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Abstract

This paper explores the structure of the electronics and the motor vehicle value chains in East Asia. Trade in value added analysis and its decomposition method are applied to the inter-country input–output data of the Organisation for Economic Co-operation and Development. The method of value chain mapping has been introduced to illustrate the upstream and downstream transactions of goods and services along the value chain. The result of the analysis shows that the electronics industry has a greater vertical specialisation (VS) share than the automotive industry. The decomposition analysis reveals that the Korean industries were strongly integrated into the Chinese value chains, whereas the Thai industries continued to be overwhelmingly dependent on Japan, albeit, with increased linkages with neighbouring Southeast Asian economies. Moreover, value chain mapping demonstrated that China has increased its presence not only as an export platform for multinational firms but also as a consumer of final goods—especially for the Korean industries.

Keywords: global value chains, industrial agglomeration, trade in value added
JEL classification: C67, L62, L63

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1. Introduction

Participation in global value chains (GVCs) has become an important strategy for economic development. Unlike in the past, a developing country today can leap into the GVCs of sophisticated products by specialising in a niche segment of the value chain, and become an exporter of such products. Moreover, participation in GVCs gives an opportunity to a developing country to upgrade local industry through linkages with and technology spillovers from multinational firms.

However, participation in GVCs is not sufficient. Structural transformation particularly industry deepening—the formation of backward linkages by creating a robust supplier base (ADB 2013)—is necessary for sustained economic growth, especially for industries such as motor vehicles. Note that the development of a local supplier base increases the competitiveness of the assembly industry by delivering parts and components at a lower cost, in a shorter time, and with more flexibility. In the case of the automotive industry, spatial proximity between the local suppliers and assemblers not only saves on transport costs for heavy and bulky components, but also facilitates just-in-time production and inventory control.[1]

On the other hand, declining trade and transportation costs that were spurred by technological progress—especially the ICT revolution—and trade liberalisation efforts since the 1990s have increased the benefits of specialisation and exchange, reaping significant gains from international division of labour—especially at different stages of

[1] In fact, due to the benefits of agglomeration and economies of scale, many developing countries have tried to develop the automotive industry—including a local supplier base—by adopting protective measures, such as import ban, high import tariffs, and local content requirements. However, many attempts have failed, and the current development literature, which focuses on engagement in GVCs, tends to emphasise the importance of access to lower-cost or higher-quality imported inputs, and thus, any trade protection measure that protects the local suppliers of inputs at the cost of production efficiency would not be recommended as an effective policy option (OECD 2013). Moreover, such protective measures have become increasingly difficult to implement as a result of trade liberalisation efforts in recent years.

production (Baldwin 2016). In particular, industries such as electronics can enjoy great benefits by breaking up the production process across space and shifting labour-intensive operations to lesser developed countries, because, unlike automotive parts, they are not penalised by high transport costs.

In sum, there are two forces working in opposite directions. One is agglomeration that encourages local supplier development and increase domestic transactions. The other is specialisation and exchange that promotes intra-industry trade of parts and components and increases international transactions. It is therefore a matter of empirical evidence which type of transaction—domestic or international—is increased as a result of expanding production networks. In the previous study, I focused on the automotive industry in Southeast Asia and found that Southeast Asian economies have become important suppliers of parts and components, although they are still highly dependent on Japan and other Northeast Asian economies, especially for sourcing basic metals (Kuroiwa 2017).

In this study, I consider the electronics and motor vehicle industries in East Asia and will compare the structures of the value chains of both industries. It is also expected that the structures of value chains are different across countries, especially between countries belonging to the Northeast and Southeast Asian economies, because the latter economies are highly dependent on multinational firms—including firms that operate in special economic zones and contribute to overseas procurement, especially from the home countries of the respective multinational firms.

The inter-country input–output data (ICIO) data of the Organisation for Economic Co-operation and Development (OECD) for 2011 will be used to examine the value chains in ten East Asian economies, which include four Northeast Asian

economies—namely, Japan, Korea, China, and Taiwan—and six ASEAN economies—Singapore, Malaysia, Thailand, Indonesia, the Philippines, and Vietnam.[2]

The paper first introduces the method of trade in value added. The analysis of trade in value added has been used in recent years to calculate the measure of vertical specialisation (VS) and to decompose export data (see Hummels, Ishii, and Yi 2001; Daudin, Rifflart, and Schweisguth 2011; Johnson and Noguera 2012; Koopman, Wang, and Wei 2014). Moreover, this paper introduces the method of decomposition of the VS measures, so that the share of foreign content embodied in a specific good or service can be estimated by country of origin or/and by sector of origin. In addition, the alternative measure of VS—which indicates the percentage share of foreign final good production induced by import of a specific intermediate goods—will be introduced in Appendix 3.

Second, the paper introduces a method of value chain mapping with the ICIO data. The value chain mapping with international input–output data shows the entire value chain of a specific product or service. First the technique is applied to the upstream transactions to demonstrate how inputs—including both intermediate transactions and value added activities—are used to produce the specific product. Furthermore, the technique of value chain mapping will be applied to the downstream transactions to demonstrate how outputs are distributed to the respective sectors for intermediate transactions or final demand transactions.

This paper is composed as follows: the paper first discusses the structure of VS in the electronics and automotive industry in East Asia using the method of trade in value added. Second, two kinds of analyses—namely the decomposition analysis of trade in value added and the value chain mapping—are applied to the electronics and

[2] The OECD ICIO tables cover 62 countries or regions with 34 sector classifications (for the sector classification, see Table A1).

automotive industries in Korea and Thailand. Finally, the paper concludes with a summary of important findings.

2. Structure of vertical specialisation

In this section, the analysis of trade in value added is performed using the OECD ICIO data for 1995 and 2011. First, the VS share is calculated to illustrate the progress of vertical trade in East Asia with particular focus on the electronics and automotive industries. Second, those industries in Korea and Thailand are selected to represent the VS in Northeast and Southeast Asian economies respectively. Moreover, the VS shares of those industries are decomposed into its components by country of origin, and industry of origin (for the method of analysis, see Appendix 2. Moreover, the alternative measure of VS—which indicates the strength of forward linkages across national borders—is introduced in Appendix 3).

2.1 The vertical specialization share

The VS share represents the percentage share of foreign content embodied in exports, i.e. the share of value added that is induced by exports, but accrues to foreign countries. Therefore, the VS share indicates the true dependency of exports on foreign content, and its value tends to increase as production processes are increasingly fragmented across national borders. Figures 1 and 2 show the VS shares of the electronics (CEO) and motor vehicle (MTR) industries in 10 East Asian economies.[3]

– Figure 1 –

[3] The OECD ICIO table has an industry classification for computer, electronic, and optical equipment (CEQ). The CEO sector is regarded as representing the electronics sector in this paper.

Figure 1 shows that the electronics sector in Japan had an extremely low VS share (6.9 percent) in 1995. Other Northeast Asian economies, such as Korea, and China also had low VS shares. On the other hand, Southeast Asian economies, except Indonesia, had high VS shares. These facts suggest that Northeast Asian economies had a stronger local supplier base and higher self-sufficiency—with less leakage of value added out of the country—than Southeast Asian economies (see also the average VS share of the Northeast and Southeast Asian economies in Figure 1).

Seven East Asian economies increased VS shares during 1995–2011, and the average VS share in East Asia—especially in Northeast Asia—increased simultaneously. Among East Asian economies, highly export-oriented Southeast economies, such as Vietnam, Thailand, and Malaysia demonstrated a rapid increase in the VS share and reached the same level as Hungary and Mexico, which are well-known export-platforms for multinational firms in the EU and the NAFTA respectively. As a result, in Vietnam and Hungary, more than 70 percent of value added was leaked out of the country for each given external demand, due to extremely high dependency on foreign sourcing of inputs.

Figure 2 shows that the VS shares of the motor vehicle industry, especially in Northeast Asia, were significantly lower than the electronics industry. For example, China's VS share of the motor vehicle industry in 1995 was 17 percent while that of the electronics industry was 40 percent. These facts suggest that the motor vehicle industry was more self-sufficient with less dependency on foreign sourcing of inputs, and this is consistent with the argument that the benefits of agglomeration are more significant for the automotive industry.

– Figure 2 –

As in the electronics sector, the Northeast Asian economies had significantly lower VS shares in the motor vehicle industry than the Southeast Asian economies. In particular, Japan and China had very low VS shares. Japan's VS share, for instance, was only seven percent in 1995. It should be noted, however, that even these economies saw a significant increase in the VS share—implying that the motor vehicle industry was increasingly integrated into production networks in East Asia.

2.2 Decomposition of the VS shares

In the above section, it is shown that (1) the electronics industry had higher VS shares than the automotive industry; and (2) the Southeast Asian economies had higher VS shares than the Northeast Asian economies. These facts suggest that the progresses of vertical integrations are substantially different depending on the natures of industries and countries.

In the sections below, Korea and Thailand are selected as respectively representing Northeast and Southeast Asian economies, and their VS shares are further decomposed into their elements by country of origin and industry of origin.[4] These will illustrate the structure of the East Asian value chain in greater detail and will bridge the

[4] The reasons for Korea and Thailand being selected for this study are as follows: First, both the electronics and automotive industries are leading industries for these two economies. Second, the types of firms engaged in GVCs are different between these two economies: the Korean electronics and automotive industries are led by the Korean multinational firms—such as Samsung, LG, and Hyundai, whereas, as in other Southeast Asian countries, foreign firms are dominant in the Thai industries. Note that such a difference in the types of firms would significantly affect the structure of value chains in the respective economies. Moreover, considering other factors such as population size, a combination of Korea and Thailand would be appropriate for the purpose of this study.

gap between the analysis of the VS shares and value chain mapping (for the relationship between these analyses, see Appendix 1 and 2).

(1) Electronics industry

Figures 3 and 4 show the top 20 countries or regions that had the highest value added content for the electronics industry. Figure 3 shows that in 1995 the largest supplier country (in terms of value added content) for the Korean electronics industry was Japan. Other important supplier countries were neighbouring East Asian economies such as Taiwan, China, and Singapore—as well as developed economies in North America and Europe, especially the USA and Germany (see also the bars for the respective regions on the right-hand side of Figure 3). In addition, natural resource rich countries, such as Australia, Saudi Arabia and Russia were important supplier countries.[5] In 2011, the structure changed significantly, and China became the largest supplier country, replacing a long-time dominant supplier country in East Asia—namely Japan. Simultaneously many East Asian economies, except Japan, increased their share as suppliers in this period, while developed economies in North America and Europe decreased theirs.

– Figures 3 and 4 –

Figure 4 shows that Japan and the USA used to be dominant supplier countries for the Thai electronics industry in 1995, but China caught up rapidly with them by 2001.

[5] Note that natural resources, such as crude petroleum and iron ore, are contained, as the product of the mining sector, in the value added of manufactured products, so that resource-rich countries are important exporters of value added content for resource-poor East Asian countries.

However, unlike Korea, Japan was still the largest supplier country in 2011. Other important supplier countries were also similar—that is to say, in addition to developed countries, resource rich countries, and Northeast Asian countries, Southeast Asian countries—such as Singapore and Malaysia—also had high value added content in the decomposed VS share of the Thai electronics industry.

Figure 5 and 6 indicate the top 20 industries that had the highest value added content for the electronics industry in 2011. Figure 5 shows that the Korean electronics industry had the greatest content share (40 percent), out of which 33 percent was held by domestic content. Other sectors that had high value-added content in the Korean electronics industry include (1) the service industry—especially wholesale and retail trade, R&D and other business activities, financial intermediation, and transport and storage; (2) the mining industry, which provides natural resources and is dominated by foreign content; (3) the materials industry—chemicals, rubber and plastic products, basic metals, and non-metallic mineral products; and (4) the machinery industry—electrical machinery, machinery and equipment. In sum, these industries provide the major constituents of electronics products in value added terms.

– Figures 5 and 6 –

Figure 5 also shows that although manufacturing (MAN) had higher value added content than services (SER), services had higher foreign content (19 percent) than manufacturing (17 percent). In particular, wholesale and retail trade, transport and storage, and computer and related activities had relatively high foreign content shares.

Figure 6 shows that the Thai electronics industry shared similarities with the Korean

electronics industry in terms of the distribution of value added content across industries. For instance, wholesale and retail trade in electronics had the largest share in both the countries. It should be noted, however, that the Thai electronics industry had a higher foreign content share than the Korean electronics industry—reflecting a weaker supplier base in the Thai manufacturing industries.

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(2) Automotive industry

Figures 7 and 8 show that the major supplier countries for motor vehicle parts and components for Korea and Thailand were similar to those for the electronics industry. Important supplier countries were the neighbouring East Asian economies—especially China and Japan—as well as developed economies in North America and Europe—particularly the USA and Germany.

– Figures 7 and 8 –

The changing trend between 1995 and 2011 was that the Korean automotive industry was increasingly involved in China's supply chain, while the Thai automotive industry continued to be overwhelmingly dependent on Japan. Simultaneously—reflecting the progress of economic integration in the region—the Thai motor vehicle industry increased its dependency on neighbouring Southeast Asian economies from less than two percent to more than six percent during 1995–2011. In sum, both the Korean and Thai electronics industries have strengthened the linkages with neighbouring economies in the respective regions. These facts suggest that geography is an important factor affecting the spatial sphere of the automotive supply

chains.

Figures 9 and 10 show that the motor vehicle industry provided the largest value added content for its own sector in 2011. The foreign content of the motor vehicle industry, however, was very low—only two percent in the case of Korea—and the proportion of local procurement in the motor vehicle industry was significantly higher than in the electronics industry (compare MTR in Figures 9 and 10 with CEQ in Figures 5 and 6). Note that this again reflects the benefits of industry agglomeration, which could contribute to local sourcing of automotive parts and components.

