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DISCUSSION PAPER No. 22

**The “Catching up” Process of
Manufacturing in East Asia**

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Abstract

This paper examines the “catching up” process of manufacturing in East Asia within the framework of North and South location. Results of this study indicate that latecomers of the ASEAN Four and China have advanced the “catching up” process. At the same time, second-runners of the Asian NIES have more extensively increased their “catching up” with Japan. Most “catching up” was realized in a very short period in the 1990s, and the advancement of the “catching up” process has moved into various industries from nondurable products to light machinery products. However, it has not yet advanced in heavy machinery such as in the industrial machinery and machine tool industries.

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1. Introduction

Transportation costs consist of tariff, shipping, and other business administration expenses for trade. These have been greatly reduced because of WTO commitment, advances in telecommunication, improvement of infrastructure, and policies to promote foreign direct investment (FDI). The substantial reduction of transportation cost has expanded cross border economic activities by multinational corporations (MNC's), and this has resulted in development of economic integration, particularly in East Asia. In the process of economic integration in East Asia, what have been the consequences on location of manufacturing activity? How the location of manufacturing in the North (forerunners) and South (latecomers) has changed becomes especially important, as there has been some controversy relative to where industries are located in these geographical areas.

Akamatsu (1961 and 1962) presented a framework to discuss trade pattern in the context of national industrialization. A "flying geese pattern" was hypothesized in which imports, domestic production, and exports occur sequentially; this moves from simple goods to complex and refined goods, such as from textiles to steel. This sequential occurrence in industry enables developing economies to catch up with developed ones.

The first theoretical consideration of international trade patterns incorporating technological change was made by Vernon (1966) who raised a fundamental doubt about the traditional Heckscher-Ohlin theorem to explain international trade patterns.¹ Vernon advocated a concept of the production cycle in which products mature along market demands from new products to standardized products. At advanced stages of product standardization, production will occur in developing economies where there are competitive advantages in production location.

Vernon's idea was further developed by Krugman (1979) who advocated that international trade patterns are determined by a continuing process of innovation and technology transfer as seen in the world of an innovating North and a non-innovating South. Each product is produced in and

¹ This is different from the Heckscher-Ohlin theorem in its consideration of market demands and standardization of technology.

exported by the North. When the technology involved in the production becomes available to the South, that is, when the Southern labor substitutes for the Northern labor, manufacturers in the North then move the industry to the South². Such relocation of manufacturing activities, led by technology transfer through FDI, can take place on a continuous basis. This may lead to a narrowing of the income gap between the North and the South. Because of the diminishing rent from new products, the North must continuously innovate. Otherwise, manufacturing in the North disappears by the hollowing out of industry. Continuous introduction of new products in the North generates a global innovation cycle that the North and South can develop together.

This argument was further extended by Krugman and Venables (1995) who incorporated the concept of transportation costs. They argue that since the North offers a large market for intermediate goods and is a more attractive place to locate production of intermediate goods (backward linkages), it is a better place to produce final goods for greater variation of intermediate goods. When transportation costs fall at first, the world economy organizes itself into an industrialized “core” and a de-industrialized “periphery,” because manufacturers in the North locate production in that area. Initially, global economic integration leads to uneven development. However, if transportation costs continue to fall, the importance of being close to markets and suppliers, that is, the importance of forward and backward linkages, will decline. At that point, the advantage of low wages in the “periphery” offsets disadvantages in being remote from markets and suppliers. Then, manufacturers in the North move out from the “core” to the “periphery”, and income between the North and the South converges.

These studies lead to the conclusion that manufacturing in the North moves to the South when products are standardized or when transportation costs fall until low wages offset the disadvantage of being remote from the market and suppliers. This North and South approach provides a framework to analyze the location of industry and the “catching up” process by the South with the North in the process of economic integration. Of course, products using advanced

² The North has advantages in producing new products. These include a more skilled labor force, external economies, and simply a difference in social atmosphere.

manufacturing processes remain in the North. Low quality big-volume products continue to be developed in the South, while high quality small volume products in the North.

This study aims to examine the “catching up” of manufacturing activities focusing on East Asia, in the framework of North and South locations. The concept of “catching up” is understood as the phenomena that the latecomer becomes major supplier replacing for the forerunner, and increasingly resembling vis-à-vis the forerunner. The real world, however, is more complicated than the simple North (forerunner) and South (latecomer) structure. In examining the actual “catching up”, three groups are identified here; Japan as a frontrunner, Asian NIES (Hong Kong, Singapore, South Korea and Taiwan) as second-runners, and the ASEAN Four (Indonesia, Malaysia, the Philippines and Thailand) and China as latecomers. In the following sessions, first, we show a measurement of “catching up” development process, and then define the “catching up” in the analytical framework. Lastly, we see how much the “catching up” process has advanced in East Asia. The analysis was attempted, by product at group, from 1990 to 2001, to understand clearly the ongoing “catching up” of manufacturing activities in the region.

2. Measurement of the “Catching up” Process

How can we view the “catching up” development process in East Asia? Competitiveness is measured by product group for each economy in the region. Then, international comparisons of competitiveness can be undertaken. It is supposed in “catching up” that a so-called “leapfrogging” occurs, that is, latecomers jump forward in disorder: and this group catches up with both the second-runner and frontrunner groups. This may happen because the latecomer implements new technology that creates the opportunity to be competitive. A flying geese pattern also occurs in which a frontrunner is followed by a second-runner. The second-runner, being followed by latecomers, may disappear for some product group but will still exist within production seen as a whole. The

development of advanced products within intra and inter industry is carried by the frontrunner.

A question arises. What indicator is appropriate for measuring competitiveness that will allow analysis of the North and South possible in conjunction with Akamatsu's or Vernon's "catching up" production cycle?

There are various methods of measuring industrial competitiveness. Competitiveness is revealed in trade. Among trade measurements, the revealed comparative advantage (RCA) index has been widely used since the work of Balassa (1965)³. The RCA index, which measures the relative degree of export specialization of a country in comparison with the world, is a useful tool to determine what product or industry for each economy in the world has comparative advantage. It gives an analysis in the context of Heckscher-Ohlin theorem. However, it is not a suitable index for the measurement of industrial competitiveness of East Asia, since China and the ASEAN Four have enhanced their competitiveness in various industries at the same time⁴. More importantly, the RCA competitiveness index does not provide a basis for discussion of the international trade pattern of East Asia in conjunction with the North and South framework.

Thus, the international competitive coefficient (ICC) index is applied in this study⁵. The ICC index is defined as net exports over total trade and can be expressed as follows:

$$\text{ICC} = (\text{exports} - \text{imports}) / (\text{exports} + \text{imports})$$

The ICC index implicitly considers demand and supply sides, since the numerator, "exports minus imports", is identical to "domestic supply minus domestic demand."⁶ By observing the simple ICC index over time, assessed by product or by industry, the domestic demand and supply gap can be

³ Also see Balassa, Bela (1979).

⁴ The RCA index shows the degree of export specialization in comparison with the world regarding specific commodities, since it is defined as j commodity's export share in i country's total export over the j commodity's export share in the total world export of the commodity.

⁵ The first study by the author was presented at the ASEAN-Japan Research Institute Meeting that was held on October 2002 in Bangkok, Thailand (see Hiratsuka, 2003). This study provides updates of data including years from 1990 to 2000 and includes discussion of the international trade pattern in the classification of intra-industry and inter-industry.

⁶ Note that domestic demand + export = domestic supply + import; export - import = domestic supply - domestic demand.

discussed.

The ICC index ranges from minus one to plus one. When the ICC index becomes positive (>0), domestic supply exceeds domestic demand. Conversely, when the ICC index becomes negative (<0), domestic supply is less than domestic demand. In cases where the ICC index is rising, domestic supply is increasing against domestic demands, and vice versa.

3. Development Stages According to the “Catching up” Product Cycle

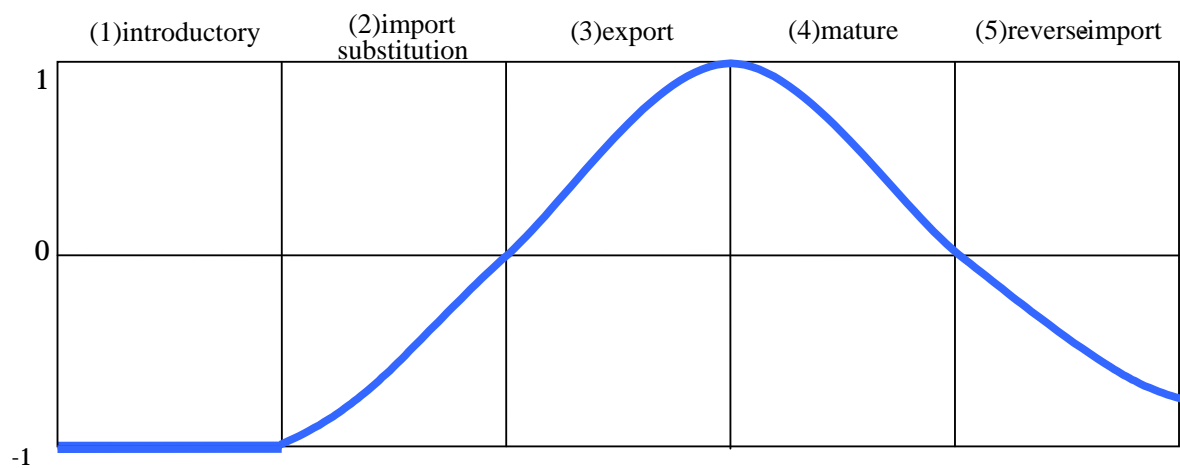
The “catching up” is the situation that a latecomer becomes a supplier in the world market, replacing for a forerunner. The graphic presentation of the ICC index reflects five development stages of a product in conjunction with import and export relations, that is, domestic supply and demand. It indicates which development stage manufacturing activities are in. Here, the five development stages defined by Yamazawa (1990) are used. These stages were used in the study of the “catching up” process in Japan. Figure 1 depicts the “ICC curve” tracing various values between minus one and plus one. These can be classified into the five stages as follows:

- (1) At the “introductory stage”, when a forerunner exports new products and a latecomer imports them, the ICC index of the latecomer takes the value of minus 1.
- (2) The stage in which the ICC index is increasing between minus one and zero is defined as the “import substitution stage”. At this stage, industry in the latecomer shows weak competitiveness since the production level is not large enough in scale. The latecomer exports inferior-quality products to some extent, and yet domestic production is still less than domestic demand (the country is a net importer).
- (3) At the “export stage”, in which the ICC index is rising between zero and plus one, the

latecomer produces at large scale and expands exports rapidly. Eventually, domestic production exceeds domestic demand. It should be noted that the latecomer exports low-end products but imports high-end products from the forerunner.

