East Asian Flying Geese Paradigm and Product Space

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East Asian industrialization and economic development are characterized by a pattern called the flying geese paradigm, whereby one economy takes a lead in industrialization and other economies in the region follows the leader (Akamatsu, 1962). In this paper, we postulate that this typical pattern of industrialization could also be explained by a more recent narration based on the product space, advanced by Hidalgo and Hausmann (2009). Japan, as a lead goose, is at the technological frontier in the region and consistently ranks first in the Hidalgo-Hausmann economic complexity index. This is followed by subsequent shifts in the production structure and export basket of other economies in the region over the years. The individual economy product space suggests that these economies successfully followed their succeeding leader and moved their production base to the core. The export basket for these economies varied from natural resources in the earlier years to textiles and footwear in later periods and finally to electronics and automobiles. China's product space is an exemplary case on successful diversification of products and industrialization.

Keywords: Flying Geese Paradigm, Economic Complexity, Product Complexity, Product Space
JEL codes: F13, N15, O11

1. Introduction

Rapid industrialization and higher economic development in East Asia has generated much interest among scholars around the world. One of the reasons for this achievement is attributed to the export led growth model that the economies in the region adopted over several decades. These exports range from natural resources and agricultural products to low technology products (like textiles and footwear) to medium and high technology products (like machinery, electrical and electronics, smart phones and automobiles). Japan led this transformation in the 1960s, followed by several economies in the region until the recent rise of China as an economic power. Japan also is the technology leader and transferred its technology to other economies in the region via vertical integration. Over time, this transformation led to structural changes in production and exports for other significant players in the region.

Akamatsu (1962) explained this phenomenon by comparing it with the flying pattern of geese where the first goose takes the lead and others follow the lead goose. He called this pattern the "Flying Geese Paradigm." His model states that the production of goods would migrate from advanced economies to

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less advanced economies as production costs increased in advanced economies. He observed this pattern in East Asia where production from Japan shifted to the Newly Industrialized Economies (NIEs) of Hong Kong, Singapore, South Korea and Taiwan during the 1980s and then to four of the economies of the Association of Southeast Asian Nations (ASEAN-4)—Indonesia, Malaysia, Philippines and Thailand during the 1990s. China then followed this pattern beginning in 2000 and Vietnam followed a few years later.

Hidalgo and Hausmann (2009) explained the pattern of industrialization by introducing the concepts of economic complexity, product complexity and the "Product Space." In the product space, the products whose 'capabilities'[1] are interconnected lie in the core whereas the products whose capabilities are less connected lie in the periphery. Then, the firms in the economy diversify to produce nearby products from where it is already producing goods using existing capabilities. Industrialization and economic development therefore is a process that requires acquiring more complex sets of 'capabilities' to move towards new activities associated with higher levels of productivity (Felipe et al., 2012).

In this study, we stipulate that the flying geese pattern could be well be explained by the concept of product space for 11 economies of East Asia. We do this first by reviewing the underlying fundamentals of the flying geese paradigm. We then look into the main export categories of each economy and their location in the product space to validate the product structure of these economies over time. In Asia, Japan remains the front runner in terms of economic complexity followed by South Korea and Taiwan. These are then followed by China, Malaysia, Philippines and Thailand.

In the next section, we review and explain the logic behind the flying geese paradigm. In Section 3 we present the theoretical background behind economic and product complexity. In Section 4, we analyze the product spaces of individual economies. In the final section, we link the two concepts and clarify how the product space can shed light on the flying geese paradigm.

2. Flying Geese Paradigm in East Asia

The Flying Geese (FG) paradigm (*Ganko-Keitai* in Japanese), was first observed by Kaname Akamatsu in the 1930s to explain Japan's industrialization (Akamatsu, 1935 & 1937). However, this model gained attention among western scholars only during 1960s when Akamatsu added another pattern of inter- country industrialization in order to explain the regional transmission of the FG development from a lead goose to a follower geese (Akamatsu, 1961 & 1962). The FG model is most well-known for describing the catching-up process in industrialization among Asian economies.

As Kojima (2000) clarified, Akamatsu's model is built on three pillars:

(1) The development path of a single industry that moves from import substitution to domestic production and finally to export promotion;

[1] Capabilities refer to knowhow in term of human and physical capital, institutions, technological wisdom, managerial competence and the like. For more details, refer Felipe et al. (2012).

(2) The diversification and upgrading development path of intra-industry and/or inter-industry products;

(3) The inter-country catching-up process which explains the regional transmission of FG development from a lead goose (e.g., Japan) to follower geese (e.g., NIEs, ASEAN4, China, Vietnam, etc.).

The basic pattern of a single industry's development is the sequence of imports (M), domestic production (P) and export (X).

> According to Akamatsu, "The first stage is when manufactured goods, mainly complete (final) consumer goods, are imported from abroad. In the second stage, domestic production emerges, which is followed by the import of natural resources and specific machines and tools for production. Third is a stage of export industrialization when an indigenous production system is established (Akamatsu, 1944)."

"This basic pattern is metaphorically applied to three time-series curves each denoting import, domestic production, and export of the manufactured goods, mainly complete consumer goods (Akamatsu, 1962)" (Refer to Figure 1: Panel A: Consumer goods). The other variant FG pattern reveals how industries diversify and upgrade from consumer goods to capital goods or/and from simple to more sophisticated products (Kojima, 2000) (Figure 1: Panel A).

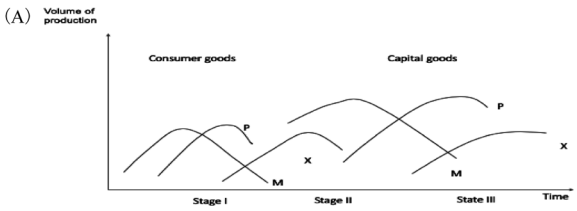

Figure 1. Panel A: The Basic Flying Geese Pattern

Source: Akamatsu (1961) and authors' representation.

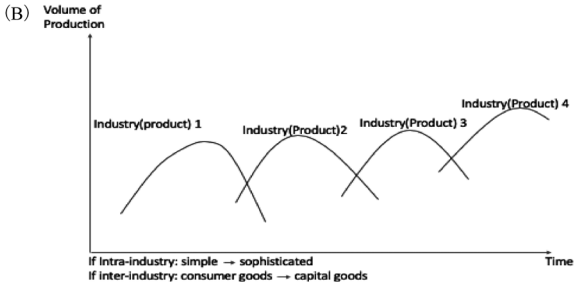

Figure 1. Panel B: The Flying Geese Patterns of Intra-Industry or/and Inter-Industry Development

Source: Akamatsu (1961) and authors' representation.

"Although reference is made here simply to consumer goods and capital goods, there are many kinds and qualities of consumer goods and capital goods. (Akamatsu, 1961)" The diversification and upgrading of products is thus classified into two patterns. One is the occurrence of intra-industry development when the new product, which is from crude and simple to sophisticated and refined, emerging in an existing industry. The other is the inter-industry cycle exhibiting the development of a brand new industry, e.g. from consumer goods to capital goods (Refer to Figure 1: Panel B).

The rationale behind the first two pillars mentioned above can be found in Akamatsu's elaborate descriptions of the three stages for an industrialization path in an underdeveloped nation. Referring again to Figure 1: Panel A, at the first stage, "when an underdeveloped nation first enters the interna-

tional economy, the primary products, which are its specialties are exported. The industrial products for consumption are imported from advanced nations since the latter's industrial products are superior in quality and cheaper in price (Akamatsu, 1961)." At the second stage, domestic production of imported complete goods is initiated since domestic demand for such products is concentrated and market becomes large enough for domestic consumption. National economic policy tends to stimulate this trend toward domestic production, and the import of the manufactured consumer goods from advanced nations stagnates and then declines. Therefore, on the one hand, the export for the finished goods from the domestic economy tends to start; on the other hand, machinery and other equipment will be imported from advanced countries to support the domestic production of the new finished consumer goods (Akamatsu, 1961). When the domestic consumer goods industry develops into the export industry and the domestic demand for consumer goods has been satisfied, the economy turns into markets for capital goods or/and for more sophisticated products. At the third stage, the domestic production of previous imported capital goods or/and sophisticated consumer goods comes to the fore, and the imports of these from more advanced countries tend to decline (Akamatsu, 1962).

The third pattern of FG development refers to a situation that underdeveloped countries adopt the industries of more advanced countries to achieve the economic development. Akamatsu (1961 & 1962) describes this fourth stage of FG development model using the international transmission example.