– Figures 9 and 10 –

The list of other sectors that had high value added content was similar to the electronics industry with the exception of basic metals: among the sectors that were deeply involved in the motor vehicle value chain, basic metals ranked highly both in Figures 9 and 10. Figure 10, however, shows that the domestic content of basic metals in Thailand was significantly lower than that in Korea, reflecting a weaker production capacity of the iron and steel industry in Thailand.

3. Value chain mapping

The above analysis illustrates the structure of the value chain from the viewpoint of supplier countries or supplier industries. In this section, it will be further decomposed into the combinations of countries and sectors—i.e. how much value added was generated in which industries and in which countries—by mapping the value chain of specific industries. Moreover, both upstream and downstream intermediate transactions

will be illustrated, in tandem with exogenous transactions—namely value added and final demand transactions.

Figures 11.a–14.b show the value chain of the electronics and motor vehicle industries in Korea and Thailand for 2011. Note that a pair of those figures show the upstream and downstream transactions respectively. The upstream value chain demonstrates the flow of upstream intermediate transactions and value added activities induced by a unit of final demand (or final goods production), whereas the downstream value chain reveals the flow of downstream intermediate transactions and final goods production induced by a unit of value added (for technical details, see Appendix 1).

The entire value chain system of respective industries—from final goods production to value added and vice versa—can be demonstrated by combining a set of two (upstream and downstream) transaction matrices for respective industries. However, (1) due to limitation of space, only upstream (downstream) transactions and value added final goods production whose values exceed one percent of the initial final demand (value added) are recorded in the figures. A unit of final demand or value added is normalised to 100 units, so that only the transactions that exceed one unit appear in Figures 11.a–14.b.[6]

(1) Electronics industry

Figure 11 and Figure 12 indicate the value chains of the electronics industry of Korea

[6] As shown in Figures 11.a–14.b, the number of the transactions whose value exceeds one is not great: for example, Figure 11.a shows that only 41 transactions meet this criterion, whereas the total number of transactions derivable from Equations (5) and (6) is extremely large (4,445,772 transactions). However, since the large transactions in the value chains are concentrated on a small number of transactions between relevant sectors, the percentage share of the transactions captured in these figures (in value added term) is not small: Figure 11.a, for example, represents 61.3 percent of all transactions in the Korean electronics value chain. The percentage share of transactions in other figures range from 38.5 percent (Figure 12.b) to 82.7 percent (Figure 14.b).

and Thailand respectively. Figure 11.a and 12.a illustrate the upstream transactions, whereas Figure 11.b and 12.b demonstrate the downstream transactions. For example, the middle section of Figure 11.a shows that 100 units of electronics (CEQ)—which were given exogenously as a final product—induced intermediate demand for 41.9 units of electronics (as a result of backward linkage effect). Simultaneously, it stimulated intermediate demand for 4.2 units of chemicals (CHM), which further induced intermediate demand for 3.0 units of chemicals and 1.5 units of refined petroleum (PET). In the value added section, 32.6 units of value added was generated in the electronics industry, followed by R& D and business services (BZS) at 4.8 units.

– Figures 11 (a, b) and 12 (a, b) –

It is shown that servicification of the economy has been proceeding in both Korea and Thailand. Service inputs—such as wholesale and retail trade, financial intermediation, transport and storage, R&D, and other business activities—hold a very high percentage share of induced value added as well as induced intermediate transactions.[7] It is also shown that since share of domestic content in Thailand is generally lower than that in Korea, the Thai electronics industry induced high value added in a variety of industries abroad, including Japan (electronics, wholesale and

[7] It is argued that servicification of the economy has been caused by (1) reclassification —many of the services traditionally sourced in house by manufacturing firms, and thus classified as manufacturing, began to be outsourced and classified accordingly as services: (2) connecting services—outsourcing and offshoring tend to increase service links (including telecommunications, transportation, and mailing) embodied in final goods; (3) changes in final goods—technological progress is enhancing the service content in the manufactured final goods, such as increased software contained in today's cars: (4) relative price shift—offshoring reduces the relative price of offshored task that are typically performed by the manufacturing sector, so that it will raise the relative share of the service content in manufactured goods (Baldwin, Forslid, and Ito 2015; Heuser and Mattoo 2017).

retail trade, and basic metals), China (electronics, wholesale and retail trade), the Rest of the World (ROW) (mining), the USA (electronics), and Taiwan (electronics).

Supplier countries of intermediate goods exhibit a similar tendency: the electronics industry in China, Japan, the USA, Korea, and Taiwan were major suppliers of intermediate goods for both the Korean and Thai electronics industry. In addition, Malaysia and Singapore were major supplier countries for the Thai electronics industry.

Figures 11.b and 12.b show that the number of downstream transactions that exceed one unit is smaller than that of upstream transactions, because the downstream transactions are concentrated on a smaller number of sectors—especially in final demand sectors, such as gross fixed capital formation and household consumption. Unlike the upstream transactions, the downstream transactions involve only a small number of domestic service sectors—such as R&D and business service activities, post, and telecommunication, in the case of Korea. Moreover, inputs provided by the electronics sectors were frequently used by the sector itself and other machinery sectors—such as machinery and equipment, motor vehicles, electrical machinery, and other transport equipment.

Figure 11.b shows that the Korean electronics industry was heavily dependent on China not only as users of intermediate goods but also as consumers of final goods. For example, the Korean electronics industry provided 24.4 units of intermediate goods for the Chinese electronics industry. Then the Chinese electronics industry provided intermediate goods for its own industry and R & D and other business activities. Simultaneously, the Chinese electronics industry provided final goods for China (gross fixed capital formation and household consumption) and the USA (gross fixed capital formation). Here, it is expected that a significant portion of these transactions—namely,

(electronics) intermediate goods from Korea to China, thereafter assembling in China and finally (electronics) final goods to China and to the USA were performed by the Korean multinational firms operating in China.

As for the transaction of final goods, the Korean electronics industry also directly exported final goods to China and to the USA, so that China consumed 6.7 units of Korean electronics products for gross fixed capital formation and 1.9 units for household consumption, whereas the USA consumed 1.7 units for gross fixed capital formation and 1.4 units for household consumption.

Figure 12.b shows that users of intermediate goods from the Thai electronics industry were more diversified than those from the Korean electronics industry. For example, it provided more than one unit of electronics products for Malaysia, Japan, Korea, the USA, and Mexico. On the other hand, final goods were largely destined for China, the USA, and Japan.

As for the role of China, a sequence of transactions similar to Korea—namely, (electronics) intermediate goods from Thailand to China, followed by processing in China and finally the movement of (electronics) final goods to China or to the USA—can be seen in the middle section of Figure 12.b. Here it is worth noting that China has increased its presence not only as an export-platform for multinational firms but also as a consumer of manufactured products from both Korea and Thailand.

(2) Automotive sector

Figure 13.a shows that the final demand for Korean motor vehicles stimulated value added activities in its own sector (30.5 units) and other domestic machinery sectors—including machinery and equipment, electronics, and electrical machinery.

Moreover, it stimulated demand in two sets of material industries—namely the metal industry (basic metals and fabricated metal products) and the chemical industry (rubber and plastic products and chemicals). Also, as in the electronics industry, the motor vehicle production stimulated demand in the service sectors—especially wholesale and retail trade, R&D and other business activities, financial intermediation, and transport and storage.

– Figures 13 (a, b) and 14 (a, b) –

Although a greater portion of value added was produced by the domestic sectors, it also stimulated value added activities in the ROW and Saudi Arabia (mining) —as well as in Japan (wholesale and retail trade).

As for the intermediate transactions, it is an interesting observation that Korean motor vehicles induced a sequence of downstream to upstream transactions—namely motor vehicles (input)→rubber and plastic products (9.7 units)→rubber and plastic products (1.1 units) and chemicals (3.2 units)→refined petroleum products (1.4 units). The metal industry also caused the following sequence: motor vehicles (input)→fabricated metal products (3.3 units)→basic metals (1.4 units). In other intermediate transactions, the motor vehicle industry in Germany, China, and Japan were important suppliers of inputs (i.e. parts and components) for the Korean motor vehicle industry.

Figure 14.a shows that compared to Korea, Thailand had a weaker local supplier base for the motor vehicles industry so that a higher percentage of value added was leaked out the country. In particular, the Thai motor vehicles industry had strong

repercussions (in value added terms) on Japan (wholesale and retail trade, basic metals, and motor vehicles), Saudi Arabia (mining), China (basic metals), and ROW (mining).

In the intermediate transactions, since Thailand had lower self-sufficiency in the metal industry—especially in iron and steel for the motor vehicles—a higher percentage of basic metals was imported from Northeast Asian countries, including Japan (4.1 units), China (1.5 units), and Korea (1.4 units) as well as from Australia (1.9 units) and the ROW (1.3 units). A major supplier country of parts and components for the Thai motor vehicles industry was Japan (5.0 units). The Philippines (1.2 units) was also an important supplier country of labour-intensive parts and components.

Figure 13.b shows that the Korean motor vehicle industry provided inputs for its own sector and service sectors (other community, social, and personal services). Simultaneously, it provided inputs for the motor vehicle industry in the USA (3.0 units) and China (2.9 units), where the Korean firms have production facilities of motor vehicles. The Korean cars assembled in the USA were then used for household consumption in the USA (1.4 units), whereas the Korean cars assembled in China were provided for gross fixed capital formation in China (1.5 units). In sum, a structure similar to the Korean electronics industry can be seen although the Korean electronics industry used China as an export platform for the US market as well. Simultaneously, motor vehicles produced in Korea were directly exported to the USA, the ROW, Saudi Arabia, China, and Brazil.

Figure 14.b shows that a large percentage of motor vehicle parts and components were exported from Thailand to neighbouring Southeast Asian countries including Indonesia and Malaysia and Japan as well. Motor vehicles assembled in Thailand were exported for gross fixed capital formation or household consumption in

Australia, Saudi Arabia, Indonesia, the Philippines, Malaysia, and the ROW.

4. Conclusion

Participation in GVCs has become increasingly important as a strategy for economic development. However, participation in GVCs is not sufficient. Industrial deepening and development of the local supplier base is necessary for sustainable economic growth, especially for industries with significant economies of scale such as the motor vehicle industry.

On the other hand, declining trade and transport costs have increased the benefits of specialisation and exchange, reaping significant gains from international division of labour. In particular, industries such as electronics can enjoy great benefits by breaking up production processes across space and shifting labour-intensive operations to less developed countries.

This paper attempts to explore the structure of the electronics and motor vehicle value chains in East Asia, with particular focus on Korea and Thailand. Trade in value added analysis is applied to the OECD ICIO data. Also, the method of value chain mapping is introduced to illustrate the upstream and downstream transactions of goods and services along the value chain. Among the findings derived from this study, the following are important.

Analysis of trade in the value added for the electronics sector shows that Northeast Asian economies had lower VS shares than Southeast Asian economies with the exception of Indonesia. This suggests that Northeast economies had a stronger supplier base and higher self-sufficiency—with less leakage of value added out of the country—than Southeast economies. It should be noted, however, that the average VS

share in East Asia, especially in Northeast Asia, increased substantially during 1995–2011—implying acceleration of vertical specialization in this region.

The motor vehicle industry had lower VS shares than the electronics industry, and this is consistent with the argument that the benefits of agglomeration are more significant for the automotive industry. Simultaneously, as in the electronics sector, Northeast Asian economies had lower VS shares than Southeast Asian economies, although the former economies saw a significant increase in the VS share during 1995–2011. One of the reasons for the high VS shares in Southeast Asia is that the leading sectors in Southeast Asia are dominated by foreign firms, which tend to increase sourcing from the supplier base in their own supply chain, particularly from the home countries of the respective firms. For example, Japanese firms are dominant motor vehicle manufacturers in Southeast Asia, and this contributes to sourcing from Japan.

The decomposition of the VS share shows that in the period 1990–2011, Japan used to be the largest supplier country (in value added terms) for the Korean electronics industry, but it was replaced by China. On the other hand, Japan continued to be the largest supplier country for the Thai electronics industry. The decomposition of the VS share by industry of origin shows that Korea and Thailand had similarities in terms of the distribution of value added content across industries, although the Thai electronics industry had higher foreign content shares than the Korean electronics industry.

The decomposed VS shares of the automotive industry show that the Korean automotive industry was getting increasingly involved in China's supply chain, while the Thai automotive industry continued to be overwhelmingly dependent on Japan. Simultaneously, the Thai motor vehicle industry increased its dependency on neighbouring Southeast Asian economies. These facts suggest that geography—as well

as the ownership structure of firms—is an important factor that affects the spatial sphere of the automotive supply chains.

The decomposition of the VS share by industry of origin shows that basic metals had high value added content in the motor vehicle industry. It also demonstrated that the domestic content of basic metals in Thailand was significantly lower than that of basic metals in Korea, reflecting a weaker production capacity of the steel and iron industry in Thailand.

The value chain mapping shows that the electronics industries in China, Japan, Korea, Taiwan, and the USA were major suppliers of intermediate goods for both the Korean and Thai electronics industry. Moreover, as a result of servicification of the economy, service inputs—such as wholesale and retail trade, financial intermediation, transport and storage—had a high percentage share of induced value added, as well as induced intermediate transactions.

As for downstream transactions, the Korean electronics industry was heavily dependent on China not only as users of intermediate goods but also as consumers of final goods. It can be seen that in the electronics industry a high percentage of intermediate goods was exported from Korea to China, assembled in China and the final goods were consumed by China and the USA. It is estimated that a significant portion of these transactions were performed by the Korean multinational firms operating in China.