- (4) At the “mature stage”, the ICC index declines to a level between plus one and zero. The product has “ripened” with the associated technology standardized. The forerunner slowly decreases exports, because it gradually fails to compete with the latecomer in its export markets. However, domestic production still exceeds domestic demand. The forerunner at the “mature stage” exports high-end products and imports low-end products.
- (5) The stage, at which the ICC index decreases to a level between zero and minus one, is defined as the “reverse-import stage”. At this stage, the forerunner fails to compete with the latecomer in the latecomer’s domestic market, and domestic supply is less than domestic demand.

Figure 1. The ICC Curve according to the “Catching up” Product Cycle



Source: by the author

According to the development stage, a latecomer initiates industrial development from the “introductory stage” in which new products are introduced via imports. The latecomer then moves to

the “import substitution stage”, and then to the “export stage” in which the latecomer catches up in economic activities with the forerunner. However, as the latecomer catches up, the forerunner fails to remain at the “export stage” and moves to a more advanced or “mature stage” in which the ICC index appears to decline. Finally, the forerunner will be forced to move further into the “reverse-import stage”. Here, the forerunner produces a few niche products without the participation of the latecomer.

We regard the latecomer achieve the “catching up”, when the latecomer move up to the “export stage”, and the forerunner move down to the “mature stage” or “reverse import stage”. More concretely saying, we can say the catching up”, when the second-runner economies of the Asian NIES reach at the “export stage” and the front-runner of Japan drop down to the “mature stage” or “reverse import stage”, and or when the latecomer economies of the ASEAN Four and China move up to the “export stage”, and the Asian NIES or Japan move down from the stage.

In applying the development stage for each product group, it can be seen that the arrival as well as the duration of “catching up” is different depending on product. “Catching up” appears early for some products, but late for others. Further, the “catching up” process may not be completed for each product. Therefore, if products that are “catching up” are aggregated into one product group with ones which are not “catching up”, then there is no clear “catching up” cycle.

All products at the 4-digit or 5-digit levels of the U.N. Standard International Trade Classification, third revised edition (SITC-R3), are classified into 43 product groups. Appendix 1 (43 Figures) gives locus charts that trace three year moving average series of the ICC index from 1990 to 2001 for all 43 products groups⁷. The table in Appendix 2 shows a list of names for the 43 product groups, and Appendix 3 gives the corresponding SITC codes⁸.

⁷ Three year moving average procedures are applied to the original series except for the initial year (1991) and the last year (2001).

⁸ Standards of trade classification differ depending on period and country - SITC-R3, HS 88 Code, and HS 96 Code - and these HS codes are reclassified into SITC-R3. Trade data were obtained from IDE AID-XT (Ajiken Indicators on Developing Economies: Extended for Trade Statistics) which uses OECD trade statistics for OECD member countries, UN trade statistics for non-OECD but UN member countries, and Statistical Department Director General of Custom Ministry of Finance, The Republic of China for Taiwan

4. The Inter-industry “Catching up” Cycle

How does “catching up” take place recurrently? There are two types of “catching up” product cycles (Kojima 2000). One is an inter-industry “catching up” cycle that shows the development of a new industry, for example, from textile to light machinery industry, and then to heavy machine industry, or from nondurable goods to durable goods, then to capital goods. The other is an intra-industry “catching up” cycle. This “catching up” may occur from a downstream industry where factor endowment plays a significant role, to a midstream industry that requires engineering elements, and then to an upstream industry that requires sizable capital and technology. In the textile industry, “catching up” may go from apparel to yarn and fabric, and then to synthetic fiber. In the machinery industry, it may go from assembly to parts, and then to other supporting industries such as molds.

This section examines inter-industry “catching up” in finished goods. Here, “catching up” is expected to occur sequentially as follows: First, “catching up” may take place in nondurable consumer goods, e.g., apparel, footwear and miscellaneous goods. Second, “catching up” may occur in durable consumer goods, e.g., furniture, home electrical appliances, personal computers, office equipment & communication apparatus. Third, “catching up” may happen in transportation goods such as motorcycles, commercial vehicles, and passenger cars. Lastly, “catching up” may occur in capital goods, e.g., machine tools and industrial machinery. Of primary concern is the “catching up” stage of the latecomers including the ASEAN Four and China.

4.1 Nondurable Consumer Goods

Figures in the Appendix showing ICC indices tells us that latecomers of the ASEAN Four and China show high ICC values in nondurable consumer goods, e.g., apparel, footwear & leather articles, and miscellaneous manufactured goods.

Among these, apparel shows a typical “catching up” pattern as seen in Figure 3 of the

Appendix 1: The latecomer group of the ASEAN Four and China shows the ICC value near to plus one, while the second-runner group of Asian NIES shows a decrease between plus one and zero. The frontrunner of Japan shows an ICC value between zero and minus one. Figure 2, which is based on judgments taken from the ICC value over time of Figure 3 of Appendix 1, defines what the “catching up” stage of apparel was in each economy. It tells us that ASEAN Four and China were in the “export stage”, where domestic supplies exceeded domestic demands. Asian NIES (second-runners) were at the “mature stage” where domestic supplies exceeded domestic demands. However, domestic supplies were decreasing against domestic demands. Japan (frontrunner) was at the “reverse import stage” in which domestic demands largely exceeded domestic supplies. This indicates that Japan failed to remain in the “mature stage” within the apparel industry and was forced to move down to the final stage. Now, Japanese apparel manufactures produce only niche goods mainly for domestic consumers.

Figure 4 and Figure 5 of Appendix 1 show the ICC value for footwear & leather articles, and furniture. The “catching up” stage of footwear & leather and furniture is similar to apparel except for a few cases: The Philippines, one of the latecomers, was faced with decreasing competitiveness at the “reverse import stage” for footwear & leather. Singapore showed rising competitiveness for furniture at the “export stage.”

The above observation indicates that in nondurable consumer goods production, latecomers of the ASEAN Four and China passed the advanced economies of Asian NIES and Japan. Manufacturing activities in the nondurable consumer goods moved to the latecomer groups of the ASEAN Four and China, as Akamatsu (1961 and 1962), Vernon (1966), Krugman (1979), and Krugman and Venables (1995) argued.

It should be noted that apparel and footwear & leather articles are subject to high tariffs in the ASEAN Four and China. Perhaps more importantly, the ASEAN Four and China have participated in a low value chain activity of manufacturing, while the higher value of economic activities such as design, distribution and marketing have been handled by MNC’s in Asian NIES,

the U.S., Japan, and the EU.

4.2 Light Machinery Assembly

Light machinery includes home electrical appliances, office & communication apparatus, personal computers & peripheral equipment, and precision apparatus. In the past, Japan was a major world exporter of this light machinery. However, in the 1980s, it was faced with a shortage of labor, especially unskilled, when Japanese manufactures expanded their world market share. This situation pushed Japanese manufacturers to transfer manufacturing sites to the ASEAN Four and then to China. When China further promoted an open door policy that in 1992 allowed foreign capital to operate for export purpose, it was chosen as a new export base by MNC's.

MNC's have chosen the ASEAN Four and China as assembly sites for personal computer & peripheral equipment in order to reduce operational costs. Figure 9 in the Appendix presents the ICC value of personal computer & peripheral equipment, and this shows that the ICC index of the ASEAN Four and China crossed from below zero to above zero in the 1990's. The Philippines shows the highest value near to plus one. In 1995 and 1996, Japanese hard disk drive (HDD) makers, namely Hitachi, Toshiba and Fujitsu, relocated the 3.5 inch HDD manufacturing factories to the Philippines where they assemble laptop computers either by own brand manufacturing (OBM) or by own equipment manufacturing (OEM). Meanwhile, Japan's ICC value decreased to below zero in the 1990's. The ICC of Taiwan and Singapore also decreased. Figure 9 of the Appendix shows that "catching up" by latecomers has advanced. The ASEAN Four and China have succeeded in climbing above their competitiveness, in the 1990's, to the "export stage", while Japan and Hong Kong declined to the "reverse import stage". South Korea, Taiwan, and Singapore are in the "mature stage".

Office & communication apparatus includes copying machines, printers, and facsimile modems and is similar to personal computer & peripheral equipment as far as "catching up" is concerned. The latecomers of the ASEAN Four and China enhanced their competitiveness in the

1990's reaching the "export stage", while Japan dramatically decreased its competitiveness in the 1990's to the "reverse import stage" (see Figure 10 in the Appendix).

Initially, home electrical appliances had developed in the ASEAN Four. In particular, Malaysia was chosen as an export base of home electrical appliances in the late 1970's by Japanese manufacturers such as Panasonic because component parts are easily procured locally. U.S. manufacturers of semiconductor had operated on Penang Island in Malaysia since the early 1970's. Due to the forward linkage effect of electronic parts, Malaysia became a production center of home electrical appliances in the early 1980's. Given this historical background, Malaysia's home electrical appliance shows very strong competitiveness. Its ICC value in the 1990's is near to plus one.

Figure 11 in the Appendix 1 indicates that a great change occurred in the 1990's. China, Thailand, and Indonesia increased their competitiveness to the "export stage", while Taiwan, Singapore, and Japan decreased to the "mature stage". It should be noted that the ASEAN Four and China group became divided. The winners were Malaysia, China, Indonesia, and Thailand; the loser was the Philippines. The Philippines failed to maintain its competitiveness because of its remoteness from intermediate parts and demands for high wages. It is noteworthy that South Korea and Japan continue to maintain competitiveness in home electrical appliances compared to personal computers & peripherals and office & communication equipment. Home electrical appliances are of rather limited production compared with diversified products that reflect varying preferences of consumers. For South Korea in the 1990's, Samsung and LG grew to be major suppliers in air conditioners, washing machines, refrigerators, color TV's, and so on.

The ASEAN Four and China have caught up with Asian NIES and Japan in office & communication equipment, personal computers & peripherals, and home electrical appliances. Japan is now only one strong export base for these light machinery goods. It should be emphasized that the ASEAN Four and China have climbed to the "export stage" through FDI, especially from Japan. Meanwhile, Japan and the Asian NIES moved to the "mature stage" and/or to the "reverse import

stage”.

As far as precision apparatus, “catching up” has not yet advanced. Not only the ASEAN Four and China, but also the Asian NIES have remained at the “imports substitution stage” although they have all increased their competitiveness. On the other hand, Japan continues to maintain strong competitiveness (see Figure 12 in the Appendix 1). This may be due to the fact that MNC’s have not taken FDI in precision apparatus; the market has not been large, and it requires high-precious processing engineering.

Figure 3 and Figure 4 summarize the current “catching up” stage for personal computers & peripherals and home electrical appliances respectively. These figures show that the ASEAN Four and China have attained “catching up” with Asian NIES and Japan.

