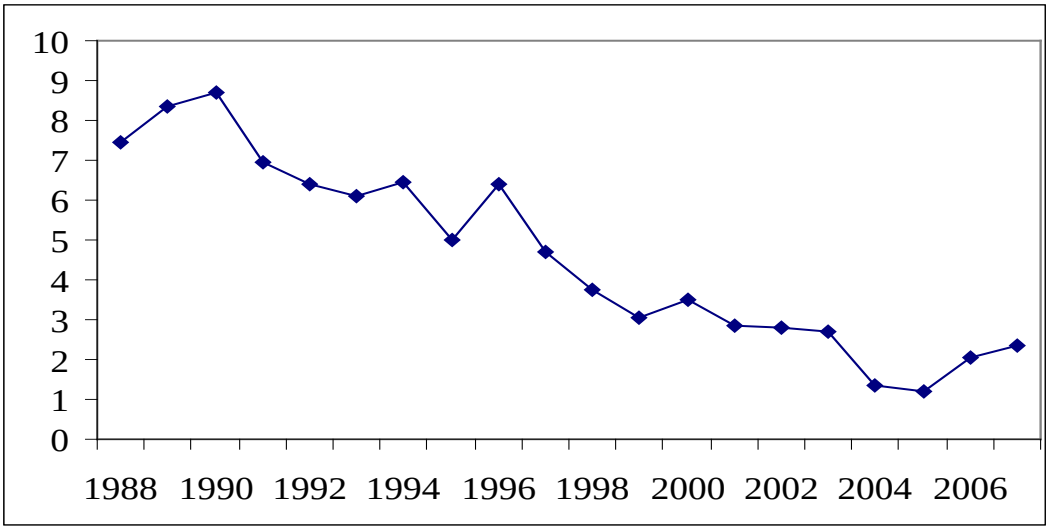
Under the new national specialization strategy, cost competitiveness is emphasized so upgrading is required. As far as functional upgrading is concerned, product development and product engineering are encompassed within the new strategy. Car assemblers do not automatically have the full information for producing a vehicle because it has not already been produced somewhere else. This is in sharp contrast to the past, when vehicle models that had already been launched somewhere else were simply repeated in developing countries. Traditionally, assembling plants were not involved in product

development and engineering but under the new strategy car assemblers and parts suppliers must jointly produce all the information necessary for the manufacturing process, based on the input prices available at selected production sites, in order to the minimize total cost of a vehicle. Hence, higher technological capabilities are required from parts suppliers as they are expected to participate in both the product development and product engineering phases of production. According to the firms interviewed by Kohpaiboon (2006a), car assemblers nowadays determine engineering properties and product qualification, as well as assign the spaces where parts have to be fitted to vehicles, over and above meeting the cost requirements of the carmakers.

One of the natural outcomes of this new strategy has been an increase in local parts procurement. Figure 6 illustrates the industrial clustering in the automotive industry by constructing the ratio where the nominator is the (real) dollar value of parts imports and the denominator is the production volume of locally assembled vehicles during the period 1988–2007. The former is a summation of import value of 91 HS 6-digit items from HS39 (plastic parts), HS40 (rubber parts), HS85 (electronic parts), and HS87 (body parts).[12] Clearly, the lower the ratio, the higher the degree of local content.[13] As illustrated in Figure 8, there was a steady decrease in the imported content of locally manufactured vehicles throughout the period 1988–2007. The real value of imported parts per 1,000 cars dropped from US$8.1 million in the late 1980s to around US$2 million in the period 2004–2005. This low import content has also been observed in other production hubs such as Brazil and Mexico (Figure 7).

Figure 6: Ratio of (Real) Import Value of Parts to Locally Assembled Cars 1988–2007

(US$ million/1000 units)



