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Abstract

This paper explores the structure of the automobile value chains in Southeast Asia. Trade in value added analysis and its decomposition method are applied to the OECD Inter-Country Input-Output (ICIO) data. Also, the method of value chain mapping is introduced to illustrate upstream and downstream transactions of goods and services along the value chain. The result of this analysis suggests that there are several groups of industries or countries that are deeply involved in the automobile value chain in Southeast Asia. Among them, Southeast Asian countries have become important suppliers of parts and components, although they are still highly dependent on Japan and other Northeast Asian countries especially for procurement of basic metal. Value chain mapping shows that motor vehicles have the highest induced value added in all the Southeast Asian countries, although the Philippine and Vietnam have relatively low intra-industry transactions in motor vehicles. A significant portion of automobile outputs are distributed to its own sector, as well as gross fixed capital formation and household consumption. It also shows that part of the motor vehicle outputs are exported to Japan and neighbouring Southeast Asian countries, as well as Australia and Saudi Arabia.

1. Introduction

Participation in global value chains (GVCs) has become increasingly important as a strategy for economic development. Unlike in the past, a current developing country 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.

However, participation in GVCs is not sufficient in itself. Structural transformation, in particular industrial deepening—the formation of backward linkages by creating a robust supplier base (ADB 2013)—is necessary for sustained economic growth, especially for industries with significant economies of scale, such as motor vehicles. Note that development of a local supplier base increases the competitiveness of assembly industry by delivering parts and components at lower cost, in a shorter time, and with more flexibility—which is considered an important element of the benefits of agglomeration. 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 delivery.

Due to the benefits of agglomeration including the above, many developing countries, including Southeast Asian countries, have tried to develop their automobile industry by adopting a protective policy, especially for local suppliers. However, many

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 measures that protect the local suppliers of intermediate inputs at the cost of production efficiency would not be recommended as an effective policy option (OECD 2013).[1] Moreover, such protective measures have become increasingly difficult to implement as a result of trade liberalisation efforts in recent years. In particular, the local content requirement (LCR), which was extensively used to protect local suppliers during the era of import substitution, has been prohibited by the WTO Agreement on Trade-Related Investment Measures (TRIMs).

Furthermore, declining trade and transportation costs have increased the benefits of specialisation and exchange, reaping significant gains from international trade. For instance, some types of automobile parts—such as a wire harness—are labour intensive, so that it would be more efficient to procure these parts from less developed countries and promote intra-industry trade of intermediate inputs. Moreover, manufacturing of

[1] It is demonstrated that an industry with a high share of imported inputs displays, on average, higher productivity in the OECD countries, because foreign inputs embody more productive technology, and resources are re-allocated more efficiently. In particular, increased productivity results from: (1) A price effect: increased intermediate imports result in stronger competition and therefore lower prices for inputs. (2) A supply effect: increased imports enhance the variety of inputs available. (3) A productivity effect: new intermediate inputs may spur innovation in the final goods sector by enhancing access to knowledge (OECD 2013).

key parts and components—such as engine and transmission parts—involves a large fixed cost and requires a well-established local supplier base; therefore, it would be more efficient to concentrate production in a single country rather than set up factories in many countries. In fact, the ASEAN countries have implemented various policy measures, such as the Brand to Brand Complementation (BBC) Scheme, the ASEAN Industrial Cooperation (AICO) Scheme, and the ASEAN Free Trade Agreement (AFTA), to promote the intra-regional trade in automotive parts and components within the region.

In summary, there are two forces working in opposite directions. One, is the benefit of agglomeration, which encourages local supplier development and increases domestic transactions. The other, is the benefit of specialisation and exchange, which promotes trade of intermediate inputs and increases international transactions. It is therefore a matter of empirical evidence how the inputs are procured from domestic or international markets and which type of transactions—domestic or international—are increased as a result of the procurement of inputs.

The objective of this paper is to demonstrate the structure of automobile value chains in five Southeast Asian countries, Thailand, Indonesia, Malaysia, the Philippines, and Vietnam, using the OECD inter-country input-output (ICIO) data for

2011.[2] Since the international input-output data covers both domestic and international intermediate transactions, it demonstrates how inter-industry linkages have been established in the automobile value chain: in particular it reveals the types of inputs that are procured from the domestic market; those imported from abroad, and the source countries.

As part of the value chain analysis, 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 trade data (see Hummels, Ishii, and Yi, 2001; Daudin, Rifflart, and Schweisguth, 2011; Johnson and Noguera, 2012; Koopman, Wang, and Wei, 2014). Furthermore, this paper introduces the method of decomposition of the VS measures, so that the share of foreign content embodied in specific products can be estimated by sector and by country of origin. A similar method of decomposition is applied to domestic content.

Second, the paper introduces a method of value chain mapping with the inter-country input-output tables, first adopted in Kuroiwa (2016). The value chain mapping with international input-output data shows the overall value chain of a specific

[2] The OECD ICIO tables cover 62 countries or regions with 34 sector classifications. They include Thailand, Indonesia, Malaysia, the Philippines, and Vietnam, and their major trade partners, such as China, Japan, Korea, the USA and the European countries, are also included as the endogenous countries in the tables.

product or service and demonstrates how domestic and imported inputs are used to produce final outputs (i.e. upstream transactions). Simultaneously, induced value added is calculated for both the domestic and foreign industries. Furthermore, the technique of value chain mapping is applied to the downstream transactions by adopting a similar method to the ICIO tables. The downstream transactions cover both intermediate and final demand transactions. Thus, it demonstrates how outputs of the automobile industry are used by the respective industries or final demand components in the respective countries.

The result of analysis suggests that there are several groups of industries or countries that are deeply involved in the automobile value chain in Southeast Asia. Among them, Southeast Asian countries have become important suppliers of parts and components, although they are still highly dependent on Japan and other Northeast Asian countries especially for procurement of basic metal. Value chain mapping shows that motor vehicles have the highest induced value added in all the Southeast Asian countries, although the Philippine and Vietnam have relatively low intra-industry transactions in motor vehicles. A significant portion of automobile outputs are distributed to its own sector, as well as gross fixed capital formation and household consumption. It also shows that part of the motor vehicle outputs are exported to Japan

and neighbouring Southeast Asian countries, as well as Australia and Saudi Arabia.

