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INDUSTRIAL UPGRADING AND GLOBAL  
RECESSION: EVIDENCE OF HARD DISK DRIVE  
AND AUTOMOTIVE INDUSTRIES IN THAILAND

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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 experience of automotive and HDD industries in Thailand because of their outstanding export performance in the developing world. An understanding of their upgrading experience can shed some light on the ongoing debate of relative importance between international production networks (IPNs) and industrial cluster and its implication on the prudential industrial policy. The impact of recent global recession is also incorporated in the paper. There is some evidence of industrial upgrading in both the automotive and HDD industries. Yet there is a policy challenge, that is, the limited role of indigenous suppliers in the MNE production network. This would be to a certain extent related to the overall incentive structure. What these two industries differ is choices of networking between IPNs and ICs. In the case of automotive industry, industrial clustering is observed and reaches a level where local content of a locally manufactured vehicle is approaching 100 per cent. In the case of HDD industry, industrial clustering naturally occurs and reaches a certain level.

Even though the current global economic crisis has severely affected their production and export, the ‘hollow out’ scenario is very unlikely for both industries. In other words, Thailand would remain bases for production and export for MNEs. This points to a need for continuity of industrial upgrading. Three policy inferences can be drawn from this paper. Firstly, the limited linkage from MNE affiliates to indigenous suppliers points to the need for comprehensive study probing possibly distorted effect on incentive structure of cascading tariff structure, the key theme of tariff policy for the past three decades. Despite the presence of consecutive government efforts to neutralize tariff structure since the mid 1990s, it is clear that much remains to be done. Secondly, choices between IPNs and ICs are purely private sector’s decision, driven by the nature of industry. There is also a possibility that IPNs and ICs co-exist. Industrial clustering can facilitate ongoing process of technological upgrading but it is not necessarily a pre-requisite for upgrading process. Finally, to promote industrial upgrading process, the government should emphasize the policy to strengthen the supply-side capability of local firms as well as creating investment climate to encourage more upgrading activities.

**Keywords:** Industrial upgrading, International production networks, industrial clusters, Automotive industry, Hard Disk Drive Industry, Thai Manufacturing.

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

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## 1. Issues

Industrial upgrading (henceforth referred to ‘upgrading’ for brevity) has always been a major challenge for policymakers in developing economies, i.e. how do firms compete in the world markets at their current stage of economic development. It is even more crucial in economies like Thailand where a number of industries are established but have not yet reached the world technological frontier as well as be under severe pressure profiting from low, unskilled wages. Upgrading is a complicated task requiring a different set of competitive assets from previous one. Changes in organizational and institutional structures are required to achieve its mid-term target of becoming a global player in mid-tech industries and to compete in those technologically advanced industries where skills are complex but not cutting-edge (Amsden and Chu, 2003).

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

Upgrading becomes even more important in presence of global recession. Although some signs of bottoming out of the global economic contraction are observed, the economic forces unleashed by the crisis will probably run rampant for years. Hence, we would expect the bleak recovery. 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 demand away from exports and towards domestic market (ADB 2009). How this would affect somehow upgrading remains unclear.

Therefore, this paper aims to undertake a systematic analysis by bringing both international production networks and industrial cluster together in the context of upgrading experience. The analysis is also extended to the impact of global recession on upgrading. Hard disk drive (HDD) and automotive industries in Thailand are chosen for the issue in hand as their development seems to be a success story of upgrading to a certain extent. Thailand becomes a major producer and exporter in the world. While (real) wages in Thailand continued to grow, albeit at the lower growth path, after the 1997/98 crisis (Kohpaiboon, 2009: Figure1), global export share in both industries has shown an upward trend for a decade. Interestingly, as argued in previous studies these industries exhibit different path of industrial upgrading. Particularly, industrial clustering has been observed in the automotive industry during the past two decades whereas HDD industry is a classic example of presence of IPNs. A comparison of these two industries would provide insights and sensible policy lessons.

The paper is organized as follows. The following section (Section 2) provides the analytical framework discussing rationale of IPNs and ICs. In Section 3, a comparative perspective of the development of Thai HDD and automotive industries is provided. Section 4 discusses the upgrading experience of both industries, followed by challenges related to industrial upgrading in the recent global recession (Section 5). Final section provides conclusion and policy lessons.

## **2. Analytical Framework**

In this study the definition of upgrading is to a large extent in line with previous studies such as Waldner (1999), Gereffi (2004) and Doner (2009). It is defined as activities 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 moving into market niches which have entry barriers and are therefore shielded from these pressures. According to the scope defined above, it includes both

product and functional upgrading. The former is referred 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 contents in this study is treated as one feature of upgrading. This is different from Doner (2009:8) where local content is treated as one of three necessary components for upgrading.<sup>1</sup>

IPNs are referred 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 *et al.* 2004). Such networks not only integrate firms (and parts of firms) into structures but also integrate national economies in ways which have enormous implications for their economic development. As a result of the increasing importance of IPNs, national and regional boundaries are cut through in highly differentiated ways and blur traditional organization boundaries-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 region to regional and global production networks.

While consensus has not reached the precise definition (Cortright, 2006), industrial cluster is usually referred to geographic concentration of interconnected companies and institutions in a particular field.<sup>2</sup> Industrial clustering was very influential especially among policymakers throughout the late 1980s and 1990s as it would be a crucial step of industrial upgrading and deepening.

Potential effects of both IPNs and ICs on success of upgrading are highlighted in previous studies.<sup>3</sup> Both of them emphasize the role played by coordination of

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<sup>1</sup> 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.

<sup>2</sup> Such a definition of cluster is to a certain extent in line with the concept proposed by Porter (1990: 78). The reason the Porter's definition used here is simply because it is the most influential one in the policy circle (Yeung, 2008). In fact it is not widely accepted among academics. For example, Martin & Sunley (2003) argue that such a definition is vague and ambiguity and its policy implication is very risky as it is one-size-fit-all approach to understanding clustering.

<sup>3</sup> For example, Grossman & Helpman (2002), Helpman (2006), Athukorala (2008), Athukorala & Kohpaiboon (2009), Cawthorne (1995), Nadvi (1999), Schmitz (1995), Knorringer (1996), Rabellotti (1997), Sandee (1995) and Visser (1996)

economic activities through non-market relationships. Such coordination could 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 ICs literature emphasizes the importance of local-level governance as a consequence of interactions between firms and with local institutions. Crucial inputs for upgrading process mainly come from the locality.<sup>4</sup> There are various inputs from the locality. Pioneered by Marshall (1920) in his *Principles of Economics*, clustering could help enterprises and small ones in particular to compete as the agglomeration of firms engaged in similar or related activities generated a range of localized external economies that lowered costs for clustered producers. Such advantages included a pool of specialized inputs and services and the quick dissemination of new knowledge, all referred to ‘external economies’. There is the conscious pursuit of joint action working over and above the so-called ‘Marshallian External Economies’ (e.g. Brusco, 1990; Cooke & Morgan, 1998; Humphrey & Schmitz, 1998; Rabellotti, 1997; Schmitz & Navdi, 1999). Studies in regional science, innovation studies and endogenous growth (e.g. Lundvall, 1993, Freeman, 1995; Edquist, 1997; Braczyk *et al.* 1998, Otsuka, 2006) strengthen the argument for promoting ICs as clustering could create conducive environment for innovation systems.

Until recently, the importance of links between the local industry clusters and the wider world have not been recognized.<sup>5</sup> For example, the extensive literature of Italian industrial districts (e.g. Pyke *et al.*, 1990; Pyke & Sengenberger, 1992; Cossentino *et al.* 1996) point the importance of external relationships especially the export-oriented clusters but the nature of the relationship is characterized explicitly or implicitly as arm’s-length transaction which is far different from that occurred within the IPNs’ quasi-hierarchy structure. Overall, resources needed for industrial upgrading

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<sup>4</sup>In a study of the connection between national exports and local industry clusters, Storper (1997) finds that the US is a strong exporter of science-based high tech products, and Italy’s exports are design-intensive. These strengths can be traced to the regional industry clusters and the continuous and localized interactions between buyers and sellers which result in product-based technological learning.

<sup>5</sup>Yet from the beginning, most cluster analysis has addressed a question of how localized concentration of firms could compete effectively in global markets (Piore and Sabel 1984; Porter 1990).

are mainly from improved organization as a consequence of interaction concentration and effort within the cluster.

IPNs take a very different view of inter-firm linkages. It is 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 that own capital and proprietary know-how. Such know-how constitutes entry barriers for other firms. These MNEs also play an important role in determining the upgrading opportunities of participating firms from developing countries which participate in their production network. This occurs irrespective of whether firms are affiliates or independent subcontractors and where they are located. IPNs emphasizes more on learning from MNEs about how to improve their production processes, attain consistent and high quality and increase the speed of response. This is very important for countries already have basic industry, but yet reaching the world technological frontier as well as be under severe pressure profiting from low, unskilled wages. Learning from MNEs is in line with the 'organizational succession' referred to in global value chain literature (e.g. Gereffi, 1999). The finished product is made to the precise specification of particular MNEs. Thus, to obtain a finished product, intensive inter-firm cooperation is needed (Hobday, 1995, 2000). In this way, 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 service to ensure that subcontracting firms can produce quality components to meet specifications. Host country subcontractors need to show their potential to deliver the final goods. This requires firms to 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 in giving advice on production, financing and management (Hobday, 1995: p.37). This eventually raises the technological capability of host country subcontractors.