Users of intermediate goods from the Thai electronics industry were more diversified than those of the Korean electronics industry whose users were mostly concentrated in China. Simultaneously, a sequence of intermediate transactions similar to Korea can be seen in the Thai electronics industry. China has fortified its presence

here not only as an export-platform but also as a consumer of final products of Thai industries.

The Korean motor vehicle industry stimulated value added in its own sector and other machinery sectors. Moreover, it activated a set of material industries—namely the metal and chemical industries—and service industries. Although a great portion of value added was produced by the domestic industries, it also stimulated value added production in the ROW (mining) and Saudi Arabia (mining), as well as in Japan (wholesale and retail trade).

Since Thailand had a weaker local supplier base for the motor vehicles industry, a higher percentage of value added was leaked out of the country. In particular, the Thai motor vehicles industry had strong repercussions on Japan, Saudi Arabia, China, and the ROW. It is also important to note that since Thailand had a lower self-sufficiency in the metal industry, a higher percentage of basic metals were imported from the Northeast Asian economies—including Japan, China, and Korea—as well as Australia and the ROW. A major supplier country of parts and components for the Thai motor vehicles industry was Japan. The Philippines, on the other hand, was an important supplier country of labour-intensive parts and components.

The Korean motor vehicle industry provided inputs for its own sector and service sectors. Simultaneously, it provided inputs for the motor vehicle industry in the USA and China. The Korean cars assembled in the USA were then used for household consumption in the USA, whereas the Korean cars assembled in China were provided for gross fixed capital formation in China—implying that motor vehicles were more likely to be assembled where the market is located.

It is shown that a large percentage of motor vehicle parts and components were

exported from Thailand to the neighbouring Southeast Asian countries including Indonesia and Malaysia and Japan as well. Motor vehicles assembled in Thailand were exported for gross fixed capita formation or household consumption in Australia, Saudi Arabia, Indonesia, the Philippines, Malaysia, and the ROW.

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Appendix 1: Method of structural analysis

This section introduces the method of structural analysis, which was first introduced by Kuroiwa (2016). The result of the analysis deals with both upstream and downstream transactions of the specific good or service.

a. Upstream transactions

First, using an input coefficient matrix of the international input–output data, the accounting identity on the output side (i.e. the equality between total outputs and intermediate inputs plus final demand) can be expressed as:

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{f}, \qquad (1)$$

where $\mathbf{x}$ is the (*nm* x 1) vector of total output; *m* and *n* represent the number of countries and sectors respectively; $\mathbf{A}$ is the (*nm* x *nm*) multi-country input coefficient matrix; and $\mathbf{f}$ is the (*nm* x 1) vector of final demand.

Solving Equation (1) for X gives

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f} = \mathbf{L}\mathbf{f}, \qquad (2)$$

where $\mathbf{I}$ is the (*nm* x *nm*) identity matrix; and $\mathbf{L}$ is the (*nm* x *nm*) multi-country Leontief inverse matrix. Then, differentiating each element in **x** in Equation (2) with respect to each element in **f** yields

$$l_{ij}^{rs} = \frac{\Delta x_i^r}{\Delta f_j^s}. \qquad (3)$$

where the *ij* element of the *rs* sub-matrix in the Leontief inverse indicates the output of sector *i* in country *r* induced directly or indirectly by one unit of final demand for sector *j* in country *s*. Thus, the column vector of sector *j* in country *s* indicates the output of all sectors (i.e. sectors 1 through *n*) in all countries (i.e. countries 1 through *m*), induced by one unit of final demand for industry *j* in country *s*, as shown below:

$$\mathbf{I}_{(j)}^{(s)} = \left[l_{1j}^{1s}, \cdots l_{nj}^{1s}, \cdots l_{1j}^{rs}, \cdots l_{nj}^{rs}, \cdots l_{1j}^{ms}, \cdots l_{nj}^{ms}\right]'$$

$$= \left[\frac{\Delta x_1^1}{\Delta f_j^s}, \cdots \frac{\Delta x_n^1}{\Delta f_j^s}, \cdots \frac{\Delta x_1^r}{\Delta f_j^s}, \cdots \frac{\Delta x_n^r}{\Delta f_j^s}, \cdots \frac{\Delta x_1^m}{\Delta f_j^s}, \cdots \frac{\Delta x_n^m}{\Delta f_j^s}\right]'. \quad (4)$$

Subsequently, the unit structure for the upstream transactions can be obtained by post-multiplying **A** by the diagonal matrix of column vector $\mathbf{I}_{(j)}^{(s)}$.

$$\mathbf{U}_{(j)}^{(s)} = \mathbf{A}\hat{\mathbf{L}}_{(j)}^{(s)}$$

$$= \begin{bmatrix} \mathbf{A}^{11} & \cdots & \mathbf{A}^{1r} & \cdots & \mathbf{A}^{1m} \\ \vdots & & \vdots & & \vdots \\ \mathbf{A}^{q1} & \cdots & \mathbf{A}^{qr} & \cdots & \mathbf{A}^{qm} \\ \vdots & & \vdots & & \vdots \\ \mathbf{A}^{m1} & \cdots & \mathbf{A}^{mr} & \cdots & \mathbf{A}^{mm} \end{bmatrix} \begin{bmatrix} \hat{\mathbf{L}}_{(j)}^{(s)1} & \cdots & 0 & \cdots & 0 \\ \vdots & \ddots & \vdots & & \vdots \\ 0 & \cdots & \hat{\mathbf{L}}_{(j)}^{(s)r} & \cdots & 0 \\ \vdots & & \vdots & \ddots & \vdots \\ 0 & \cdots & 0 & \cdots & \hat{\mathbf{L}}_{(j)}^{(s)m} \end{bmatrix}, \quad (5)$$

where $\hat{\mathbf{L}}_{(j)}^{(s)}$ is the diagonal matrix of column vector $\mathbf{I}_{(j)}^{(s)}$. Then, using Equation (3), it can be shown that $\mathbf{U}_{(j)hi}^{(s)qr} = \mathbf{A}_{hi}^{qr}\hat{\mathbf{L}}_{(j)i}^{(s)r} = \frac{\Delta z_{hi}^{qr}}{\Delta x_i^r}\frac{\Delta x_i^r}{\Delta f_j^s} = \frac{\Delta z_{hi}^{qr}}{\Delta f_j^s}$,[8] where $\mathbf{Z}_{hi}^{qr}$ denotes the value of intermediate inputs produced by industry *h* in country *q*, and used by industry *i* in country *r*. Hence, if *j* is specified as the electronics sector, $\mathbf{U}_{(j)hi}^{(s)qr}$ represents an intermediate transaction from industry *h* in country *q* to industry *i* in country *r*, induced by one unit of final demand for the electronics product in country *s*. Then, $\mathbf{U}_{(j)}^{(s)}$ indicates the sequences of inter-industry transactions of goods and services that occur along the upstream electronics value chain.

Similarly, induced value added which is the remuneration paid for primary inputs, such as labour compensation, profits, and indirect taxes—is calculated by post-multiplying the row vector of the value added coefficients by $\hat{\mathbf{L}}_{(j)}^{(s)}$.

$$\mathbf{v}_{(j)}^{(s)\prime} = \mathbf{v}(\mathbf{c})'\hat{\mathbf{L}}_{(j)}^{(s)}$$

[8] Due to the assumption of linearity in the input–output model, it holds that $\mathbf{A}_{hi}^{qr} = \frac{\mathbf{Z}_{hi}^{qr}}{\mathbf{x}_i^r} = \frac{\Delta z_{hi}^{qr}}{\Delta x_i^r}$.

$$= [\mathbf{v(c)}^{1\prime} \quad \cdots \quad \mathbf{v(c)}^{r\prime} \quad \cdots \quad \mathbf{v(c)}^{m\prime}] \begin{bmatrix} \hat{\mathbf{L}}_{(j)}^{(s)1} & \cdots & \mathbf{0} & \cdots & \mathbf{0} \\ \vdots & \ddots & \vdots & & \vdots \\ \mathbf{0} & \cdots & \hat{\mathbf{L}}_{(j)}^{(s)r} & \cdots & \mathbf{0} \\ \vdots & & \vdots & \ddots & \vdots \\ \mathbf{0} & \cdots & \mathbf{0} & \cdots & \hat{\mathbf{L}}_{(j)}^{(s)m} \end{bmatrix}, \qquad (6)$$

where $\mathbf{v(c)}^{r}$ is the (*n* x 1**)** column vector of the value added coefficients for county *r*.

In Equation (6), $\mathbf{v}_{(j)i}^{(s)r}$ $(\mathbf{r} \neq \mathbf{s})$ represents the value added produced by industry *i* in country *r* and absorbed by industry *j* in country *s*, which is equivalent to the value added exports from source country *r* to destination country *s* (see Johnson and Noguera 2012).

b. Downstream transactions

For mapping downstream transactions, a different approach is necessary. This paper proposes to use the Ghosh inverse as an alternative to the Leontief inverse. As a mirror image of the Leontief inverse, the Ghosh inverse indicates outputs in the respective sectors induced by one unit of primary input (land, capital, and labour) for a specific sector (Ghosh 1958).

Using the allocation coefficient matrix, the accounting identity on the input side (i.e. the equality between total inputs and intermediate inputs plus value added) is expressed as

$$\mathbf{x}' = \mathbf{x}'\mathbf{B} + \mathbf{v}', \qquad (7)$$

where $\mathbf{B}$ is the (*nm* x *nm*) multi-country output coefficient matrix. $\mathbf{v}$ is the (*nm* x 1) vector of value added. Solving Equation (7) for **x** gives

$$\mathbf{x}' = \mathbf{v}'(\mathbf{I} - \mathbf{B})^{-1} = \mathbf{v}'\mathbf{G}, \qquad (8)$$

where $\mathbf{G}$ is the (*nm* x *nm*) multi-country Ghosh inverse matrix. Then, differentiating each element in **x** in Equation (8) with regard to each element in **v** yields

$$g_{ij}^{rs}=\frac{\Delta X_j^s}{\Delta v_i^r} \quad . \qquad (9)$$

It should be noted that contrary to Equation (3), g_{ij}^{rs} represents the output of sector *j* in country *s* induced directly or indirectly by one unit of primary inputs in sector *i* in country *r*. Therefore, the row vector of sector *i* in country *r* reveals the output of all sectors in all countries induced by sector *i* in country *r*:

$$\mathbf{g}_{(i)}^{(r)} = [g_{i1}^{r1},\cdots g_{in}^{r1},\cdots g_{i1}^{rs},\cdots g_{in}^{rs},\cdots g_{i1}^{rm},\cdots g_{in}^{rm}]$$

$$=\left[\frac{\Delta X_1^1}{\Delta v_i^r},\cdots\frac{\Delta X_n^1}{\Delta v_i^r},\cdots\frac{\Delta X_1^s}{\Delta v_i^r},\cdots\frac{\Delta X_n^s}{\Delta v_i^r},\cdots\frac{\Delta X_1^m}{\Delta v_i^r},\cdots\frac{\Delta X_n^m}{\Delta v_i^r}\right]. \qquad (10)$$

Then, the unit structure for the downstream transactions can be obtained by pre-multiplying **B** by the diagonal matrix of row vector $\mathbf{g}_{(i)}^{(r)}$.

$$\mathbf{D}_{(i)}^{(r)}=\widehat{\mathbf{G}}_{(i)}^{(r)}\mathbf{B}$$

$$=\begin{bmatrix}\widehat{\mathbf{G}}_{(i)}^{(r)1} & \cdots & 0 & \cdots & 0\\ \vdots & \ddots & \vdots & & \vdots\\ 0 & \cdots & \widehat{\mathbf{G}}_{(i)}^{(r)s} & \cdots & 0\\ \vdots & & \vdots & \ddots & \vdots\\ 0 & \cdots & 0 & \cdots & \widehat{\mathbf{G}}_{(i)}^{(r)m}\end{bmatrix}\begin{bmatrix}\mathbf{B}^{11} & \cdots & \mathbf{B}^{1s} & \cdots & \mathbf{B}^{1m}\\ \vdots & & \vdots & & \vdots\\ \mathbf{B}^{r1} & \cdots & \mathbf{B}^{rs} & \cdots & \mathbf{B}^{rm}\\ \vdots & & \vdots & & \vdots\\ \mathbf{B}^{m1} & \cdots & \mathbf{B}^{ms} & \cdots & \mathbf{B}^{mm}\end{bmatrix}, \qquad (11)$$

where $\widehat{\mathbf{G}}_{(i)}^{(r)}$ is the diagonal matrix of row vector $\mathbf{g}_{(i)}^{(r)}$. Here, as in Equation (5), it holds that $\mathbf{D}_{(i)}^{(r)\ st}_{\ \ jk}=\widehat{\mathbf{G}}_{(i)j}^{(r)s}\mathbf{B}_{jk}^{st}=\frac{\Delta x_j^s}{\Delta v_i^r}\ \frac{\Delta Z_{jk}^{st}}{\Delta x_j^s}=\ \frac{\Delta Z_{jk}^{st}}{\Delta v_i^r}$.

Analogous to Equation (6), the final goods production induced by primary inputs for sector *i* in country *r* is calculated as:

$$\mathbf{F}_{(i)}^{(r)}=\widehat{\mathbf{G}}_{(i)}^{(r)}\mathbf{F}(\mathbf{c})$$

$$=\begin{bmatrix}\widehat{\mathbf{G}}_{(i)}^{(r)1} & \cdots & 0 & \cdots & 0\\ \vdots & \ddots & \vdots & & \vdots\\ 0 & \cdots & \widehat{\mathbf{G}}_{(i)}^{(r)s} & \cdots & 0\\ \vdots & & \vdots & \ddots & \vdots\\ 0 & \cdots & 0 & \cdots & \widehat{\mathbf{G}}_{(i)}^{(r)m}\end{bmatrix}\begin{bmatrix}\mathbf{F}(\mathbf{c})^1\\ \vdots\\ \mathbf{F}(\mathbf{c})^s\\ \vdots\\ \mathbf{F}(\mathbf{c})^m\end{bmatrix}, \qquad (12)$$

where $\mathbf{F}(\mathbf{c})^s$ is the final demand coefficients matrix in country *s* (i.e. the ratios of final demand components to outputs).