The paper first discusses the structure of vertical specialisation in the automotive industry in five ASEAN countries using the method of trade in value added. Second, the method of value chain mapping is applied to the automobile industry. 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 implemented using the OECD inter-country input-output tables (the OECD ICIO tables) for 2011. First, the vertical specialisation (VS) share is calculated to illustrate the structure of the vertical trade in the automobile industry. Second, the value added content—as well as the VS share—is decomposed into its components by (i) Country of origin, (ii) Domestic content by industry of origin, and (iii) Foreign content by industry of origin.

2.1 The VS share

The vertical specialisation (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 the foreign countries. However, it should be noted that although the VS share by

definition indicates the foreign content of exports, the same numerical value applies to the foreign content of other final demand components, such as private consumption, government consumption, and investment. This is due to the assumption of an input-output model whereby the input structure is the same regardless of the final demand components (for details of the VS share and its decomposition method, see Appendix 1).

Therefore, the VS share indicates the true dependency (in value added terms) of exports or other final demand components on foreign inputs, and its value tends to increase as the production processes are increasingly fragmented across national borders. Figure 1, shows the VS share of the automotive industry in 16 countries or regions.[3] Japan had an extremely low VS share, reflecting its highly self-sufficient industrial structure. On the other hand, some Southeast Asian countries, such as Malaysia, Thailand, and Vietnam, have high VS shares. As discussed below, this reflects the fact that the automotive industry in Southeast Asia is heavily dependent on imported inputs, especially from Japan and the neighbouring Southeast Asian countries. Note that a similar structure can be seen in Canada and Mexico, which have a close relationship

[3] In this analysis, a group of countries—such as the EU member countries—are aggregated into one region, as shown in Figure 1.

with the USA through the North American Free Trade Agreement (NAFTA).[4]

-Figure 1-

On the other hand, Indonesia has a relatively low VS share, reflecting its relatively large population and market size: note that a larger country tends to have a higher self-sufficiency level. However, the Indonesian motor vehicle industry still needs to import key auto parts and components from Japan and its neighbouring Southeast Asian countries.

2.2 Decomposition of the value added components

(1) Decomposition of the value added components by country of origin

Table 1, shows the decomposition of the value added components by country of origin

[4] Note that similar phenomena can be observed in Europe. For instance, among the 62 countries or regions covered by the OECD ICIO tables, Hungary has the highest VS share (62%), followed by the Slovak Republic (61%). These countries are heavily dependent on inputs imported from Germany and other European countries: for instance, a unit of automotive final demand in Hungary induced 16.9 % of value added in Germany, 3.9 % in Italy, and 3.7% in the USA. In the case of the Slovak Republic, the shares were 12.6% in Germany, 9.8% in the Rest of the World, and 4.0% in the Czech Republic. On the other hand, in Mexico, such shares were 16.5% in the USA, 5.9% in China, and 3.7% in Japan, and in Canada 26.0% in the USA, 5.7% in Japan, and 5.0% in Mexico. The USA occupied the dominant position as a supplier of automotive parts and components in North America. As discussed below, Japan plays a similar role to Germany and the USA in Southeast Asia.

embodied in automotive exports or other final demand components in Southeast Asia: due to space limitation, only the 15 highest countries are listed in the table. First, it shows that the highest value added is generated in its own country: that is, domestic content has the highest share in all the countries. For example, the share of domestic content in Indonesia is 74.5 %, followed by the Philippines.[5] This is not surprising given the fact that many Southeast Asian countries have a long history of promoting the automobile and its ancillary industries. It is also natural that local procurement is prioritized by the automobile companies due to the benefit of spatial proximity and lower transport costs.

- Table 1 -

The share of Japanese content is the highest in all the countries except Vietnam: note that the share of Japanese content is high, especially in Thailand. China has the second highest foreign content in all the countries except Vietnam.

Other countries that have high foreign content are classified into four groups. The first group is the Southeast Asian countries, in particular Thailand and Indonesia:

[5] It holds that the VS share (as shown in Figure 1) + the domestic content share = 1, where the VS share is the sum of the foreign content by country of origin.

Thailand, for example, has the third highest foreign content in Indonesia, while Indonesia has the sixth highest in Thailand. Other countries, such as Malaysia, Singapore, and the Philippines, also have a high foreign content share.

The second group comprises motor vehicle producing countries in the Asia-Pacific region, especially Korea and the USA. For example, Korea has the fourth highest foreign content in Vietnam, followed by the USA, Australia, and Taiwan.

The third group comprises major motor vehicle producing countries in Europe, particularly Germany, which demonstrate the fourth highest foreign content in Malaysia. Other European countries, such as Great Britain and France, also have a high foreign content in Malaysia.

The fourth group is the natural resource rich countries, such as Saudi Arabia and Russia: the Rest of the World (ROW) also appears frequently as a major supplier of natural resources. These countries provide natural resources or processed materials, such as mining, refined petroleum products, chemicals, and basic metals for the motor vehicle industry. Saudi Arabia and Russia, for instance, have the fourth and eight highest foreign contents in the Philippines.

(2) Decomposition of domestic content by industry of origin

Table 2, shows the decomposition of domestic content by industry of origin. Obviously the motor vehicle industry—which comprises parts and components as well as assembly activities—has the highest domestic content in all the countries. For instance, the domestic content of motor vehicles in Indonesia is 55.8 %, and that in the other countries exceeded 20%. It should also be noted that motor vehicles occupy a dominant share of the domestic content, as exemplified by the example of Indonesia, where motor vehicles comprises 75% of domestic content (compare the 1st row in Tables 1 and 2).

- Table 2 -

Service industries—such as wholesale and retail trade, transportation services, post and telecommunications, financial intermediation, real estates, business services, electricity, gas, and water—have a high domestic content. For instance, the second in terms of domestic content was wholesale and retail trade in all the countries except Vietnam: financial intermediation also has a high domestic content, particularly in Thailand and Indonesia.

(i) Agriculture (rubber trees, wood trees, animal hides, and natural fibres) and (ii) mining (iron ore, coal, aluminium, copper, and crude petroleum) have a high

domestic content: for example, mining that have the fourth highest domestic content in Indonesia. Although these natural resource-based industries are not directly used by the automobile industry, their value added is contained and induced indirectly through the material industries that process the products of the natural resource-based industries.