The consumer goods industry in a less developed country graduates to that of an advanced country in the third stage of FG (Figure 1: Panel A) as the production of capital goods becomes homogenized. In this case, the country enters into the fourth stage and domestically produced capital goods in the third stage begin to be exported. Alternatively, the production of consumer goods shifts to less advanced countries, which still enjoy low wages, cheap raw materials and domestic markets. In this way, the development in a wild-geese-flying pattern emerges. In other words, the decline in consumer goods exports is replaced by capital goods exports and these reach the stage of high-degree heterogeneity in regard to other less advanced countries (Akamatsu, 1961).

The underdeveloped follower geese are chasing those ahead of them by creating homogeneity. Some fly more rapidly, and some more slowly. The more advanced geese are trying to maintain their lead position by consistently innovating and by seeking to maintain heterogeneity (Akamatsu, 1962). This third pillar of FG development is the most well-known explanation of the regional development path in East Asia. It is also very useful for understanding the co-existence of competition and cooperation in East Asia regional relationships.

Japan, as the lead goose, experienced rapid industrialization in the late 19th century. After Japan advanced into more technology-intensive production, the rate of industrialization occurred in the four tigers of NIEs during the mid-20th Century. Later, this rapid industrialization was observed in the ASEAN-4 economies and then in China during the 1990s and 2000s. Vietnam also followed later.

Nevertheless, it should be noted that the ability to develop is influenced by several factors such as the capabilities a country possesses and its education level, labor wage, population, political policy,

international trade policies, and so on. The first and the second FG patterns might not develop in the same way in all countries. The rate of chase for different follower geese might be different as well. Moreover, it becomes challenging to maintain the lead position in the long-run. The analysis of economic complexity and product space to be introduced and analyzed in the succeeding sections will further complement the analysis of the third FG pattern and will show the possible differentiations among 11 East Asian economies.

3. Economic Complexity and Product Complexity

Hidalgo and Hausmann (2009) presented a formal definition of economic complexity and product complexity, and provided a framework to quantify them. Conceptually, economic complexity is defined as the ability of a country to accumulate capabilities to produce more diverse and sophisticated products. Product complexity is measured by the degree to which a country's export are non-ubiquitous and diversified. Sophisticated products will not be exported by many countries since they require advanced capabilities; moreover, sophisticated products are highly likely exported by countries with more diverse exports. If a country can export more sophisticated products, it tends to have a higher level of economic complexity (ibid).

Hidalgo and Hausmann (2009) used the analogy of building Lego models to help understand economic complexity and product complexity. If the products that a country can produce are determined by the country's capabilities and if the Lego models that can be built depend upon the variety and the abundance of the Lego pieces within a Lego bucket, the analogy could be drawn between these two. A Lego bucket can represent a country and the variety of Lego pieces the capabilities that the country has. The different Lego models that can be built using the Lego bucket will represent the country's economic complexity. For example, a Lego bucket for building airplanes might be able to build bicycles as well; however, a Lego bucket for making bicycles could not be used for making airplanes. If Lego pieces determine what kind of Lego models can be built, the complexity level of a Lego bucket can be measured by looking at the Lego models it can build directly (ibid). Thus, the economic complexity (the capabilities a country has) determines what a country can produce (the product complexity). Measuring the economic complexity by looking at the products it produces is like determining the diversity and exclusivity of the Lego pieces in a Lego bucket by simply looking at the Lego models it can build (ibid).

Nevertheless, identifying and measuring capabilities is complicated. Hidalgo and Hausmann (2009) and Hausmann et al. (2014) present the method of reflection to calculate economic complexity and product complexity. As mentioned above in the Lego model analogy, the complexity level of a Lego bucket can be measured by looking at the Lego models it can build directly. The economic complexity can be reflected by the country's export sophistication level. The authors capture the set of countries and the set of products via a bipartite network using the world bilateral international trade data as measured either by the SITC (1962–2017) or HS codes (1995–2017) (Figure 2). For example, country

C1 which has all three capabilities (A1, A2 and A3) would be able to produce products that need these capabilities (P1, P2 and P3). However, country C3 has only one capability (A3) and would be able to produce only one product (P3).

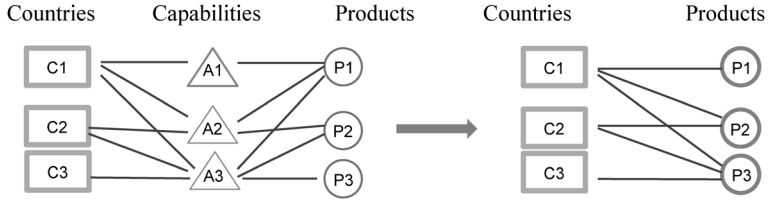

Figure 2. A Bipartite Network

Source: Adapted from Hidalgo and Hausmann (2009).

In order to endorse that the countries are producing and exporting as postulated by the theory of comparative advantage, the measurement only includes those exports in which the countries have Revealed Comparative Advantage (RCA). RCA, as defined by Balassa (1965), can be computed as:

$$RCAc,p = \frac{Xc,p \Big/ \sum_{p} Xc,p}{\sum_{p} Xc,p \Big/ \sum_{c,p}^{c} Xc,p}$$

where, c represents a country, p represents a product produced by a particular country, and Xc,p is the export value of product p by country c. The RCA ratio estimates the export share of a given product in the country's export basket relative to the importance that the same product in world trade. The natural cutoff used to determine whether a country has RCA in a product is if RCA≥1. This means the country's share of the product's market is equal or larger than the product's share of the world market.

Finally, an adjacency matrix Mcp is introduced to describe the bipartite network mentioned above.

$$Mcp = \begin{cases} 1 & if\ RCAc,p \geq 1 \\ 0 & otherwise \end{cases}$$

Diversification is defined as the number of products that a country exports with RCA and therefore measures economic complexity. In the Lego analogy, this represents the number of models a Lego bucket can build. Secondly, ubiquity is defined as the number of countries that export the same product with RCA. It measures product complexity. In the Lego analogy, this represents the exclusivity of the Lego pieces in the bucket. Diversification and ubiquity can be computed as follows:

$$K_{c,0} = \sum_{p=1}^{Np} Mcp \qquad \text{(Diversification)}$$

$$K_{p,0} = \sum_{c=1}^{Nc} Mcp \qquad \text{(Ubiquity)}$$

An iterative process called the method of reflections based on above two equations helps is used to

estimate the Economic Complexity Index (ECI) for individual countries and the Product Complexity Index (PCI) for individual products. For the purpose of this paper, we focus on economic complexity since we are interested in determining economy level positions. Nevertheless, these two are interlinked such that complex economies are able to produce and export more complex products. This is because in general the higher the ECI for any country the higher its capability to diversify and create additional opportunities. In this way, economic complexity is related with the product space.

3.1 Economic Complexity of East Asian Economies

Next, we look into the economic complexity achievements of 11 East Asian (EA) economies which are the focus of this study. Japan is a technology giant and is the world leader with the number one ECI ranking and the highest ECI values (Figure 3). Japan is followed by the four Newly Industrialized Economies (NIEs) (Hong Kong, Singapore, South Korea and Taiwan). As can be seen in the figure, the gap between Japan and these four tigers has narrowed during the 1990s and particularly after 2000. Evident from the figure also is the rise of the ASEAN-4 economies. The economic complexity of these economies has progressed significantly after 1997. China is a remarkable phenomenon whose ECI level was much lower at the earlier years but advanced rapidly after joining World Trade Organization (WTO) in 2001. It has approached the four tigers and even surpassed Hong Kong to rank fifth in 2017. Vietnam has the lowest ECI ranking among the 11 economies examined; however, its ECI values have increased in recent years and they surpassed Indonesia in 2017.

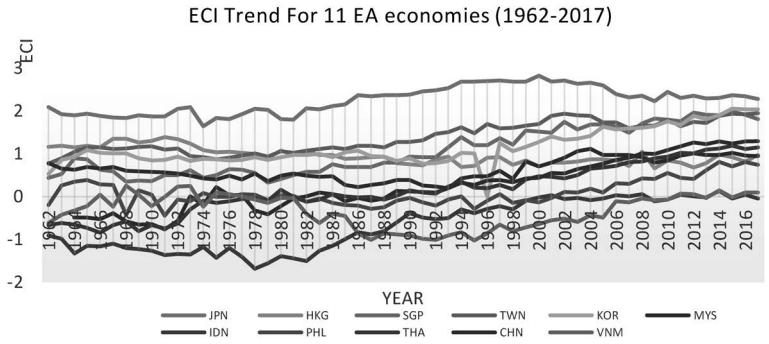

Figure 3. ECI for 11 Asian Economies

Colour versions of the figures are available upon request.
Source: The Growth Lab at Harvard University, 2019, "International Trade Data (SITC, Rev.2).