Appendix 2: The VS share and its decomposition

Using the notations in Appendix 1, the VS share of sector *j* in country *s*—which is equivalent to Equation (40) in Koopmans, Wang, and Wei (2014)—can be expressed as:

$$VS_{(j)}^{(s)}\ \text{share} = 100\ \text{X}\ \sum_{r\neq s}^{m}\sum_{i=1}^{n}\mathbf{v}(\mathbf{c})_{i}^{r}\hat{\mathbf{L}}_{(j)i}^{(s)r} = 100\ \text{X}\ \sum_{r\neq s}^{m}\sum_{i=1}^{n}\mathbf{v}_{(j)i}^{(s)r}, \qquad (13)$$

where $\mathbf{v}(\mathbf{c})_{i}^{r}$ is a value added coefficient of sector *i* in country *r* and $\mathbf{v}_{(j)i}^{(s)r}$ represents a share of the value added in sector *i* in country *r* contained in the exports of sector *j* in country *s*. Here the VS share is expressed in percentage terms, so that it can range from 0 to 100—the higher the VS share, the stronger the backward linkages across national borders. Moreover, the $VS_{(j)}^{(s)}$ share can be decomposed as follows:

(1) Share of foreign content by country of origin (r) is calculated by

$$VS\_f_{(j)}^{(s)r}\text{share} = 100\ \text{X}\sum_{i=1}^{n}\mathbf{v}_{(j)i}^{(s)r}. \qquad (14)$$

Note that if *r*=*s* in Equation (14), the above index represents domestic content.

(2) Share of foreign content by industry of origin (*i*) is given by

$$VS\_f_{(j)i}^{(s)}\ \text{share} = 100\ \text{X}\ \sum_{r\neq s}^{m}\mathbf{v}_{(j)i}^{(s)r}. \qquad (15)$$

In sum, the $VS\_f_{(j)}^{(s)r}\text{share}$ and $VS\_f_{(j)i}^{(s)}\ \text{share}$ can be derived from Equation (6) by aggregating $\mathbf{v}_{(j)i}^{(s)r}$ across industries and countries respectively.

Appendix 3: The VSG share and its decomposition

As a mirror image of the VS share, an alternative index of the VS can be produced by using the Ghosh inverse. This new index, which I call here the VSG share, represents the percentage share of foreign final goods induced by the import of specific intermediate goods or services, i.e. the share of final good production that is induced by imported intermediate goods but accrues to foreign countries. In contrast to the VS share, the VSG share indicates the strength of forward linkages across national borders. The VSG share of sector *i* in country *r* can be expressed as:

$$VSG_{(i)}^{(r)} \text{ share} = 100 \text{ X } \sum_{s \neq r}^{m} \sum_{j=1}^{n} \widehat{\mathbf{G}}_{(i)j}^{(r)s} \mathbf{f(c)}_{j}^{s} = 100 \text{ X } \sum_{s \neq r}^{m} \sum_{j=1}^{n} \mathbf{f}_{(i)j}^{(r)s}, \qquad (16)$$

where $\mathbf{f(c)}_{j}^{s}$ is a final demand coefficient (i.e. the ratio of final demand to outputs) of sector *j* in country *s*, and $\mathbf{f}_{(i)j}^{(r)s}$ represents a share of final good production in sector *j* in country *s* induced by the import of intermediate goods for sector *i* in country *r*. Furthermore, as in Equation (13), Equation (16) can be decomposed into shares of foreign final good production by country of destination and by industry of destination.

Figure A1 shows the relationship between VS and VSG shares in the electronics sector for the year 2011. It is shown that those countries that have higher VS shares than VSG shares—namely strong backward linkages and weak forward linkages—are located downstream in the value chain and are mostly developing economies with a weak supplier base. On the other hand, developed economies including Japan, Korea, and Taiwan have an opposite structure, i.e. they are located upstream in the value chain and provide inputs for less developed countries in the region.[9] At the same time, the countries that were far from the origin in Figure A1 were

[9] In this regard, the Philippines is an exception (see Figure A1). The electronics sector in the Philippines has a high VSG because its electronics industry is highly export-oriented and competitive in the parts and components sector—such as semiconductors and hard disk drives (HDD).

very active in vertical specialization. They include Southeast Asian economies with high export-orientation such as Vietnam, Malaysia, and Thailand as well as well-known export platforms such as Hungary and Mexico.

– Figure A1 –

Figure A2 shows that many East Asian motor vehicle industries have greater VS shares than VSG shares except Japan. This implies that it would take more time for developing economies to become a supplier country of motor vehicle parts and components. It should be noted, however, that the countries that are far from the origin in Figure A1 continue to be in a similar position in Figure A2. Populous countries such as China and Indonesia tend to have low VS and VSG shares.

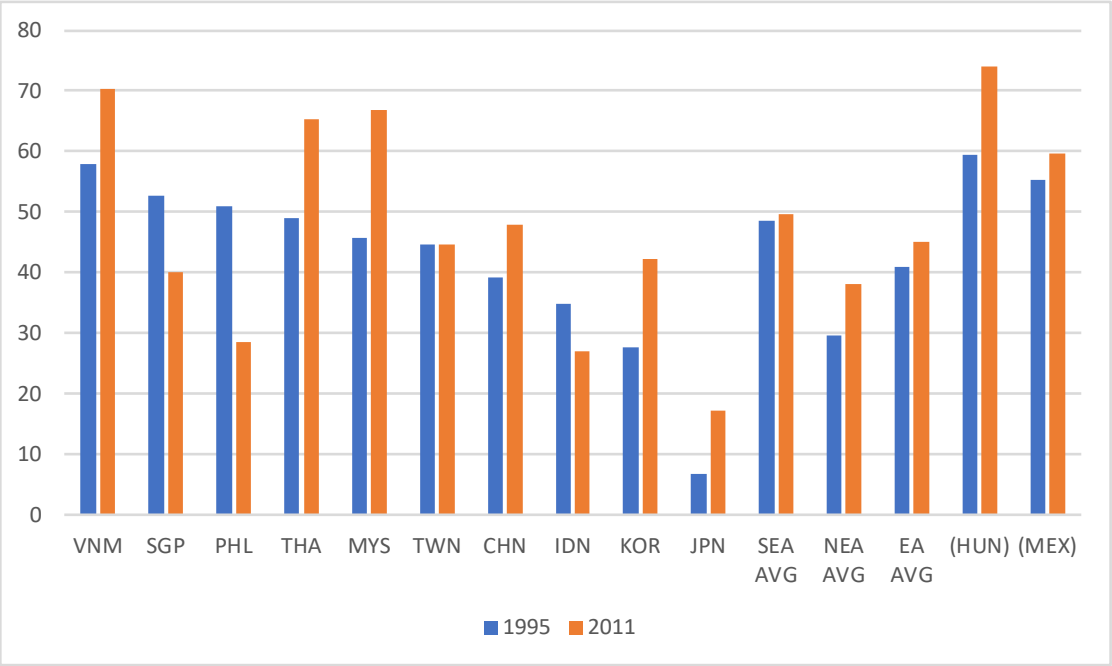
– Figure A2 –

Table A1. Sector classification of the OECD ICIO table

AGR	Agriculture, hunting, forestry, and fishing	PVH	Private households with employed persons
MIN	Mining and quarrying		
FOD	Food products, beverages, and tobacco	HC	Household consumption
TEX	Textiles, textile products, leather, and footwear	NPI	Non-profit institution serving household
WOD	Wood and products of wood and cork	GGF	General government final consumption
PAP	Pulp, paper, paper products, printing, and publishing	GFC	Gross fixed capital formation
PET	Coke, refined petroleum products and nuclear fuel	INV	Changes in inventories
CHN	Chemicals and Chemical products	CON	Direct purchase abroad by residents
RBP	Rubber and plastic products	DISC	Discrepancies
NMM	Other non-metallic mineral products		
MET	Basic metals	VA	Value added
FBM	Fabricated metal products	CT	Output at basic prices
MEQ	Machinery and equipment, nec		
CEQ	Computer, Electronic and optical equipment		
ELQ	Electrical machinery and apparatus, nec		
MTR	Motor vehicles, trailers, and semi-trailers		
TRQ	Other transport equipment		
OTM	Manufacturing nec; recycling		
EGW	Electricity, gas, and water supply		
CON	Construction		
WRT	Wholesale and retail trade; repairs		
HTR	Hotels and restaurants		
TRN	Transport and storage		
PTL	Post and telecommunications		
FIN	Financial intermediation		
REA	Real estate activities		
RMQ	Renting of machinery and equipment		
ITS	Computer and related activities		
BZS	R&D and other business activities		
GOV	Public admin. and defence; compulsory social security		
EDU	Education		
HTH	Health and social work		
OTS	Other community, social and personal services		

(Source: OECD ICIO table)

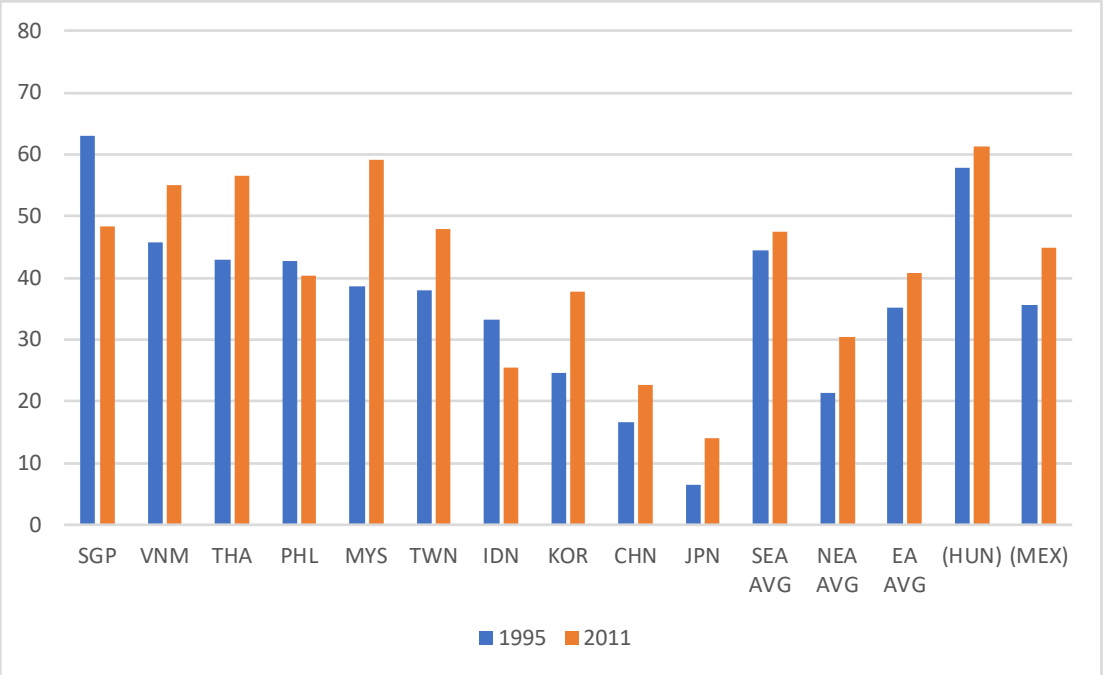
Figure 1. VS share of the CEQ sector (1995, 2011)



Source: Calculated from the OECD ICIO tables (1995, 2011)

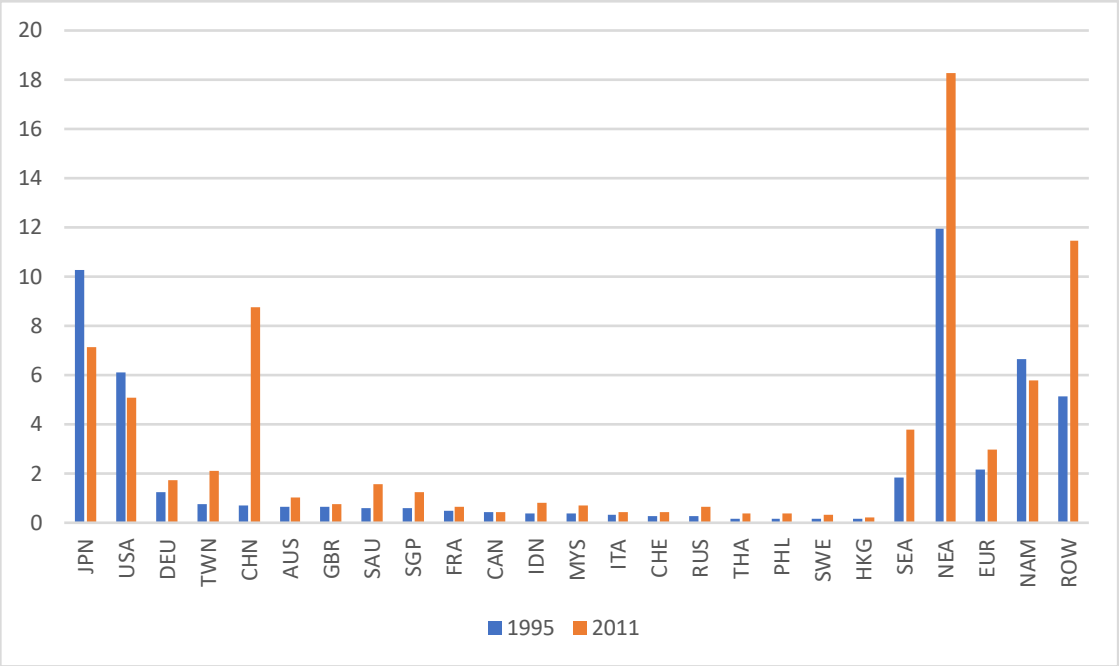
1. SEA: Southeast Asia, NEA: Northeast Asia, EA: East Asia, EUR: Europe, NAM: North America ROW: Rest of the World, PRI: primary industry, MAN: manufacturing industry, SER: service industry (the symbols are the same for Tables 1-10)