Material industries, which comprise (i) Basic metals, fabricated metal products, (ii) Refined petroleum products, chemical products, rubber and plastic products, (iii) Non-metallic mineral products, and (iv) Textiles, have a high domestic content. In particular, iron and steel are the most important materials for manufacturing motor vehicles, so that fabricated metal products and basic metals have a high domestic content, as seen in Vietnam, where they have the second and seventh highest domestic content respectively. Also, rubber and plastic products are important materials, as shown by the rubber and plastic products, refined petroleum products, and chemical product in the Philippines.

The last group is the machinery industry, comprising electrical machinery, computers, electronics, and optical equipment; machinery and equipment; and other transport equipment: computers, electronics, and optical equipment, for example, have the fourth highest domestic content in the Philippines, while machinery and equipment have the fourth highest domestic content in Thailand.

(3) Decomposition of foreign content by industry of origin

As discussed above, a higher domestic content creates a significant benefit of agglomeration. On the other hand, the benefit of specialisation and exchange could be obtained by procurement from countries where the products are produced at a lower cost or at a higher level of efficiency due to factor endowments or economy of scale in production.

Table 3, shows that unlike domestic content, motor vehicles do not have the highest foreign content share, but wholesale and retail trade do have the highest foreign content share, as shown in Malaysia and Thailand. Note that other service activities—such as transportation, financial intermediation, business services—also have a high foreign content. Motor vehicles, on the other hand, have the second highest foreign content in Indonesia and a relatively high content in other countries.

The share of service imports is high, because many services inputs are used and embodied in traded goods and indirectly traded in international transactions. The other factor is that some service activities—such as wholesale and retail trade, transport, and storage－are combined by international trade and thus directly traded.

- Table 3 -

Mining and material products—especially basic metals, fabricated metal products, refined petroleum products, chemical products, rubber and plastic products—comprise an important portion of foreign content.[6] Mining products need to be imported (or imported indirectly through the import of materials), if a country is not endowed with natural resources or cannot produce them at low cost. In fact, the Southeast Asian countries have a high foreign content in mining: for example, mining has the highest foreign content in the Philippines; the second highest in Thailand, Vietnam and Malaysia; and the third highest in Indonesia.

Also, basic metals have a high foreign content, as shown by the third highest foreign content in Thailand, Vietnam and the Philippines; and the fourth highest in Indonesia and Malaysia. In fact, Southeast Asian countries lack the capacity to produce high-quality iron and steel—which is essential for motor vehicle manufacturing. Thus, they are highly dependent on the iron and steel imported from Japan and the other Northeast Asian countries.

[6] Note that the mining industry has a higher value added ratio (i.e. the ratio of value added to gross output) than other industries, so that even if imports of mining products are relatively low, it could achieve a higher share of foreign content.

In addition to motor vehicles, other machinery industry—such as electrical machinery, computers, electronics, optical equipment, machinery, and equipment—also indicate a high foreign content. For instance, computers, electronics, and optical equipment have the third highest foreign content in Malaysia and the fifth highest in the Philippines. Note that these machinery products—in tandem with automobile parts and components—comprise essential inputs and thus need to be imported to produce automobiles in Southeast Asia.

Finally, it is important to note that, although the foreign content in motor vehicles is not particularly high, each Southeast Asian country is highly dependent on specific countries for procurement of parts and components. Such a structure in the value chains reflects the comparative advantages of the respective countries, as well as the historical path of regional integration in Southeast Asia.[7] Furthermore, the motor vehicle industry in Southeast Asia is still highly dependent on the parts and components imported from Japan, reflecting the higher share of Japanese automobile companies in Southeast Asia, although there was a significant shift in the source countries especially from Japan to the ASEAN countries (Kuroiwa 2017).

[7] It is well-known that the respective Southeast Asian countries specialise in the production of specific automobile parts or components, such as diesel engines in Thailand, gasoline engines in Indonesia, and transmissions in the Philippines. Furthermore, intra-regional trade in these products has been promoted through regional trade agreements in ASEAN, such as the BBC, AICO, and AFTA.

To investigate the structure of the automobile value chain in more detail, we explore in the next section the result of the value chain mapping of the automobile industry. Note that the analyses in this section—which decompose domestic and foreign content by country of origin and by industry of origin—are all integrated into the value chain mapping analysis, which focuses on the overall value chain of a specific country.

3. Value chain mapping of the automotive industry in Southeast Asia

Figures 2.a-6.a show the upstream value chains in the motor vehicle industry in the five ASEAN countries for 2011. The upstream value chain demonstrates the flow of intermediate transactions, as well as value added, induced by a unit of final demand — which is normalised to 100 units in this study. In these figures intermediate (1) represents the intermediate transactions that are induced directly by the induced output of motor vehicles. Similarly, intermediate (2) represents transactions that are induced directly by the induced output of intermediate (1). Moreover, due to space limitation, only intermediate transactions and value added whose values exceed one percent of the initial final demand are recorded in the figures.

On the other hand, Figures 2.b-6.b show the downstream value chains in the motor vehicle industry. The downstream value chains demonstrate the flow of the intermediate transactions, as well as the final demand, induced by 100 units of value added (for the analysis method, see Appendix 3).

a. Thailand

Figure 2.a shows that when 100 units of final demand are given to the Thai motor vehicle industry, 24.5 units of motor vehicles are provided (as intermediate inputs) in its own sector, and this is followed by machinery, equipment and basic metals. Similarly, a large proportion of the induced intermediate transactions occurred not only in the manufacturing sectors but also in a range of the service sectors, including wholesale and retail trade, financial intermediation, electricity, gas, and water supply, and transportation.

Regarding international transactions, Japan is the most important supplier of motor vehicle inputs (i.e. parts and components) and basic metal, whereas Australia, China, Korea, and the Rest of the World are the major suppliers of basic metals, and the Philippines is an important supplier of motor vehicle inputs to Thailand.

The upper left column in Figure 2.a shows that 25.7 units of value added are

generated in the motor vehicle industry. It is worth noting that all the five industries in the upper left column of Figure 2.a are listed in the upper middle column. A similar phenomenon is observed in other countries. This implies that those industries whose intermediate transactions are stimulated more strongly tend to have higher induced value added.

- Figures 2.a and 2.b -

Higher value added is induced in wholesale and retail trade, basic metals, and motor vehicles in Japan. Mining in Saudi Arabia and the Rest of the World is also induced strongly. Service and mining tend to have a relatively high induced value added vis-à-vis induced intermediate transactions owing to their higher value added ratio (i.e. ratio of value added to output).