3.2 Income Per Capita vs Economic Complexity

It should be noted that a country's income and ECI are positively correlated (Hausmann et al., 2014). Regressing income per capita on ECI and an interactive term between ECI and the initial level of GDP per capita, the authors found that these variables are positively correlated and explain 43.4% of the variance in growth rates, over the period of 1978–2008. A similar relationship can be observed in the case of the 11 EA economies for 2017, where ECI is positively correlated with the log of GDP per capita (Figure 4).

Economic complexity is not only related to a country's level of prosperity but can be used to predict future economic growth. Hausmann et al. (2014) explain that the difference between a country's level of income and its economic complexity is the key variable to predict future growth. The basic logic is that the countries whose economic complexity is greater than what we would expect, given their level of income, tend to grow faster than those that are too rich for their current level of economic complexity. As seen in Figure 4, among 11 EA economies, Vietnam, Philippines, Thailand, China, Taiwan and South Korea lie below the fitted line. This means that these economies are likely to have higher potential for future economic growth, compared with the rest.

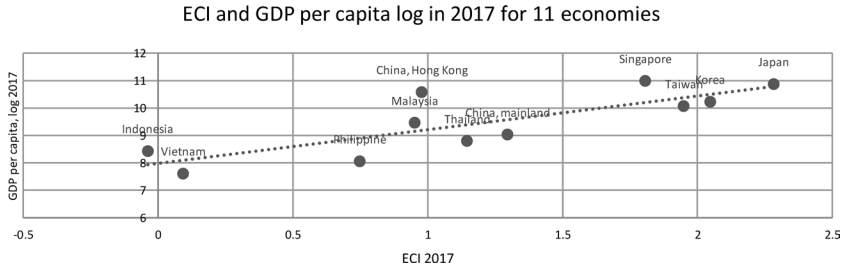

Figure 4. Relationship between ECI and GDP per capita for 11 EA economies (2017)

Source: The Growth Lab at Harvard University, 2019, International Trade Data (SITC, Rev.2) and CEPII-Chelem.

The flying geese analysis of these 11 economies discussed in the previous section followed the similar trend and manifests the pattern observed in the model. This sparked our interest in observing the link between FG model and the analysis based on economic complexity.

4. Product Space Analysis

The level of prosperity of an economy depends upon the availability and diffusion of capabilities; and the complexity of an economy reflects the amount of productive knowledge that it contains. The product space is based on the interconnectedness of export data for the countries in the world in more than 1,000 HS products. Consequently, in the product space diagram, more sophisticated products tend to be located in a densely connected core of the product space whereas less sophisticated products tend to lie on the periphery of the space diagram. Generally, relatively high developed countries with sophisticated export basket tend to be on the core but low income countries with less sophisticated export basket lie on the periphery providing less opportunities for them to diversify. This is the first proposition of the product space.

The second proposition is that the product space can be used to understand how countries could accumulate capabilities. The firms in the economy tend to jump from one industry to another nearby industry in the process of diversifying its production process. For this, the country which already has knowledge to produce one specific product will find it relatively easy to move to producing goods which requires similar capabilities. Hence, diversification is about adding capabilities. This is how the

countries then diversify their capabilities over time.

Identifying the initial location of the country in the product space therefore becomes important in order for countries to diversity and move into more complex products. The dots or bubbles in the product space diagram are individual exported products (with RCA≥1) for all the countries in the world. In that sense it is the universe of all the products produced and exported by all the countries in the world. The central dense core is made up of machinery, metal products, chemicals and capital-intensive goods. Therefore, these products are highly interconnected in their production capabilities. The products in the periphery are products such as petroleum, seafood, garments and raw materials and are weakly interconnected. In general terms, products along the periphery are less sophisticated as opposed to the ones in the core. The closeness between the bubbles in the space indicates the proximity of the products in terms of requirement of capabilities to produce these products. The size of each bubble represents the amount of that particular product being exported in US dollar terms.

It is also possible to see country specific product spaces for each country based on the export basket of that particular country. In order to do this, we have to focus on the color bubbles with each specific color belonging to a specific category of industries.[2] For example, the red bubbles represent manufactured items; the blue bubbles represent machinery and transport; the green bubbles represent clothing and textiles; the yellow bubbles represent food such as fruits, vegetables, fish and live animals; and so on. Again, the size of the bubble represents the amount of exports; and the closeness between the bubbles represents the proximity of the products. This means, the color bubbles would show the product space of that specific country in the universe of the products.

4.1 Evolving Product Space of Japan

In the series of figures below, we analyze Japan's evolving product space from the 1960's to more recent times and see how the export basket of Japan has changed and diversified by moving into nearby and other products, during these time period.[3] Figure 5: Part A shows Japan's product space for 1962.[4] In 1962, Japan had USD 4.89 billion worth of exports and they are biased towards relatively less sophisticated products. For example, the largest export item was clothing and textiles related items accounting or over 6% of total exports. It is located on the core of the space and indicated by the green bubble color. It was followed by other less sophisticated or low skilled products such as ships and boats (4.7%), iron or steel plates (2.5%), basic children toys (2.1%) and footwear (1.7%). These products are located in the periphery of the space diagram. This indicates that although Japan was trying to upgrade into more high skill industries, its prime exports were relatively low skill products. Nevertheless, it should be noted that Japan had diversified the range of products in its export basket, from textiles to iron to toys.[5] This can be seen in Figure 5: Part A which has different colored bubbles to

[2] Refer to Figure 5 as an example.

[3] We analyse the product space of the economies from 1962 (the earliest available data based on SITC) to 2017 (the latest) in the Atlas database.

[4] Product space figures are constructed based on SITC categories for products with RCA equal to or more than one.

[5] Refer to Appendix for the full table of top 5 exports.

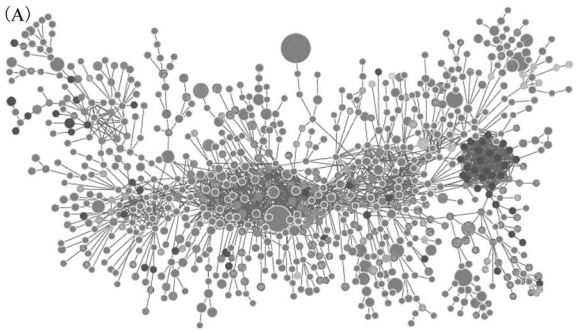

Figure 5. Part A: Japan's product space (1962)

Colour versions of the figures are available upon request.
Source: Atlas of Economic Complexity (http://atlas.cid.harvard.edu/)

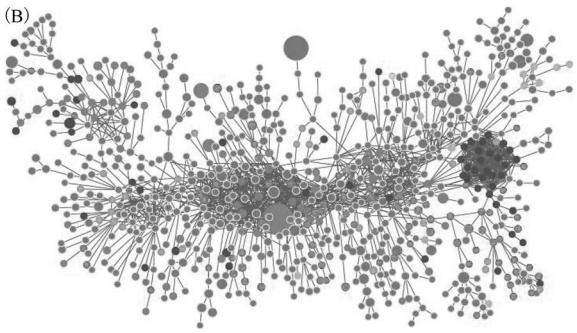

Figure 5. Part B: Japan's product space (1970)

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Source: Atlas of Economic Complexity (http://atlas.cid.harvard.edu/)

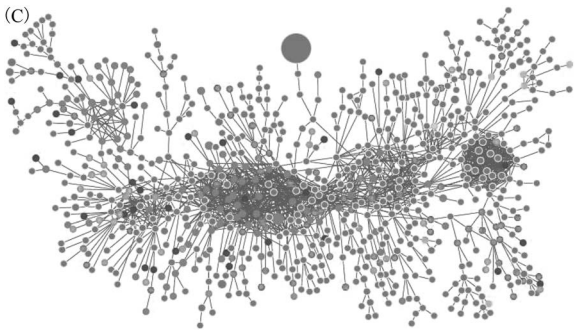

Figure 5. Part C: Japan's product space (1980)

Colour versions of the figures are available upon request.
Source: Atlas of Economic Complexity (http://atlas.cid.harvard.edu/)

indicate each product category, including several red bubbles that indicate the manufacture of items related to materials like iron, rubber, carpets, papers, etc.