Figure 2. VS share of the MTR sector (1995, 2011)



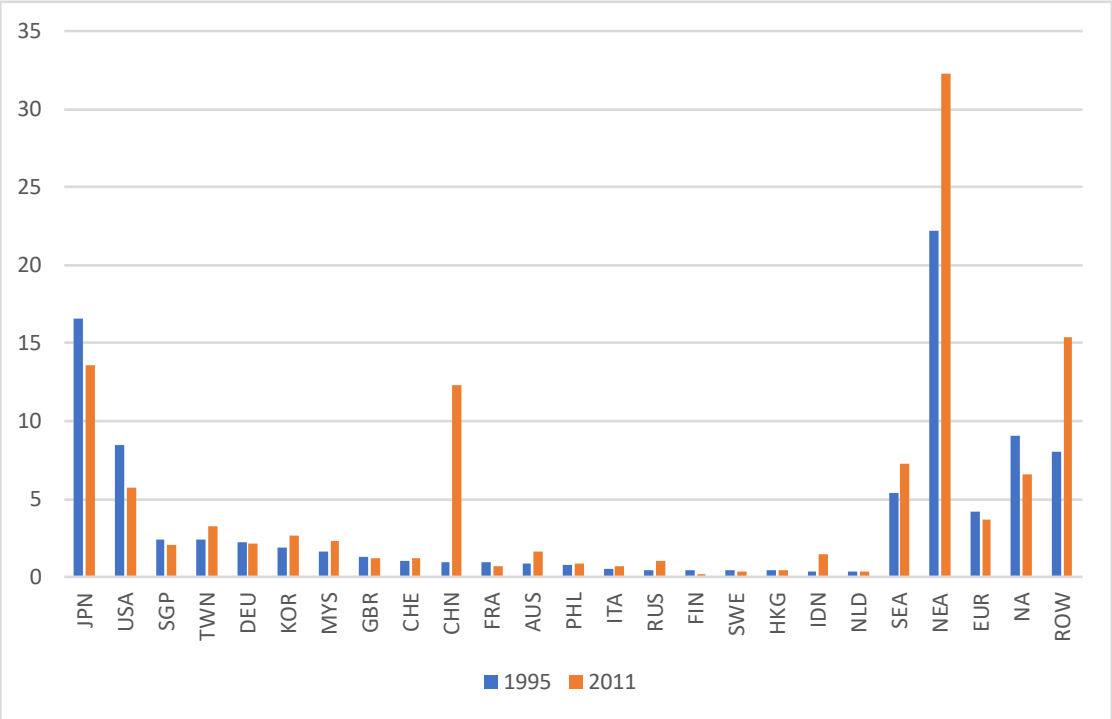
Source: Calculated from the OECD ICIO tables (1995, 2011)

Figure 3. Decomposition of the VS share by country of origin: CEO sector in Korea (1995, 2011)



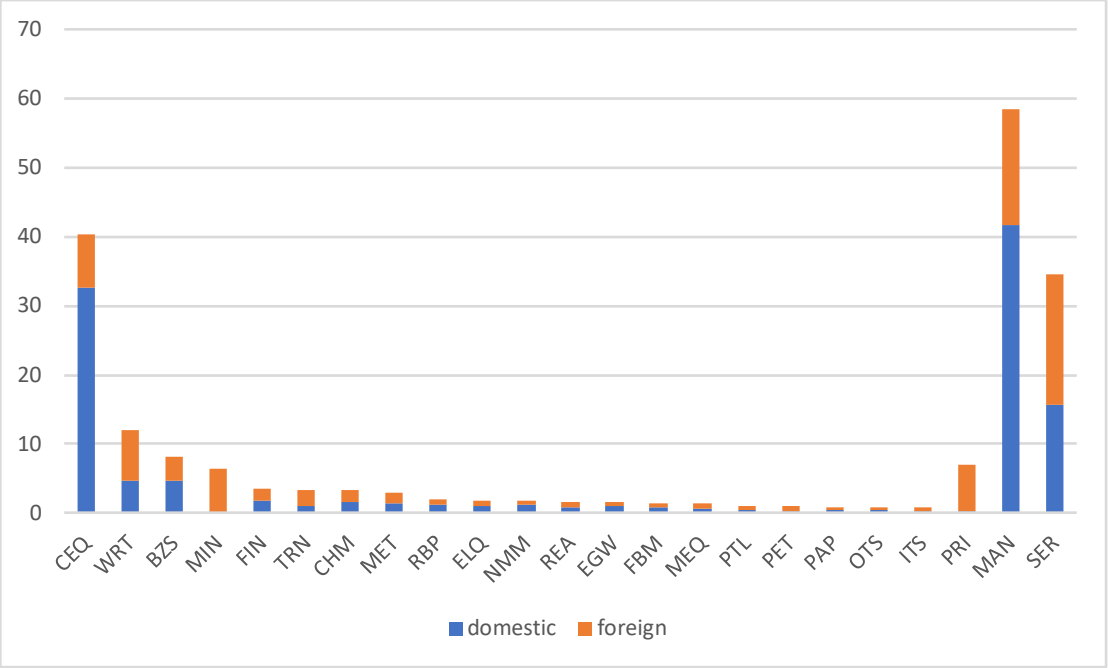
Source: Calculated from the OECD ICIO tables (1995, 2011)

Figure 4. Decomposition of the VS share by country of origin: CEO sector in Thailand (1995, 2011)



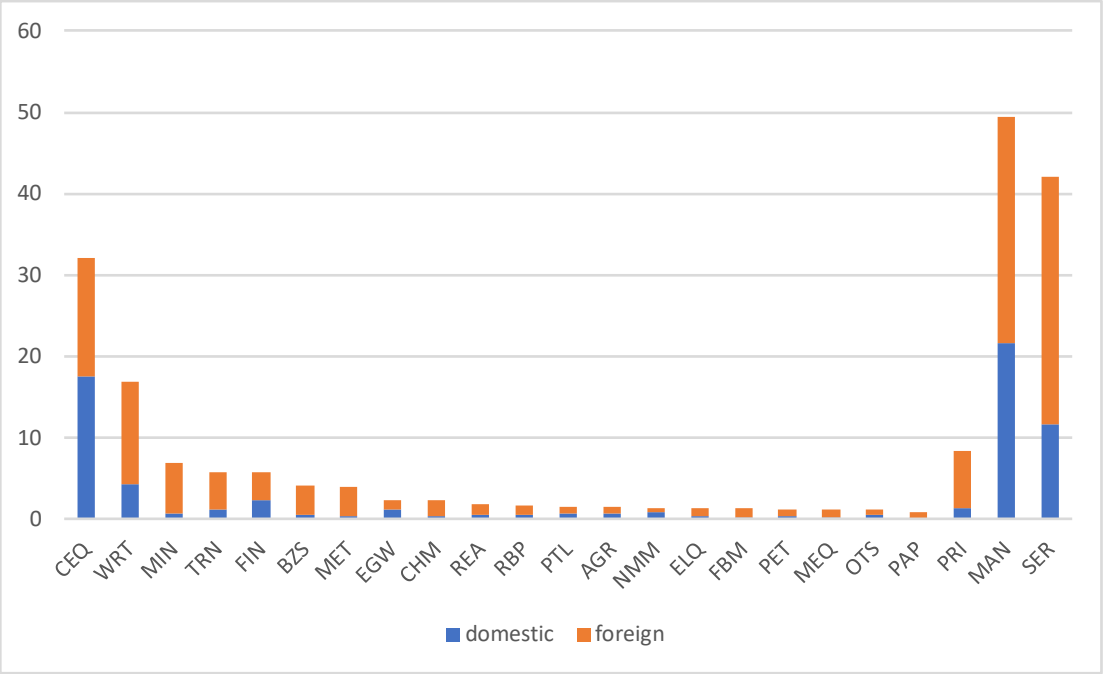
Source: Calculated from the OECD ICIO tables (1995, 2011)

Figure 5. Decomposition of the VS share by industry of origin: CEO sector in Korea (2011)



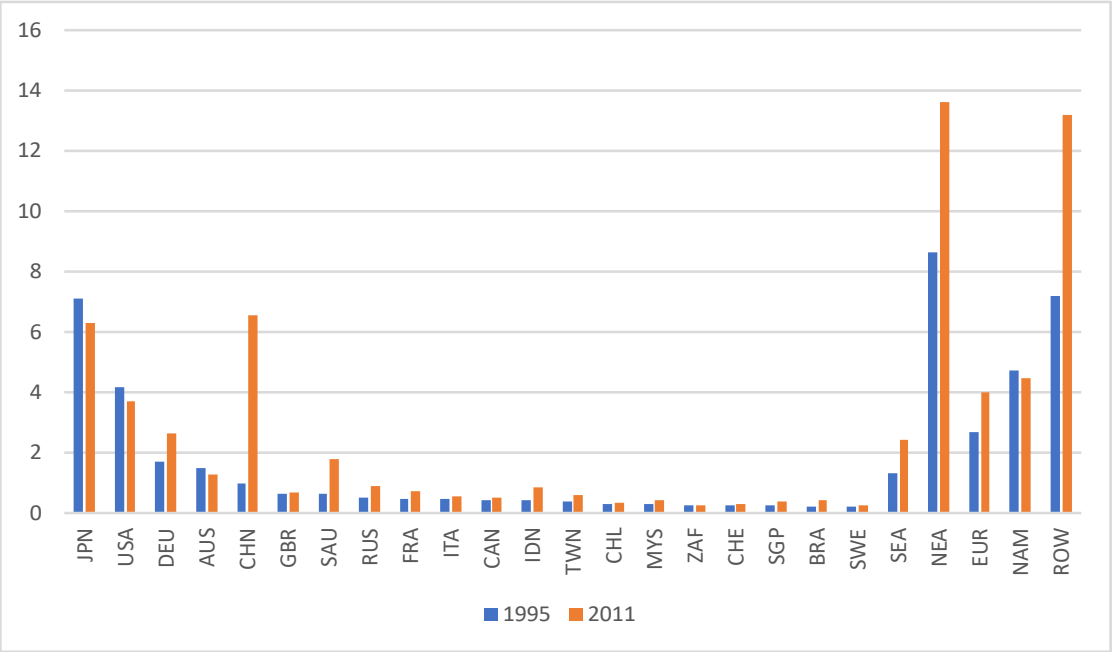
Source: Calculated from the OECD ICIO tables (2011)

Figure 6. Decomposition of the VS share by industry of origin: CEO sector in Thailand (2011)



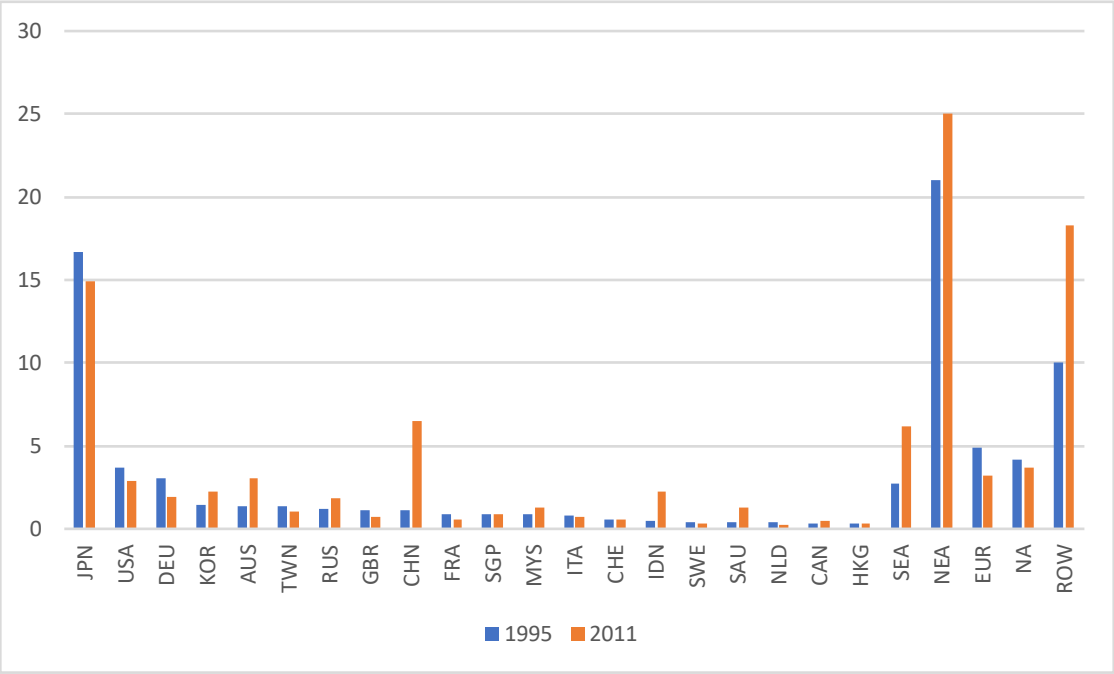
Source: Calculated from the OECD ICIO tables (2011)

Figure 7. Decomposition of the VS share by country of origin: MTR sector in Korea (1995, 2011)