Figure 2.b shows the downstream value chain in the Thai automotive industry. This figure shows how many units of the intermediate transactions and final demand components would be stimulated in the international and domestic markets, when 100 units of the primary inputs for motor vehicles are generated.

Regarding intermediate transactions, 24.5 units of motor vehicles are provided in its own industry. Motor vehicles are also provided for the motor vehicle industry in

Indonesia, Japan, Malaysia, and the ROW. Interestingly, motor vehicles in Thailand stimulate community, social, and personal services in Indonesia, which finally induce household consumption in the latter country.

For the final transactions, 31.3 units of gross fixed capital formation (GFC) and 12.0 units of household consumption (HC) are stimulated in Thailand. Simultaneously, GFC is stimulated significantly in Australia, Saudi Arabia, the Philippines, Malaysia and the ROW. Since many motor vehicles produced in Thailand are commercial vehicles—especially pickup trucks—they are used for fixed capital formation in export markets.

b. Indonesia

Figure 3.1 shows that motor vehicles are the largest supplier of inputs for its own industry, and this was followed by wholesale and retail trade and financial intermediation. Material industries, such as rubber and plastic products and fabricated metal products also demonstrated a similar trend. Motor vehicles in Thailand and Japan are major suppliers of inputs for the Indonesian motor vehicle industry. Moreover, Japan is an important supplier of basic metals to Indonesia.

As a reflection of higher intermediate transactions, 55.8 units of value added

are induced in the Indonesian motor vehicle industry: note that this share is extremely high compared with other Southeast Asian countries. Simultaneously, 1.2 units and 1.1 units of value added are generated respectively in motor vehicles in Japan and Thailand.

- Figures 3.a and 3.b -

Figure 3.b shows that motor vehicles stimulate 26.9 units of intermediate transactions in other community, social and personal services, which then induced a variety of service activities, such as transportation, public administration, and wholesale and retail trade: moreover, these service activities are finally embodied in household consumption and the government's general final consumption. A significant amount of motor vehicle inputs is provided to the motor vehicle industry in Indonesia, as well as in Thailand and Japan.

Unlike Thailand, motor vehicles in Indonesia stimulate more household consumption than gross fixed capital. In addition, they induce more than one unit of fixed capital formation in Saudi Arabia, Thailand, and the Philippines.

c. Malaysia

Table 4.a shows that motor vehicles are the largest supplier of intermediate inputs in Malaysia, followed by fabricated metals and wholesale and retail trade. Also, the machinery industry, such as electrical machinery, other transport equipment, computers, electronics, and optical equipment, are import suppliers of inputs.

Japan is an important supplier of motor vehicle inputs, followed by Thailand and Germany. Computers, electronics, and optical equipment are provided by China, the USA, and Singapore.

25.6 units of Malaysian value added are induced in motor vehicles, followed by wholesale and retail trade and fabricated metal products. Also 1.0 unit of value added is stimulated in agriculture. Japanese value added is stimulated in the wholesale and retail trade, motor vehicles, and basic metals, followed by wholesale and retail trade in China and computers, electronics, and optical equipment in the USA.

- Figures 4.a and 4.b -

Figure 4.b shows that 45.4 units of motor vehicles are used as inputs in its own sector. It is interesting to note that food products are induced by wholesale and retail trade and agriculture, and the food products affect household consumption. Gross fixed

capital formation was induced more strongly than household consumption. No significant foreign final demand was induced by the Malaysian motor vehicle industry.

d. Philippines

Figure 5.a shows that motor vehicles in the Philippines, Thailand, and Japan are major suppliers of inputs for the Philippines motor vehicle industry. It should be noted that the value in the Philippines is much lower than that of Thailand, Indonesia, and Malaysia[8]. This reflects the weak supplier base of the Philippines motor vehicle industry. On the other hand, basic metals are the largest supplier of inputs, supplemented by imports from Japan, China, and Korea.

As in other countries, the value added in motor vehicles is induced most strongly by motor vehicles' final demand. The material and natural resource-based industries are also affected significantly—in particular basic metals, rubber and plastic products, and refined petroleum products in the Philippines, mining in Saudi Arabia and the Rest of the World.

[8] Unlike Thailand, Indonesia, and Malaysia, induced value added in motor vehicles in the Philippines (23.5 units) is much greater than the induced intermediate transactions of motor vehicles (6.0 units). This occurs because the initial final demand for motor vehicles induces only value added in the same sector, and it significantly increases value added in the motor vehicle sector, even if repercussion effects through intermediate demand are very small. Note that a similar phenomenon is observed in the Vietnamese motor vehicle industry.

- Figures 5.a and 5.b -

Figure 5.b shows that motor vehicles in the Philippines provide inputs to its own industry in Thailand and Japan, which then induce final demand in the latter countries. This suggests that the Philippines is integrated into the automobile supply chain in eastern Asia as a supplier of parts and components. On the other hand, only 6.0 units of input are provided to its own industry, reflecting the weak supplier network within the country.

Gross fixed capital and household consumption are induced significantly in the Philippines. In addition, it induces gross fixed capital and household consumption in other east Asian countries, such as Thailand, Japan, and Indonesia.

e. Vietnam

Figure 6.a shows that the material industry—such as fabricated metal products, basic metals, non-metallic mineral products, rubber and plastic products, and chemical products—are stimulated strongly by automobiles' final demand. Moreover, basic metals are imported from Korea, China, Japan, and Taiwan. In cotrast, similar as in the

Philippines, only 4.1 units of motor vehicle input are provided for own sector, suggesting the weak supplier base in Vietnam.

Significant amount of value added is induced not only in the motor vehicle industry but also in the mining and material industries, such as fabricated metals, mining, non-metallic mineral products, and metal products. Value added is also induced in the metal products in Japan, China, and Korea, as well as mining in Saudi Arabia and the Rest of the World.

- Figures 6.a and 6.b -

Figure 6.b shows that the impact of motor vehicle production in Vietnam is concentrated in gross fixed capital and household consumption. In addition, more than one unit of household consumption or gross fixed capital is induced in Japan and the United States. Motor vehicle inputs are provided in Vietnam and Japan, but the value in Vietnam is extremely low compared with the other Southeast Asian countries, including Thailand, Indonesia, and Malaysia.