The composition of this export basket changed slightly in 1970. Although Japan continued to produce and export textiles, sea vessels (ships, boats and other) became the first export item accounting for 7.3%. An interesting new export category that came into the limelight at this time is passenger motor vehicles. It was the second largest export category (4.6%). It belonged to the transport industry and is indicated by blue bubbles scattered in the diagram but largely interconnected (Figure 5: Part B). By 1980, passenger vehicles took the number one spot with 12.1% of exports. It was followed by motor vehicles for transport of goods and materials (4.6%). Ships and boats became third largest export category. These vehicle related products lay in the core of the space diagram (Figure 5: Part C). Another interesting composition that can be observed is the emergence of sound recording systems that accounted for 2.5% and stood as the fourth largest export category.

Machinery and transport (blue bubbles) which is located in the core of the space diagram continued to be the Japan's primary exports in 1990. Passenger vehicle accounted for 13.8% of total exports and ranked first in its export basket (largest blue bubble) followed by other vehicle-related products. These products are close in proximity in terms of the capabilities required to produce them. Further, apart from sound

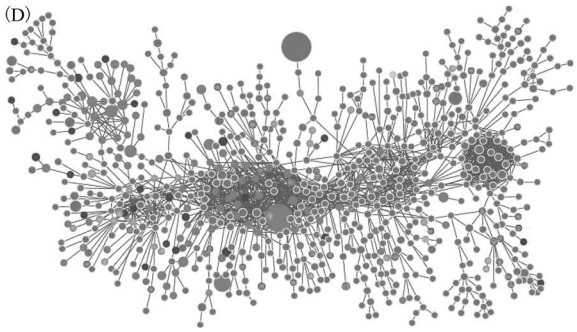

Figure 5. Part D: Japan's product space (1990)

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Source: Atlas of Economic Complexity (http://atlas.cid.harvard.edu/)

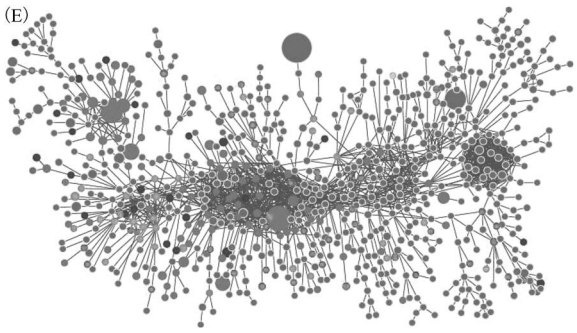

Figure 5. Part E: Japan's product space (2000)

Colour versions of the figures are available upon request.
Source: Atlas of Economic Complexity (http://atlas.cid.harvard.edu/)

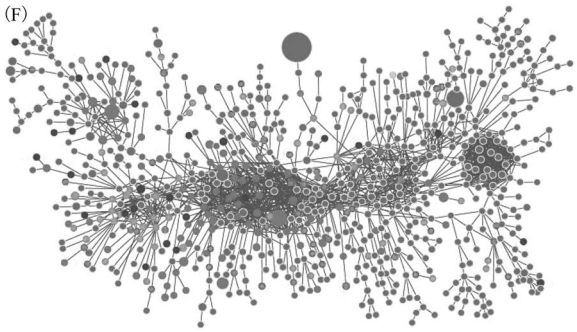

Figure 5. Part F: Japan's product space (2010)

Colour versions of the figures are available upon request.
Source: Atlas of Economic Complexity (http://atlas.cid.harvard.edu/)

system, electronic microcircuits (the blue bubbles towards top left) also appeared to be one of the top 5 exports by 1990 (Figure 5: Part D). The total value of exports equaled USD 294 billion at this time.

Electronic items and motor vehicles continued to be the top exports of Japan for next couple of decades (Figure 5: Part E and Part F). Apart from these two dominating product categories, machinery of specialized industries, components of vehicles and machineries became Japan's major exports. It should be noted that these products are highly sophisticated in nature and placed in the core of the product space diagram, along with the larger blue bubbles than in the previous decades indicating the larger volume of exports. It is during this time that Japan get involved in East Asian production networks and exported sophisticated parts and components to other Asian countries for the production of final goods. It is also interesting to observe that by this time, the low skilled, low sophisticated products like textile and footwear are completely out of the Japan's export basket. This trend clearly shows the shift in Japan's pathway to the production and exports and is consistent with the notion of Hausmann et al. (2014) in terms of development of new product categories that are close to the existing products in the product space diagram.

The latest year of 2017 resembled the similar mix of export basket for Japan with passenger motor vehicle being the number one exports accounting for 11% share of total exports (again the largest blue bubble

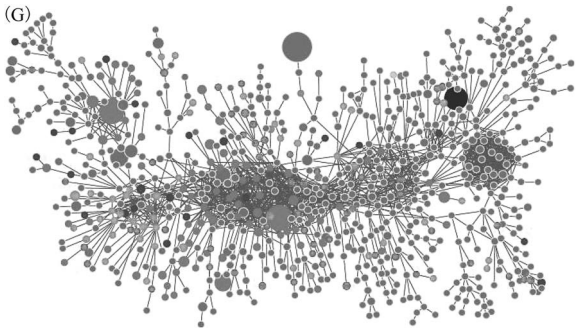

Figure 5. Part G: Japan's product space (2017)

Colour versions of the figures are available upon request.
Source: Atlas of Economic Complexity (http://atlas.cid.harvard.edu/)

in the middle). It is then followed by parts and components for vehicles (several blue bubbles connected to each other). Other major exports continued to be electronic microcircuits and machinery for specialized industries (Figure 5: Part G). Compared to earlier years, the red bubbles declined vastly indicating a decrease in the exports of other low scale manufacturing items. The value of total exports increased more than threefold after 1990 and reached USD 928 billion in 2017.

4.2 Product Space of Other East Asian Economies

In this sub section we look into the product space of other economies of interest from the region and see how the product structure for these economies has changed over the 1962–2017 period.[6] We start by looking at the four tiger economies (Hong Kong, Singapore, South Korea and Taiwan), then the ASEAN-4 economies (Indonesia, Malaysia, Philippines, Thailand) followed by China and Vietnam.

In 1962, Hong Kong's top exports were cotton fabrics, textiles and footwear, which they continued to export during 1970s, 1980s and 1990s. However, over this time other export items also came to the fore such as children's toys, watches, knitted outwears and travel goods including leather handbags etc. A marked change emerged in 2000 when Hong Kong's export basket topped with electronics and machinery items. This trend continued up until now as more varieties of electrical and electronic goods such as microcircuits, television, radio broadcasting transmitters, telephonic and telegraphic apparatuses became prominent. In the case of Singapore, the early exports (1962, 1970) were primarily natural resources and agricultural goods such as natural rubber, refined petroleum products, rice, palm oil, coffee, etc. Singapore started to export some electronic microcircuits in 1980 but it was in 1990 and afterwards that electronics and related items became the top exports in its export basket. In 2017, Singapore also exported medical items which comprised of about 1% of total exports. Taiwan is similar to Singapore in that most of its exports during the earlier years were agricultural items such as sugar, fruits, cotton, and tea. It then expanded to toys, textiles and footwear in 1980 and 1990. Then, beginning in 2000, Taiwan's export basket also included electronic and machinery goods. This continued until 2017; along with a larger variety of goods such as optical instruments, diodes and transistors. South Korea is similar. Whereas some of its early exports were natural resources and agricultural items that included ores, rice, raw silk; during 1980 and 1990, it produced and exported textile and footwear items. It started exporting electronic items beginning in 1990. During the 2000s, it also

[6] The product space diagrams of these individual economies are not presented in this paper keeping in mind the space limitation. These could be retrieved from Atlas website or available upon request.

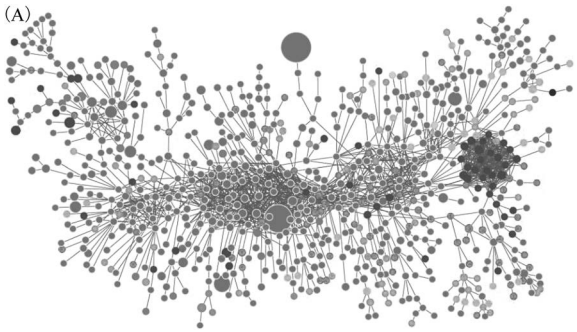

Figure 6. Part A: China's product space (1990)

Colour versions of the figures are available upon request.
Source: Atlas of Economic Complexity (http://atlas.cid.harvard.edu/)

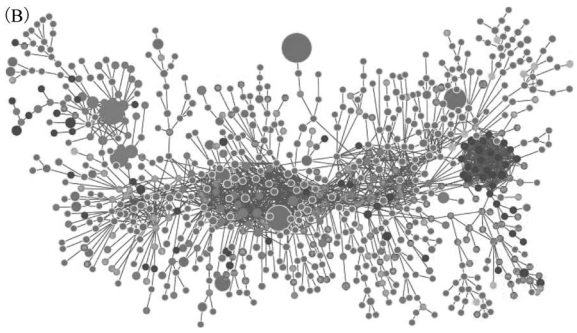

Figure 6. Part B: China's product space (2017)

Colour versions of the figures are available upon request.
Source: Atlas of Economic Complexity (http://atlas.cid.harvard.edu/)

produced and exported motor vehicles. By 2017, electronic items and motor vehicles became the top two export categories, accounting for 15% and 5.7% respectively of total exports.