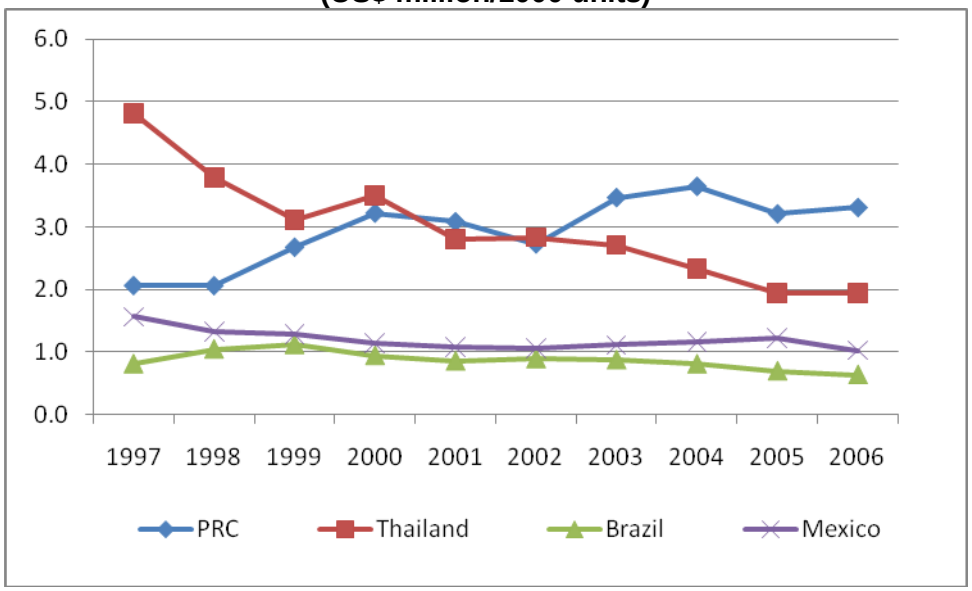
Sources: Import value of parts is compiled from UN Comtrade Database at http://comtrade.un.org/db/ according to the list in Appendix 1 of Kohpaiboon (2009). Vehicle units and their shares are from the Thai Automotive Industry Association.

[12] See full lists of auto parts in Appendix 1 in Kohpaiboon (2009b).

[13] Note that the import value of parts covers items for both original and replacement equipment manufacturers (OEM and REM respectively) so the ratio tends to overestimate the imported content of locally manufactured vehicles.

Figure 7: Ratio of (Real) Import Value of Parts to Locally Assembled Cars in Selected Emerging Markets

(US$ million/1000 units)



Note: Lists of auto parts are complied from carefully choosing from 6 digit HS items. The final lists cover 91 items from HS39, HS40, HS85, and HS87. See the full list of auto parts in Appendix 1 of Kohpaiboon (2009b).

Sources: Production data is compiled from the CEIC Database and import values of parts are from the UN Comtrade Database, available at http://comtrade.un.org/db/.

Linkages allow car assemblers and parts suppliers to work closely together from the initial stage of product design, to prototype production, and then finally to mass production. The whole process commences up to a few years before the vehicle is launched. All in all, this process (instigated by the change in MNE strategy) leads to the clustering of the automotive industry. In addition to the Marshallian trinity of reasons for industrial clustering (i.e., labor market pooling, supplier specialization, and knowledge spillovers), another important incentive for automotive MNEs and their parts suppliers to locate their plants close to each other is the benefit that arises from geographical proximity. To develop new models, car manufacturers have to have frequent communication and meetings with part suppliers so that the quality of parts can be assured. Geographical proximity facilitates closer communication and also enables car manufacturers to fully adopt just-in-time production schedules which require the prompt delivery of parts to assembly plants—the so-called milk-run system.

The remaining problem for the upgrading of the automotive industry at this point is the role of indigenous suppliers in the value chain. Policy attempts to develop indigenous parts suppliers were present in the first stages of industrialization in the early 1970s. During the 1980s, when car assemblers were still operating in a highly protected domestic market, indigenous firms supplied their products directly to carmakers. Interestingly, when MNE car assemblers shifted toward national specialization strategies and began to source more locally manufactured parts, they switched to other MNEs as their tier-1 parts suppliers. Most of the indigenous suppliers were downgraded to become the “suppliers of suppliers” or tier-2 suppliers. One major reason for this was that indigenous suppliers had limited capabilities with regard to product development and engineering and these capabilities were demanded from tier-1 suppliers under the new strategy. As a result, indigenous firms could only participate in the value chain by

supplying semi-finished parts to tier-1 suppliers for further processing. Findings such as this call into question the ability of industrial upgrading policy packages, which include the protection of vehicles and imposition of LCR measures and the like, to promote the Thai automotive industry. It would be difficult to refute the hypothesis that during the import-substitution period, local suppliers did gain technological capability benefits from the presence of LCRs and other protection measures. The relevant question is whether such protection measures generate sufficient benefits to induce sustainable development in the automotive sector, particularly in the auto parts industry where local firms participate. The fact that only a few indigenous suppliers have survived in the new environment suggests that LCR measures are not a sufficient condition for building up the technological capabilities of local suppliers and enabling them to benefit from the gains of dynamic economies. Whilst LCR measures did help local firms to acquire well-established quality-controlled production technology, they failed to provide sufficient motivation for firms to use this technology efficiently and advance to even higher levels of technology.