4.3 Transportation machinery

Motorcycles, commercial vehicles, and passenger cars are quite different from light machinery & assembly goods in trade patterns within the region as well as in production history. Light machinery & assembly started mainly for export purposes, while transportation machinery was initially produced for domestic markets.

Among these, motorcycles are the most popular transportation tool for the ASEAN Four and China. The motorcycle industry initially developed in Thailand, Indonesia, and China as a domestic market oriented industry. Due to the so called “home market effect”, it has become an export industry in recent years. Japanese motorcycle manufactures such as Honda and Suzuki have their mother factories in Thailand. Initially, a new model for the Asian market was introduced in Thailand, and then it was expanded to Indonesia and Vietnam. By contrast, China has a large numbers of indigenous motorcycle manufacturers. Chinese motorcycle manufacturers, faced with an oversupply problem like other industries, have begun to export to neighboring countries.

Japan, South Korea and Taiwan still remain competitive in the “export stage” (Figure 13 in the Appendix 1). Why has the frontrunner of Japan been able to maintain competitiveness in spite of

the rise of the ASEAN Four and China? How can Japan, the ASEAN Four, and China co-exist?

First, product quality is different between the ASEAN Four and China. Motorcycles made in the ASEAN countries are produced by Japanese affiliates. At the same time, Chinese made motorcycles are accepted in low-income countries such as Vietnam and Laos. Second, product quality between Japan and the ASEAN Four is different. Japanese manufactures produce high and medium priced models in Japan, and their subsidiaries in Thailand and Indonesia produce low quality models. Honda, Suzuki, and Yamaha have established an international division of labor. The ASEAN Four produce low-end goods to compete with South Korea and Taiwan, while Japan exports high-end products to U.S. and EU markets. This East Asia wide division of labor, with differences in quality, allows the co-existence of the latecomers of the ASEAN Four and China with the first runner Japan.

Similarly, commercial vehicles and passenger cars have developed as export products in a few countries such as Thailand, China, South Korea, Taiwan and Japan. These products were initially developed as domestic market oriented products. Thailand is the second largest world market of one-ton pickup trucks. Parts suppliers are located in Thailand. Isuzu-GM, Honda, Matsuda-Ford, Mitsubishi, Suzuki, and Toyota, have adopted a strategy in which Thailand is a base of commercial one-ton pickups not only for the domestic market but also for external ones. Thailand's performance of commercial vehicle production and export in which it exports a product when it has a large domestic market is explained by the "home market effect". The ICC index value from Thailand shows that it has climbed to the "export stage" (see Figure 14 in the Appendix 1). Japan, South Korea, and Thailand comprise the few export suppliers of passenger cars. Japan has maintained an ICC value at the "export stage". South Korea attained its highest ICC value (see Figure 15 in the Appendix 1) because imports were restricted by high tariffs. South Korea has now caught up with Japan. Thailand increased its ICC value to the "export stage" in the 1990's. Malaysia at one time exported its national car, the Proton Saga, to the U. K., Iran and other markets. However, these exports have decreased recently, and the import of high quality vehicles has increased, because of

the rise of national income in Malaysia.

4.4 Heavy Machinery

The heavy machinery industry contains machine tools (Figure 36 in the Appendix 1) and industrial machinery (Figure 37 in the Appendix 1). Heavy machinery, including machine tools and industrial machinery, exhibit similar international trade patterns with precious apparatus. Because of small production and the requirement of integral products that require high technology and know-how, the number of players is greatly limited. Japan has been a major supplier of heavy machinery, and Japanese manufactures have not given FDI to the ASEAN Four and China except in a few cases. For these reasons, the ASEAN Four, China, and also the Asian NIES have remained at the “import substitution stage”. Japan preserves very high competitiveness (Figure 6). Thus in East Asia, “catching up” has not yet advanced in the heavy machinery industries.

5. The Intra-industry “Catching up” Cycle

It was observed in the previous section that the latecomers of the ASEAN Four and China have advanced in the “catching up” process for various finished goods. “Catching up” has partly advanced in transportation machinery but not at all in heavy machinery. The “catching –up” process tends to advance fast in downstream industries and later in midstream and upstream industries because the downstream industries are relatively more labor intensive while mid and upstream industries are more technology and capital intensive. This section examines whether “catching up” has occurred from downstream to midstream and upstream industries. This section specifically deals with fabric& weaving, synthetic fiber, parts of light machinery, parts of transportation machinery, parts of heavy machinery industry, molds, steel and iron, and chemical products.

5.1 The Textile Industry

The textile industry is roughly composed of three streams: the downstream of apparel, the midstream of fabric & weaving, and the upstream of fiber. As discussed in the previous section, the ASEAN Four and China have finished the “catching up” with Asian NIES and Japan in the area of apparel. Apparel is a labor-intensive industry in which low wages play a more significant role than other factors such as distance to market and access to suppliers. However, the midstream textile industry and yarn & fabric, are different from apparel.

Yarn & fabric have developed well in East Asia. In 2002, Taiwan and South Korea were the first and the second largest exporters of synthetic yarn (HS 5202). These countries produce products in mass and export them at low prices. Taiwan exports low medium priced yarn (US\$ 1503 per ton) and imports high priced yarn (US\$ 3763). South Korea exports medium-low priced yarn (US\$ 2153) and imports medium-high priced yarn (US\$ 2472). Indonesia, Malaysia, and Thailand became net exporters of yarn & fabric. Indonesia is the ninth largest supplier of synthetic yarn, exporting low priced (US\$ 1236) and importing medium high priced (US\$ 2712). Malaysia is the twelfth largest exporting country, and Thailand is the twentieth. They also export low priced yarn and import medium priced. Japan is still the largest net export country of yarn and fabric, but at the “mature stage”. She exports high priced yarn (US\$ 4931) and imports medium-low priced yarn (US\$ 1968).

These differences in export and import unit prices imply that there is a quality ladder in East Asian yarn & fabric. This ladder is embedded in the regional intra-industry trade and implies that latecomers produce low quality products while forerunners produce high price ones.

Figure17 and Figure 7 in the Appendix 1 show that Taiwan and South Korea have the highest ICC value at the “export stage”. Due to the “home market effect”, Indonesia maintains itself at the “export stage.” Thailand, Malaysia, and China reached the “export stage” in 2000. Surprisingly, Japan has remained at the “export stage.”

The upstream textile industry, synthetic fiber, requires huge capital and advanced technology.

Taiwan and South Korea have raised their competitiveness to the “export stage” (Figure 21 and Figure 8 in the Appendix 1). Thailand has also reached the “export stage.” Other East Asia economies are still at the “import substitution stage”. On the other hand, Japan remains the most competitive among East Asian nations. This indicates that “catching up” has not yet advanced in the upstream textile of synthetic fiber.

5.2 Light Machinery Parts

As discussed in the previous section, the ASEAN Four and China have progressed in the “catching up” process for light machinery including home electrical appliances, office & communication apparatus, and personal computers & peripherals. The development of light machinery assembly creates opportunities for these countries’ parts industries to develop through the “backward linkage effect”. A question arises as to whether or not the light machinery parts industries have developed in the ASEAN Four and China.

The ICC values for parts of home electrical appliance show that not only South Korea, Taiwan and Singapore have raised competitiveness to the “export stage”, but also Indonesia, Thailand and China. Malaysia has raised its competitiveness to just short of the “export stage” (Figure 28 in the Appendix). On the other hand, Japan has remained the most competitive among East Asian nations at the “export stage.” The ICC values for the ASEAN Four, China, and Asian NIES have not yet exceeded that of Japan. This fact shows that East Asia as a whole is very competitive within the world.

In comparison with home electrical appliances parts, “catching up” in electronic parts and office & communication apparatus parts are more advanced. Here, the ICC values of the latecomers of the ASEAN Four and China, and the second-runner group of the Asian NIES, became close to those of Japan (Figure 26, Figure 27, and Figure 9 in the Appendix).

In East Asia, the competitiveness of light machinery parts usually converges. This means that the international trade pattern in East Asia has changed from traditional “one way trade” to

“intra-regional trade”. At one time, Japan exported most parts to other countries in the region, but today Japan exports key and advanced parts only. China produces many fuse units, while Japan produces large scale integrated circuits (LSI) in electronics parts. Further, Japan, South Korea, and Taiwan produce integral type parts, while the ASEAN Four and China produce modular types in the same category. These are functionally equivalent, but quality, reliability and durability are different. Portable devices require expensive compact and durable parts, but stationary devices accept inexpensive large and nondurable parts. According to locational advantage, different processing and function, parts of different quality and reliability are mutually traded within the region. This is done through a production network that has contributed to the development of cross-border production sharing (so called fragmentation) as well as within-border production sharing.

5.3 Molds

Molds, essential for machine assembly and the parts industries, are capital goods. The “catching up” process of molds in East Asia developed as Japan moved ahead of other economies. This was followed by Taiwan, and South Korea. In the 1990’s, however, South Korea raised competitiveness by a great margin, while Japan increased its imports of molds and decreased ICC values slightly. As a result, the values of South Korea’s ICC exceeded those of Japan (Figure 35 in the Appendix). Taiwan and Singapore also enhanced competitiveness. By contrast, the ASEAN Four and China have remained at the “import substitution stage” for molds in spite of the fact that their markets are growing due to the development of the light machinery industry. It will take many years for molding industries in the ASEAN Four and China to become competitive, because molds require high precision techniques with machine tools.

5.4 Transportation and Heavy Machinery Parts

The motorcycle parts industry has developed along with its assembling industry in East Asia. Not only South Korea and Taiwan, but also China and Thailand have enhanced their competitiveness to

the “export stage” (Figure 31 in the Appendix). The motorcycle assembly and parts industries seem to be growing through mutual backward and forward linkages except in the Philippines. Here, the “export stage” has been reached for motorcycle parts but not for motorcycle assembly. Japan preserves high competitiveness in the “mature stage”.

The motorcycle parts industry has become the base of automobile parts industry because the motorcycle and automobile industries share similar engineering technologies for parts. Taiwan, South Korea and the Philippines raised competitiveness in automobile parts as well as in motorcycle parts (Figure 32 in the Appendix).

The ASEAN Four, China, and Asian NIES have raised competitiveness of their industrial machinery and machine tools parts industries, but they still remain at the “import substitution stage” (Figure 33 and 34 of the Appendix). This indicates that the “catching up” process has not advanced for heavy machinery so far.