In the case of ASEAN-4, both Indonesia and Malaysia had similar export baskets in the early years, primarily natural resources which continued until 1990. Nevertheless, Malaysia diversified its export basket to include electronic items and machinery goods in 2000. In later years, Malaysia's top export was electronic microcircuits accounting for 16% of total exports in 2010 and 22% in 2017. Its other key exports included petroleum products and palm oil. For Indonesia, its top exports were natural resources such as oil, coal, petroleum gases, and natural rubber but it also diversified into footwear in 2000. The Philippines started to produce and export electronics items beginning in 1980 and then it became the top export category in 1990 and afterwards. Most of the exports were that of electronics items including diodes, transistors, photocells and other related electrical machinery and equipment. Before that, Philippines' export basket contained primarily of agricultural goods. In the case of Thailand, the electronic microcircuits became the major export item only in 2000. Nevertheless, machinery parts and components were also major exports.

China was not a major player in the world trade scenario until it joined the WTO in 2001. China's total exports in 2000 was USD 469 billion. This increased to USD 1.9 trillion in 2010 and USD 2.73 trillion in 2017. From the 1960s until 2000, China's exports were mainly natural resources and agricultural products such as petroleum, silk, rice, and cotton. Beginning in 1990, footwear, children toys and textiles became more important. These are indicated by the green bubbles in Figure 6: Part A.[7] These items are in the core of the China's product space diagram, whereas some other items such as manufacturing and machinery are scattered all around the space (blue, yellow, red bubbles). By 2000, its top exports were toys (5.5% of total exports) and footwear (4.2%) along with textiles. China's product

[7] Given China's remarkable performance in world trade and progress in product diversity, we included a pair of China's product space figures for more clarification and in-depth analysis.

space became more and more distinct in 2010 with electrical/electronic and machinery items being the key exports. These are represented by the growing bubbles in the product space. Although toys and footwear remained among the top 5 exporting items, they became less important. In 2017, the major exports were television and radio transmitting items accounting for 8.5% of total exports, along with the parts and components of the related headings. Electronic microcircuits accounted for 2.9% of total exports. In Figure 6: Part B, we can see the expansion of blue bubbles not only the numbers but also the size. It is to be noted that in 2017, the product categories that China exported has increased immensely. This shows China's phenomenal ability to diversify its production capabilities.

The comparison between Part A (1990) and Part B (2017) of Figure 6 also have some interesting elements. In 1990, the only core that could be seen is the green bubbles representing textiles and related items. We can see that there are lots of other color bubbles, like red manufactured items and yellow food items but these are primarily in the periphery. This shows that China's production structure is already diversified during this time. Compared to this, in 2017, the diagram shows that China's production and exports are concentrated more into core, the main item being blue bubbles that represent electrical, electronics and machineries. The red bubbles also moved closer to the core.

In the case of Vietnam, until 2010, its export basket was comprised of items such as footwear, crude petroleum, rice and coffee. However, in 2017, it diversified into television and radio transmitters (14.9% of total exports) and electronic microcircuits (6.6%). Footwear remained an important category, though, with 6.65% of total exports.

5. Concluding the Link between Product Space and Flying Geese

The product space signifies the path of industrialization for any particular country. One of the fundamental implications of the product space is the need for countries to diversify their production bases from relatively low technology-intensive items to complex items. This diversification occurs by migrating from the products it already exports to ones that require similar set of capabilities. This process continues over time and over different sets of products. Nevertheless, it should be noted that this process may vary among countries depending upon their initial locations in the space and their abilities to acquire the necessary capabilities.

We observe from the product space analysis that the product structure of East Asian economies has changed over time and between economies. All the economies more or less started by exporting natural resources and/or agricultural items before moving to textiles and toys. Afterwards, their exports were upgraded and diversified to manufacturing items. The mix of these exports could be broadly classified into two categories—electrical/electronic related items and vehicles (both passenger and heavy). In the latest years, the industry has expanded to include more technologically advanced products related to information technology like computers, smart phones and particularly microcircuits. This trend was initiated by Japan whose prime exports were textiles in early 1960s before it diversified into electronics in the 1980s and passenger vehicles afterwards. This was emulated by the

four NIEs economies that diversified their export baskets particularly staring from 1980 and later years. The ASEAN-4 economies joined this phenomenon during 1990 and afterwards. China is the exemplary economy that demonstrated how harnessing and acquiring new capabilities could transform its industrialization development. It successfully upgraded its product structure and export basket after 2000. This could be also observed in the case of Vietnam.

One of the main lessons of the flying geese paradigm is that one lead goose takes the initiative in industrialization and breaks the boundary of the production of primary goods such as natural resources and/or agricultural goods. This is undertaken by practices such as import substitution and export orientation. The process continues to expand to other product categories from consumer goods to capital goods and other technologically advanced products. This is the key of the third pattern of the model as described in section 2. In order for this process to take place, the firms in an economy continue to diversify their production to cater to the newly available or created technology. This is also one of the vital aspects of product space analysis. In the case of East Asia, Japan played the role of lead goose which was then followed by NIEs and the ASEAN-4 economies and then by China and Vietnam. Product space analysis also helps us examine the potential of countries to produce different products and to project their likely growth paths. This is based on the premise that even low income countries could have high capabilities to increase its future opportunities by utilizing their existing capabilities. This means that the initial location of individual countries in the product space becomes important for predicting the future of that country. Therefore, if the country has diversified products in its product space, it can jump to nearby products of higher sophistication more easily than completely new product which the country has never produced.

We look into one additional concept being used in the analysis of product space, namely Complexity Outlook Index (COI). COI measures the ability of countries to produce the number of complex products which are nearby to the current set of capabilities. It could be seen in Figure 7 that the higher the ECI for any country, the higher its COI, indicating that higher ECI countries have greater capability to diversify. Further, it should be noted that relatively richer economies as measured by GDP per capita tend to have higher potential to diversify (Figure 8).

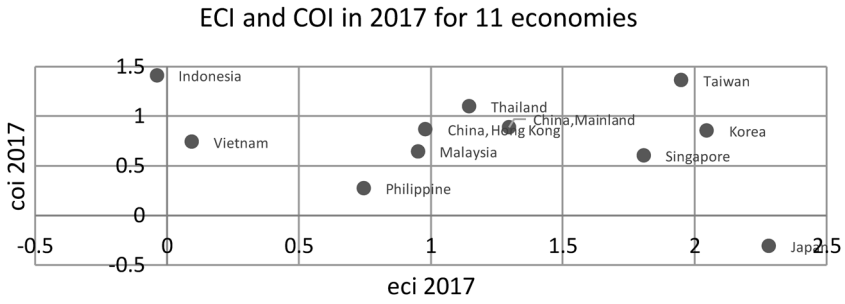

Figure 7. ECI and COI for 11 EA economies (2017)

Notes: ECI＝Economic Complexity Index. COI＝Complexity Outlook Index. Both ECI and COI are based on SITC 4 digit products.
Source: The Growth Lab at Harvard University, 2019, International Trade Data (SITC, Rev.2).

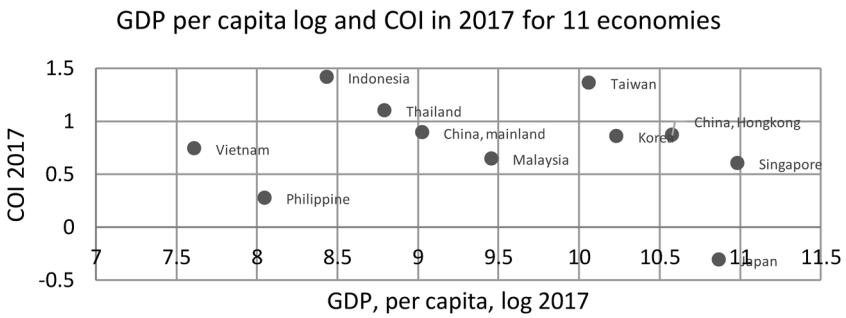

Figure 8. GDP per capita and COI for 11 EA economies (2017)

Notes: COI＝Complexity Outlook Index. COI is based on SITC 4 digit products.
Source: The Growth Lab at Harvard University, 2019 and CEPII-Chelem.