### **3. Overview of the HDD and Automotive Industries in Thailand**

In this section, two industries are briefly compared in three aspects, namely policy environment, role of MNEs, and their economic performance to overview their past development. Policy environment is firstly discussed with an emphasis on the

incentive structures faced by the firms in the past three decades. It is followed by a discussion of the role of MNEs in linking the countries in the region to regional and global production networks. The final sub-section illustrates economic performances of these two industries in a comparative aspect.

### 3.1 Policy Environment

With regard to the policy environment, this paper focuses on trade policy which is a major instrument to influence resource allocation across industries during the past three decades in Thailand. The trade policy in these two industries is completely different. The automotive industry is at one end of the protective policy spectrum where the Thai government has been heavily involved in creating a policy-induced incentive structure to promote local assembly activities since the early 1970s. The HDD industry is at the other end where policy environment has always been liberal.

Like other developing countries, Thai government granted high level of border protection against import of CBU vehicles as well as imposed local content requirements with an aim to create linkages to various local supporting industries. Such a policy package is in line with the 'infant industry' argument. 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. But since the early 1990s, policy measures towards the automotive industry have become more liberal (Table 1).<sup>6</sup> Despite the 1997 economic crisis, in 1998 the Thai government approved keeping the WTO commitment to abolish LCR policies on schedule in January 2000. While protection toward the automotive industries was still relatively high, compared to other industries, absolute protection was considerably reduced for the auto assembly industry from the early 1990s to the present.

During the 1990s where there was evidence that a number of carmakers decided to export vehicles from Thailand, Thai government narrowed its emphasis on supporting industries and mould and die industries in particular. The indigenous suppliers in these industries are presumed to have comparative advantage and can

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<sup>6</sup> 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 per cent in 1992, from 300 per cent before 1991.

intensively participate with MNE affiliates. Some of these policy efforts are, for example, an establishment of the BOI Unit for Industrial Linkage Development (BUILD) (1991), the National Supplier Development Program (1994), a creation of the Metal Industries Development Agency (1995), an establishment of the Automotive Development Institute in 1999, an establishment of the National Institute of Molds and Dies (2003) and an initiation on the Automotive Human Resources Development Project (AHRDP) (2006). All of them reflect the market friendly approach in policy designed throughout the past three decades (Kohpaiboon, 2006) and the policymakers' ideology that the assemblers would become the key drivers and that linkage from MNE affiliates would be a conducive channel of technology transfer to indigenous suppliers. Nevertheless, these policy efforts have not so far achieved much outcome because of small budget allocation and the country's general problem of policy implementation (Doner, 2009). This conclusion is consistent with the interview conducted in Kohpaiboon (2009) where neither automakers nor suppliers point to their relative importance.

In HDD industry, tariffs related to HDD industry (both intermediates and final goods) are usually lower than the average rates during the period 1995-2006. Its tariff structure is distorted where intermediates' tariffs are always higher than those on final goods (HDD) (Table 2). Nonetheless, the distorted effect from such a tariff structure is offset by presence of various tariff exemptions/rebate schemes. Since most of HDD makers and their parts suppliers are foreign-owned and export-oriented (McKendrick et al. 2000), they are eligible for investment privileges offered by Thailand's Board of Investment (BOI), one of which was tariff exemptions which started offering in 1983.<sup>7</sup>

In the new millennium, policy emphasis in both industries shifted away from protection and tax incentive to strengthening supply-side capability of firms and indigenous suppliers in particular, e.g. promote human capital development,

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<sup>7</sup> It is worth clarifying the difference between tariff exemptions granted by the BOI and the alternative schemes. While tariff exemptions and tax rebate schemes are administered by the Department of Customs, the BOI scheme offers a prior exemption scheme that is less cumbersome than the two existing schemes. After receiving approval from the BOI, export-oriented promoted firms are automatically allowed to access their imports without a delay to calculate and pay levies. This reduces custom procedures that before 1997 were considered unusually cumbersome and imposed costs on importers (European Commission, 1999; and United States Trade Representative, 1999, cited in Warr, 2000: 1233).

financially support research and development (R&Ds) projects, and strengthen linkages from MNEs to indigenous enterprises. There are several government agencies involved such as the National Electronics and Computer Technology Center, Ministry of Science, and the Offices of Industrial Economics, Ministry of Industry and BOI. Most of the policy measures are a result of close consultation with the private sector. For example, many R&D projects initiated by the private sector are co-financed by the government. A portion the government financial contribution depends on a nature of the project's outcomes, i.e. whether they are proprietary or common knowledge. The more common the knowledge created by the projects, the larger the government contribution.

As seen later in Section 3.3, these policy measures would contribute to a certain extent the increased local content ratio observed nowadays. For example, import content of HDD dropped from 90 per cent in the early 1990s to about 50 per cent in 2006 whereas local content of vehicles is virtually close to 100 per cent (Kohpaiboon, 2009a; 2009b). As argued in Kohpaiboon (2009c), the nature of product fragmentation is different in these two industries so that the observed local content in both industries are far different. What remain the policy challenges is weak link between MNE affiliates and the indigenous suppliers. MNE affiliates in these industries have virtually operated in their enclave. Interestingly, the so-called 'enclave' situation also occurs in other export-oriented industries like garments where export-oriented garment firms relies more on imported fabrics (Kohpaiboon, 2009c). It occurs regardless of the design of industry-specific policy and is also observed in other industries in Southeast Asian economies like Malaysia (Yusuf and Nabeshima, 2009) and Indonesia (Athukorala & Santosa, 1997; Najoko, 2007). While it is far beyond the scope of this paper to provide satisfactorily explanation, our conjecture is related to the dualistic trade policy popularly used in the region where tariff exemptions/rebate scheme has been extensive since the early stage of export-orientation industrialization strategy. That is, it is unlikely for the export-oriented firms to create backward linkages to local suppliers because of tariff on locally manufactured inputs as opposed to imported inputs that are eligible for tariff exemption/rebate schemes.

### **3.2 Patterns of Multinational Enterprises Involvement**

Both industries share a common feature, that is, the multinational enterprises (MNEs) especially from developed countries play a dominant role. These enterprises are in the leading position in research and development as well as marketing, distribution, and post-sale services. Interestingly, their involvement occurs in a form of equity participation. This is in contrast to the traditional labor intensive products like footwear and clothing in which MNEs participate through their buyer link (Gereffi et al. 2005; Kohpaiboon, 2006a).

MNEs became increasingly involved in the Thai automotive industry from the mid-1980s. Figure 1 illustrated FDI inflows of machinery and transport equipment used for a proxy of FDI inflows in these two industries between 1970-2008. The FDI inflows were more or less unchanged from 1970–85, with annual inflows amounting to less than \$5 million. Its share of total manufacturing FDI inflows was around 5 per cent. Following this, the annual average value of inflows increased dramatically to \$37 and \$87 million during the periods 1986–90 and 1991–5, respectively. After the 1997 crisis, the FDI inflows continued to increase. Its value reached the peak in 2007 at \$ 3,300 mil and then slightly declined to \$ 2,934.5 million in 2008. The dramatic increase in FDI inflows resulted in a share of 26.6 per cent of total FDI inflows for the manufacturing sector between 2000 and 2008.

The huge increase in FDI inflows was a result from both incumbents' capacity expansion and the entry of new firms. In the automotive industry, MNE involvement increased at the phenomenal rate in the mid 1990s. Not only the Japanese affiliates upgraded their production, the US Big-three MNEs (i.e. Ford, GM and Chrysler) re-entered in the mid 1990s before the 1997 crisis. A number of MNE parts suppliers has followed their carmaker customers, increasing from around 30 firms during the period 1971–85 to 312 firms (Kohpaiboon, 2006a). Incumbents also expanded their existing activities and introduced new parts.<sup>8</sup>

MNE involvement in HDD industry started after Seagate Technology shifted its Head-stack assembly (HSA), the most labor intensive segment in HDD production process out of Singapore in 1983. From then on, HDD industry began to form a clustering pattern. After manufacturing HSA, Seagate expanded their existing capacity as well as started high-volume production of Head-Drive Assembly (HDA)

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<sup>8</sup> See Kohpaiboon (2009b) Figure 5 for experience of Denso (Thailand).

in Thailand in 1987 and began manufacturing spindle motor in 1994. This demonstrated net gains of carrying HDD production in Thailand to other HDD firms. In addition, Seagate Technology involved training of numerous technical workers and enhanced availability of skilled labour (McKendrick *et al.*, 2000). This in turns created a magnetic effect enticing other key players such as IBM (1991), Fujitsu (1991), Western Digital (2001), Hitachi Global Storage (2004) and Toshiba (2008).<sup>9</sup>

Many MNE parts suppliers like NMB (1988), T.P.W. (1989), Nidec (1989), K.R. Precision (1988) and Magnetec (1992) also entered into Thailand. A number of firms in HDD industries increased from 5 firms during the period 1981-85 to 74 firms between 2001 and 2006 (Table 3). Industrial clustering observed in both industries in Thailand supports the argument that there is a general tendency for MNE affiliates to become increasingly embedded in host countries the longer they are present there and the more conducive the overall investment climate of the host country becomes over time (Rangan & Lawrence 1999).