Nonetheless, being tier-2 suppliers does not necessarily mean that indigenous firms will acquire little technological benefit from automotive production networks. There is preliminary evidence (e.g., Kohpaiboon et al. 2010) which suggests intense interaction between tier-1 and tier-2 suppliers. Tier-1 suppliers place more price, quality, and time delivery demands on tier-2 suppliers, all of which are key mechanisms for productivity improvement and technological progress. In other words, we would expect more technological gains to ensue for tier-2 suppliers.

4.2 The HDD Industry

Over the past two decades, there has been both product and functional upgrading within Thailand's HDD industry. In the early stages of industry development, Thai workers had not yet acquired sufficient knowledge to enable operations beyond mass production to be undertaken by Thai affiliates. At present, however, operations in Thai affiliates start with the development of prototypes. As with other manufactured products, there are several tasks that lie between the product design and mass production stages. After receiving HDD blueprints, workers need to develop basic and detailed designs for production processes. Production facility, tooling, and other requirements must be developed and ordered, and task details prepared for workers in the production line. Other tasks include pilot runs, during which production processes for mass production are put through final checks. In order to carry out these additional tasks, affiliates must hire more engineers and scientists. This is particularly true nowadays where the HDD industry has essentially transitioned from using longitudinal magnetic recording (LMR) head technology for the head writer function to perpendicular magnetic recording (PMR) technology.

Further, after going through functional upgrading, industrial clustering started to develop. This was because intensive cooperation between HDD makers and suppliers was needed to establish effective coordination and achieve "virtual integration of the entire system." (Kohpaiboon 2009a, p.16) Usually, HDD makers ask their suppliers to assign a few staff members to work with their own staff, thereby forming an inter-company team to exchange information about production efficiency and cost effectiveness and to suggest changes. One or two staff members are assigned to work with each customer on a daily basis, to exchange production-related information, match production and delivery schedules, and outline and fulfill certain performance measures. Sometimes, HDD makers request that suppliers change their tier-2 suppliers of certain parts, for e.g. electronics, in order to improve the performance of finished HDDs. This could happen

even at very short notice and may run back and forth as part of the HDD maker's experimental process. The speed at which such requests are responded to forms one of the performance indicators that HDD makers monitor in order to rank their tier-1 suppliers and determine future order volumes.

Under these conditions of close coordination, HDD makers also benefit from being able to oversee their suppliers' capabilities and productivity. Since the former is at the network's center and has the best information with regard to all of the parts to be assembled in the later stages of production, they are in a better position to offer sensible suggestions to improve the performance of their suppliers. This position of oversight is also advantageous in situations where a problem occurs with a particular part that requires the cooperation of other parts suppliers to fix. Further, even though there is no requirement that tier-1 suppliers serve only one particular HDD maker, suppliers must have an individual production line for each individual customer. Even with regard to a relatively generalized part for HDDs, suppliers must establish an individual production line for each customer.

It is in the nature of the HDD industry that there are extremely short product life cycles and market demand is highly volatile. Leadership positions cannot be taken for granted, so HDD makers must be ready to cope with the emergence of new and uncharted market opportunities. For this reason, firms in such an industry usually have slightly excess capacity and their suppliers must also have capacity ready to respond to any immediate changes that might occur. When there is product innovation from R&D labs, the firm that owns the innovation must have the production capacity ready to enable it to serve the market and harness the gains from it. Even though HDD makers outsource the manufacture of peripheral parts to third parties, their relationships are very different from arm's length transactions, which are characterized by a loose patchwork of stand-alone affiliates, joint ventures, and suppliers. Hence, there is an effort made by HDD makers to network their own operations and inter-firm relationships, across both function and location (Borrus, Ernst, and Haggard 2000).