5.5 The Material Industries

Material industries include basic petrochemical and petrochemical & steel. Their competitiveness is almost completely determined by production scale. In East Asia, these material industries have developed, under protection, by joint ventures of domestic and foreign capital. The material industries that have developed for domestic markets, exhibit a typical flying geese trade pattern of an international nature (Figures 22, 23, and 24 of the Appendix). Japan has remained ahead of other East Asian economies except in the case of the basic petrochemical industry of Singapore. However,, Asian NIES raised competitiveness in 1990’s, and the competitiveness gap between Japan and Asian NIES became marginal. As for the basic petrochemical industry, Singapore is already ahead of Japan in terms of the ICC index. Latecomers of the ASEAN Four and China have raised their competitiveness, but they still remain at the “import substitution stage” where domestic demand exceeds domestic supply.

Summary and Conclusion

This study has examined the “catching up” process in East Asia. This is a process in which manufacturing in the North moves to the South when rent generated from development of products in the North disappear. The competitiveness of each East Asia economy is measured using product groups, from 1990 to 2001. The international competitiveness coefficient (ICC), which is calculated by net export over total trade, is applied to each product group.

Results of this study indicate that in various manufactured product groups, latecomers of the ASEAN Four and China increased their competitiveness, in terms of the ICC value, rapidly in the 1990's; their ICC values exceeded those of the Asian NIES and Japan. The ASEAN Four and China have advanced the “catching up” process. Second-runners of the Asian NIES have been able to achieve more “catching up” with Japan. Surprisingly, most “catching up” came about in a very short period in the 1990's. Advancement of the “catching up” process has occurred in various industries. Inter-industry “catching up” was observed in industries ranging from apparel to light machinery assembling industries such as electrical appliances, personal computers & peripherals, and office & communication apparatus. The “catching up” process has advanced even in the motorcycle, commercial vehicle, and passenger car industries. Thailand and South Korea have raised their competitiveness for all three types of products, and China for motorcycles and commercial vehicles. However, the “catching up” process has not yet advanced in heavy machinery such as in the industrial machinery and machine tool industries.

The “catching up” process has also advanced in intra-industry to some extent. “Catching up” extends from downstream industries to midstream industries, e.g. fabric & yarn and synthetic fiber in textile industry, and in light machinery parts. The development of finished goods seems to have led to production of intermediate goods through the “backward linkage effect”. Asian NIES have succeeded in “catching up” with Japan in moldings, an upstream industry, but the ASEAN Four and China have not.

The study found that the ASEAN Four, China, the Asian NIES and Japan have tended to converge in competitiveness for light machinery parts. This reflects production networks that have developed in East Asia as well as intra-industry trade that has advanced in the parts industries. Indeed, each East Asian economy has traded parts mutually with other economies. This means that with the advancement of the “catching up” process, East Asia has established a regional self-organizing process in which each economy can provide components for assembly parts and finished goods.

Until now, this study has not dealt with the issue of whether “catching up” is driven by forces from indigenous firms or forces from foreign firms. According to Kasahara (2004), “catching up” is driven by two forces. One is by indigenous suppliers and the other is by foreign suppliers through foreign direct investment (FDI). “Catching up” that is driven by indigenous firms may be applied to Japan, South Korea, Taiwan and Singapore. “Catching up” driven by foreign suppliers might be seen in the cases of the ASEAN Four and China. The ASEAN Four and China succeeded in rapidly “catching up” in the 1990’s through FDI. When many MNC’s transferred their factories to these regions, a large number of small and medium scale enterprises of Japan and Taiwan followed. China may be able to promote a “catching up” process driven by indigenous firms in the future because a large number of state and private enterprises are enhancing the link between MNC and indigenous firms. However, whether or not indigenous firms in the ASEAN Four will be able to participate in manufacturing processes with the linkage of the foreign suppliers is an issue of concern.

Lastly, for reference, Appendix 4 Table shows the world export share of product group for each East Asian economy. The world export share shows that Japan dropped the world export share greatly, while China and the ASEAN Four raised the position in the world as supplier.

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Figure2 “Catching up” Stage : Apparel (Code 08)