4. Conclusion

Participation in global value chains (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 motor vehicles. This paper explores the structure of the automobile value chain in Southeast Asia. Trade in value added analysis is applied to the OECD Inter-Country Input-Output (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.

The result of the analysis suggests that there are several group of countries that have a higher foreign content in the automobile value chain in Southeast Asia, namely the largest supplier countries of inputs, such as Japan and China; neighbouring Southeast Asian countries, particularly Thailand and Indonesia; major motor vehicle producing countries in the Asia-Pacific region, such as Korea and the USA; major motor vehicle producing countries in Europe, particularly Germany; and natural resource rich countries, such as Saudi Arabia and Russia.

Decomposition of the domestic content shows that motor vehicles have the highest domestic content in all the countries. Other industries which have a high

domestic content are the service industries, particularly wholesale and retail trade and financial intermediation; agriculture and mining; the materials industry, such as basic metals, chemical products, non-metallic mineral products, and textiles; and the machinery industry, such as electrical and electronic machinery, general machinery, and other transport equipment.

Unlike the domestic content, motor vehicles do not have the highest foreign content, but the wholesale and retail trade has the highest foreign content in several countries. Mining and materials as well as the machinery industry also have a high foreign content. In particular, basic metals have a high foreign content because the Southeast Asian countries do not produce high-quality iron and steel and depend on Japan and the other Northeast Asian countries for procurement of these materials.

Although the foreign content in motor vehicles is not particularly high, each Southeast Asian country is highly dependent on a specific country for procurement of parts and components. Such a structure in the value chains reflects the comparative advantage of the respective countries, as well as the historical path of regional integration in Southeast Asia. Furthermore, the motor vehicle industry in Southeast Asia is still highly dependent on parts and components imported from Japan, reflecting the higher share of Japanese automobile companies in Southeast Asia.

Regarding upstream transactions in the value chain mapping, motor vehicles have the highest induced value added in all the Southeast Asian countries. Those industries whose intermediate transactions are stimulated most strongly also tend to have a higher induced value added, although the Philippines and Vietnam have relatively low intra-industry transactions in motor vehicles. This structure in the Philippines and Vietnam reflects the weak supplier base of the motor vehicle industry.

Regarding downstream transactions, a significant portion of automobile outputs are distributed to its own sector (as intermediate inputs), as well as gross fixed capital formation and household consumption. In countries like Thailand, where many motor vehicles are used for commercial purposes, gross fixed capital formation is greater than household consumption. It also shows that part of the motor vehicle outputs are exported to Japan and neighbouring Southeast Asian countries, as well as Australia and Saudi Arabia.

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Appendix 1: Calculation of the VS share index

The VS share represents the percentage share of foreign content embodied in exports, i.e. the share of value added induced by exports accruing to foreign countries. The methodology was originally developed by Hummels, Ishi, and Yi (2001), and it was introduced into the analysis of "Trade in value added" by Koopmans, Wang, and Wei (2014).

Using the notation in Appendix 2, the VS share is calculated as $VS_j^s = 100 \text{ X } \sum_{r \neq s}^{m} \sum_{i=1}^{n} \mathbf{V}(\mathbf{c})_i^r \mathbf{L}_{ij}^{rs}$, where VS_j^s represents the share of foreign content contained in the exports of sector j in country s. Here the VS share is expressed in percentage terms, so that it can take a range of 0 to 100.

Moreover, VS_j^s is decomposed as follows:

(1) Share of foreign content by country of origin:

$$VS_j^{rs} = 100 \text{ X} \sum_{i=1}^{n} \mathbf{V}(\mathbf{c})_i^r \mathbf{L}_{ij}^{rs}$$

where VS_j^{rs} represents the share of foreign content of country r contained in the exports of sector j in country s.

(2) Share of foreign content by sector of origin:

$$VS_{ij}^{s} = 100 \text{ X} \sum_{r \neq s}^{m} \mathbf{V}(\mathbf{c})_i^r \mathbf{L}_{ij}^{rs}$$

where VS_{ij}^{s} represents the share of foreign content of sector *i* contained in the exports of sector *j* in country *s*.

(3) The share of domestic content by sector of origin:

$$DC_{ij}^{s} = 100 \text{ X } \text{V(c)}_{i}^{S} \; L_{ij}^{SS}$$

where DC_{ij}^{s} represents the share of domestic content of sector *i* contained in the exports of sector *j* in country *s*.

Appendix 2: Sector classification of the OECD ICIO tables

- Table A1 -

Appendix 3: Method for mapping the value chains

(1) Upstream transactions

This section introduces the method for the structural analysis, which was originally developed by Ozaki (1980) for a single country input-output model. Here, it is extended to a multi-country model, so that cross-border transactions of goods and services can be traced inside the model. Moreover, induced value added is calculated to trace the sequence of value adding activities.[9]

Using an input coefficient matrix, the accounting identity on the output side (i.e. the equality between total output and intermediate input plus final demand) can be expressed as

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

where

$$\mathbf{x} = \begin{bmatrix} \mathbf{x}^1 \\ \vdots \\ \mathbf{x}^r \\ \vdots \\ \mathbf{x}^m \end{bmatrix}$$

is the vector of total output ($\mathbf{x}^r$ is country r's n x 1 vector of output: m and n respectively represent the number of countries and sectors).

$$\mathbf{A} = \begin{bmatrix} \mathbf{A}^{11} & \cdots & \mathbf{A}^{1s} & \cdots & \mathbf{A}^{1m} \\ \vdots & & \vdots & & \vdots \\ \mathbf{A}^{r1} & \cdots & \mathbf{A}^{rs} & \cdots & \mathbf{A}^{rm} \\ \vdots & & \vdots & & \vdots \\ \mathbf{A}^{m1} & \cdots & \mathbf{A}^{ms} & \cdots & \mathbf{A}^{mm} \end{bmatrix}$$

is the multi-country input coefficient matrix ($\mathbf{A}^{rs}$ is an $n \times n$ sub-matrix that indicates the ratio of intermediate inputs provided by the industries in country r to

[9] For the technical details of the method, see Kuroiwa 2016.

the industries in country *s* relative to the industrial outputs in country *s*).

$$\mathbf{f} = \begin{bmatrix} \mathbf{f}^1 \\ \vdots \\ \mathbf{f}^r \\ \vdots \\ \mathbf{f}^m \end{bmatrix}$$

is the vector of final demand ($\mathbf{f}^r$ is country r's *n x 1* vector of final demand).