### 3.3. Economic Performance

Both industries are the country's leading export-oriented sector. Starting as import-substituting, the Thai automotive industry has shifted towards export orientation since 1996. The industry's export-output ratio has surpassed 50 per cent since 2005 (Figure 2). Its export value increased from about \$1,000 mil in 2000 to \$5,000 mil in 2007 as the completely built-up (CBU) vehicles have become the industry's major export item. The predominant export role of parts which accounted for the lion share of the industry's export prior 1996 has been replaced by that of CBU vehicle. As indicated in Figure 3, export value of auto parts grew moderately with average annual growth of 10 per cent during the period 2000-07. Its growth performance was far behind that of CBU vehicles. As a result, the export share of parts to the industry's export sharply declined from 80 per cent during the first half of 1990s to around 52 per cent during the period 2000-07.

On the contrary, HDD is one of the most important electronic exports of Thailand and is always export-oriented. Its export value increased from \$37 mil in

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<sup>9</sup> In 2008, Toshiba started producing HDD in Thailand, using production facility of Fujitsu as a result of the joint investment in manufacturing HDD from both companies (Interview; Bloomberg, January 14, 2009).

1998 to \$4,500 mil in 1996-97 (Figure 4). Between 1999 and 2003, there was slightly downward trend in export value as a consequence of the crisis in global IT industries. Its export value dropped to \$ 3,400 mil, the average figure during the period 1999-2003. From then on, HDD export grew at the phenomenon rate, reaching \$8,214 mil in 2005 and \$ 15,493 mil in 2008. As a result, HDD exports accounted 45 per cent of total IT exports in 2008. Its share of Thailand's total export was 15 per cent in 2008.

Thailand is one of major producers in both vehicles and HDD in the world. Table 4 provides distribution of vehicle production around the world during the period 2000-08. While most of vehicles are still manufactured in the developed countries, developing countries net of three developing countries with enormous domestic markets, i.e. China, India and Russia, gain their relative importance. Interestingly, production capacity was concentrated in only a handful of developing countries participate in the production networks. Nine developing countries listed in Table 4 (Brazil, Mexico, Thailand, Ukraine, Czech Republic, Poland, Slovak, Argentina, and Indonesia) accounted for 33 per cent of total vehicle production in developing countries in 2008. The share increased from 13 per cent in 2000. In Southeast Asia and Oceania, Thailand was the major hub for vehicle production, accounting for about 12 per cent of total vehicle production in developing countries.

Figure 5 shows the world market share of major exporters between 1990 and 2008. Thailand is the second largest HDD exporters, accounting for 17 per cent in 2008, behind only China (35 per cent). Interestingly, Thailand's market share increased throughout after the new millennium except 2008. The country's market share went hand in hand with that of China.

#### **4. Upgrading Experience of Automotive and HDD Industries in Thailand**

This section reviews the past development and upgrading experience of firms in the automotive and HDD industries, i.e., how firms in both industries reach the current of development stage. Materials used in this section are drawn heavily from Kohpaiboon (2006a), Kohpaiboon (2009b) and Kohpaiboon (2009c) for automotive industry and Kohpaiboon (2009a) for hard disk drive industry, all of which are interview-based evidence.

##### **4.1 Automotive Industry**

Since the late 1980s, industrial upgrading in the automotive industry has been observed. This was a result of changes in business strategies of MNE carmakers. In the past when the automotive industries in developing countries were highly protected by cross-border trade protection, these MNE set up assembly facilities in each country to access the highly-protected domestic markets and, thus, earned economic rent. Driven by the increased global competition in the automotive industry during the late 1980s and promising growth prospects for vehicle sales in emerging market economies, the car assemblers change their strategy to pursue national specialization strategy in each region. That is, in each region (e.g. North America, Latin America, Southeast Asia), there would be few production bases (countries) that specialized in producing and exporting certain types of vehicle models. Vehicles manufactured in a certain production base would be sold mainly within the region. The exception would be pick-up truck which is more or less world-wide model as it consists of few region-specific features such as product design, safety feature. Consider the National Specialization strategy of Toyota in Southeast Asia, Oceania and Middle East. Toyota uses Thailand as a production and export base of small-to-medium passenger cars (Vios, Altis, Camry) as well as one-ton pickups (Hilux and Tiger) (Figure 7). In the meantime, the company uses its production base in Indonesia for another family vehicle models, Avanza and Inova. Orders for Inova model in the region will be supplied by Toyota affiliates in Indonesia.

Other companies pursue more or less the same strategies though trade, investment and production patterns are not necessarily the same. Another example is the network of Ford and Mazda which uses Thailand as a base for manufacturing one-ton pickups (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 in determining which models/parts to produce at which locations (country) for which markets. This was in sharp contrast from the past when the local assembly facilities manufactured whatever vehicles they could under the border protection that allowed them to earn economic rent in local markets.

Under the new national specialization strategy, the car assemblers emphasize cost competitiveness so that upgrading is needed. Where functional upgrading is concerned, product development and product engineering stages are undertaken under the new strategy. Car assemblers did not have full information on producing a vehicle because it had not already been produced somewhere else. This is sharply different from the past where vehicle models already launched somewhere else were repeated in developing countries. Assembling activities are not involved in product development and engineering. But under the new strategy, car assemblers and parts suppliers have to jointly work out all necessary information for the manufacturing process based on input prices available at selected production sites to minimize total costs of a vehicle. Hence, higher technological capability from their parts suppliers is required as they are expected to participate in the product development and product engineering. According to the firm interview by Kohpaiboon (2006a), car assemblers nowadays just provide engineering properties and product qualification as well as assign space where parts have to be fitted to the vehicle, over and above cost requirements of the car makers.

One of the outcomes of the strategy change was to increase local parts procurement naturally. Figure 8 illustrates the industrial clustering in the automotive industry by constructing the ratio where the nominator is the (real) dollar value of parts imports whereas the denominator is 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, HS40, HS85 and HS87.<sup>10</sup> The lower the ratio, the

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<sup>10</sup> See full lists of auto parts in Appendix 1 in Kohpaiboon (2009b).

higher degree the local content.<sup>11</sup> As illustrated in Figure 8, there was a downward trend of the imported content of locally manufactured vehicles during the period 1988-2007. Real value of imported parts per 1,000 cars dropped from \$8.1million during the late 1980s to around \$ 2 million during the period 2004-05. The low import content was also observed in other production hubs like Brazil and Mexico (Figure 7).

Linkages allow car assemblers and parts suppliers to work closely together from the stage of product design, to prototype production and then mass production. The whole process commences even a few years before the vehicle is launched . All in all, the automotive industry starts clustering. 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 the car MNEs and their parts suppliers to locate their plants close to each other is benefits from geographical proximity. To develop the new models, the car manufactures have to have frequent communication and meetings with part suppliers so that the quality of the parts can be assured. The geographical proximity also enables the car manufacturers to fully adopt the just-in time production process which in turn, requires the prompt delivery of parts to their assemble plants, the so-called milk-run system.

The remained problem of the automotive industry's upgrading so far is the role of indigenous suppliers in the value chain. Policy attempts to mature indigenous part suppliers were firstly found in the early stage of industrialization in the early 1970s. During the 1980s where car assemblers were still operating for highly protected domestic market, these indigenous firms supplied their products for carmakers directly. Interestingly, when MNE car assemblers shifted toward National Specialization Strategy and began to source more locally manufactured parts, they have switched to the MNEs as their tier-1 part suppliers. Most of these indigenous suppliers were downgraded to be 'suppliers of suppliers' or Tier-2 suppliers. One major reason is these indigenous suppliers had limited capability on product development and engineering, which are highly needed for being Tier-1 suppliers

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<sup>11</sup> Note that the import value of parts covers items for both original and replacement equipment manufactures (henceforth referred to OEM and REM respectively) so that the ratio tends to overestimate the import content of locally manufactured vehicles.

under the new strategy. As a result, these indigenous firms can only participate in the value chain by supplying semi-finished parts to Tier-1 suppliers to further process. Such evidence casts doubt on the effectiveness of the industrial upgrading policy packages, i.e. protection of vehicles and imposition of LCR measures and the likes to promote the Thai automotive industry. It is unlikely to be able to reject a hypothesis that during the IS period, local suppliers did gain technological capability benefit from the presence of LCR and the other protection measures granted so far. The relevant question is whether such protection measures generate sufficient benefits to induce sustainable development of the automotive sector, especially the auto parts industry, where local firms participate. The fact that only few indigenous suppliers survive in the new environment suggests the LCR measures were not a sufficient condition in building up the technological capability of local suppliers and allowing them to benefit from the gains of dynamic economies. They did help local firms to acquire well-established quality-controlled production technology but failed to motivate them to use this technology efficiently and advance to even higher levels of technology.