Nonetheless, while the industry is clustering, this by no means rules out the possibility of the industry taking advantage of globalized production. International fragmentation takes place in only a few parts in the first layer and mostly in the second layer of HDD production, where tier-1 suppliers participate with their own suppliers (tier-2 suppliers). Intermediate goods produced by the tier-2 suppliers for their tier-1 supplier customers are less customized than those produced on the first layer. This is especially true for electronics parts. Intermediate goods traded in the second layer, such as printed circuit boards (PCBs), integrated circuits, resistors, and semiconductors are used not only in HDD industries but also in other industries. This has been reinforced by the digitalization phenomenon, wherein electronic elements have become an important part in determining the performance of manufactured goods. In addition, there are a number of MNEs, such as Celestica, Flextronics, Jabil Circuit, Sanmina, and Solectron, that specialize in the manufacture of these parts and components and play an important role in global trade (Lakeman, Boyd, and Frey 2001; Yasuf 2004: 11–12).[14] More importantly, these MNEs

[14] Sometimes, they are referred to as contract equipment manufacturers (CEMs) (Lakeman, Boyd, and Frey 2001). The emergence of these manufacturers is partly related to changes in the high-tech industries' business environment, brought about by business consolidation strategies and an increasing number of common parts across products (e.g., a certain kind of chip can be used not only in computers but also in other electrical appliances). In this environment, business opportunities for CEMs are even greater. They can quote the lowest prices because of the high turnovers that result from them being able to offer a wide range of electronic items to a wide range of customers. They can switch production from one category of

have their own production networks around the globe (Yusuf and Evenett 2002; Sturgeon and Lester 2004). Hence, these companies can make their own decisions about from where to serve their clients (either setting up another affiliate geographically closer to their clients or exporting from their existing production capacities). The longer lead times required in the second layer is another factor explaining why it is not necessary for first and second-tier suppliers to be located near to one another and could satisfactorily be located in different countries.

Yet there are some exceptions to the general rules that define production relationships in the first layer, that is, between HDD makers and tier-1 suppliers. These exceptions relate to wafer, media, and other minor and small parts, which are usually imported from the HDD maker's affiliates abroad. Wafer and media play a very important role in determining business competency and, consequently, their production, especially that of the latter, is likely to be in-house. Both Seagate Technology and Western Digital import these items from affiliates in Johor Malaysia (Kohpaiboon 2009a; Seagate Technology 2008; Western Digital 2008). The production of both parts is very capital intensive and involves huge sunk costs. For example, Showa Denko set up its new plant in Singapore in 2006. The factory cost about ¥60 billion and employs approximately 600 workers. Needless to say, once a factory has been established in a given location, it takes time and great expense to establish a new factory in another country.

There are numerous metallic parts required for linking several major parts in HDDs, including spring wires, bottom VCs, top VCMs, TG clamps, top cover assemblies, top cover seals, positional seals, and window clock seals. These parts are physically small and economies of scale matter in their production processes. Hence, it is worth it economically to supply them for a certain factory. All in all, evidence from the HDD industry in Thailand suggests the possibility of coexistence between ICs and IPNs. MNEs can complement them to enhance their competitiveness. Even where industrial clustering is observed in the first layer, MNEs can still harness the benefits from dispersed resource endowments in the second layer.

Yet one policy challenge remains, i.e., the limited role of indigenous suppliers in the network. At present, there are very few indigenous suppliers participating in the network. Most of the increased local content is supplied by foreign suppliers. As revealed in Kohpaiboon (2006a; 2009b), MNE affiliates have difficulty finding capable indigenous suppliers. Similarly, responses given in the interviews undertaken with government officers point in the same direction. The limited linkages with indigenous suppliers are a consequence of the dualistic nature of the trade policy regime applicable to export-oriented and labor-intensive industries, including the HDD industry. Tariff structures in these industries, particularly automotive, remain distorted. In the case of the HDD industry, HDD inputs are still subject to higher tariff rates than outputs. Hence, it is difficult to find indigenous enterprises able to sell their products at competitive world prices while their products' tariffs are not zero and it is more profitable for them to find their niches in domestic markets. Similarly, export-oriented and foreign-owned firms would prefer imported inputs to locally produced ones as they can then apply for tariff exemptions.