Solving the equation (A1) for X yields

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

where

$$\mathbf{I} = \begin{bmatrix} \mathbf{I} & \cdots & \mathbf{O} & \cdots & \mathbf{O} \\ \vdots & \ddots & \vdots & & \vdots \\ \mathbf{O} & \cdots & \mathbf{I} & \cdots & \mathbf{O} \\ \vdots & & \vdots & \ddots & \vdots \\ \mathbf{O} & \cdots & \mathbf{O} & \cdots & \mathbf{I} \end{bmatrix}$$

is the identity matrix (sub-matrix $\mathbf{I}$ is an $n \times n$ identity matrix and $\mathbf{O}$ represents an $n \times n$ matrix of zeros)

$$\mathbf{L} = \begin{bmatrix} \mathbf{L}^{11} & \cdots & \mathbf{L}^{1s} & \cdots & \mathbf{L}^{1m} \\ \vdots & & \vdots & & \vdots \\ \mathbf{L}^{r1} & \cdots & \mathbf{L}^{rs} & \cdots & \mathbf{L}^{rm} \\ \vdots & & \vdots & & \vdots \\ \mathbf{L}^{m1} & \cdots & \mathbf{L}^{ms} & \cdots & \mathbf{L}^{mm} \end{bmatrix}$$

is the multi-country Leontief Inverse matrix ($\mathbf{L}^{rs}$ is an $n \times n$ Leontief Inverse sub-matrix).

Then, differentiating each element in **x** in equation (2) with regard to each element in **f** yields

$$l_{ij}^{rs} = \frac{\Delta \mathbf{x}_i^r}{\Delta \mathbf{f}_j^s} \qquad (3)$$

That is to say, the *ij* element in the sub-matrix *rs* in the Leontief Inverse indicates the

output of sector *i* in country *r* that is induced directly or indirectly by one unit of final demand of sector *j* in country *s*. Thus, a column vector of, say, sector *j* in country *s* reveals the output of all the sectors (i.e. sector 1 through sector *n*) in all the countries (i.e. country 1 through country *m*) that is induced by one unit of final demand (for sector *j* in country *s*) as shown below:

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

$$= \left[\frac{\Delta \mathbf{X}_1^1}{\Delta \mathbf{f}_j^s}, \cdots \frac{\Delta \mathbf{X}_n^1}{\Delta \mathbf{f}_j^s}, \cdots \frac{\Delta \mathbf{X}_1^r}{\Delta \mathbf{f}_j^s}, \cdots \frac{\Delta \mathbf{X}_n^r}{\Delta \mathbf{f}_j^s}, \cdots \frac{\Delta \mathbf{X}_1^m}{\partial \Delta \mathbf{f}_j^s}, \cdots \frac{\Delta \mathbf{X}_n^m}{\Delta \mathbf{f}_j^s}\right]'. \qquad (4)$$

Then, the unit structure for the upstream value chain can be obtained by post-multiplying **A** by the diagonal matrix of column vector $\mathbf{l}_{\bar{j}}^{\bar{s}}$.

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

$$= \begin{bmatrix} \mathbf{A}^{11} & \cdots & \mathbf{A}^{1s} & \cdots & \mathbf{A}^{1m} \\ \vdots & & \vdots & & \vdots \\ \mathbf{A}^{r1} & \cdots & \mathbf{A}^{rs} & \cdots & \mathbf{A}^{rm} \\ \vdots & & \vdots & & \vdots \\ \mathbf{A}^{m1} & \cdots & \mathbf{A}^{ms} & \cdots & \mathbf{A}^{mm} \end{bmatrix} \begin{bmatrix} \hat{\mathbf{L}}_{\bar{j}}^{\bar{s}\ 1} & \cdots & 0 & \cdots & 0 \\ \vdots & \ddots & \vdots & & \vdots \\ 0 & \cdots & \hat{\mathbf{L}}_{\bar{j}}^{\bar{s}\ r} & \cdots & 0 \\ \vdots & & \vdots & \ddots & \vdots \\ 0 & \cdots & 0 & \cdots & \hat{\mathbf{L}}_{\bar{j}}^{\bar{s}\ m} \end{bmatrix}, \qquad (5)$$

where $\hat{\mathbf{L}}_{\bar{j}}^{\bar{s}}$ is the diagonal matrix of column vector $\mathbf{l}_{\bar{j}}^{\bar{s}}$.

Analogously, induced value added is calculated by post-multiplying the row vector of the value added coefficients by $\hat{\mathbf{L}}_{\bar{j}}^{\bar{s}}$.

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

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

where

$$\mathbf{v}(\mathbf{c}) = \begin{bmatrix} \mathbf{v}(\mathbf{c})^1 \\ \vdots \\ \mathbf{v}(\mathbf{c})^r \\ \vdots \\ \mathbf{v}(\mathbf{c})^m \end{bmatrix}$$

is a column vector of the value added coefficients ($\mathbf{v}(\mathbf{c})^r$ is country r's $n \times 1$ vector of the value added coefficients).

(2) Downstream transactions

Regarding downstream transactions, this paper proposes to use the Ghosh Inverse (Ghosh1958), as an alternative to the Leontief Inverse, and apply the analytical method analogous to the upstream transactions, as shown below.[10]

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

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

where

[10] Ozaki's method, which uses the Leontief Inverse for the structural analysis of input structure, cannot be used for the analysis of output structure. Therefore, it is necessary for us to use the Ghosh Inverse, which assumes a fixed output coefficient matrix.

$$\mathbf{B} = \begin{bmatrix} \mathbf{B}^{11} & \cdots & \mathbf{B}^{1s} & \cdots & \mathbf{B}^{1m} \\ \vdots & & \vdots & & \vdots \\ \mathbf{B}^{r1} & \cdots & \mathbf{B}^{rs} & \cdots & \mathbf{B}^{rm} \\ \vdots & & \vdots & & \vdots \\ \mathbf{B}^{m1} & \cdots & \mathbf{B}^{ms} & \cdots & \mathbf{B}^{mm} \end{bmatrix}$$

is the multi-country output coefficient matrix ($\mathbf{B}^{rs}$ is an $n \times n$ sub-matrix that indicates the ratio of intermediate outputs distributed from the industries in country r to the industries in country s relative to the industrial outputs in country *r*).

$$\mathbf{v} = \begin{bmatrix} \mathbf{v}^{1} \\ \vdots \\ \mathbf{v}^{r} \\ \vdots \\ \mathbf{v}^{m} \end{bmatrix}$$

is the vector of value added ($\mathbf{v}^{r}$ is country *r*'s *n x 1* vector of value added).