Nonetheless, being Tier-2 suppliers does not necessarily mean the less technological benefits indigenous suppliers can acquire from the automotive production networks. There is preliminary evidence (e.g. Kohpaiboon *et al.* 2009) suggesting intense interaction between Tier-1 and Tier-2 Suppliers. Tier-1 suppliers place more emphasis on price, quality and time delivery on Tier-2 suppliers, all of which are the key mechanism of productivity improvement and technological progress for the latter. In other word, we would expect more technological gains.

## **4.2 HDD Industry**

Over the past two decades, there were both product and functional upgrading in Thai HDD industry. In the early stage, Thai workers did not yet acquire such tacit knowledge so that only mass production was undertaken in Thailand's affiliates. At present, activities in Thailand's affiliates start from developing prototypes. Like other manufacturing products, there are several tasks involved between product design and mass production stages. After receiving HDD blueprints, workers need to develop basic and detailed designs for production processes. Production facilities, tooling and other requirements are then developed and ordered. Task details are

prepared for workers in production line. Other tasks include pilot runs, during which production processes are put under final checks for the in mass production.

To carry out these tasks, the affiliates have to hire more engineers and scientists. This is true nowadays where the HDD industry has essentially transitioned from the use of longitudinal magnetic recording (LMR) head technology for the head writer function to perpendicular magnetic recording (PMR) technology. In addition, after experiencing functional upgrading, industrial clustering develops. This is because intensive cooperation between HDD makers and suppliers is needed to establish effective coordination and achieve 'virtual integration of the entire system'. Usually, HDD makers request their suppliers to assign few staffs to work with the former's staff as an inter-company team work to exchange information about production efficiency and cost effectiveness and to make changes. A group of staffs (e.g. 1-2 persons) are assigned to work with each customer on daily basis for exchanging production-related information, matching their production and delivery schedules, measuring and informing certain performance measures. Sometimes, HDD makers request suppliers to change certain parts like electronic parts from one supplier (i.e. Tier-2 suppliers) to another to improve finished HDDs' performance. This could happen even in a very short notice and occur like back-and-forth as a part of HDD makers' experimental process. Speed to respond to such requests is one of the performance indicators HDD makers monitor and rank their Tier-1 suppliers for future order volume.

Under the close coordination, HDD makers also benefit from overseeing their suppliers' capability and productivity. Since the former is at the network's center and has better information of all parts assembled in the last stage, they would be in a better position to provide some sensible solution to improve performance of their suppliers. Sometimes, a problem occurs in a particular part but needs cooperation from other parts suppliers to fix it. Even though there are not restrictions for Tier-1 suppliers to serve solely a particular HDD maker, these suppliers have to have individual production line for each individual customer. Even in a relatively generalized part for all HDD makers, it cannot be a single production line for all customers. This would be due to the industry nature in which there are extremely short product life cycles and market demand is highly volatile. Leadership position cannot be taken for granted so that HDD makers must be ready to cope with the

emergence of new and uncharted markets opportunities. Hence, firms in such an industry usually have slightly excess capacity and their suppliers must have capacity ready to respond to any immediate changes that might occur. When there is product innovation from R&D labs, the firm who owns such an innovation must have the production capacity ready to serve the market and harness gains from its innovation. Even though HDD makers outsource peripheral parts to the third party, their relationship is far different from arms' length transaction which is characterized by a loose patchwork of stand-alone affiliates, joint ventures, and suppliers. Hence, there is the effort by HDD makers to network its own operations and inter-firm relationships, across both functions and locations (Borrus *et al.*, 2000).

Nonetheless, while the industry is clustering, it does by no means rule out the industry to make use 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 suppliers referred to as Tier-2 suppliers. Intermediates produced by the Tier-2 suppliers for their Tier-1 supplier customers are less customized as opposed to the first layer. This is especially true for electronic parts. Intermediates traded in the second layer such as printed circuit board (PCB) integrated circuit (IC), resistant, semiconductor are used not only in HDD industries but also other industries. This is reinforced by digitalization phenomenon where electronic elements become an important part in determining performance of manufacturing goods. In addition, there are a number of MNEs such as Celestica, Flextronics, Jabil Circuit, Sanmina and Solectron, whose specialization is to manufacture these parts and components and play an important role in global trade (Lakeman *et al.* 2001; Yasuf, 2004: 11-12).<sup>12</sup> More importantly, these MNEs have their own production networks around the globe. (Yusuf & Evenett, 2002; Sturgeon & Lester, 2004). Hence, these companies make their own decision where to serve their

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<sup>12</sup> Sometimes, they are referred to as contract equipment manufacturers (CEMs) (Lakeman *et al.* 2001). Emergence of these manufacturers is partly related to changes in high-tech industries' business environment such as business consolidation strategy and an increasing number of common parts across products (i.e. a certain kind of chips can be used not only in computer but also in other electrical appliances). Under this environment, business opportunities for CEMs are even greater. They can quote the lowest prices because of their high turnover because they are now able to offer a wide range of electronic items and customers. They can switch production from one category of manufacturers to another. They can pool the inventories of several customers and thereby cut total inventories.

clients (either setting up another affiliate geographically close to their clients or exporting from their existing production capacity). The longer lead time required in the second layer is another factor explaining possibility that the first and second-tier suppliers are not necessarily located nearby. Hence, Tier-1 and 2 suppliers can be located in different countries.

Yet there are some exceptions in the first layer between HDD makers and Tier-1 suppliers. These exceptions are wafer, media and other minor and small parts, usually imported from the HDD makers' affiliates abroad. Wafer and media play very important role in determining business competency and their production, especially the latter, is likely to be in house. Both Seagate Technology and Western Digital imported them from affiliates in Johor Malaysia (Kohpaiboon, 2009a; Seagate Technology, 2008; Western Digital, 2008). The production of both parts are very capital intensive and involve huge sunk costs. For example, Showa Denko set up its new plant in Singapore in 2006. The factory costs about 60 billion Japanese yen and employed about 600 workers. Hence, once the factory is located in a given location, it takes time to establish a new factory in another country. There are numerous metallic parts for linking several major parts in HDD. They include spring wire, bottom VC, top VCM, TG clamp, top cover assy, top cover seal, positional seal, and window clock seal. These parts are physically small and economies of scale matter in their production process. Hence, it is economically worth to supply them for a certain factory. All in all, evidence of HDD industry in Thailand suggests a possibility of the coexistence between industrial clustering and IPNs. MNEs can complement them to enhance their competitiveness. While industrial cluster is observed in the first layer, MNEs still can manage to harness benefit from dispersion of resource endowment in the second layer.

Yet there remains some policy challenge, i.e., the limited role of indigenous suppliers in the network. There are few indigenous suppliers participating in the network. As revealed from the enterprise interview, MNE affiliates have difficulties in finding capable indigenous suppliers. Similarly, the interview with the government officers points in the same direction. The limited linkages to indigenous suppliers would be a consequence of the dualistic feature of trade policy regime widely applicable for export-oriented and labor-intensive industries including HDD industries. Tariff structure in these industries, particularly automotive, remained

distorted. In the case of HDD industry, HDD inputs are still subject to higher tariff rates as opposed to outputs. Hence, it is difficult to find indigenous enterprises who want to sell their product at the world price while their products' tariff is not zero. It would be more profitable to find their niches in the domestic market. Similarly, export-oriented and foreign-owned firms would prefer imported inputs to locally produced ones as they can apply for tariff exemption.

### **4.3 Comparative Aspects**

A comparison of upgrading experience in both industries is provided in Table 5. We compare them in seven aspects ranging from policy environment, upgrading, motivation, types of upgrading, choices between IPNs and ICs, and remained policy challenges. Three inferences can be drawn from Table 5. Firstly, both industries were operating in different policy environment. The automotive industry is one of the few industries where the Thai government has been involved in creating a policy-induced incentive structure to promote local assembly activities since the early 1970s. Until the 1990s, the policy became more liberal. This is in sharp contrast to policy environment in HDD industry, which has been consistently liberal. HDD industry is relatively less restrictive as opposed to other industries. Nonetheless, timing of upgrading is not significantly different from each other.

Secondly, there are both functional and product upgrading in these two industries. Becoming major exporters in developing countries in both industries are clear evidence supporting their successful upgrading. Interestingly, they share a common policy challenge, the limited role of indigenous suppliers in the production network. Such common patterns are not related to how and how long government intervention involved, suggesting for further investigation of incentive structure toward indigenous suppliers.