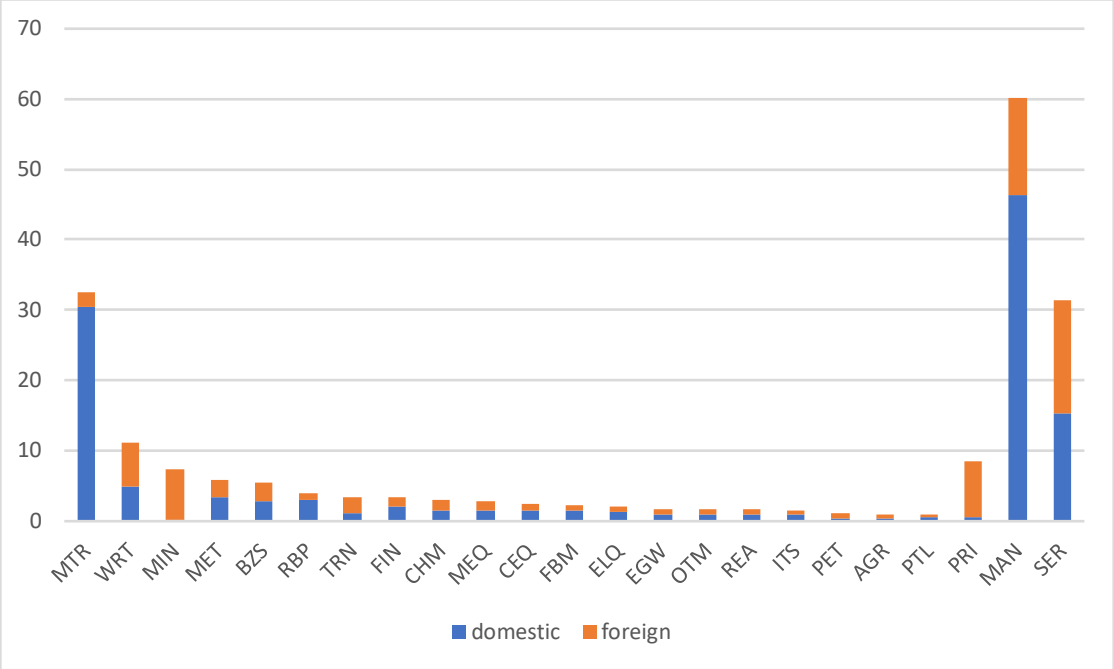
Source: Calculated from the OECD ICIO tables (1995, 2011)

Figure 8. Decomposition of the VS share by country of origin: MTR sector in Thailand (1995, 2011)



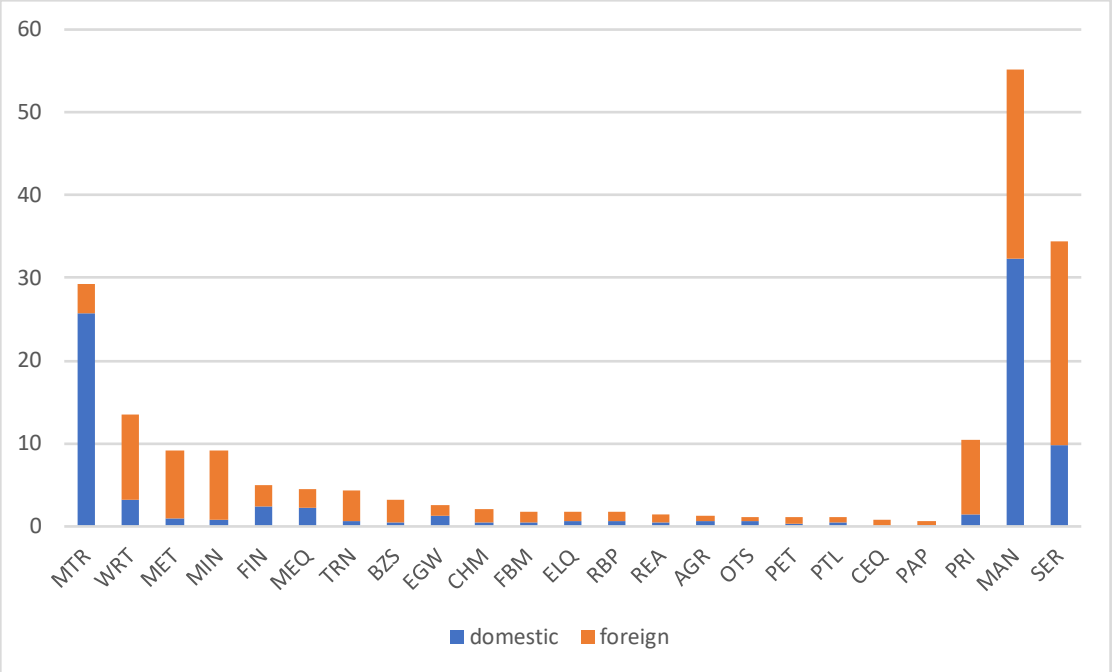
Source: Calculated from the OECD ICIO tables (1995, 2011)

Figure 9. Decomposition of the VS share by industry of origin: MTR sector in Korea (2011)



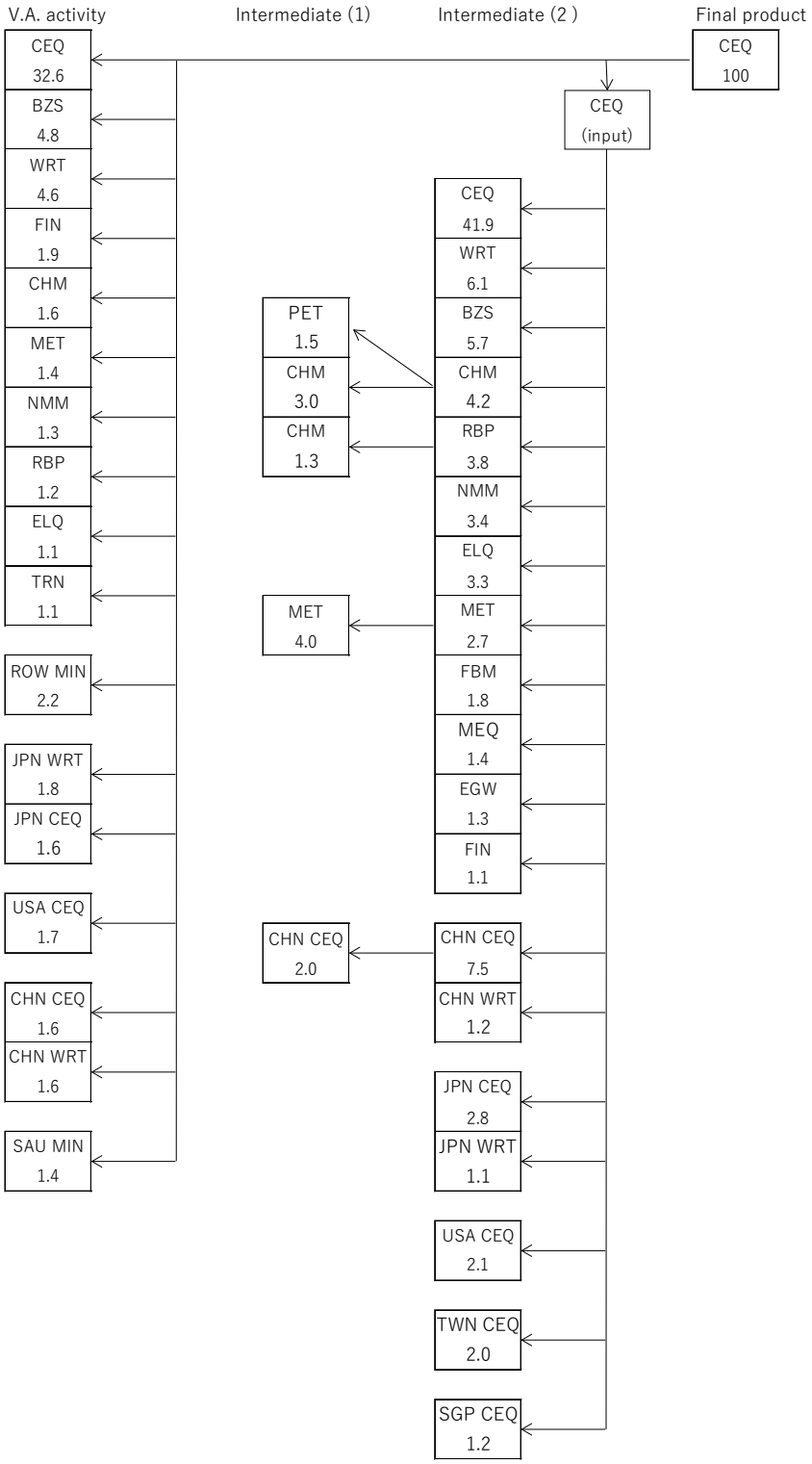
Source: Calculated from the OECD ICIO table (2011)

Figure 10. Decomposition of the VS share by industry of origin: MTR sector in Thailand (2011)



Source: Calculated from the OECD ICIO table (2011)

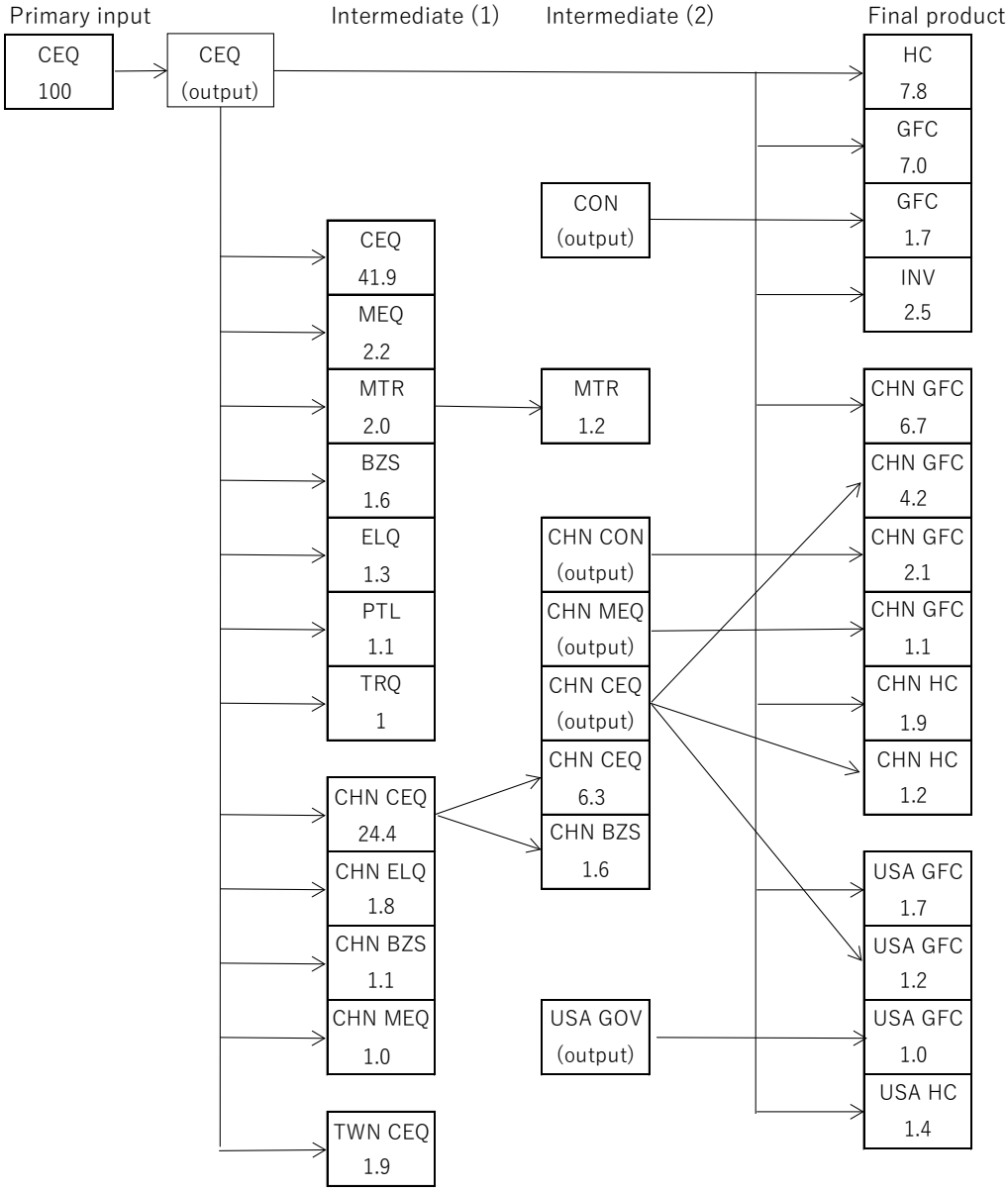
Figure 11.a. Flow of upstream transactions: CEQ sector in Korea (2011)



Source: Calculated from the OECD ICIO table (2011)

1. The arrow indicates the direction of backward linkage effects (Figure 11.a-14.a).
2. The symbol (input) indicates the sector that uses inputs provided by the arrowed sector.