Solving the equation (7) for **x'** gives

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

where

$$\mathbf{G} = \begin{bmatrix} \mathbf{G}^{11} & \cdots & \mathbf{G}^{1s} & \cdots & \mathbf{G}^{1m} \\ \vdots & & \vdots & & \vdots \\ \mathbf{G}^{r1} & \cdots & \mathbf{G}^{rs} & \cdots & \mathbf{G}^{rm} \\ \vdots & & \vdots & & \vdots \\ \mathbf{G}^{m1} & \cdots & \mathbf{G}^{ms} & \cdots & \mathbf{G}^{mm} \end{bmatrix}$$

is the multi-country Ghosh Inverse matrix ($\mathbf{G}^{rs}$ is an $n \times n$ Ghosh Inverse sub-matrix).

Then, differentiating each element in **x** in the equation (8) with regard to each element in **v** yields

$$g_{ij}^{rs} = \frac{\Delta \mathbf{x}_j^s}{\Delta \mathbf{v}_i^r} . \qquad (9)$$

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 input in sector *i* in country *r*. Therefore, the row vector of sector *i* in country *r* reveals the output of all the sectors in all the countries induced by sector *i* in country *r*:

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

$$=\left[\frac{\Delta \mathbf{X}_1^1}{\Delta \mathbf{v}_i^r}, \ldots \frac{\Delta \mathbf{X}_n^1}{\Delta \mathbf{v}_i^r}, \ldots \frac{\Delta \mathbf{X}_1^s}{\Delta \mathbf{v}_i^r}, \ldots \frac{\Delta \mathbf{X}_n^s}{\Delta \mathbf{v}_i^r}, \ldots \frac{\Delta \mathbf{X}_1^m}{\Delta \mathbf{v}_i^r}, \ldots \frac{\Delta \mathbf{X}_n^m}{\Delta \mathbf{v}_i^r}\right] \quad (11)$$

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

$$\mathbf{D}_{\bar{\imath}}^{\bar{r}} = \widehat{\mathbf{G}}_{\bar{\imath}}^{\bar{r}} \mathbf{B}$$

$$= \begin{bmatrix} \widehat{\mathbf{G}}_{\bar{\imath}}^{\bar{r}\,1} & \cdots & 0 & \cdots & 0 \\ \vdots & \ddots & \vdots & & \vdots \\ 0 & \cdots & \widehat{\mathbf{G}}_{\bar{\imath}}^{\bar{r}\,s} & \cdots & 0 \\ \vdots & & \vdots & \ddots & \vdots \\ 0 & \cdots & 0 & \cdots & \widehat{\mathbf{G}}_{\bar{\imath}}^{\bar{r}\,m} \end{bmatrix} \begin{bmatrix} \mathbf{B}^{11} & \cdots & \mathbf{B}^{1s} & \cdots & \mathbf{B}^{1m} \\ \vdots & & \vdots & & \vdots \\ \mathbf{B}^{r1} & \cdots & \mathbf{B}^{rs} & \cdots & \mathbf{B}^{rm} \\ \vdots & & \vdots & & \vdots \\ \mathbf{B}^{m1} & \cdots & \mathbf{B}^{ms} & \cdots & \mathbf{B}^{mm} \end{bmatrix} \quad (12)$$

where $\widehat{\mathbf{G}}_{\bar{\imath}}^{\bar{r}}$ is the diagonal matrix of row vector $\mathbf{g}_{\bar{\imath}}^{\bar{r}}$.

Finally, the induced final demand is calculated as

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

$$= \begin{bmatrix} \widehat{\mathbf{G}}_{\bar{\imath}}^{\bar{r}\,1} & \cdots & 0 & \cdots & 0 \\ \vdots & \ddots & \vdots & & \vdots \\ 0 & \cdots & \widehat{\mathbf{G}}_{\bar{\imath}}^{\bar{r}\,s} & \cdots & 0 \\ \vdots & & \vdots & \ddots & \vdots \\ 0 & \cdots & 0 & \cdots & \widehat{\mathbf{G}}_{\bar{\imath}}^{\bar{r}\,m} \end{bmatrix} \begin{bmatrix} \mathbf{F}(\mathbf{c})^1 \\ \vdots \\ \mathbf{F}(\mathbf{c})^s \\ \vdots \\ \mathbf{F}(\mathbf{c})^m \end{bmatrix} \quad (13)$$

where

$$\mathbf{F}(\mathbf{c}) = \begin{bmatrix} \mathbf{F}(\mathbf{c})^1 \\ \vdots \\ \mathbf{F}(\mathbf{c})^s \\ \vdots \\ \mathbf{F}(\mathbf{c})^m \end{bmatrix}:$$

is the matrix of the final demand coefficient[11] ($\mathbf{F}(\mathbf{c})^r$ is country r's $n \times 6$ sub-matrix of the final demand coefficient).[12]

[11] A final demand coefficient is the ratio of final demand to total output.

[12] The reason why the final demand matrix for each country has 6 x m columns is that in the ICIO tables the distribution of goods and services for final consumption is divided into m destination countries and six final demand columns (i.e. household consumption, non-profit institutions serving households, general government final consumption, gross fixed capital formation, changes in inventories, and direct purchases abroad by residents) for each destination country.