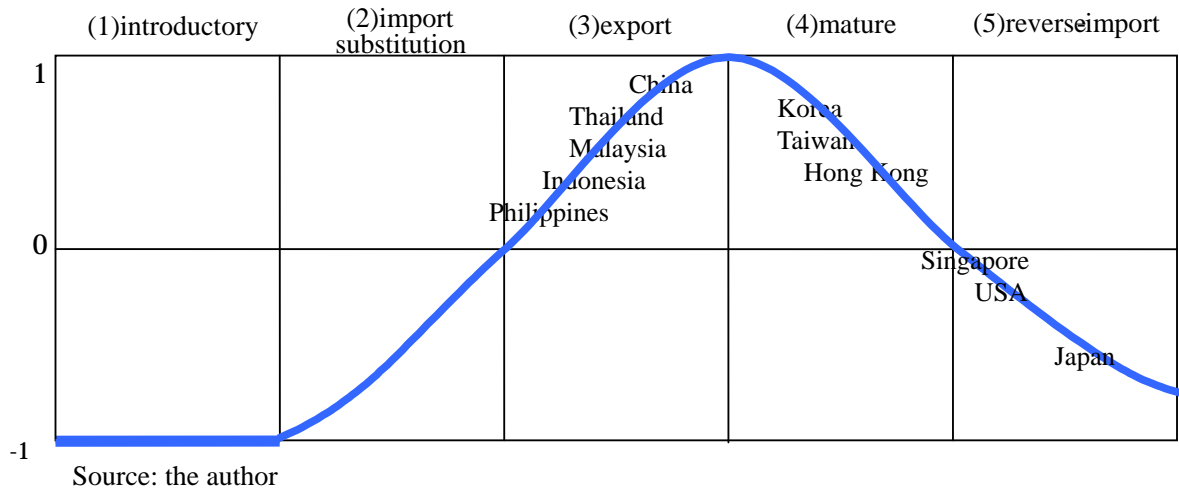


Figure 3 “Catching up” Stage : Personal Computers & Peripherals

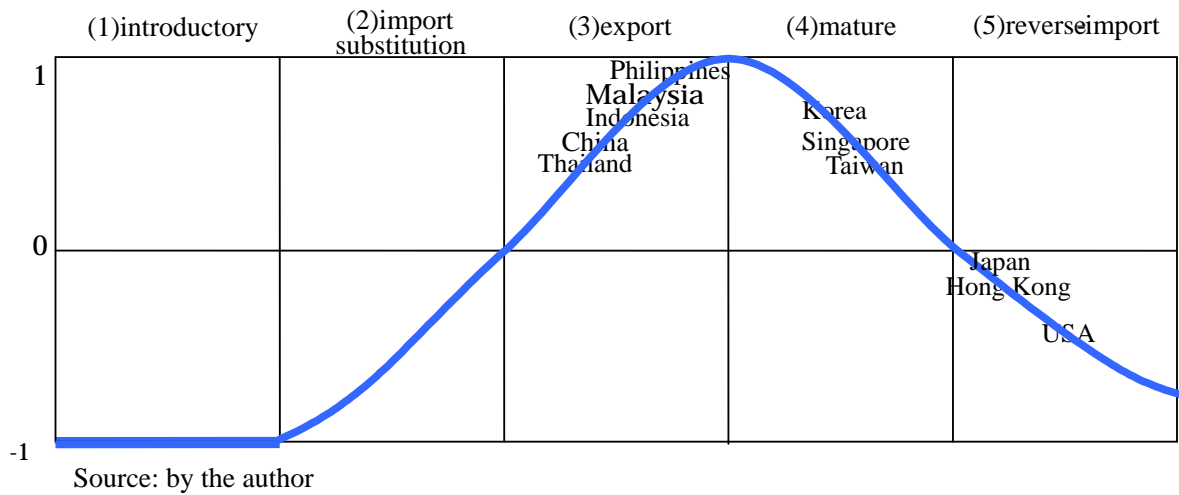


Figure 4 “Catching up” Stage : Home Electrical Appliances

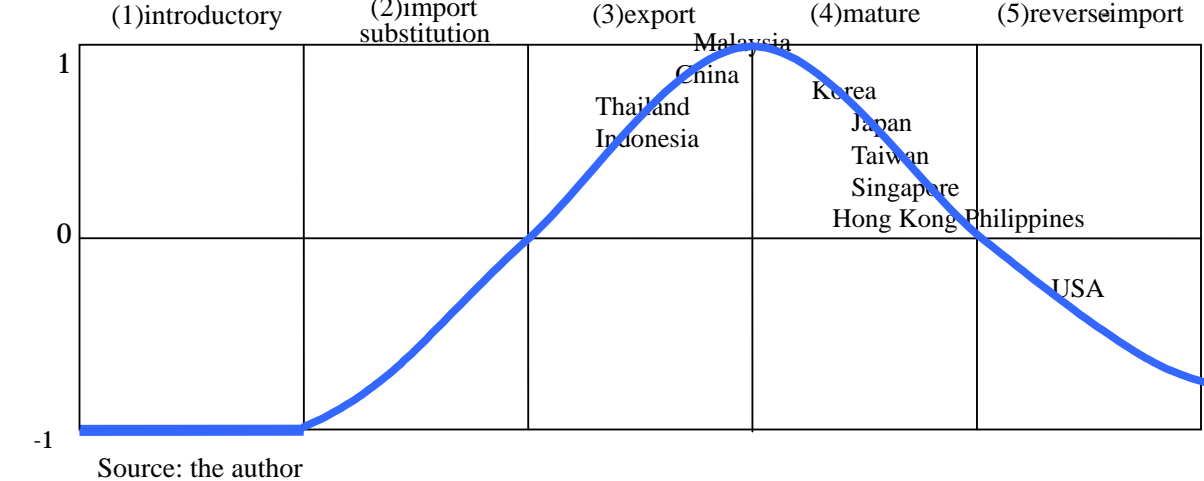


Figure 5 “Catching up” Stage : Motorcycles

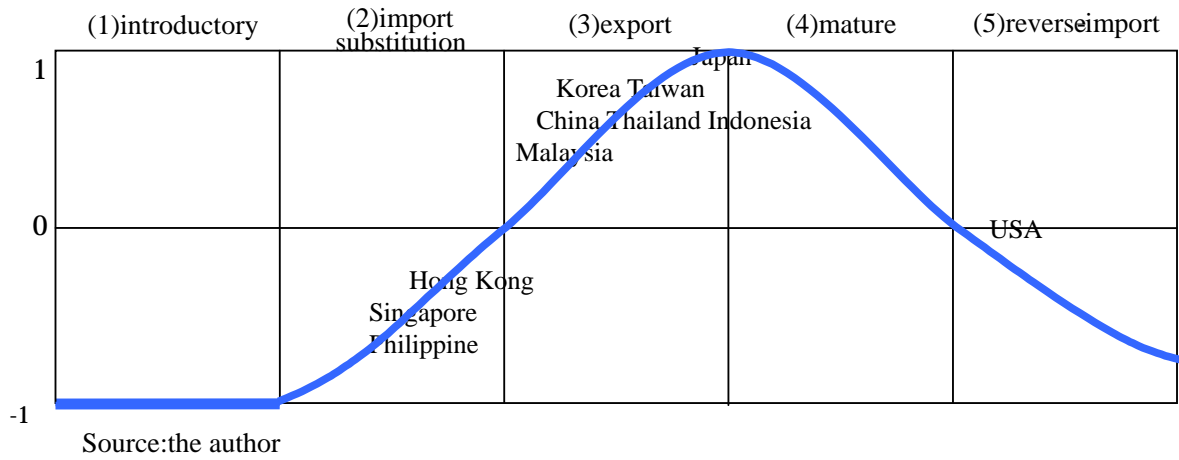


Figure 6 “Catching up” Stage : Industrial Machinery

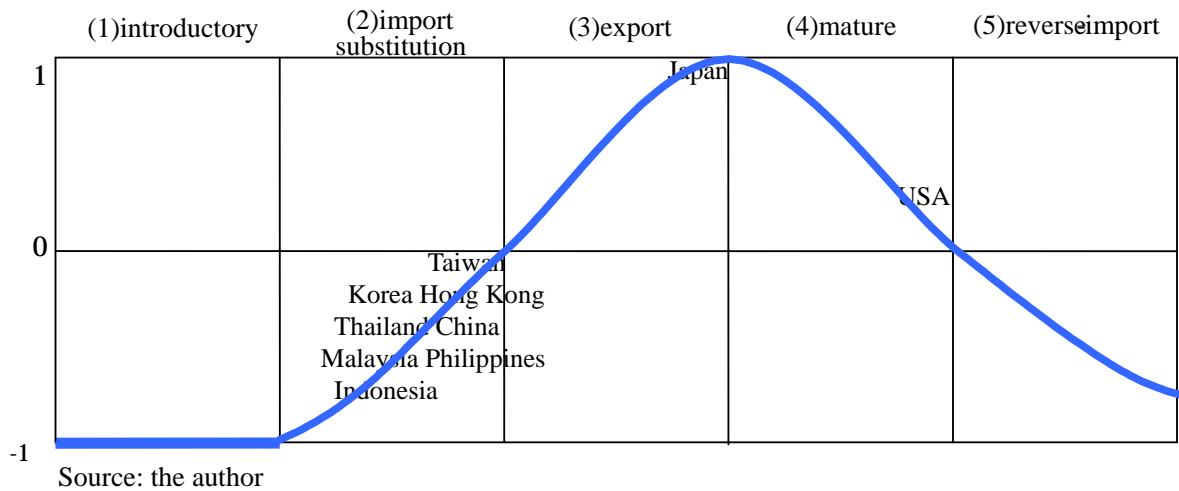


Figure 7 “Catching up” Stage : Yarn & Fabric

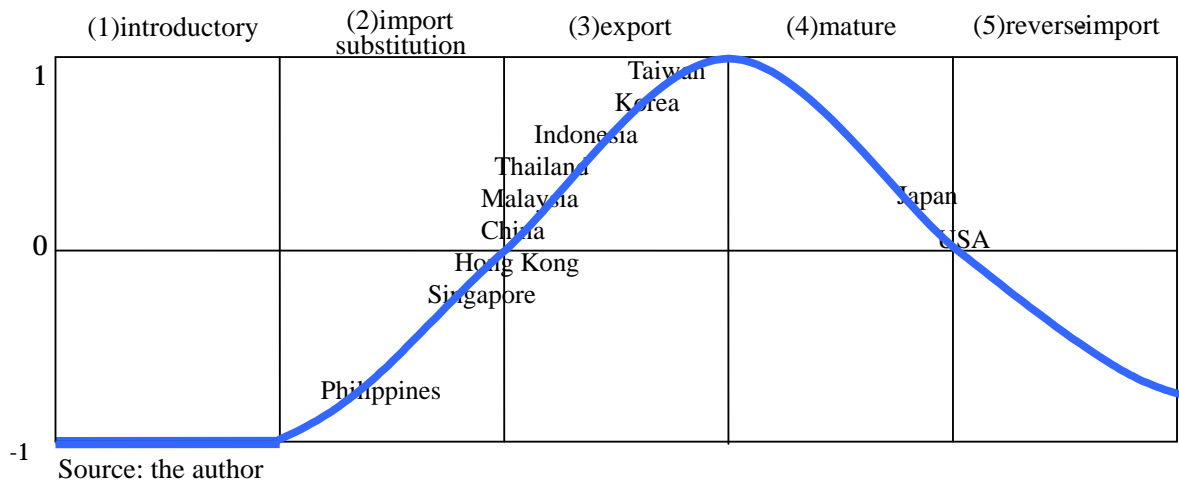


Figure 8 “Catching up” Stage : Synthetic Fiber

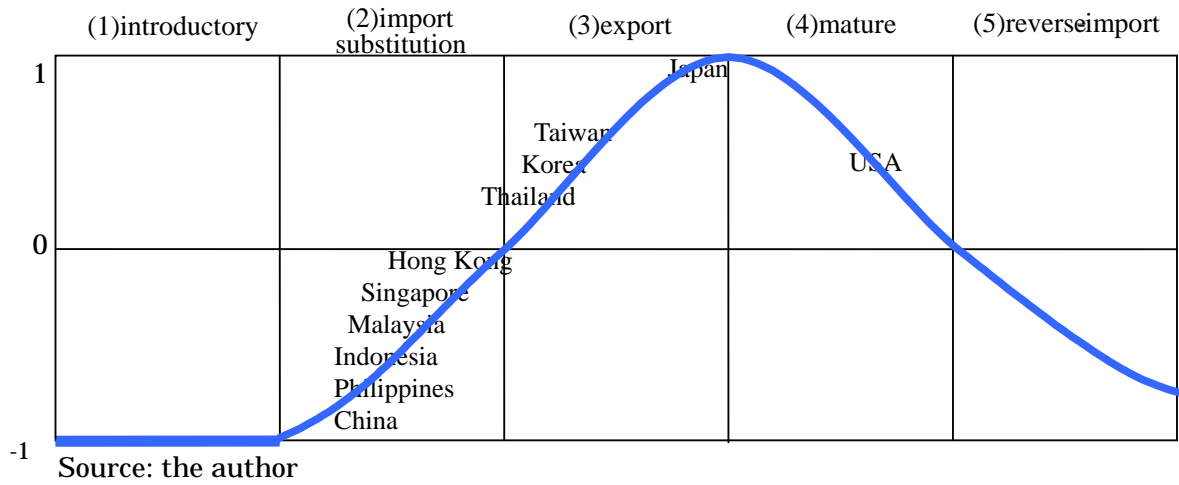


Figure 9 “Catching up” Stage : Electronics Parts

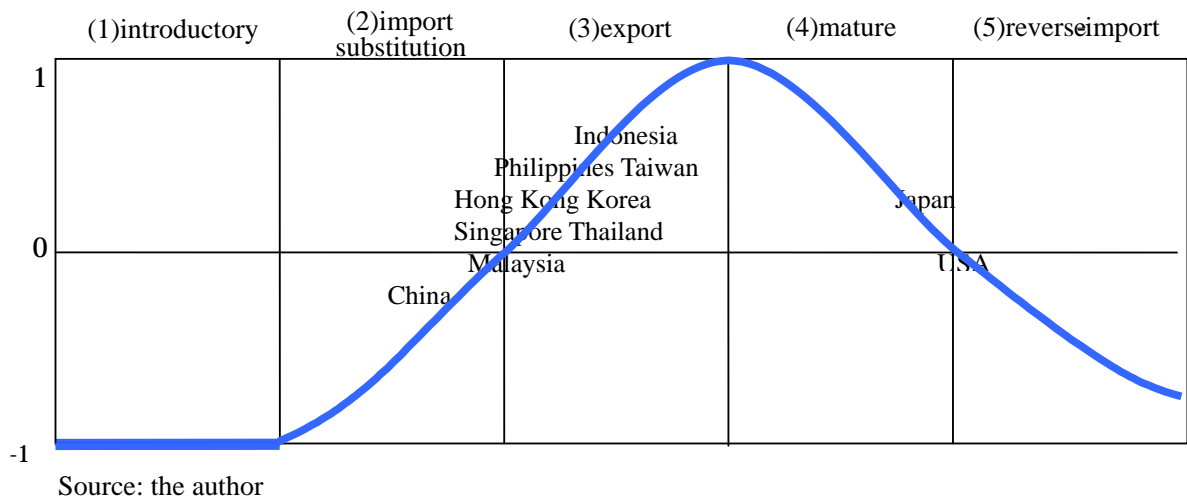
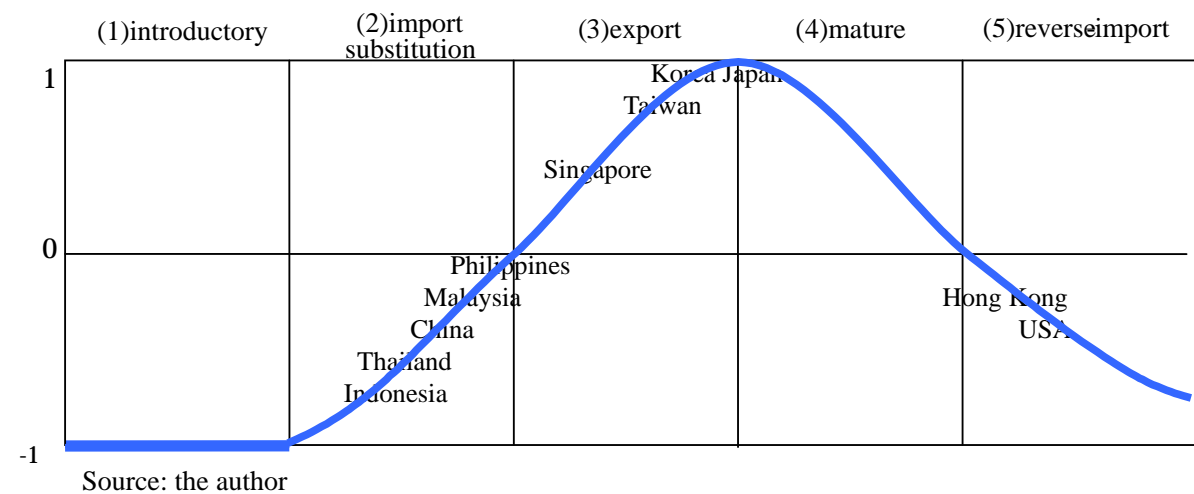