We can also see from these figures that even lower income economies and economies with lower ECI at present could have higher potential in the future to expand their export baskets by using their existing capabilities. Indonesia, Vietnam, Thailand, China being the key examples of countries that have relatively low ECI's and lower GDP's per capita but relatively higher COI scores. Therefore, the product space helps economies to identify and focus on the product structure they could potentially produce and export in the future. This depends upon the ability of economies to accumulate the capabilities over time.

Appendix

Table A-1. Top 5 export categories of 11 East Asian economies (1962)

	1962									
	Category	%	Category	%	Category	%	Category	%	Category	%
Japan (JPN)	Cotton fabrics, Woven, Bleached, Dyed, etc, or otherwise finished	6.16%	Ships, boats and other vessels	4.67%	Other sheet and plates, of iron or steel,worked	2.55%	Children's toys, indoor games, etc	2.14%	Footwear	1.69%
Hong Kong (HKG)	Cotton fabrics,woven,unbleached,not mercerized	5.27%	Cotton fabrics, woven, bleached,dyed,etc,or otherwise finished	3.59%	Footwear	2.95%	Children's toys, indoor games, etc	2.56%	Other made-up articles of textile materials,nes	2.22%
Singapore (SGP)	Natural rubber latex; natural rubber and gums	34.57%	Petroleum products, refined	24.42%	Rice,semi-milled or wholly milled	2.33%	Special transactions,commodity not classified according to class	2.00%	Tin and tin alloys,unwrought	1.71%
South Korea (KOR)	Ores and concentrates of other non-ferrous base metals	7.97%	Rice, semi-milled or sholly milled	6.71%	Raw silk (not thrown)	5.85%	Crustaceans and molluscs, fres, chilled, frozen, salted, etc	5.20%	Other materials of vegetable origin, nes	4.75%
Taiwan (TWN)	Sugars,beet and cane, raw,solid	14.50%	Refined sugar etc	4.86%	Fruit prepared or preserved, nes	4.10%	Cotton yarn	3.36%	Tea	3.31%
Indonesia (IDN)	Natural rubber latex; natural rubber and gums	30.41%	Petroleum products, refined	27.97%	Crude petroleum and oils obtained from bituminous materials	10.33%	Coffee green, roasted; coffee substitutes containing coffee	4.09%	Petroleum jelly and mineral waxes	3.26%
Malaysia (MYS)	Natural rubber latex; natural rubber and gums	41.26%	Tin and tin alloys, unwrought	15.90%	Sawlogs and veneer logs, of non-coniferous species	6.71%	Petroleum products,refined	5.83%	Wood, non-coniferous species, sawn, planed, tongued,grooved, etc	3.38%
Philippines (PHL)	Copra	21.24%	Sawlogs and veneer logs, of non-coniferous species	20.66%	Sugars, beet and cane, raw, solid	20.44%	Copper ore and concentrates; copper matte; cement copper	4.70%	Manila hemp, raw or processed but not spun, its tow and waste	4.10%
Thailand (THA)	Rice, semi-milled or wholly milled	31.94%	Natural rubber latex; natural rubber and gums	19.52%	Tin ores and concentrates	7.07%	Flour, meals and flakes of potatoes, fruit and vegetables, nes	5.24%	Maize, unmilled	5.20%
China (CHN)	Silver,unwrough, unworked, or semi-manufactured	8.23%	Rice, semi-milled or sholly milled	5.69%	Soy beans	5.48%	Cotton fabrics, woven, unbleached, not mercerized	4.01%	Edible products and preparations, nes	3.37%
Vietnam (VNM)	Natural rubber latex; natural rubber and gums	73.64%	Rice, semi-milled or wholly milled	5.90%	Tea	2.86%	Crustaceans and molluscs, fres, chilled, frozen, salted, etc	1.26%	Edible products and preparations, nes	1.16%

Notes: Based on SITC-4 digit and exclusive of service. % is percentage share in total export. Start year for Malaysia is 1964.

Table A-2. Top 5 export categories of 11 East Asian economies (1970)

	1970									
	Category	%	Category	%	Category	%	Category	%	Category	%
Japan (JPN)	Ships,boats and other vessels	7.28%	Passenger motor vehicles (excluding buses)	4.61%	Other sheet and plates, of iron or steel, worked	4.00%	Parts,nes of and accessories for apparatus falling in heading 76	2.35%	Sheets,plates, rolled of thickness less 3mm, of iron or steel	2.04%
Hong Kong (HKG)	Children's toys, indoor games, etc	4.73%	Aircraft,nes and associated equipment	3.64%	Manufactured goods,nes	3.63%	Cotton fabrics, woven, unbleached, not mercerized	3.20%	Cotton fabrics, woven, bleached, dyed,etc, or otherwise finished	2.63%
Singapore (SGP)	Petroleum products, refined	25.81%	Natural rubber latex; natural rubber and gums	16.88%	Palm oil	1.67%	Special transactions, commodity not classified according to class	1.48%	Coffee green, roasted;coffee substitutes containing coffee	1.34%
South Korea (KOR)	Aircraft, nes and associated equipment	5.85%	Manufactured goods, nes	5.74%	Wood-based panels, nes	5.48%	Plywood consisting solely of sheets of wood	5.48%	Raw silk (not thrown)	4.29%
Taiwan (TWN)	Cotton fabrics,woven, unbleached, not mercerized	4.21%	Footwear	3.38%	Edible products and preparations,nes	2.85%	Vegetables, prepared or preserved, nes	2.54%	Banana, plantain, fresh or dried	2.43%
Indonesia (IDN)	Natural rubber latex; natural rubber and gums	18.77%	Petroleum products, refined	17.70%	Crude petroleum and oils obtained from bituminous materials	13.33%	Sawlogs and veneer logs, of non-coniferous species	10.46%	Tin ores and concentrates	6.01%
Malaysia (MYS)	Natural rubber latex; natural rubber and gums	35.52%	Tin and tin alloys, unwrought	16.43%	Sawlogs and veneer logs, of non-coniferous species	12.67%	Wood, non-coniferous species, sawn, planed, tongued, grooved, etc	4.73%	Petroleum products, refined	4.51%
Philippines (PHL)	Sawlogs and veneer logs, of non-coniferous species	23.62%	Copper ore and concentrates;copper matte;cement copper	15.53%	Refined sugar etc	13.16%	Copra	8.20%	Coconut(copra) oil	7.17%
Thailand (THA)	Rice, semi-milled or wholly milled	15.52%	Natural rubber latex; natural rubber and gums	13.68%	Tin and tin alloys, unwrought	10.97%	Maize, unmilled	10.91%	Vegetable products roots and tubers, nes, fresh, dried	8.13%
China (CHN)	Rice, semi-milled or wholly milled	5.25%	Raw silk (not thrown)	4.27%	Cotton fabrics, woven, bleached, dyed, etc, or otherwise finished	4.23%	Cotton fabrics, woven, unbleached, not mercerized	3.71%	Edible products and preparations,nes	3.56%
Vietnam (VNM)	Natural rubber latex; natural rubber and gums	36.12%	Waste and scrap metal of iron or steel	13.63%	Special transactions, commodity not classfied according to class	12.53%	Other non-ferrous base metal waste and scrap, nes	3.41%	Ships, boats and other vessels	3.41%

Notes: Based on SITC-4 digit and exclusive of service. % is percentage share in total export.