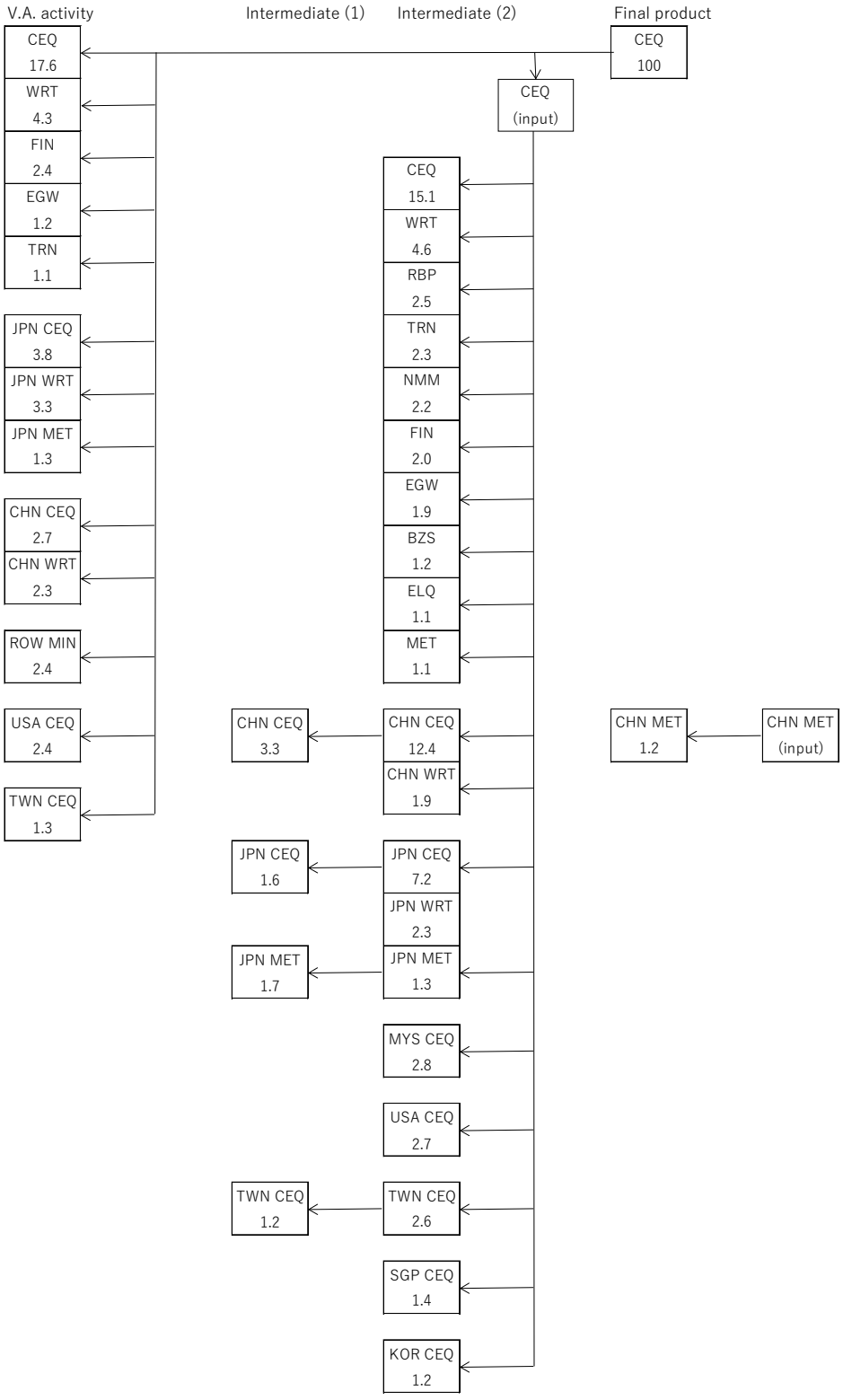
Figure 11.b. Flow of downstream transactions: CEQ sector in Korea (2011)



Source: Calculated from the OECD ICIO table (2011)

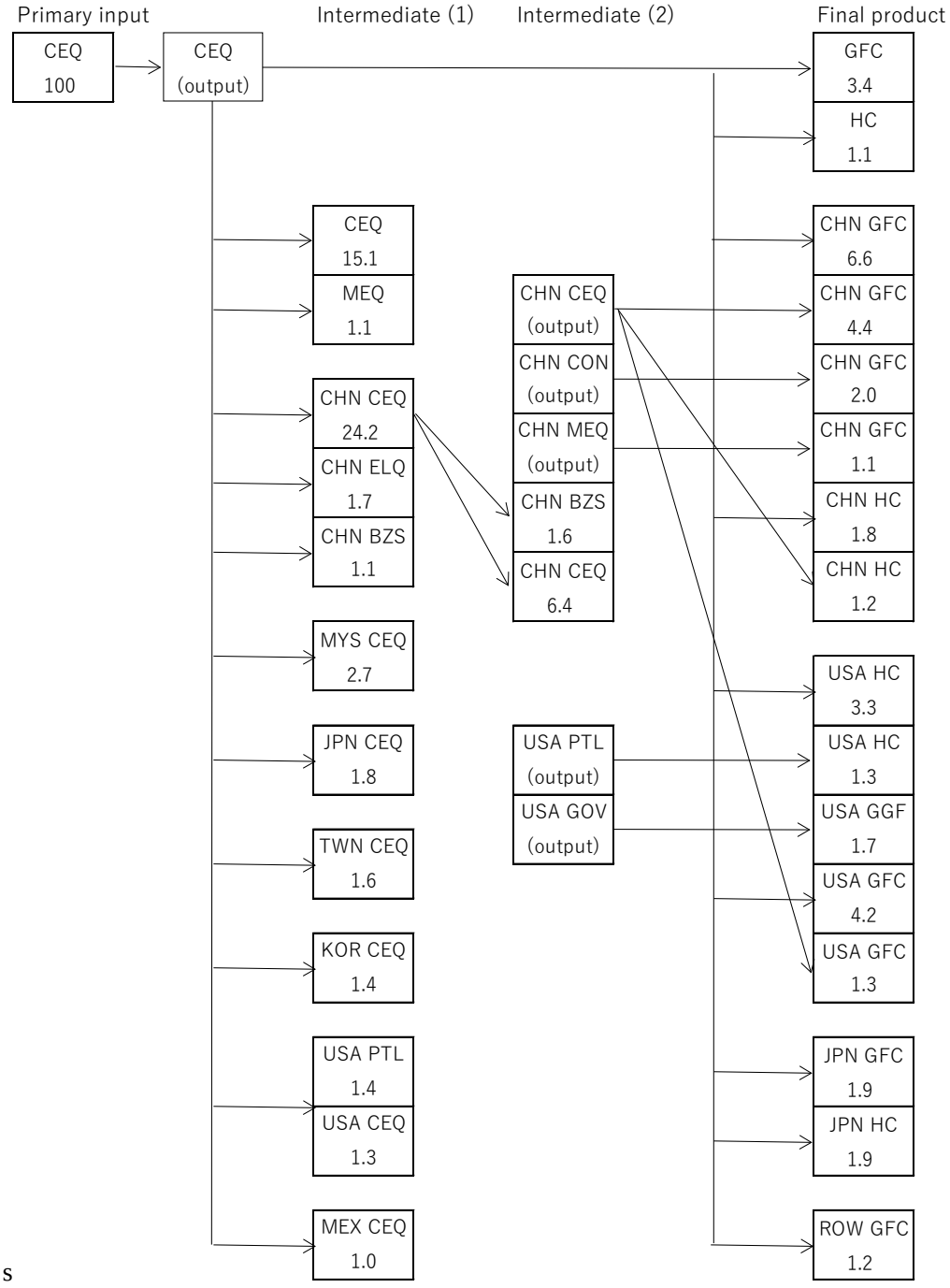
1. The arrow indicates the direction of forward linkage effects (Figure 11.b-14.b).
2. The symbol (output) indicates the sector that provides its outputs (i.e. intermediate goods or final goods) for the arrowed sector.

12.a. Flow of upstream transactions: CEQ sector in Thailand (2011)



Source: Calculated from the OECD ICIO table (2011)

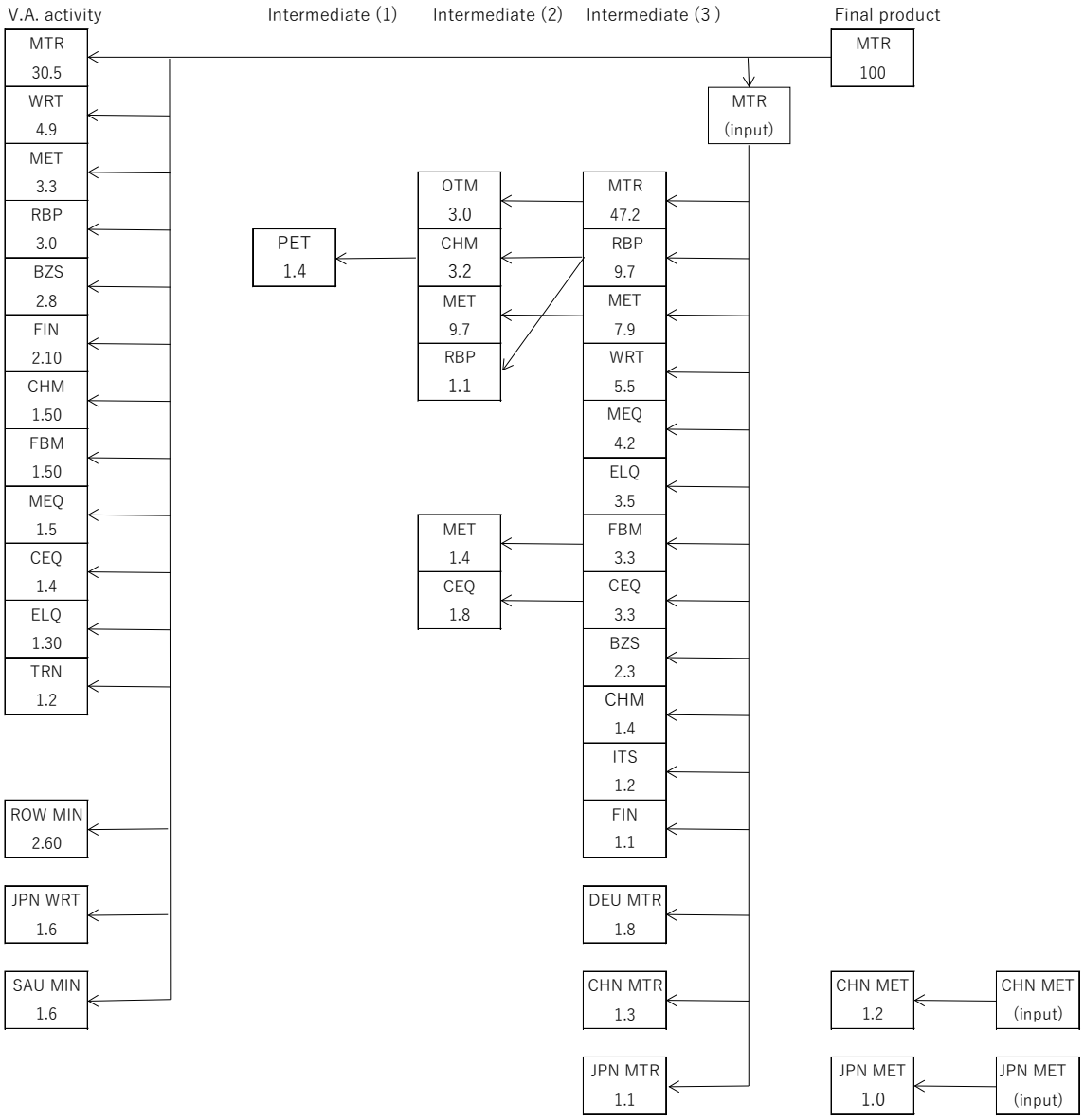
12.b. Flow of downstream transactions: CEQ sector in Thailand (2011)



s

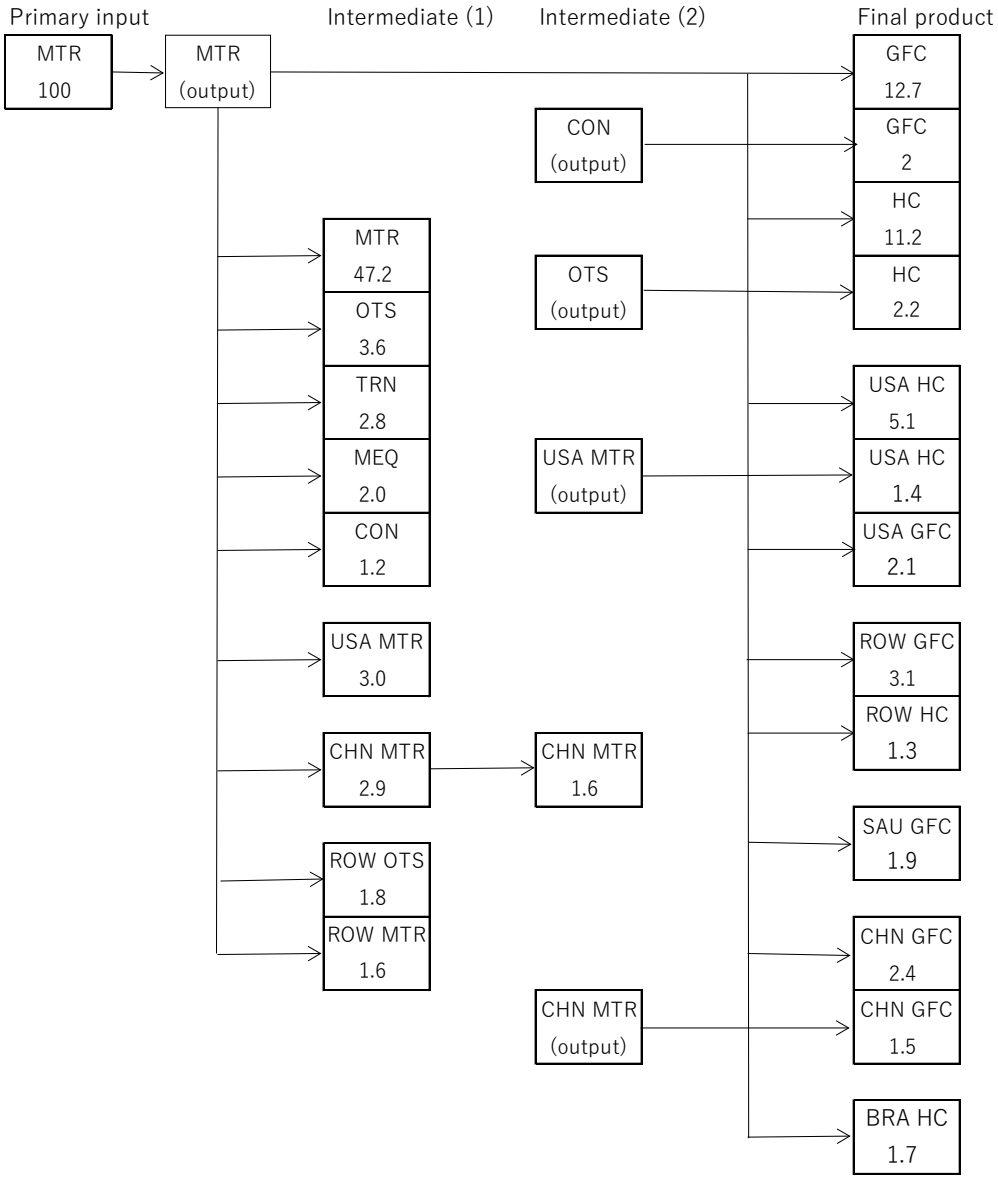
Source: Calculated from the OECD ICIO table (2011)