Thirdly, what these two industries differ is choices between IPNs and ICs. In the case of automotive industry, industrial clustering is observed, regardless which layers are concerned. This is in contrast to the case of HDD industry in which there is a co-existence between IPNs and ICs. In particular, ICs occur in the first layer whereas Tier-1 suppliers internationally source their inputs, i.e. presence of IPNs. Interestingly, industrial clustering naturally occurs after affiliates reach a certain level of technological capability. It is not a pre-requisite for upgrading process.

## 5. Impact of Global recession

The recent global recession triggered by the US subprime crisis has affected countries around the globe including East Asian economies which have experienced precipitous export contraction since the last quarter of 2008 (Athukorala & Kohpaiboon, 2009). Production contraction has been firstly observed since the last quarter 2008. This seems to be in contrast to other manufacturing goods which experienced export contraction in the second quarter of 2008. The car exports fell from 124,656 units in October 2008 to 61,067 units in February 2009. The car output contraction reached bottom in April 2009 at 53,644 units, the lowest since the 1997 crisis. In May and June 2009, vehicle production showed a sign of recovery, reaching 61,752 and 74,717 units, respectively. The recovery sign in vehicle sales is to a certain extent a consequence of fiscal stimulus in many countries around the world. Patterns observed from the export-production ratio suggest that output contraction comes from both domestic market and export. The ratio more or less remained unchanged during the period 2007-the first half of 2009. The HDD industry in Thailand also experienced output contraction as a consequence of global recession. Due to its highly export-oriented nature, the pattern of export value would be a reasonable proxy for production. As illustrated in Figure 11, export value sharply dropped from \$8 billion in Oct 2008 to \$ 4 billion in February 2009. From then on, recovery process was set in. Export value in June 2009 was about \$ 6 billion so that many HDD firms in Thailand have resumed their usual working hours since April 2009, some of which hire more workers (Kohpaiboon, 2009c).

Even though both of industries experienced severe output contraction, we do not expect presence of global recession would slowdown upgrading. In fact, global recession makes even a stronger case for needs of industrial upgrading. As discussed so far, global economy is at the very high level of specialization in value chain activities around the globe. Factories located in a given country are not only for domestic demands but also exports. International trade remains the engine of growth for East Asian developing economies in spite of the lesser 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 demand away from exports and towards domestic market (ADB 2009), the policy measures under consideration include both measures to redress export bias in the incentive structure

and various measures to reduce high saving propensity with a view to boosting domestic demand (ADB 2009). The major focus of this policy advocacy is on China. It is clear that the role of China to substitute decreasing demand from the US and European countries would be limited simply because Chinese economy still heavily relies on export to promote domestic economy (Athukorala & Kohpaiboon, 2009). Hence, global competition would be even more intense.

This is reinforced by the adaptation of modularization by MNEs and the rise of protectionist threat amidst the global economic crisis. In the modularization, MNEs tend to specialize in upstream (R&D, product design) and downstream (marketing) parts of value chains. This opens up certain middle segments for Asian firms, particularly in low- and medium-value mass products. There is also a rise of protectionist threat amidst the current global crisis. In fact, there are already some signs of such tendencies (Bradsher, 2009, Athukorala & Kohpaiboon, 2009). Opting to protection measures seems to be a tempting political option aiming to protect domestic activities and redress unemployment situation. It occurs in both North-South and South-South trade (Erixon & Razeen, 2009; Athukorala & Kohpaiboon, 2009). For example, there has been a rise of initiated investigations of non-tariff barriers since the late 2008 (Bown, 2009) as well as stringent implementation of technical and sanitary and phyto- sanitary standard , in addition of course to massive financial support extended by the US and some other countries to automobile manufacturers (Gamberoni and Newfarmer 2009). All in all, competitiveness would remain at the centre of policy priority for promoting economic growth. This instead points out to need for industrial upgrading for the even more intense global competition.

When the automotive industry is concerned, emerging market economies in East Asia remain the playing field for carmakers to gain their market share. For example, in 2006, more than 50 per cent of GM Motors revenue came from their affiliates in the developing country (Economists, 2008). Demand in many emerging market economies as well as OCEANIA would be boosted by stimulus packages used in these economies (ADB, 2009). Therefore, competition in the region would be even more intense. It would not be surprised why many automotive firms in Thailand continued their investment plan in spite of presence of global recession and

experience of output contraction e.g., Nissan's eco car project, Auto Alliance's plan to produce B cars, GM's investment expansion in engine (Kohpaiboon *et al.*, 2009).

Similarly, it is unlikely that the recent global crisis would induce HDD firms to change significantly their sourcing behavior. Similar to other standard electronics (e.g. computer) where they become increasingly important in usual business operation, demand for HDD seems less sensitive to global economic environment. Hence demand for HDD as a derived demand of computer tends to recover quickly. Given the existing production network, there would be no motivation for firms to change their sourcing strategy as a result of global crisis.<sup>13</sup>

## 6. Conclusions and Policy Implications

This paper illustrates upgrading experience of automotive and HDD industries in Thailand. They are selected simply because of their outstanding export performance in the developing world. Their upgrading experience is brought into the debate of relative importance between international production networks (IPNs) and industrial cluster with a view to provide prudential policy for sustainable industrial development. The impact of recent global recession is also incorporated.

Although some studies argue that the Thai industry is more successful in industrial diversification than in industrial upgrading (Doner, 2008), we found some evidence of industrial upgrading in both the automotive and HDD industries. Manufacturing activities in both industries are far beyond mass production process. Certain stages of product and process development are undertaken in Thailand. Production of both industries also relies more on locally manufactured parts. A remained policy challenge is the limited role of indigenous suppliers in the MNE production network. Both automotive and HDD industries share the same policy challenge, regardless how and how long government effort to forge link between these two types of firms. This would be to a certain extent related to the overall incentive structure.

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<sup>13</sup> Production capacity of HDD is highly concentrated as six major exporting countries accounted for 70 per cent. In particular, Thailand and China accounted for nearly 50 per cent of total export. As reflected in the intra regional trade pattern, most of HDD inputs (e.g. media, wafer, ICs, PCB, semi-conductors) are sourced from East Asian economies including Taiwan (Kohpaiboon, 2009a: Table 3).

What these two industries differ is choices between IPNs and ICs. In the case of automotive industry, industrial clustering is observed and reach a level where local content of a locally manufactured vehicle is approaching 100 per cent. In the case of HDD industry, industrial clustering naturally occurs and reaches a certain level. Even though the current global economic crisis has severely affected their production and export, the 'hollow out' scenario is very unlikely for both industries. In other words, Thailand would remain bases for production and export for MNEs. This points to need for continuity of industrial upgrading.

There are three policy inferences drawn from this paper. Firstly, the limited linkage from MNE affiliates to indigenous suppliers points to a need for comprehensive study probing possibly distorted effect of incentive structure of cascading tariff structure, the key theme of tariff policy for the past three decades. Even though there have been consecutive government efforts to neutralize tariff structure since the mid 1990s, it is clear that much remains to be done. There are about 20 per cent of tariff lines subject to high tariffs (greater than 20 per cent). Secondly, choices between IPNs and ICs are purely private sector's decision, driven by the nature of industry. There is a possibility that IPNs and ICs co-exist. Industrial clustering can facilitate ongoing process of technological upgrading but it is not necessarily a pre-requisite for upgrading process. Finally, to promote industrial upgrading process, the government should emphasize strengthening supply-side capability of local firms as well as creating investment climate to encourage more upgrading activities. IPNs and ICs require different type of infrastructure. For example, courier services and broadband internet are more important in IPNs while ICs need complementary infrastructures, e.g. road network, industrial estates to maximize benefits of geographical proximity. Hence, an effective coordination in public goods investment activities between private and public sectors and liberalisation of the service sector are needed.

Table 1

Tariff (per cent) related to Completely Built-up (CBU) and Completely Knocked-down (CKD) Vehicles, before 1992–present

	Before 1992	1992	1999	2000-present
<b>Completely built-up (CBU) vehicle</b>				
Passenger cars over 2,400 cc. <sup>1</sup>	300	68.5	80	80
Passenger cars under 2,400 cc. <sup>1</sup>	180	42	80	80
Pick-up truck	120	60	60	80
<b>Completely knocked-down (CKD) vehicle</b>				
Passenger cars over 2,400 cc. <sup>1</sup>	112	42	20	33 (30) <sup>2</sup>
Passenger cars under 2,400 cc. <sup>1</sup>	112	42	20	33
Pick-up truck	72	20	20	33

Notes: <sup>1</sup> Before 1992, the classification of a passenger vehicle is 2,300 cc.

<sup>2</sup> A number in parenthesis is tariff in 2005.

Source: Ministry of Finance.