4.3 Comparative Aspects

The comparative upgrading experiences of both industries are summarized in Table 5. They have been compared across the seven categories discussed in this paper, namely,

manufacturers to another and they can pool the inventories of several customers and thereby cut total inventories.

the policy environment, the timing of observed upgrading, motivations, functional upgrading, product upgrading, choices between IPNs and ICs, and remaining policy challenges. Three points can be made from the data presented in Table 5. Firstly, both industries were operating in different policy environments. The automotive industry is one of the few industries where the Thai government has been involved—indeed since the early 1970s—in creating a policy-derived incentive structure to promote local assembly activities. In the 1990s, however, this policy started to be liberalized. This is in sharp contrast to the policy environment for the HDD industry, which has been consistently liberal. Nevertheless, despite these differing policy environments the timing of upgrading for both industries did not significantly differ.

Table 5: Comparison of Upgrading Experiences of Thailand's Automotive and HDD Industries

	Automotive Industry	**HDD Industry**
Policy Environment	- Restrictive policy regime up to the late 1980s. - There have been policies designed to promote backward linkages between MNEs and indigenous suppliers	- Always liberal policy environment due to tariff exemption schemes - Strengthening of supply side capabilities through R&D and training
Timing of Observed Upgrading	Throughout the late 1980s and early 1990s as the industry became much more export oriented. Export-output ratio surpassed 50% in 2005.	Commencing in the mid-1990s. The country's world market share has increased since 2000
Motivation	- Changes in business strategies of MNE carmakers, i.e., the n*ational specialization strategy*. Relatively liberal environment as opposed to other economies in the region	- To gain more skill and (tacit) knowledge for local workers. - Cooperation between private and public sector conducive to strengthening supply side capabilities
Functional Upgrading	Most activities in the value chain (ranging from product development, prototyping, and process engineering) undertaken in Thailand	Activities in Thailand's affiliates include developing prototypes, developing basic and detailed designs, and undertaking pilot runs, final checks in readiness, and mass production.
Product Upgrading	Specializing in the production of original	Export composition shifted toward

	vehicle models. This is in sharp contrast to the past where a pre-existing model was repeated.	finished HDD instead of head gimbals assembly and head-stack assembly (HSA) .
IPNs vs. ICs	Industrial clustering observed. Increased ratio of imported parts to produced vehicle units.	Coexistence between IPNs and ICs. Industrial clustering observed and local content increased to certain levels.

Secondly, there has been both functional and product upgrading in both of these industries. The fact that both industries have become major exporters is clear evidence of their successful upgrading. Interestingly, they share a common policy challenge, the limited role of indigenous suppliers in their production networks. As these common patterns are not related to types and duration of government intervention the further investigation of incentive structures for indigenous suppliers may be a fruitful avenue of inquiry.

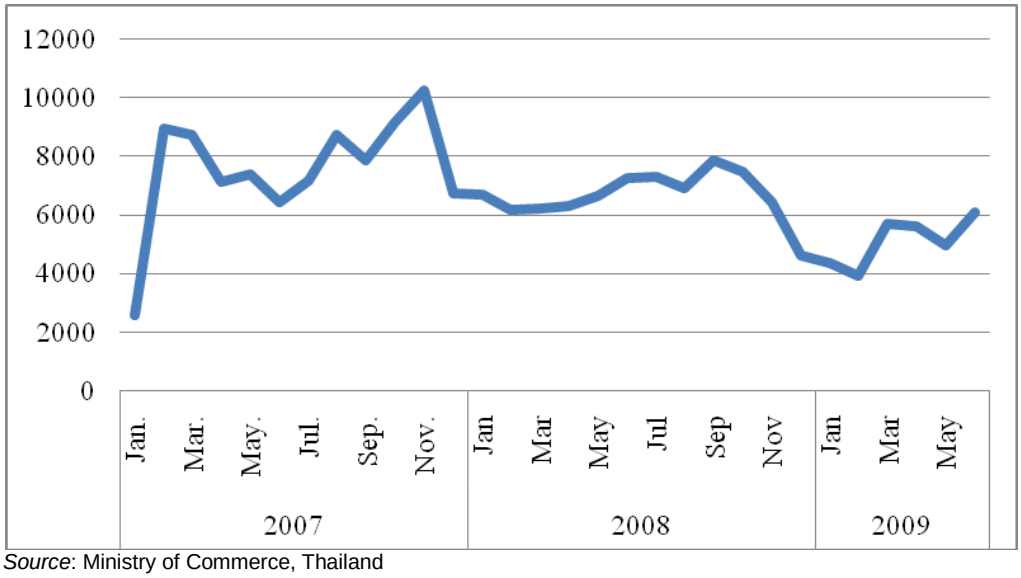
Thirdly, these two industries differ in their choice between IPNs and ICs. In the case of the automotive industry, industrial clustering has occurred regardless of the layers of production involved. This is in contrast to the HDD industry in which an IPN and IC co-exist. In particular, ICs occur in the first layer of production, whereas tier-1 suppliers tend to source their inputs internationally, i.e., utilize IPNs. Interestingly, industrial clustering naturally occurs after affiliates reach a certain level of technological capability. Nevertheless, it is not a pre-requisite for upgrading process.