Figure 10 “Catching up” Stage : Molding



Appendix 1. International Competitive Coefficient (ICC) Index

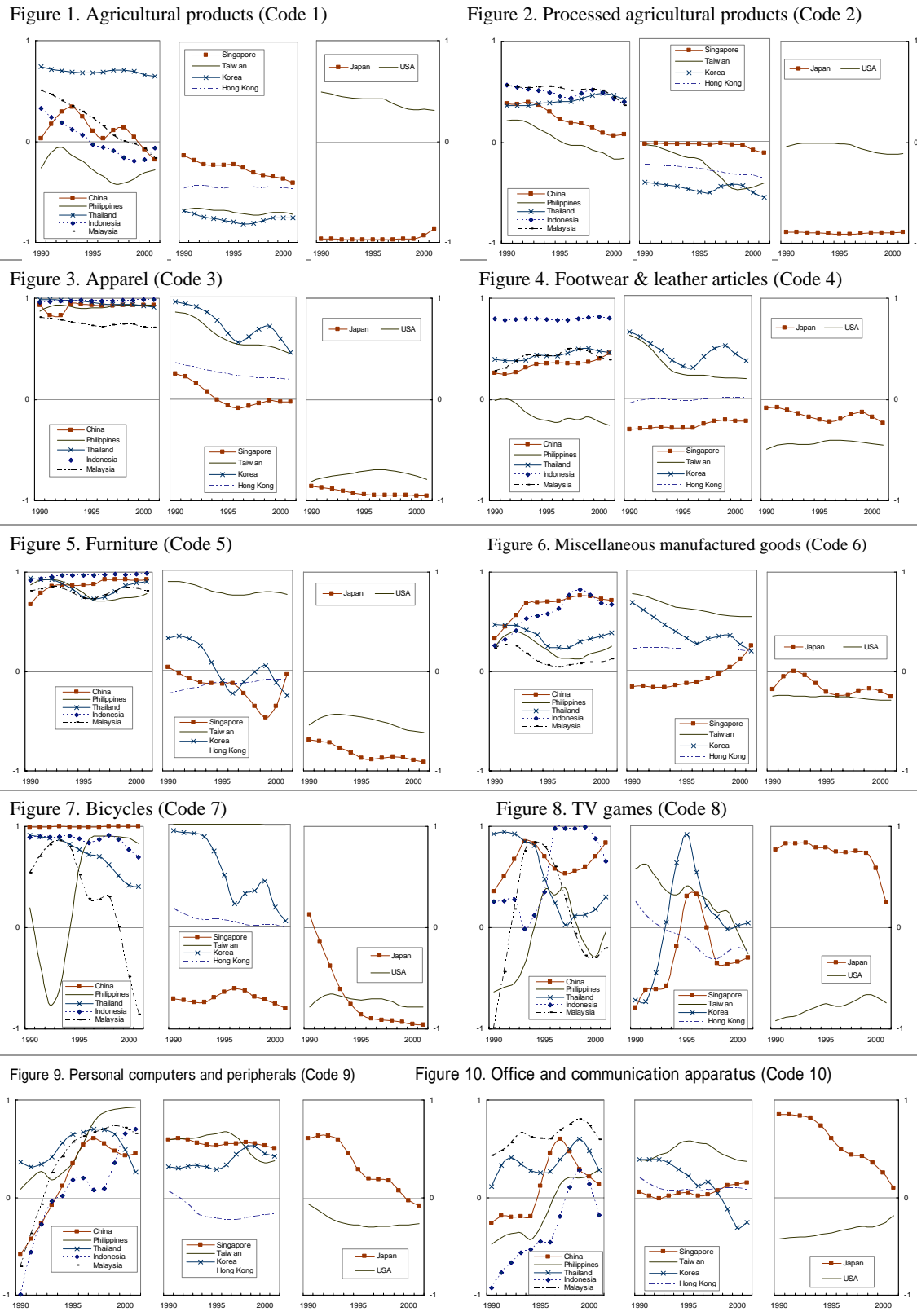


Figure 21 Synthetic fiber textile (Code 21)

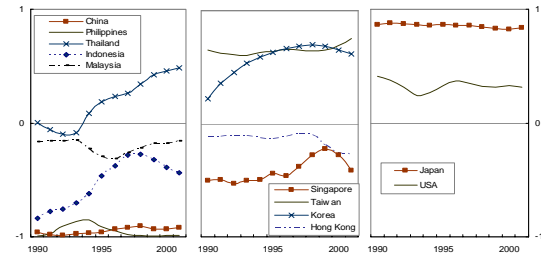


Figure 22. Basic petrochemical products (Code 22)

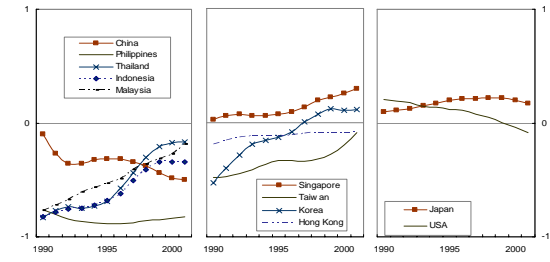


Figure 23. Petrochemical products (Code 23)

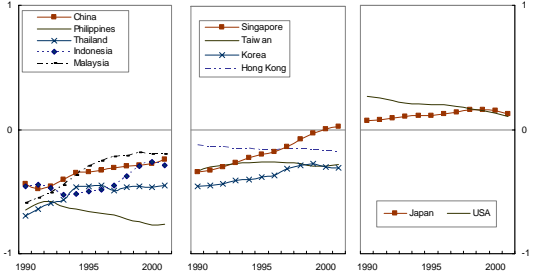


Figure 24. Iron & steel (Code 24)

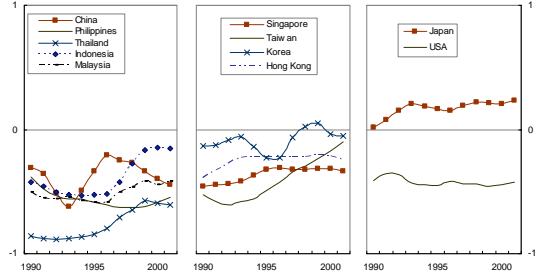


Figure 25. Metal processing (Code 25)

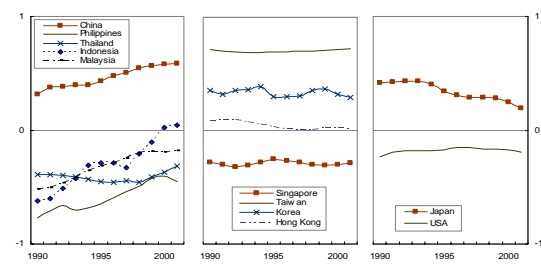


Figure 26. Electronic parts (Code 26)

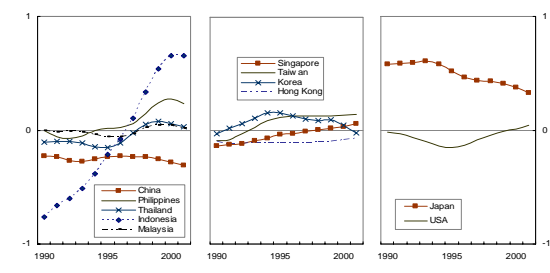


Figure 27. Office & communication apparatus parts (Code 27)

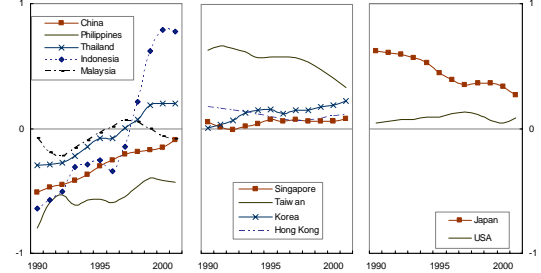


Figure 28. Home electrical appliance parts (Code 28)

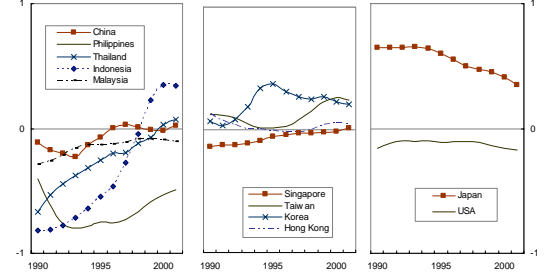


Figure 29. Precision apparatus parts (Code 29)

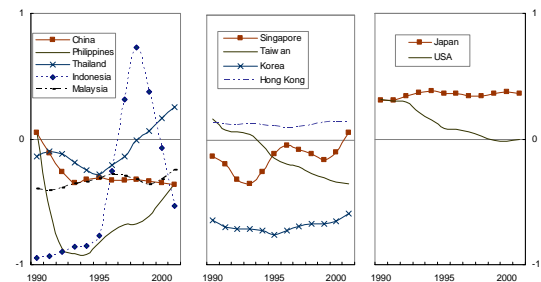


Figure 30. Bicycle parts (Code 30)

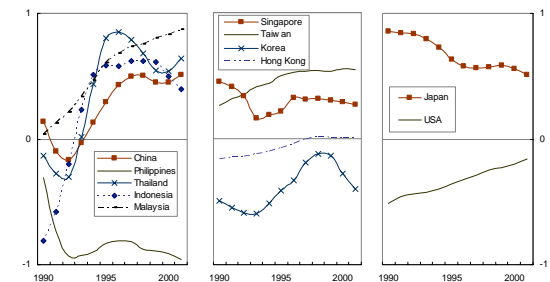


Figure 41. Vessel (Code 41)

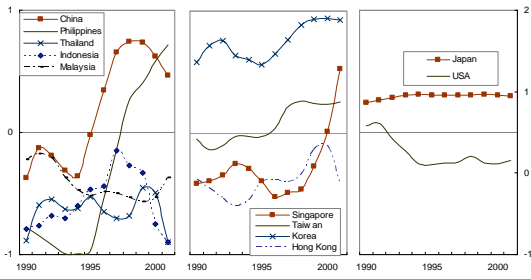


Figure 42. Aircraft (Code 42)

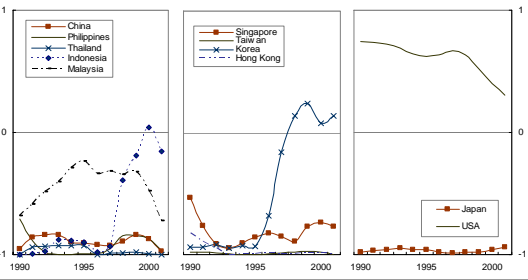


Figure 43. Unclassified (Code 43)

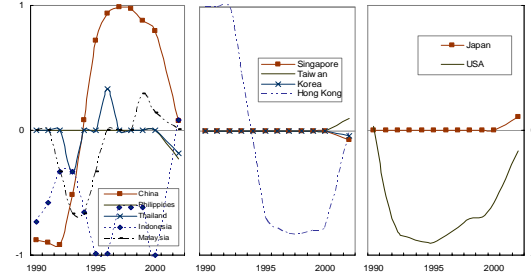
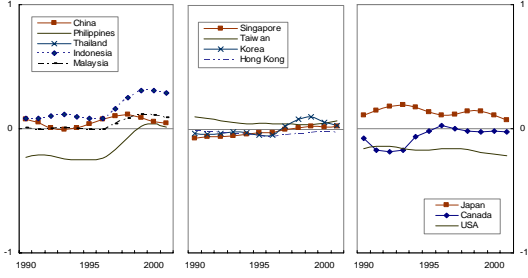


Figure 44. All Commodities



Note: Three year moving average procedures are applied to the original series except for 1990 and 2001.