Table A-3. Top 5 export categories of 11 East Asian economies (1980)

	1980									
	Category	%	Category	%	Category	%	Category	%	Category	%
Japan (JPN)	Passenger motor vehicles (excluding buses)	12.10%	Motor vehicles for the transport of goods and materials	4.56%	Ships,boats and other vessels	3.52%	Other sound recording and reproducer,nes; video recorders	2.51%	Motorcycles,autocycles;side-cars of all kind,etc	2.09%
Hong Kong (HKG)	Watches,watch movements and case	7.03%	Children's toys, indoor games, etc	5.76%	Womans, girls, infants outerwear, textile, not knitted or crocheted,other outer garments of textile fabrics, notknitted,crocheted	3.17%	Men's and boys' outerwear, textile fabrics not knitted or crocheted;trousers, breeches and the like	3.04%	Outerwear knitted or procheted, not elastic nor rubberized; jerseys, pullovers, slip-overs, cardigans, etc	3.04%
Singapore (SGP)	Petroleum products, refined	22.60%	Natural rubber latex; natural rubber and gums	5.05%	Special transactions, commodity not classfied according to class	4.43%	Gold, non-monetary(excluding gold ores and concentrates)	2.69%	Electronic microcircuits	2.62%
South Korea (KOR)	Footwear	3.83%	Ships, boats and other vessels	3.22%	Fabrics, woven, of continuous synthetic textile materials	2.55%	Under garments of textile fabrics, not knitted or crocheted; mens and boys shirts	2.06%	Plywood consisting solely of sheets of wood	1.43%
Taiwan (TWN)	Footwear	7.33%	Children's toys, indoor games, etc	2.95%	Travel goods, handbags etc, of leather, plastics, textile, others	2.95%	Outerwear knitted or crocheted, not elastic nor rubberized;jerseys, pullovers, slip-overs,cardigans, etc	2.31%	Other sporting goods and fairground amusements, etc	2.05%
Indonesia (IDN)	Crude petroleum and oils obtained from bituminous materials	49.55%	Petroleum gases, nes, in gaseous state	8.63%	Petroleum gases and other gaseous hydrocarbons, nes liquefied	7.77%	Swalogs and veneer logs, of non-coniferous species	6.78%	Petroleum products, refined	5.68%
Malaysia (MYS)	Crude petroleum and oils obtained from bituminous materials	17.27%	Natural rubber latex; natural rubber and gums	16.10%	Sawlogs and veneer logs, of non-coniferous species	9.71%	Tin and tin alloys, unwrought	7.36%	Palm oil	5.48%
Philippines (PHL)	Copper ore and concentrates; copper matte; cement copper	8.34%	Coconut(copra) oil	6.90%	Sugars, beet and cane, raw, solid	6.27%	Electronic microcircuits	4.73%	Special transactions, commodity not classified according to class	3.70%
Thailand (THA)	Vegetable products roots and tubers, nes, fresh, dried	9.74%	Rice, semi-milled or wholly milled	8.52%	Tin and tin alloys, unwrought	8.02%	Natural rubber latex; natural rubber and gums	6.89%	Maize, unmilled	3.71%
China (CHN)	Crude petroleum and oils obtained from bituminous materials	13.75%	Petroleum products, refined	7.35%	Linens and furnishing articles of textile, not knitted or crocheted	2.51%	Cotton fabrics, woven, unbleached, not mercerized	2.04%	Cotton fabrics, woven, bleached, dyed, etc, or otherwise finished	1.98%
Vietnam (VNM)	Anthracite, not agglometrate	22.50%	Natural rubber latex; natural rubber and gums	11.97%	Crustaceans and molluscs, fresh, chilled, frozen, salted, etc	10.98%	Unknown	7.94%	Refined sugar etc	4.12%

Notes: Based on SITC-4 digit and exclusive of service. % is percentage share in total export.

Table A-4. Top 5 export categories of 11 East Asian economies (1990)

	1990									
	Category	%	Category	%	Category	%	Category	%	Category	%
Japan (JPN)	Passenger motor vehicles (excluding buses)	13.79%	Other parts and accessories, for vehicles of headings 722,781-783	3.78%	Other sound recording and reproducer,nes; video recorders	2.94%	Peripheral units, including control and adapting units	2.83%	Electronic microcircuits	2.67%
Hong Kong (HKG)	Children's toys, indoor games, etc	5.61%	Watches, watch movements and case	3.53%	Outerwear knitted or procheted, not elastic nor rubberized; jerseys, pullovers, slip-overs, cardigans, etc	3.18%	Travel goods, handbags etc, of leather, plastics,textile, others	2.50%	Parts, nes of and accessories for apparatus falling in heading 76	2.41%
Singapore (SGP)	Petroleum products, refined	14.68%	Digital central storage units, separately consigned	4.77%	Electronic microcircuits	4.29%	Parts,nes of and accessories for machines of headings 7512 and 752	3.18%	Peripheral units,including control and adapting units	2.96%
South Korea (KOR)	Footwear	5.53%	Electronic microcircuits	4.75%	Ships boats and other vessels	3.14%	Fabrics, woven, of continuous synthetic textile materials	2.96%	Articles of apparel, clothing accessories of leather	2.51%
Taiwan (TWN)	Footwear	3.60%	Peripheral units, including control and adapting units	3.49%	Parts, nes of and accessories for machines of headings 7512 and 752	3.07%	Children's toys, indoor games, etc	2.50%	Miscellaneous articles of plastic	2.18%
Indonesia (IDN)	Crude petroleum and oils obtained from bituminous materials	18.94%	Petroleum gases and other gaseous hydrocarbons,nes,liquefied	14.14%	Plywood consisting solely of sheets of wood	8.70%	Petroleum products, refined	5.28%	Natural rubber latex; natural rubber and gums	3.30%
Malaysia (MYS)	Crude petroleum and oils obtained from bituminous materials	10.55%	Electronic microcircuits	9.47%	Sawlogs and veneer logs, of non-coniferous species	5.78%	Wood, non-coniferous species, sawn, planed, tongued, grooved, etc	4.41%	Natural rubber latex; natural rubber and gums	3.79%
Philippines (PHL)	Electronic microcircuits	7.10%	Special transactions, commodity not classified according to class	4.00%	Coconut(copra) oil	3.49%	Banana,plantain, fresh or dried	2.52%	Womens, girls, infants outerwear, textile, not knitted or crocheted, other outer garments of textile fabrics, not knitted, crocheted	2.37%
Thailand (THA)	Rice, semi-milled or wholly milled	3.59%	Crustaceans and molluscs, fresh, chilled, frozen, salted, etc	3.46%	Natural rubber latex; natural rubber and gums	3.13%	Parts,nes of and accessories for machines of headings 7512 and 752	2.82%	Footwear	2.24%
China (CHN)	Children's toys, indoor games, etc	6.01%	Crude petroleum and oils obtained from bituminous materials	3.87%	Footwear	3.83%	Travel goods, handbags etc, of leather, plastics,textile, others	2.95%	Outerwear knitted or crocheted, not elastic nor rubberized; jerseys, pullovers, slip-overs, cardigans,etc	2.56%
Vietnam (VNM)	Crude petroleum and oils obtained from bituminous materials	25.35%	Crustaceans and molluscs, fresh, chilled, frozen, salted, etc	17.00%	Rice, semi-milled or wholly milled	11.27%	Unknown	4.92%	Sawlogs and veneer logs, of non-coniferous species	4.44%

Notes: Based on SITC-4 digit and exclusive of service. % is percentage share in total export.

Table A-5. Top 5 export categories of 11 East Asian economies (2000)