13.a. Flow of upstream transactions: MTR sector in Korea (2011)



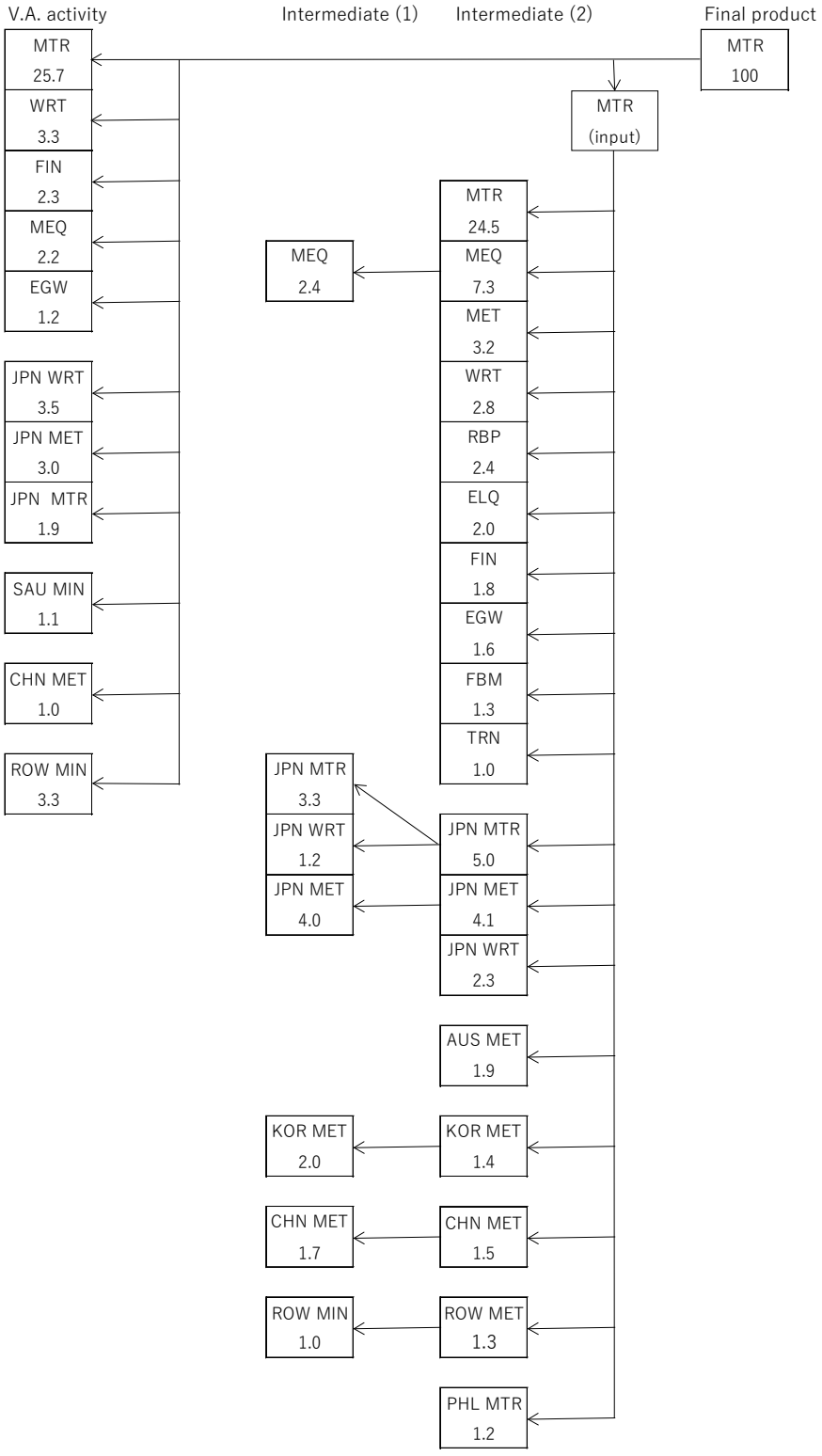
Source: Calculated from the OECD ICIO table (2011)

13.b. Flow of downstream transactions: MTR sector in Korea (2011)



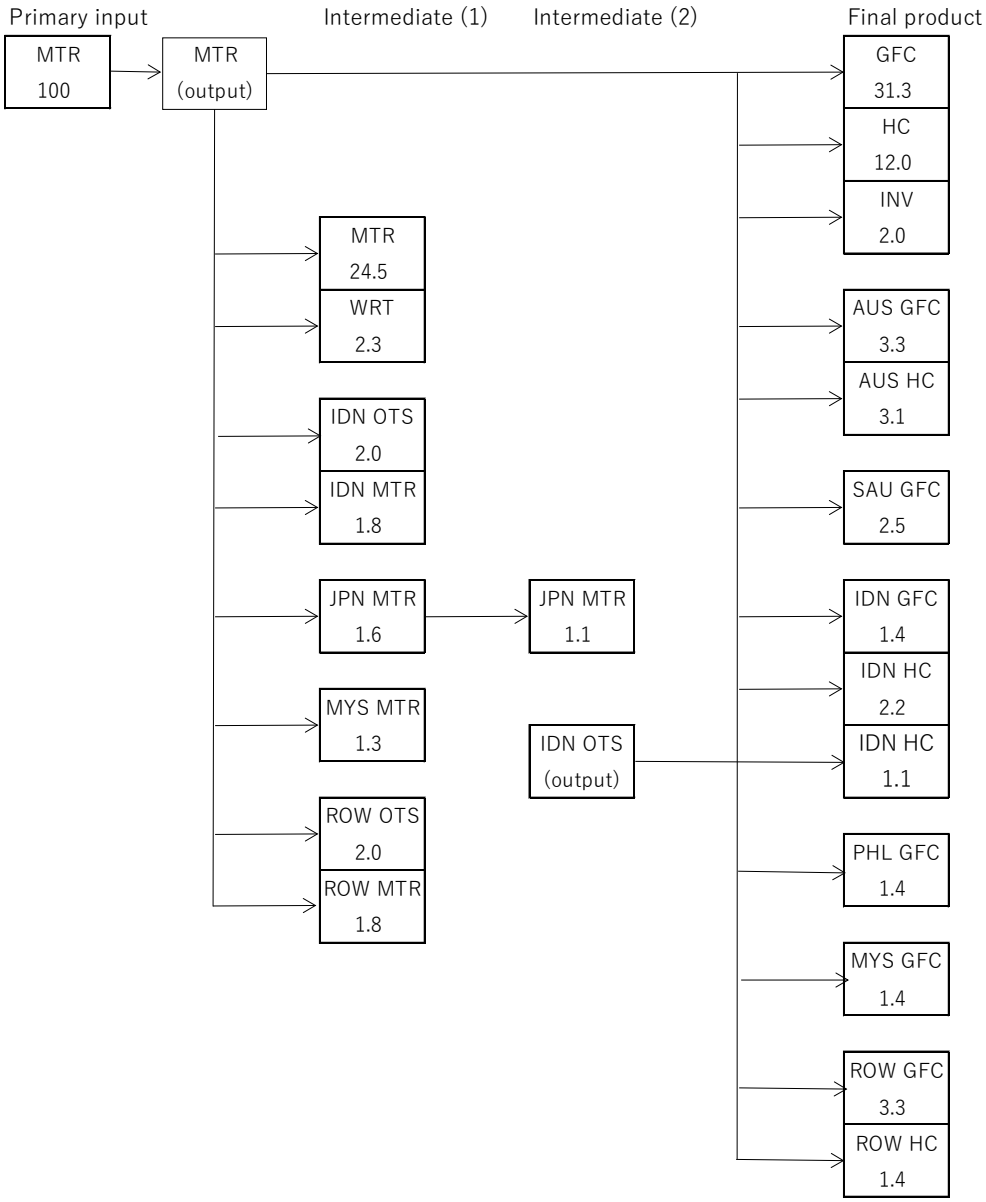
Source: Calculated from the OECD ICIO table (2011)

14.a. Flow of upstream transactions: MTR sector in Thailand (2011)



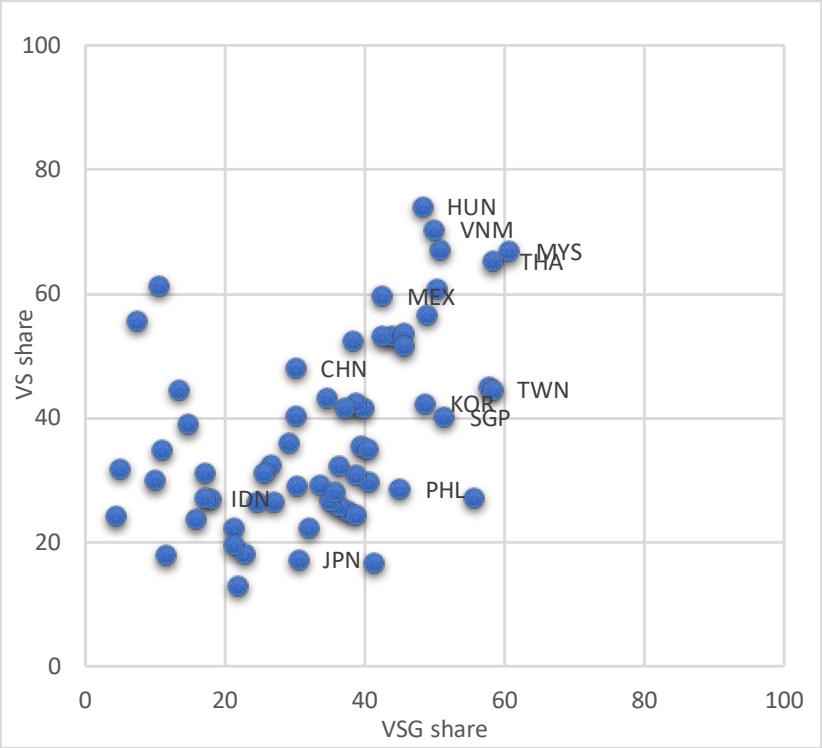
Source: Calculated from the OECD ICIO table (2011)

14.b. Flow of downstream transactions: MTR sector in Thailand (2011)



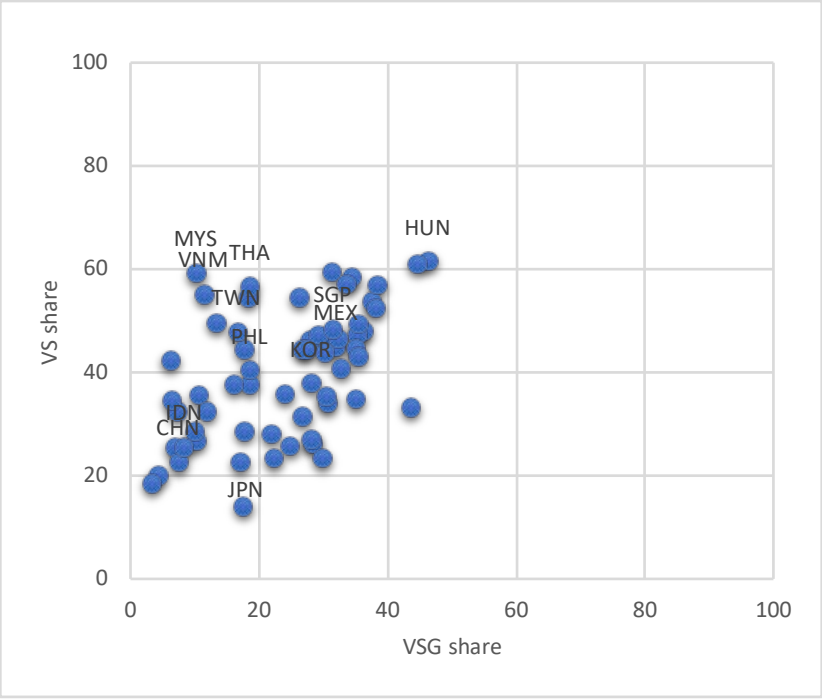
Source: Calculated from the OECD ICIO table (2011)

Figure A1. VS and VSG shares: CEQ sector (2011)



Source: Calculated from the OECD ICIO table (2011)

Figure A2. VS and VSG shares: MTR sector (2011)



Source: Calculated from the OECD ICIO table (2011)