Table 2  
Tariff Structure in Hard Disk Drive Industry 1995-2006

	1995*	2002	2003	2006
Hard Disk Drive (HS 847170)	9.8	0	0	0
<b>Inputs</b>				
1. Wafer (HS3818)	11	0	0	0
2. Printed Circuit Boards (PCBs) (HS8534)	14	8	4	0
3. Integrated Circuits (HS8542)	14	0	0	0
4. Semi-conductors (HS8541)	14	1	1	0
5. Motors	14	9	8	8
5.1 Finished Motors (HS8501)	14	8	7	7
5.2 Parts for Motor (HS8503)	14	10	10	10
6. Ball Bearing (HS848210)	10	10	10	1
7. Aluminum Plate (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

*Notes:* \* it is proxied by 2 digit HS847170 e.g. tariff of hard disk drive in 1995 is proxied by the average tariff of HS 84

*Source:* Office of Fiscal Economics, Ministry of Finance

Table 3 A Number of Enterprises in Hard Disk Drive Industry in Thailand 1981-2006

	1981-85	1986-90	1991-95	1996-2000	2001-06
Number of enterprises *	5	18 (13)	36 (18)	51 (15)	74 (23)
Name	1.Seagate (1983)- HSA 2.GSS Arrays (1985)-HSA 3.Fujikara (1985)-Actuators 4.NMB (1985) Bearing 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 Motor 8. NMB (1988)-Spindle Motor 9. Nidec (1989)-Spindle Motor 10. Elec &Eltek (1988)- PCB 11.SCI (1988)-PCB 12. TPW (1989)-Base plates 13.Magnetec (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 magnet 10. Hana (1993)-Voice coil magnet 11. NHK (1994)-Bearing 12. Seagate (1994)-Magnet 13. Daido (1995)-Magnet 14. Seagate (1994)-PCBs	1. IBM-SPT (1997)-Disk assembly 2. Fujitsu (1999)-HGA 3. Maxtor (1996)-HAS 4. IBM-SPT (1997)-HAS 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)-	1. Benchmark Electronics (2007)-Flex suspension 2. Comp Part Precision (2003)-Arm coil 3. Innoven (2002)-Printer Flex 4. Innoven (2005)-PCB 5. LCET (2006)-Coil assembly 6. LCET (2005) Membrane switch circuit assembly 7. LCET (2004)-Write-Read Head 8. LCET (2004)-Coil assembly 9. PCTT (2007)-PCBA 10. PCTT (2006)-FPCB 11. PCTT (2003)-FPCB multi layer 12. Intreflex (2006)-Metalic parts 13. Cal Comp electronics (2007)-Semi-PCBA 14. Star microelectronics (2005)-PCBA 15. Beyonic Technology (2002)-Base plate

			15. Hana (1993)-PCBs 16. Boron (1995)-Flex circuit 17. Wearnes Precision (1994)-Housing and base plates 18. NHK Precision (1993)-Housing/base plates	Polished substrates 14. Arrow mizutani (1998)-Heat sink 15. G.D.P. (1998)-General machining	16. Single point parts (2006)-Ring motor, sleeve, shaft 17. Chin-ed Su Magnetic (2006)-Voice coil motor 18. MPN technology (2005)-Base plate 19. World Precision (2004)-Base plate 20. Altum Precision (2006)-Base plate 21. Silatic (2004)-PCBAs 22. Prem Star (2006)-PCBAs 23. Prem star (2006)-electronic micro assembly
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*Note:*\* the number in the parenthesis indicates additional establishments.

*Sources:* Data between 1981 and 2000 are from McKendrick et al. (2000) and those during the period 2001-06 are from Kohpaiboon (2009a)

Table 4

## World Vehicle Production 2000-08

## 4.1 All types of vehicles

	2000	2005	2006	2007	2008
Total vehicle production (mil Units)	58.4	66.5	69.2	73.2	70.5
% of 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
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 Country	10.0	11.7	14.6	15.5	17.2
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
Slovak	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 (mil Units)	17.2	19.6	19.3	20.1	17.9
% of 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
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 Country	8.7	13.0	14.9	15.2	18.4
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
Slovak	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

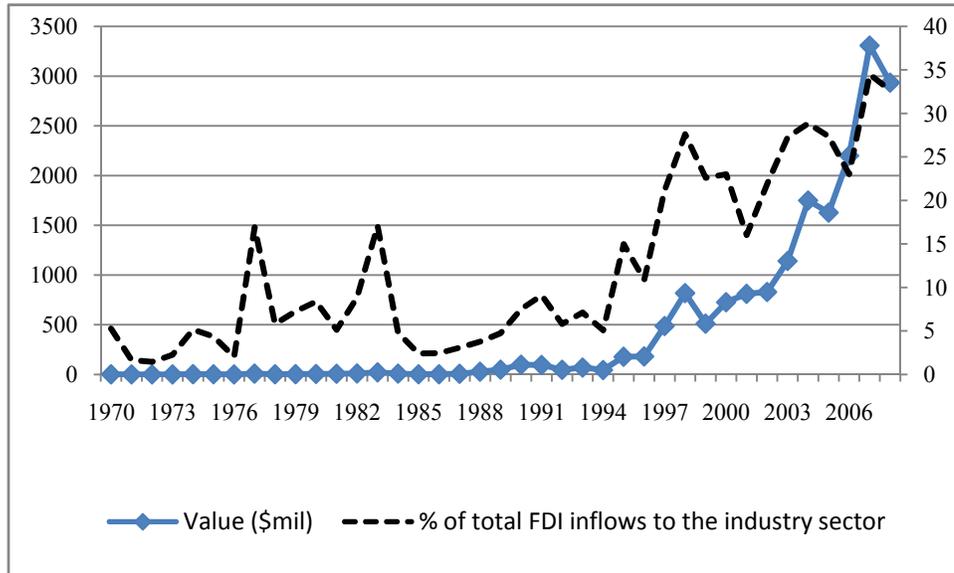
*Source:* Kohpaiboon (2009c)

Table 5: Comparison of Upgrading Experiences in Automotive and HDD Industries

	<b>Automotive Industry</b>	<b>HDD Industry</b>
<b>Policy Environment</b>	<ul style="list-style-type: none"> <li>- Restrictive policy regime up to the late 1980s.</li> <li>- There have been policy measures promoting backward linkages between MNEs and indigenous suppliers</li> </ul>	<ul style="list-style-type: none"> <li>- Always liberal through tariff exemption schemes</li> <li>- Strengthen supply side capabilities through R&amp;D, training</li> </ul>
<b>Observed upgrading</b>	The late 1980s and early 1990s as the industry has become much more export oriented. Export-output ratio surpassed 50 per cent since 2005.	The mid 1990s as the country's world market share has increased since 2000
<b>Motivation</b>	<ul style="list-style-type: none"> <li>- Changes in business strategies of MNE carmakers, i.e. <i>National Specialization Strategy</i>.</li> <li>- Relatively liberal environment as opposed to other economies in the region</li> </ul>	<ul style="list-style-type: none"> <li>- Gain more skill and (tacit) knowledge of local workers.</li> <li>- Conducive cooperation between private and public sectors on strengthening supply side capability</li> </ul>
<b>Functional upgrading</b>	Most of value chain activities (ranging from product development, prototype, process engineering) undertaken in Thailand	Activities in Thailand's affiliates include developing prototypes, develop basic and detailed designs, pilot runs, final checks in readiness, and mass production.

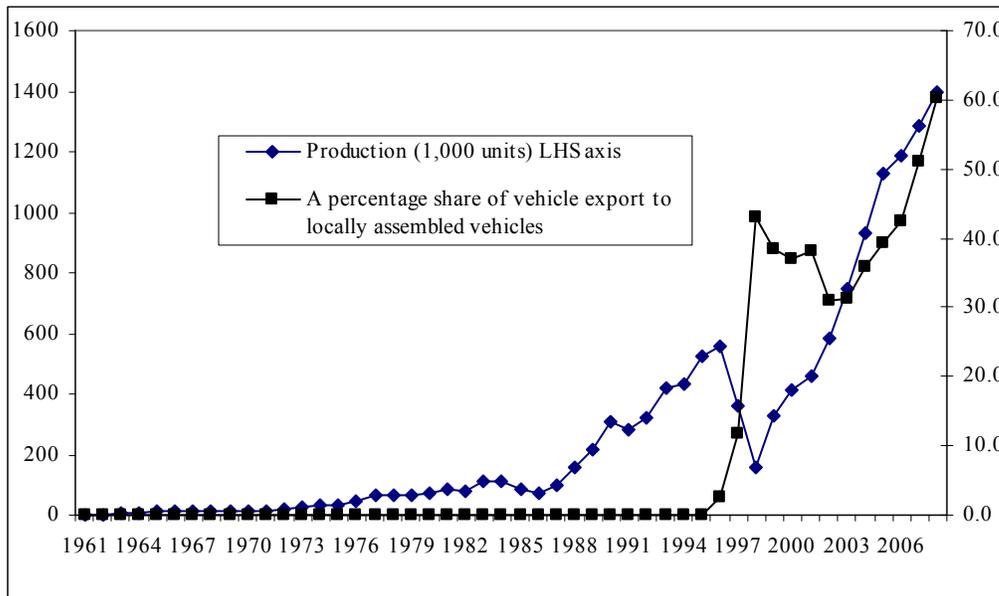
<b>Product upgrading</b>	Specializing certain models of vehicles that are originally developed. This is in sharp contrast to the past where repeated model was produced.	Export composition shifted toward finished HDD instead of HGA, HAS.
<b>IPNs vs. ICs</b>	Industrial Clustering is observed. The increased ratio of imported parts to produced vehicle units.	Coexistence between IPNs and ICs. Industrial clustering is observed and the local content increased to a certain level.