	2000									
	Category	*%*	*Category*	*%*	*Category*	*%*	*Category*	*%*	*Category*	*%*
Japan (JPN)	Electronic microcircuits	5.30%	Other parts and accessories, for vehicles of headings 722,781-783	3.08%	parts, nes of and accessories for machines of headings 7512 and 752	2.62%	machinery for specialized industries and parts thereof, nes	2.55%	Peripheral units, including control and adapting units	2.37%
Hong Kong (HKG)	Children's toys,indoor games, etc	4.95%	Electronic microcircuits	4.55%	Parts, nes of and accessories for machines of headings 7512 and 752	4.32%	Parts, nes of and accessories for apparatus falling in heading 76	3.54%	Footwear	2.60%
Singapore (SGP)	Electronic microcircuits	14.68%	Peripheral units,including control and adapting units	9.56%	Petroleum products,refined	6.77%	Parts,nes of and accessories for machines of headings 7512 and 752	6.76%	Special transactions, commodity not classified according to class	2.93%
South Korea (KOR)	Electronic microcircuits	10.11%	Passenger motor vehicles (excluding buses)	5.49%	Parts, nes of and accessories for machines of headings 7512 and 752	4.29%	Patroleum products, refined	4.17%	Peripheral units, including control and adapting units	3.43%
Taiwan (TWN)	Electronic microcircuits	12.50%	Parts,nes of and accessories for machines of headings 7512 and 752	7.89%	Complete digital data processing machines	6.49%	Peripheral units, including control and adapting units	2.76%	Printed circuits, and parts thereof, nes	2.03%
Indonesia (IDN)	Petroleum gases and other gaseous hydrocarbons, nes, liquefied	9.13%	Crude petroleum and oils obtained from bituminous materials	7.81%	Plywood consisting solely of sheets of wood	2.73%	Footwear	2.38%	Peripheral units, including control and adapting units	2.12%
Malaysia (MYS)	Electronic microcircuits	16.48%	Parts,nes of and accessories for machines of headings 7512 and 752	9.74%	Peripheral units, including control and adapting units	6.34%	Crude petroleum and oils obtained from bituminous materials	2.79%	Petroleum gases and other gaseous hydrocarbons, nes, liquefied	2.78%
Philippines (PHL)	Electronic microcircuits	32.82%	Peripheral units,including control and adapting units	10.42%	Parts, nes of and accessories for machines of headings 7512 and 752	7.01%	Diodes, transistors,photocells, etc	2.62%	Special transactions, commodity not classified according to class	1.48%
Thailand (THA)	Parts,nes of and accessories for machines of headings 7512 and 752	6.05%	Electronic microcircuits	5.05%	Peripheral units, including control and adapting units	4.09%	Crustaceans and molluscs, fresh, chilled, frozon, salted, etc	2.22%	Natural rubber latex;natural rubber and gums	2.05%
China (CHN)	Children's toys,indoor games, etc	5.55%	Footwear	4.22%	Peripheral units, including control and adapting units	2.79%	Parts, nes of and accessories for machines of headings 7512 and 752	2.60%	Travel goods, handbags etc, of leather, plastics, textile, others	2.15%
Vietnam (VNM)	Crude petroleum and oils obtained from bituminous materials	17.32%	Footwear	11.61%	Crustaceans and molluscs, fresh, chilled, frozen, salted, etc	5.88%	Rice, semi-milled or wholly milled	3.63%	Coffee green, roasted; coffee substitutes containing coffee	3.35%

Notes: Based on SITC-4 digit and exclusive of service. % is percentage share in total export.

Table A-6. Top 5 export categories of 11 East Asian economies (2010)

	2010									
	Category	*%*	*Category*	*%*	*Category*	*%*	*Category*	*%*	*Category*	*%*
Japan (JPN)	Passenger motor vehicles(excluding buses)	9.89%	Other parts and accessories, for vehicles of headings 722,781-783	3.76%	Electronic microcircuits	3.66%	machinery for specialized industries and parts thereof, nes	3.36%	Special transactions,commodity not classified according to class	3.12%
Hong Kong (HKG)	Unknown	6.81%	Diamonds(non-industrial), not mounted or set	3.80%	Special transactions, commodity not classified according to class	3.40%	Electrical line telephonic and telegraphic apparatus	2.90%	Gold, non-monetary (excluding gold ores and concentrates)	2.61%
Singapore (SGP)	Electronic microcircuits	14.82%	Petroleum products, refined	12.31%	Special transactions, commodity not classified according to class	4.94%	Crystals, and parts, nes of electronic components of heading 776	2.43%	Parts, nes of and accessories for machines of headings 7512 and 752	2.31%
South Korea (KOR)	Electronic microcircuits	8.69%	Ships, boats and other vessels	6.62%	Passenger motor vehicles(excluding buses)	5.38%	Petroleum products, refined	5.31%	Optical instruments and apparatus	4.58%
Taiwan (TWN)	Electronic microcircuits	24.45%	Optical instruments and apparatus	5.74%	Petroleum products, refined	4.37%	Parts, nes of and accessories for machines of headings 7512 and 752	2.83%	Diodes, transistors, photocells, etc	2.73%
Indonesia (IDN)	Other coal, not agglomerated	9.79%	Palm oil	7.46%	Petroleum gases and other gaseous	5.57%	Crude petroleum and oils obtained from bituminous materials	5.36%	Natural rubber latex;natural rubber and gums	4.30%
Malaysia (MYS)	Electronic microcircuits	16.01%	Petroleum products, refined	5.47%	Palm oil	4.64%	Petroleum gases and other gaseous hydrocarbons, nes, liquefied	4.40%	Crude petroleum and oils obtained from biruminous materials	4.20%
Philippines (PHL)	Electronic microcircuits	24.05%	Special transactions, commodity not classified according to class	5.95%	Peripheral units, including control and adapting units	5.35%	Diodes, transistors, photocells, etc	3.75%	Parts,nes of and accessories for apparatus falling in heading 76	1.68%
Thailand (THA)	Peripheral units, including control and adapting units	6.58%	Electronic microcircuits	4.42%	Natural rubber latex;natural rubber and gums	3.20%	Petroleum products, refined	3.01%	Passenger motor vehicles (excluding buses)	2.69%
China (CHN)	Complete digital data processing machines	5.47%	Television, radio-broadcasting; transmitters, etc	3.35%	Parts, nes of and accessories for apparatus falling in heading 76	3.09%	Children's toys indoor games, etc	2.36%	Footwear	2.26%
Vietnam (VNM)	Footwear	8.40%	Crude petroleum and oils obtained from bituminous materials	5.87%	Rice, semi-milled or wholly milled	3.65%	Precious jewellery, goldsmiths' or silversmiths' wares	3.15%	Coffee green, roasted; coffee substitutes containing coffee	2.47%

Notes: Based on SITC-4 digit and exclusive of service. % is percentage share in total export.

Table A-7. Top 5 export categories of 11 East Asian economies (2017)

	2017									
	Category	%	Category	%	Category	%	Category	%	Category	%
Japan (JPN)	Passenger motor vehicles(excluding buses)	11.01%	Other parts and accessories, for vehicles of headings 722,781-783	3.83%	Electronic microcircuits	3.46%	Special transactions,commodity not classified according to class	3.07%	Machinery for specialized industries and parts thereof,nes	2.80%
Hong Kong (HKG)	Gold, non-monetary(excluding gold ores and concentrates)	7.25%	Television, radio-broadcasting;transmitters,etc	6.57%	Unknown	4.72%	Electronic microcircuits	2.84%	Parts,nes of and accessories for apparatus falling in heading 76	2.51%
Singapore (SGP)	Electronic microcircuits	16.05%	Petroleum products, refined	8.41%	Special transactions,commodity not classified according to class	3.73%	Gold, non-monetary(excluding gold ores and concentrates)	2.06%	Medicaments(including veterinary medicaments)	1.06%
South Korea (KOR)	Electronic microcircuits	15.44%	Passenger motor vehicles (excluding buses)	5.74%	Petroleum products, refined	4.51%	Ships, boats and other vessels	3.87%	Other parts and accessories, for vehicles of headings 722,781-783	2.73%
Taiwan (TWN)	Electronic microcircuits	39.28%	Optical instruments and apparatus	3.17%	Parts, nes of and accessories for machines of headings 7512 and 752	2.56%	Petroleum products, refined	2.36%	Parts,nes of and accessories for apparatus falling in heading 76	1.88%
Indonesia (IDN)	Palm oil	8.92%	Other coal, not agglomerated	8.88%	Petroleum gases and other gaseous hydrocarbons, nes, liquefied	3.12%	Footwear	2.93%	Natural rubber latex; natural rubber and gums	2.91%
Malaysia (MYS)	Electronic microcircuits	22.01%	Petroleum products, refined	4.36%	Parts, nes of and accessories for machines of headings 7512 and 752	3.43%	Diodes, transistors,photocells, etc	3.28%	Palm oil	3.21%
Philippines (PHL)	Electronic microcircuits	21.72%	Parts, nes of and accessories for machines of headings 7512 and 752	6.34%	Peripheral units,including control and adapting units	3.59%	Other electrical machinery and equipment,nes	2.49%	Diodes, transistors, photocells, etc	2.14%
Thailand (THA)	Parts,nes of and accessories for machines of headings 7512 and 752	6.32%	Electronic microcircuits	3.91%	Motor vehicles for the transport of goods or materials	3.20%	Passenger motor vehicles (excluding buses)	2.75%	Natural rubber latex; natural rubber and gums	2.49%
China (CHN)	Television, radio-broadcasting; transmitters, etc	8.52%	Peripheral units, including control and adapting units	3.97%	Parts, nes of and accessories for machines of headings 7512 and 752	3.41%	Electronic microcircuits	2.97%	Parts,nes of and accessories for apparatus falling in heading 76	2.84%
Vietnam (VNM)	Television, radio-broadcasting; transmitters, etc	14.94%	Parts, nes of and accessories for apparatus falling in heading 76	7.19%	Footwear	6.65%	Electronic microcircuits	6.63%	Special transactions, commodity not classified according to class	3.59%

Notes: Based on SITC-4 digit and exclusive of service. % is percentage share in total export.

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