5. THE IMPACT OF THE GLOBAL RECESSION

The recent global recession triggered by the US subprime crisis has affected countries around the globe, including the East Asian economies which have been experiencing precipitous export contractions since the last quarter of 2008 (Athukorala and Kohpaiboon 2009). Production contraction was also first observed in the last quarter of 2008. This seems to be in contrast to other manufacturing goods, which experienced export contractions in the second quarter of 2008. Thailand's car exports fell from 124,656 units in October 2008 to 61,067 units in February 2009. The car output contraction bottomed-out in April 2009 at 53,644 units, its lowest level since the 1997 crisis. In May and June 2009, vehicle production showed signs of recovery, reaching 61,752 and 74,717 units respectively. These recovery signs in vehicle sales were to a certain extent the consequence of the fiscal stimulus responses occurring in many countries around the world. Patterns observed from export-production ratios suggest that the output contraction derived from both the domestic market and exports and the ratio more or less remained unchanged from 2007 to the first half of 2009. The HDD industry in Thailand also experienced an output contraction as a consequence of the global recession. Due to its highly export-oriented nature, the pattern of export value stands as a reasonable proxy for production. As illustrated in Figure 8 export value dropped sharply from US$8 billion in October 2008 to US$4 billion in February 2009. Since that time, the

recovery process has set in. Export value in June 2009 was about US$6 billion and many HDD firms in Thailand resumed their usual working hours in April 2009, some of which hired more workers (Kohpaiboon 2009c).

Figure 1 HDD Exports (US $) from January 2007 to June 2009



Source: Ministry of Commerce, Thailand

Even though both industries have experienced severe output contractions, it is not expected that the global recession will slow down upgrading. In fact, the global recession makes the need for industrial upgrading even stronger. As discussed, the global economy now exhibits a very high level of specialization in value chain activities. Factories located in any given country produce not only for domestic demand but also for export. International trade remains the engine of growth for East Asian developing as they still rely on external trade, though to a lower extent. While there has been a growing emphasis in Asian policy circles on the need for rebalancing growth—engineering a structural shift in aggregate domestic production away from exports and toward domestic markets (ADB 2009)—the policy measures under consideration include measures to both redress export biases in incentive structures and reduce high saving propensities with a view to boosting domestic demand (ADB 2009). The major focus of this policy advocacy is the PRC. It is clear that the ability of the PRC to make up for decreasing demand from the US and European countries is limited, simply because the PRC still relies heavily on exports to boost the domestic economy (Athukorala and Kohpaiboon 2009). Hence, external trade remains important for East Asian developing economies in the growth-generating process and intense global competition is to be expected.

Intense global competition is reinforced by the adaptation of modularization undertaken by MNEs and the rise of the threat of protectionism amidst the global economic crisis. With modularization, MNEs tend to specialize in the upstream (R&D and product design) and downstream (marketing) segments of value chains. This opens up certain middle segments for Asian firms, particularly in low- and medium-value mass production. The current global crisis also brings with it the threat of increased protectionism and, in fact, there are already signs of such tendencies (Bradsher 2009; Athukorala and Kohpaiboon 2009). Opting for protectionist measures to protect domestic activities and redress the unemployment situation seems to be a tempting political option. It has occurred in both North-South and South-South trade (Erixon and Sally 2009; Athukorala and Kohpaiboon 2009). For example, there has been an increase in initiated investigations of non-tariff

barriers since late 2008 (Bown 2009) as well as stringent implementation of technical, sanitary, and phyto-sanitary standards, in addition, of course, to the massive financial support extended by the US and some other countries to their automobile manufacturers (Gamberoni and Newfarmer 2009). Yet, all in all, competitiveness remains a central policy priority for promoting economic growth. This points to, rather than protectionism, the need for industrial upgrading to create even more intense global competition.