Source: Ajiken Indicators on Developing Economies: Extended for Trade Statistics (IDE AID-XT)

Appendix 2 Table List of Product Groups

Code	Commodity Group	Example of Commodity
1	Agricultural products	cereals, vegetables, fruits, tobacco, oilseeds, natural rubber
2	Processed agricultural products	cereal preparation, sugar, coffee, spices, feeding stuff, beverages, tobacco manufacturing, wood and pulp
3	Mineral products	Minerals, coal, crude petroleum, natural gas
4	Petroleum products & gases	ferrous and nonferrous metal, petroleum products
5	Natural fiber textiles	silk, cotton, wool
6	Synthetic fiber textiles	synthetic fiber for spinning
7	Yarn & fabric	textile yarn, cotton fabric, manmade fabric, knit fabric
8	Apparel	made-up articles, bed linen, apparel
9	Basic petrochemical products	synthetic rubber, inorganic chemicals, organic chemicals, dye, polymers
10	Petrochemical products	chemical fertilizer, plastic in non primary form
11	Iron & steel	pig iron, flat-rolled iron, iron and steel bar, wire, non-ferrous metal
12	Metal processing	Containers, nails, screws
13	Footwear & leather articles	footwear, leather products, rubber products, plywood, wood manufacturing, bags, chairs, beds
14	Furniture	
15	Miscellaneous manufactured goods	sinks, sanitary, stationary goods, jewels, musical instruments
16	Glass & cement	cement, glass, ceramics
17	Industrial machinery parts	boiler-parts, turbine parts, filters for engines
18	Industrial machinery	boilers, condensers, boring machines, agricultural machines, weaving machines
19	Machine tool parts	machine tool parts
20	Machine tools	Machining, grinding machines, presses for working metal, welding machines
21	Molding	molds, mold bases
22	Electronic parts	printed circuits, condensers, CPU's
23	Office & communication apparatus parts	photo-copying machine parts
24	Office and communication apparatus	photo copying machines, other office machines, telephone receivers
25	Personal computers and peripherals	personal computers, peripherals
26	Home electrical appliance parts	compressors, motors, trans, generators, TV tubes
27	Home electrical appliances	air conditioners, color TV's, video recorders
28	Precision apparatus parts	microscope parts, medical instruments
29	Precision apparatus	microscopes, medical instruments, measurements
30	Automobile parts	chassis, brakes, gear boxes, drive-axles
31	Commercial vehicles	trucks, buses
32	Passenger cars	Passenger cars
33	Motorcycle parts	motorcycle parts
34	Motorcycles	Motorcycle
35	Bicycle parts	Bicycle parts
36	Bicycle	Bicycle
37	Rail locomotive parts	rail locomotive parts
38	Rail locomotives	electric rail locomotives
39	Aircraft parts	aircraft and helicopter parts
40	Aircraft	aircraft, helicopters
41	Vessels	ships, boats, yachts
42	TV games	video, game
43	Unclassified items	Electricity

Source: by the author.

Appendix Table 2 List of SITC Code for Product Groups

1	001,041,042,043,044,045,054,057,121,222,223,231,244,245,246,247,291,292,411
2	011,012,016,017,022,023,024,025,034,035,036,037,046,047,048,056,058,059,061,062,071,072,073,074,075,081,091,098,111,112,122,211,212,248,251,421,422,431
3	273,274,277,278,281,283,284,285,286,287,289,321,322,325,333
4	282,288,334,335,342,343,344,345
5	261,263,264,265,268
6	266,267
7	651,652,653,654,655,656,657
8	269,658,841,842,843,844,845,846
9	232,511,512,513,514,515,516,522,523,524,525,531,532,551,571,572,573,574,575,579
10	272,533,541,542,553,554,562,581,582,583,591,592,593,597,598,882,883
11	671,672,673,674,675,676,677,678,679,681,682,683,684,685,686,687,689
12	691,692,693,694,695,696,697,699
13	611,612,613,621,625,629,633,634,635,641,642,8311,848,851
14	82111,82113,82114,82115,82116,82117,82118,8212,8213,8215,8217,8724
15	8110,81221,81229,81311,8312,8313,8319,892,893,8941,8942,89433,89435,89437,89439,8944,8947,895,896,897,898,899
16	659,661,662,663,664,665,666,667 7119,7128,713,7144,71481,7149,71819,71878,71879,71899,72119,72129,72139,72198,72199,7239,72439,72449,
17	72467,72468,72488,72491,72492,7259,72689,7269,72719,72729,72819,72839,7285,74128,74135,74139,74149,74172,7419,7422,74291,74295,74363,74364,7438,74391,74395,74419,7449,74529,74539,74568,74593,74597,746,747,748,7492,7499,81219 7111,7112,7121,71489,71811,71871,71877,71891,71892,71893,72111,72112,72113,72118,72121,72122,72123,
18	72126,72127,72131,72138,72138,72191,72195,72196,7223,72249,7231,7232,7233,7234,72433,72435,72441,72442,72443,7245,72461,7247,72481,72483,72485,7251,7252,7263,7265,7266,72681,72711,72721,72722,72811,72812,72831,72832,72833,72834,7284,74121,74123,74125,74131,74132,74133,74134,74136,74137,74138,74143,74145,74171,74173,74174,74175,7418,74211,74219,7423,7424,7425,7426,74271,74275,74311,74313,74319,74345,74351,74355,74359,74361,74362,74367,74369,74411,74412,74413,74414,74415,7442,7443,7444,7447,7448,74521,74523,74523,74527,74531,74532,74561,74562,74563,74564,74565,74591,74595,81211,81215,81217
19	7359,73729,73739,73749,74519
20	7311,7312,7313,7314,7315,7315,7316,7317,7331,7339,7351,7371,73721,73731,73732,73733,73734,73735,73736,73737,73741,73742,73743,74511,74512
21	7491
22	75997,77129,772,773,7741,77423,77429,77549,77579,7763,7764,7768,7781,77848,7786,7787,77881,77886
23	75991,75993,75995,7649
24	751,7641,752
25	752 7161,7162,7163,7164,7165,7169,74159,74315,74317,7711,77121,77123,77125,77588,77589,7761,7762,7782,
26	77833,77835,77882,77883,77885,77889,8138,8139,82119,8218 74151,74155,74341,74343,761,762,763,76421,76422,76423,76424,76425,76426,7643,7648,7751,7752,7753,
27	77541,77542,77571,77572,77573,77581,77582,77583,77584,77585,77586,77587,77831,77834,77841,77843 77845,77884,81312,81313,81315,81317,8132 87119,87139,87149,87199,87319,87329,87412,87414,87424,87426,8743987449,87454,87456,87469,87479,8749,
28	88114,88115,88123,88124,88134,88136,88422,88591,88592,88593,88597,88599,89121,89122,89123,89124,89191,89193,89195,89199 77421,77422,87111,87115,87131,87141,87143,87145,87191,87192,87193,8721,8722,8723,87311,87313,87315
29	,87321,87325,87411,87413,87422,87423,87425,87431,87435,87437,87441,87442,87443,87444,87445,87446,87451,87452,87453,87455,87461,87463,87465,87471,87473,87475,87477,87478,88111,88112,88113,88121,88122,88131,88132,88133,88135,8841,88421,88423,8843,8853,8854,8855,8857,88594,88595,88596,88598,8911,89129,89131,89139
30	784,78689,82112
31	72241,7811,7821,7831,7832,7861,7862,7863,78683,78685
32	7812
33	78535
34	7851
35	78536,78537
36	7852, 78531
37	7919
38	7911,7912,7916,7917,7918
39	7929
40	7921,7922,7923,7924,7925,7928
41	793
42	89431
43	351

Source: the author.

Appendix 4 The World Export Share by Country/Region and by Product Group (%)