Figure 1  
FDI Inflows in Machinery and Transport Equipment in Thailand 1970-2008p



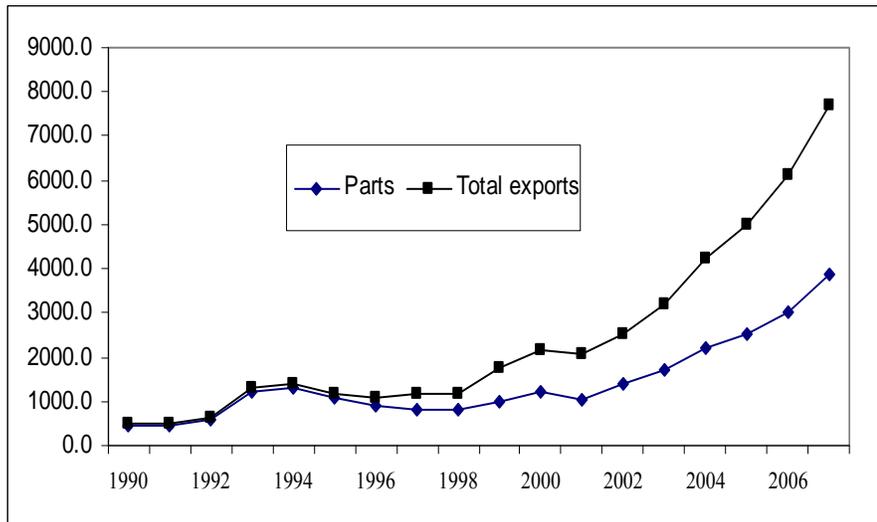
Note: Data of 2008 is preliminary  
Sources: Bank of Thailand

Figure 2  
Volume of Vehicle Production and Share of Vehicle Exports, 1961-2008



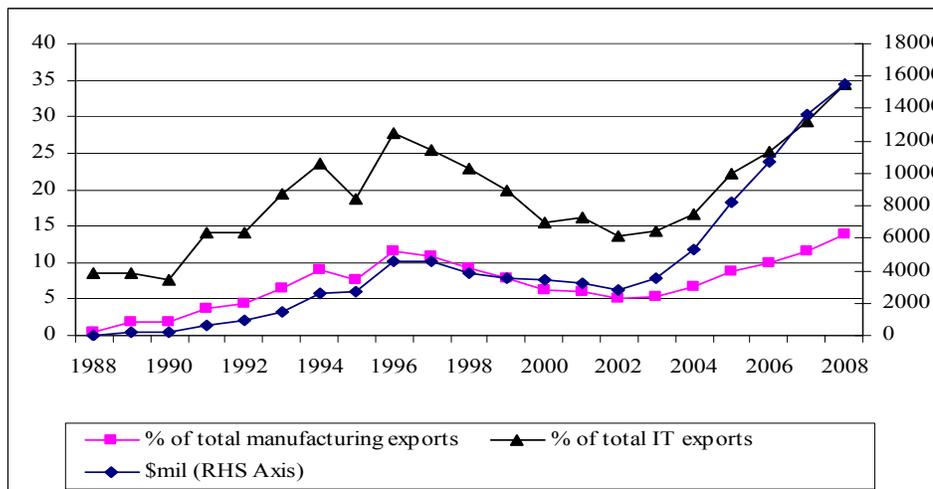
Source: Thai Automotive Association

Figure 3  
Export Value (\$million) of Thai Automotive Industry, 1990-2007



Source: Kohpaiboon (2009b)

Figure 4  
HDD Exports 1988-2008

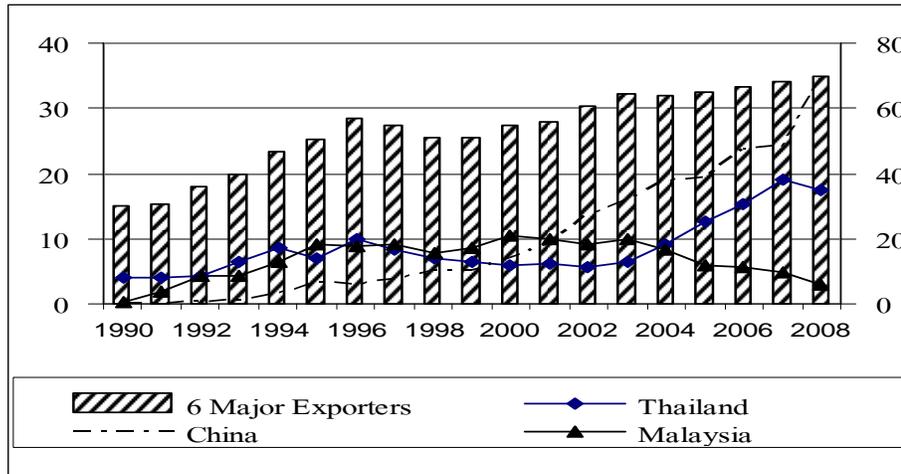


Notes: IT is referred to SITC 75-77, Manufacturing is SITC 5-8 net of 68 and HDD is HS 847170.

Sources: Author's Compilation from UNComtrade database

Figure 5

Market Share of Major HDD Exporters, 1990-2008

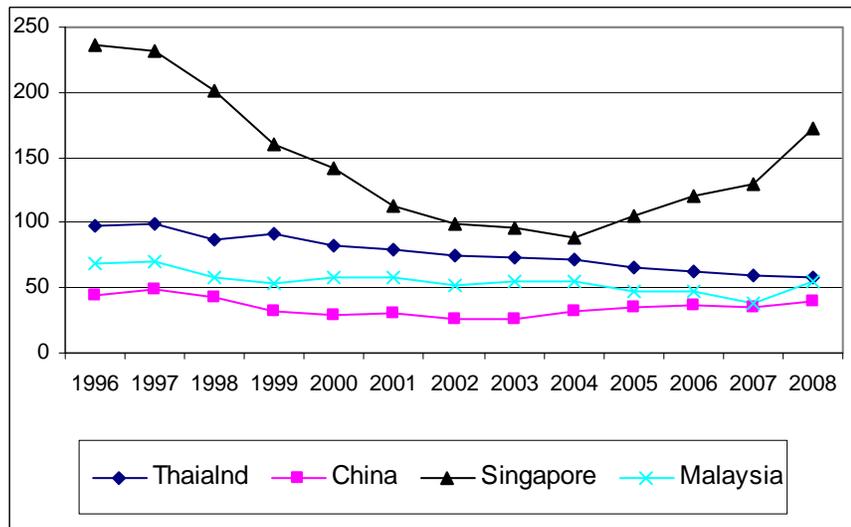


Notes: Six major exports consist of China, Thailand, Malaysia, Singapore, Ireland and the Philippines

Sources: Author's Compilation from UN Comtrade database

Figure 6

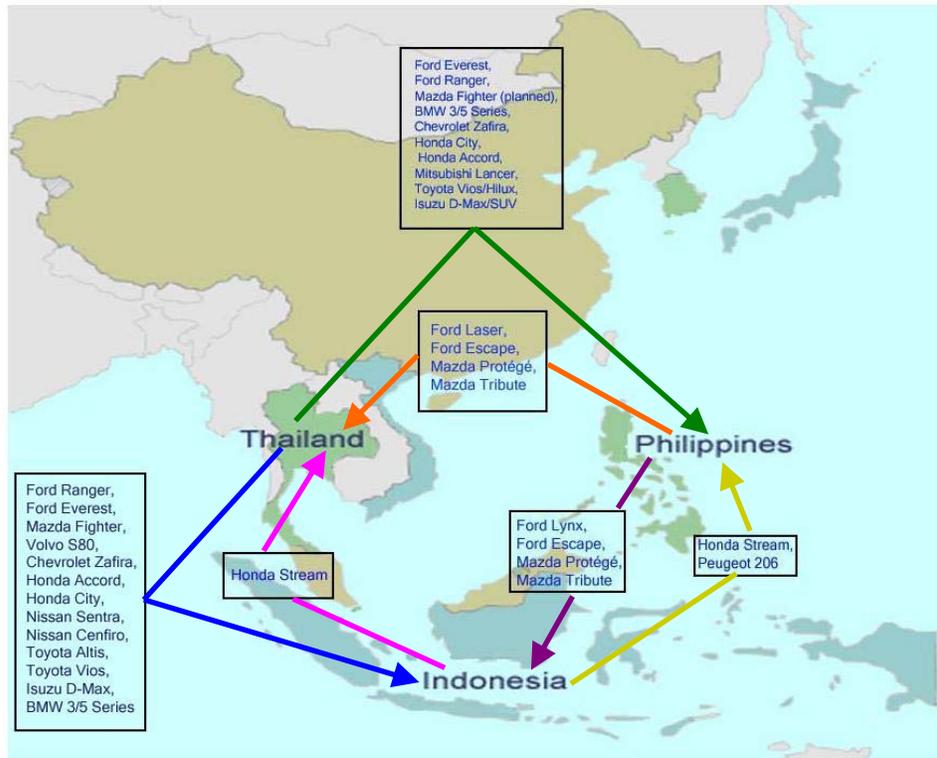
Export Unit Value of Major HDD Exporters in East Asia