Where the automotive industry is concerned, emerging market economies in East Asia remain the playing field in which carmakers can gain or increase market share. For example, in 2006, more than 50% of General Motors revenue came from their affiliates in developing countries (The Economist 2008). Demand in many emerging market economies, as well as in Oceania, will be boosted by the stimulus packages being used in these economies (ADB 2009). Therefore, competition in the region should be even more intense. It will come as no surprise that many automotive firms in Thailand continued with their investment plans in spite of the global recession and the experience of output contraction, e.g., Nissan's eco car project, Auto Alliance's plan to produce B cars, General Motor's investment expansion in engines (Kohpaiboon et al., 2010).

Similarly, it is unlikely that the recent global crisis will induce HDD firms to significantly change their sourcing behavior. In a similar fashion to other standard electronics (e.g., the computer), which have become increasingly important for normal business operations, the demand for HDDs seems less sensitive to the global economic environment. Hence, the demand for HDDs, as a demand derived from computer use, tends to recover quickly. Given the existing production network, there is no motivation for firms to change their sourcing strategies as a result of global crisis.[15]

6. CONCLUSIONS AND POLICY IMPLICATIONS

This paper has outlined the upgrading experiences of the automotive and HDD industries in Thailand, which were selected because of their outstanding export performances in the developing world. The discussion of their upgrading experiences is intended to feed into the debate about the relative importance of international production networks (IPNs) and industrial clusters (ICs), and was undertaken with a view to formulating the most prudential policy for sustainable industrial development. The impact of the recent global recession has also been incorporated into the discussion.

Although some studies argue that Thai industry has been more successful with industrial diversification than with industrial upgrading (Doner 2009), we found evidence of industrial upgrading in both the automotive and HDD industries. Manufacturing activities in both industries have gone far beyond the mass production process and certain stages of product and process development are now undertaken in Thailand. Production in both industries also now relies more on locally manufactured parts. One remaining policy challenge is the limited role of indigenous suppliers in the MNE production network. Both the automotive and HDD industries share this policy challenge, despite government policy efforts to encourage links with indigenous suppliers. This situation is, to a certain extent, related to the overall incentive structure.

[15] The production capacity of HDDs is highly concentrated and six major exporting countries account for 70% of production. In particular, Thailand and the PRC account for nearly 50% of total exports. As reflected in intra-regional trade patterns, most HDD inputs (e.g., media, wafers, integrated circuits, PCBs, and semiconductors) are sourced from East Asian economies, including Taipei,China (Kohpaiboon 2009a: Table 3).

Where these two industries differ is in their choice between IPNs and ICs. In the case of the automotive industry, industrial clustering has occurred and has reached a level where the local content of a locally manufactured vehicle is approaching 100%. In the case of the HDD industry, industrial clustering has occurred naturally and has reached a certain level. Nevertheless, there are numerous parts and electrical ones in particular sourced globally, i.e. IPNs. Even though the current global economic crisis has severely affected production and exports, the "hollow out" scenario is very unlikely for either industry. In other words, Thailand should remain a base of production and export for MNEs, which points to the need for continual industrial upgrading.

There are three policy-related conclusions drawn in this paper. Firstly, the limited linkage of MNE affiliates to indigenous suppliers points to the need for a comprehensive study probing the possibly distorted incentive structure that arises from the cascading tariffs that have characterized Thai tariff policy for the past three decades. Even though there have been consecutive government efforts to neutralize the effects of the tariff structure since the mid-1990s, it is clear that much remains to be done. 20% of tariff lines subject to high tariffs (greater than 20%).

Secondly, the choice between IPNs and ICs is a purely private sector decision, driven by the nature of the specific industry. It is unlikely to be influenced by policy measures in favour one to the other. Finally, to promote the industrial upgrading process, the government should focus on strengthening the supply-side capabilities of local firms as well as creating an investment climate that will encourage further upgrading activities. IPNs and ICs require different types of infrastructure. For example, courier services and broadband internet are more important for IPNs, while ICs need complementary infrastructures, for e.g., road networks and industrial estates, to maximize the benefits of geographical proximity. Hence, effective coordination between the private and public sectors with regard to public goods investment activities and the liberalization of the service sector are needed.

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