product group	China		ASEAN Four		Singapore		ASEAN Five		Taiwan		South Korea		Hong Kong		East Asia		Japan		All East Asia		NAFTA		EU	
	1990	2001	1990	2001	1990	2001	1990	2001	1990	2001	1990	2001	1990	2001	1990	2001	1990	2001	1990	2001	1990	2001	1990	2001
Finished goods (weighted average)	2.8	7.6	3.9	5.2	1.9	1.9	5.8	7.1	3.0	1.9	3.1	2.7	4.3	4.8	18.9	24.1	11.1	6.6	30.0	30.8	17.6	22.9	52.3	46.3
Agricultural products	3.8	5.2	8.6	6.9	1.3	0.4	9.9	7.3	0.6	0.4	0.7	0.5	0.9	0.8	15.9	14.1	0.3	1.2	16.2	15.3	36.9	39.4	46.9	45.3
Processed agricultural products	2.7	3.9	6.5	7.7	1.4	1.0	7.9	8.7	22.5	22.5	1.0	0.8	1.7	1.4	14.6	15.5	0.9	0.8	15.4	16.4	22.5	24.8	62.0	58.8
Apparel	12.0	24.5	7.0	7.9	1.8	1.1	8.8	9.0	4.3	1.7	7.0	3.0	17.3	15.2	49.4	53.3	0.7	0.3	50.1	53.7	3.5	12.2	46.5	34.1
Footwear & leather articles	2.9	9.6	4.9	6.5	0.6	0.5	5.6	7.0	4.3	1.5	5.9	2.6	4.2	6.2	22.8	26.8	4.2	3.1	27.0	30.0	14.1	18.3	58.9	51.8
Furniture	1.7	10.3	3.8	8.4	0.5	0.8	4.3	9.2	6.3	2.5	0.9	0.3	1.5	2.1	14.6	24.4	0.9	0.3	15.5	24.7	8.4	20.9	76.1	54.5
Miscellaneous manufactured goods	2.8	9.9	2.7	3.3	1.2	2.4	3.9	5.7	6.6	2.8	4.1	1.6	7.6	9.8	25.0	29.9	6.5	3.4	31.5	33.3	14.6	22.7	54.0	44.0
Bicycle	3.6	34.9	2.1	1.6	0.1	0.0	2.2	1.6	44.0	24.1	2.5	0.9	2.7	2.8	55.0	64.3	3.2	0.3	58.2	64.6	4.1	6.5	37.7	28.9
TV games	2.0	18.9	0.2	0.3	0.5	1.1	0.7	1.4	19.9	0.2	0.3	0.1	15.5	2.6	38.4	23.1	34.6	12.5	72.9	35.6	13.5	20.8	13.5	43.7
Personal computer & peripheral	0.1	7.2	0.7	8.2	10.3	9.1	11.0	17.3	6.1	6.7	3.0	4.1	1.4	2.6	21.6	38.0	18.4	7.0	39.9	44.9	22.6	21.3	37.5	33.8
Office & communication apparatus	1.0	7.8	2.1	4.6	2.6	1.7	4.7	6.2	3.6	4.4	2.2	1.5	5.1	6.3	16.6	26.4	31.5	6.4	48.1	32.7	11.6	21.4	40.3	45.9
Home electrical appliances	3.0	11.2	3.8	7.9	5.2	2.4	9.0	10.4	4.4	1.9	6.2	7.1	6.7	6.1	29.3	36.6	25.7	8.5	55.0	45.1	8.6	18.7	36.4	36.2
Precision apparatus	1.5	3.2	0.8	2.5	1.4	2.4	2.3	4.9	1.9	1.4	1.2	0.8	6.6	5.7	13.4	16.0	17.4	9.9	30.8	25.8	22.6	30.9	46.6	43.2
Motorcycle	0.1	7.7	0.4	1.8	3.1	0.1	3.4	1.9	1.4	2.3	0.5	0.8	2.8	0.6	8.2	13.4	59.7	48.7	67.9	62.1	7.2	6.8	24.9	31.1
Commercial vehicle	0.4	3.5	0.3	1.8	0.2	0.1	0.5	1.9	0.8	0.2	2.4	1.7	0.2	0.1	4.2	7.4	20.1	8.6	24.3	16.0	23.4	35.1	52.3	48.9
Passenger cars	0.0	0.0	0.1	0.3	0.0	0.0	0.1	0.3	0.0	0.0	1.1	4.1	0.1	0.2	1.3	4.7	25.2	18.1	26.5	22.7	16.2	22.2	57.3	55.0
Material (weighted average)	2.7	4.7	3.6	4.5	2.1	1.9	5.7	6.4	2.1	2.7	2.1	3.5	2.3	2.6	14.9	20.0	6.6	5.9	21.4	25.9	17.9	20.8	60.6	53.3
Natural fiber textile	15.4	13.5	1.4	1.3	0.4	0.2	1.8	1.5	1.6	2.3	2.1	3.5	4.1	1.7	23.1	19.5	0.4	0.1	23.5	19.7	43.6	45.8	33.0	34.6
Yarn & fabric	6.2	11.2	2.9	5.1	1.1	0.6	4.0	5.7	7.5	8.5	7.2	9.3	9.0	10.3	33.9	45.1	7.3	5.4	41.1	50.5	6.1	10.7	52.8	38.8
Glass & cement	2.5	5.8	2.8	3.6	0.6	0.5	3.3	4.1	1.9	0.8	1.1	1.0	2.9	3.7	11.7	15.5	5.3	5.1	17.1	20.6	8.3	17.0	74.7	62.4
Mineral products	7.4	7.7	17.7	16.7	0.1	0.1	17.8	16.9	0.0	0.1	0.2	0.1	0.2	0.2	25.7	24.9	0.6	0.8	26.3	25.7	43.8	41.2	29.9	33.0
Petroleum products & gases	1.4	2.1	8.5	10.7	12.2	7.0	20.7	17.7	0.7	1.4	0.9	6.0	0.8	0.4	24.5	27.5	1.5	1.6	26.0	29.1	21.6	26.4	52.3	44.5
Synthetic fiber textile	0.4	1.0	1.9	6.3	0.1	0.1	2.0	6.4	8.5	11.8	5.6	12.0	1.8	1.9	18.4	33.2	12.7	15.3	31.1	48.5	18.0	20.0	51.0	31.5
Basic petrochemical products	1.6	3.3	0.5	2.9	1.5	2.6	2.0	5.5	1.2	2.5	1.2	4.1	1.8	2.5	7.9	17.8	7.8	7.8	15.7	25.6	20.0	20.6	64.3	53.8
Petrochemical products	1.3	2.1	0.9	1.4	1.2	1.5	2.1	2.9	0.9	1.1	0.7	1.1	1.8	1.4	6.7	8.7	6.3	5.7	13.1	14.3	18.0	20.3	68.9	65.4
Iron & steel	1.4	3.9	1.5	2.5	0.8	1.0	2.3	3.5	1.2	3.1	3.0	4.6	0.9	2.1	8.8	17.2	11.3	10.8	20.1	28.0	13.5	15.9	66.4	56.1
Metal processing	1.9	8.7	1.0	2.3	1.1	0.9	2.0	3.2	5.6	5.5	2.8	2.5	2.0	2.8	14.4	22.6	7.3	5.2	21.7	27.9	12.3	21.1	66.0	51.1
Parts (weighted average)	1.5	3.8	2.4	6.6	2.4	4.6	4.8	11.2	2.7	3.7	2.0	3.0	2.7	4.6	13.7	26.4	15.3	11.1	29.0	37.5	22.3	26.2	48.7	36.2
Electronic parts	0.5	4.0	5.2	11.3	4.2	8.0	9.4	19.3	2.8	6.0	3.7	4.0	3.3	6.2	19.8	39.5	18.4	11.7	38.1	51.2	22.6	22.7	39.3	26.1
Parts of office & communication	0.9	8.8	4.0	5.6	5.5	3.4	9.5	9.0	11.7	2.5	2.9	4.5	7.9	11.6	32.8	36.4	15.8	10.7	48.6	47.1	17.6	21.8	33.8	31.1
Parts of home electrical appliances	2.2	7.3	1.7	4.9	2.7	2.5	4.4	7.4	4.9	3.2	3.1	4.2	6.4	5.5	20.9	27.5	18.4	9.6	39.3	37.2	15.2	26.5	45.5	36.3
Parts of precision apparatus	4.2	2.1	1.7	2.9	1.4	3.6	3.0	6.5	2.0	1.4	0.6	0.5	9.9	6.7	19.8	17.2	12.0	10.0	31.8	27.2	23.8	30.8	44.3	42.0
Parts of bicycle	1.5	14.7	1.2	6.8	4.5	5.6	5.7	12.4	22.7	21.4	0.3	0.3	1.9	5.1	32.2	53.9	31.4	11.0	63.6	64.9	3.7	7.8	32.7	27.4
Parts of motorcycle	1.7	8.7	1.1	7.7	0.0	0.1	1.1	7.8	11.1	10.1	0.1	1.3	2.4	0.2	16.3	28.1	49.5	34.5	65.8	62.6	3.5	6.0	30.7	31.4
Parts of automobile	3.7	1.1	0.1	1.2	0.3	0.4	0.4	1.6	1.0	1.3	0.3	1.5	0.1	0.1	5.5	5.6	13.9	12.0	19.4	17.6	26.5	35.0	54.2	47.5
Parts of machine tool	7.1	2.6	0.2	0.7	0.7	1.5	0.9	2.3	1.5	2.7	0.5	1.2	0.7	1.3	10.8	10.1	8.6	12.4	19.3	22.5	19.3	24.1	61.4	53.4
Parts of Industrial machinery	0.7	1.9	0.4	1.0	1.1	1.4	1.5	2.4	0.8	0.9	0.7	1.2	0.5	0.8	4.0	7.2	11.3	10.1	15.4	17.4	23.5	30.3	61.1	52.3
Capital goods (weighted average)	0.5	1.7	0.4	0.7	0.8	0.9	1.2	1.6	1.4	1.7	1.7	3.9	1.7	3.9	6.0	9.7	12.4	11.4	18.4	21.1	23.0	26.9	58.6	37.5
Mold	1.2	2.1	0.6	2.0	1.1	1.8	1.7	3.8	2.9	6.2	2.6	6.6	6.4	3.3	14.8	22.0	15.3	18.8	30.2	40.8	14.4	20.2	55.5	39.0
Machine tool	1.3	1.7	0.2	0.7	0.8	1.0	1.0	1.7	3.4	5.6	0.6	1.8	1.8	1.9	8.1	12.6	22.5	23.6	30.6	36.2	10.1	16.3	59.3	47.5
Industrial machinery	0.4	1.7	0.2	0.8	0.6	0.8	0.8	1.6	1.7	2.0	0.8	1.9	1.0	1.2	4.7	8.4	14.1	12.7	18.7	21.1	14.0	19.8	67.2	59.1
Parts of rail locomotive	0.5	1.7	0.0	0.1	0.1	0.0	0.1	0.2	0.5	0.0	0.6	0.3	0.0	0.1	1.8	2.2	4.9	7.2	6.7	9.4	28.9	35.9	64.4	54.8
Rail locomotive	0.0	0.5	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.0	2.9	2.0	0.0	0.0	3.0	2.5	6.7	7.1	9.8	9.6	40.1	38.5	50.2	51.9
Parts of aircraft	0.9	0.9	0.6	0.9	1.5	1.2	2.2	2.1	0.0	0.2	0.9	0.6	3.7	0.3	7.6	4.1	2.3	4.3	9.9	8.4	58.1	45.6	32.0	46.0
Vessel	1.0	5.3	1.7	0.4	1.6	1.8	3.3	2.2	1.5	1.2	12.1	26.6	0.1	0.1	17.9	35.3	24.0	23.1	41.9	58.5	6.3	6.7	51.7	34.8
Aircraft	0.0	0.1	0.5	0.1	0.4	0.5	0.8	0.6	0.0	0.0	0.1	0.3	0.1	0.0	1.1	1.0	0.1	0.0	1.1	1.1	52.3	50.9	46.5	48.0
Unclassified items	0.2	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	1.0	2.4	8.0	0.0	0.0	2.4	8.0	22.7	35.6	74.9	56.4
Total Products	2.3	5.4	3.2	4.9	2.0	2.5	5.2	7.4	2.5	2.5	2.4	3.1	3.1	3.9	15.4	22.4	10.6	8.2	26.1	30.6	19.2	23.5	54.7	45.9

Source: by the author based on Ajjken Indicators on Developing Economies: Extended for Trade Statistics (IDE AID-XT).

Notes: The world is composed of East Asia, NAFTA, and EU15. ASEAN Four (Indonesia, Malaysia, the Philippines, and Thailand), ASEAN Five (ASEAN Four and Singapore), East Asia (ASEAN Five, South Korea, Hong Kong, and Taiwan), All East Asia (East Asia and Japan).