Sources: Kohpaiboon (2009a)

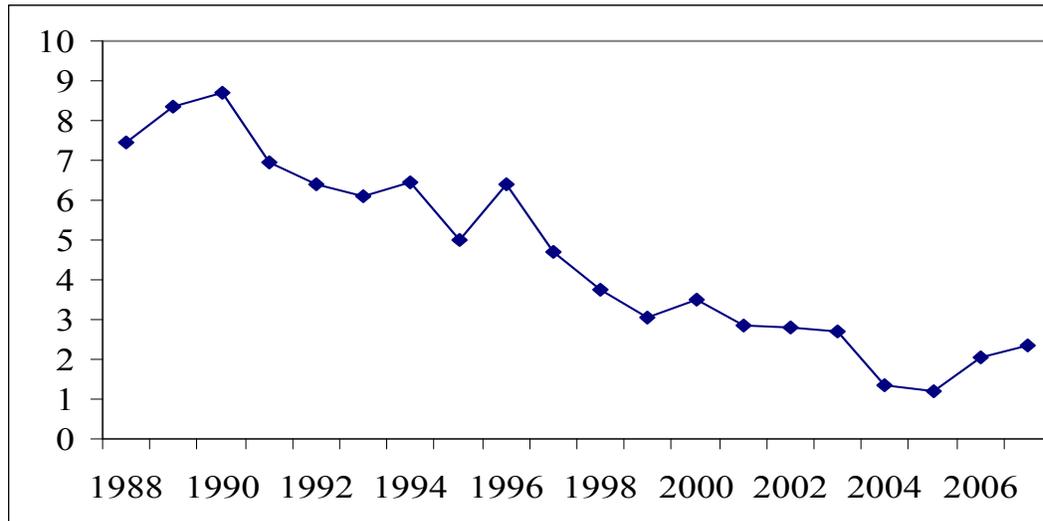
Figure 7

Production and International Trade Networks in Southeast Asia of Selected MNE Car Assemblers



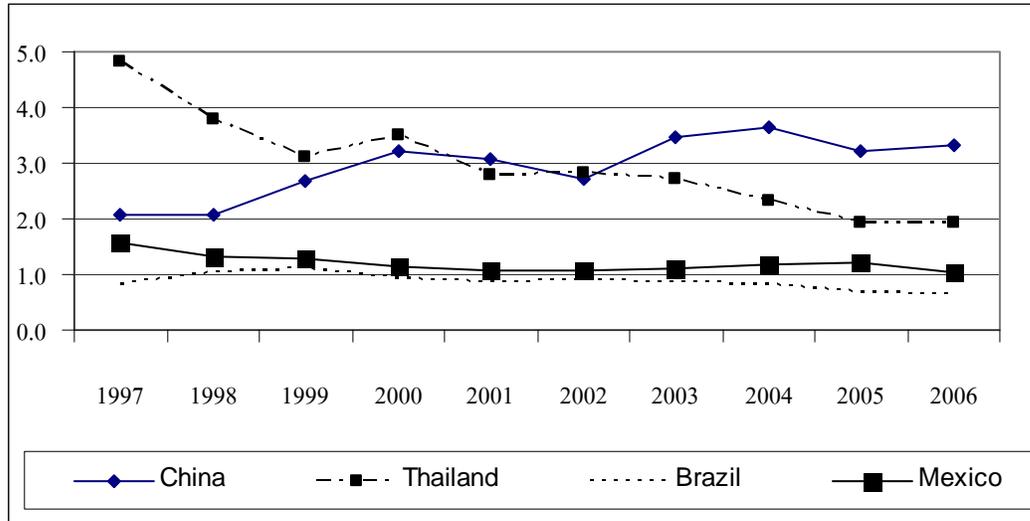
Source: Kohpaiboon (2006a)

Figure 8  
Ratio of (real) Import Value of Parts to Locally Assembled Cars  
(\$million/1000 units), 1988-2007.



*Source:* Import value of parts is compiled from UN Comtrade Database according to the list in Appendix 1 of Kohpaiboon (2009) whereas vehicle units and their share are from Thai Automotive Industry Association.

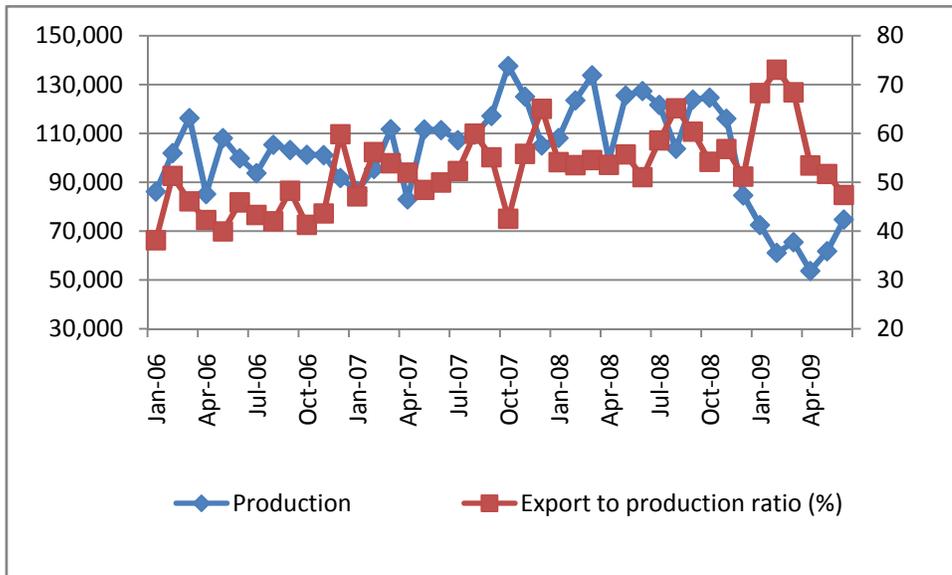
Figure 9  
 Ratio of (real) Import Value of Parts to Locally Assembled Cars  
 (\$million/1000 units) of Selected Emerging Market



*Note:* Lists of auto parts are compiled 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 (2009).

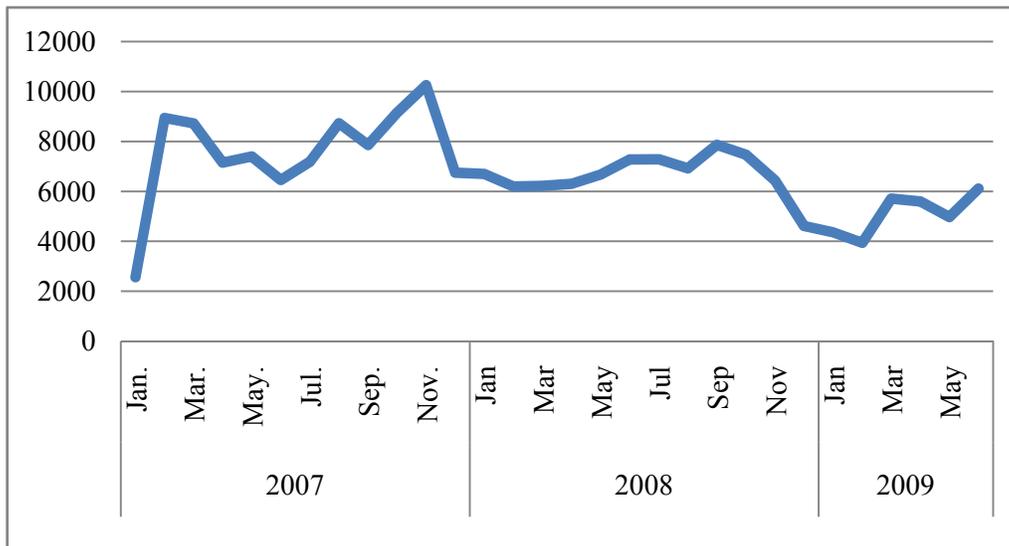
*Sources:* Production data are compiled from CEIC Database whereas import value of parts are from UN Comtrade Database.

Figure 10  
 Vehicle Production and Export Jan 2006-June 2009



Source: Thai Automotive Institute

Figure 11  
 HDD Export during Jan 2007-Jun 2009



Source: Ministry of Commerce

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