Table A1. Sector classification of the OECD ICIO table

AGR	Agriculture, hunting, forestry and fishing	PUH	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
SFBM	Fabricated metal products	CT	Output at basic prices
MEQ	Machinery and equipment, nec		
CEO	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: the OECD ICIO table, 2011

Table 1 Decomposition of Value Added Components by Country of Origin (2011)

Thailand		Indonesia		Malaysia		Philippines		Vietnam	
THA	43.5	IDN	74.5	MYS	40.9	PHL	59.7	VNM	44.9
JPN	14.9	JPN	6.2	JPN	11.3	JPN	6.9	CHN	11.9
CHN	6.5	CHN	3.2	CHN	9.6	CHN	5.3	JPN	7.2
ROW	5.1	THA	2.5	USA	5.2	ROW	3.9	ROW	5.1
AUS	3.1	ROW	1.9	DEU	3.7	SAU	3.1	KOR	5.0
USA	2.9	USA	1.1	ROW	3.5	IDN	2.3	USA	2.4
IDN	2.3	KOR	1.1	THA	2.9	KOR	2.2	AUS	2.2
KOR	2.2	DEU	0.9	IDN	2.4	USA	2.2	TWN	2.2
DEU	1.9	AUS	0.9	SGP	2.3	RUS	1.8	THA	2.1
RUS	1.8	IND	0.7	KOR	2.3	THA	1.7	IDN	1.6
SAU	1.3	MYS	0.7	TWN	1.7	AUS	1.4	DEU	1.5
MYS	1.3	SGP	0.7	AUS	1.4	TWN	1.4	SAU	1.4
PHL	1.2	SAU	0.6	GBR	1.2	MYS	1.1	MYS	1.3
TWN	1.1	RUS	0.6	FRA	1.2	SGP	0.9	RUS	1.3
IND	1.0	TWN	0.4	IND	1.0	IND	0.7	IND	0.9

Source: Calculated from the OECD ICIO table, 2011

Table 2 Decomposition of Domestic Content by Industry of Origin (2011)

Thailand		Indonesia		Malaysia		Philippines		Vietnam	
MTR	25.7	MTR	55.8	MTR	25.6	MTR	23.5	MTR	27.4
WRT	3.3	WRT	3.6	WRT	3.4	WRT	8.6	FBM	3.7
FIN	2.3	FIN	2.5	FBM	1.3	MET	7.0	WRT	3.1
MEQ	2.2	MIN	1.5	FIN	1.1	CEQ	3.6	MIN	1.6
EGW	1.2	TRN	1.1	RBP	1.1	RBP	3.0	NMM	1.2
MET	0.9	ELQ	1.0	AGR	1.0	EGW	2.7	EGW	1.1
MIN	0.7	PTL	0.9	EGW	0.9	PET	1.8	MET	1.0
AGR	0.7	OTS	0.8	CHM	0.7	FIN	1.8	FIN	0.8
ELQ	0.7	BZS	0.7	MIN	0.6	CHM	1.0	REA	0.8
TRN	0.7	PET	0.7	TRN	0.5	TRN	0.9	RBP	0.8
OTS	0.6	CHM	0.6	ELQ	0.5	MIN	0.8	AGR	0.5
RBP	0.6	AGR	0.5	PET	0.5	REA	0.7	BZS	0.4
BZS	0.5	FBM	0.5	BZS	0.4	BZS	0.7	CHM	0.4
PTL	0.5	TEX	0.5	TRQ	0.4	AGR	0.6	ELQ	0.3
FBM	0.5	RBP	0.4	REA	0.4	FBM	0.4	CON	0.3

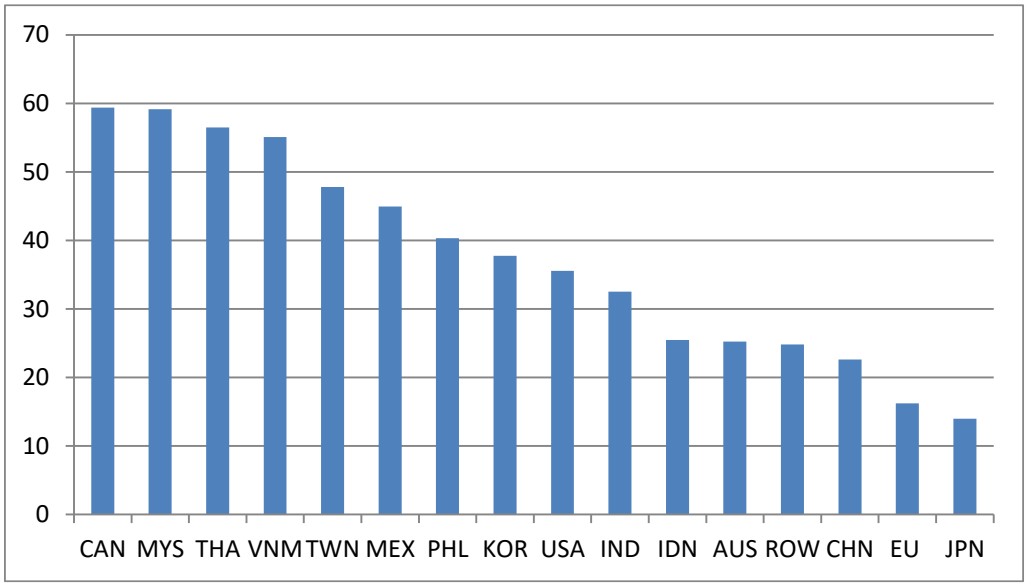
Source: Calculated from the OECD ICIO table, 2011

Table 3 Decomposition of Foreign Content by Industry of Origin (2011)

Thailand		Indonesia		Malaysia		Philippines		Vietnam	
WRT	10.3	WRT	4.6	WRT	10.8	MIN	9.4	WRT	8.9
MIN	8.4	MTR	3.4	MIN	5.6	WRT	6.4	MIN	8.8
MET	8.3	MIN	3.0	CEQ	4.4	MET	4.9	MET	8.1
TRN	3.7	MET	2.7	MET	4.3	TRN	2.1	TRN	3.2
MTR	3.6	TRN	1.4	MTR	3.9	CEQ	1.7	CHM	3.0
FIN	2.7	BZS	1.4	TRN	3.6	MTR	1.7	FBM	2.8
BZS	2.6	FIN	1.2	ELQ	3.4	BZS	1.6	BZS	2.4
MEQ	2.3	CHM	0.7	BZS	3.4	CHM	1.6	FIN	2.2
CHM	1.7	MEQ	0.6	MEQ	3.2	FIN	1.5	ELQ	1.5
EGW	1.3	ELQ	0.6	FIN	2.2	RBP	1.4	MEQ	1.5
FBM	1.3	EGW	0.6	CHM	1.8	PET	0.9	EGW	1.4
RBP	1.1	CEQ	0.5	FBM	1.3	EGW	0.8	MTR	1.2
ELQ	1.0	RBP	0.5	REA	1.2	ITS	0.7	PET	1.2
REA	1.0	FBM	0.5	EGW	1.1	AGR	0.7	RBP	1.1
PET	0.8	REA	0.5	RBP	1.0	REA	0.6	REA	1.0

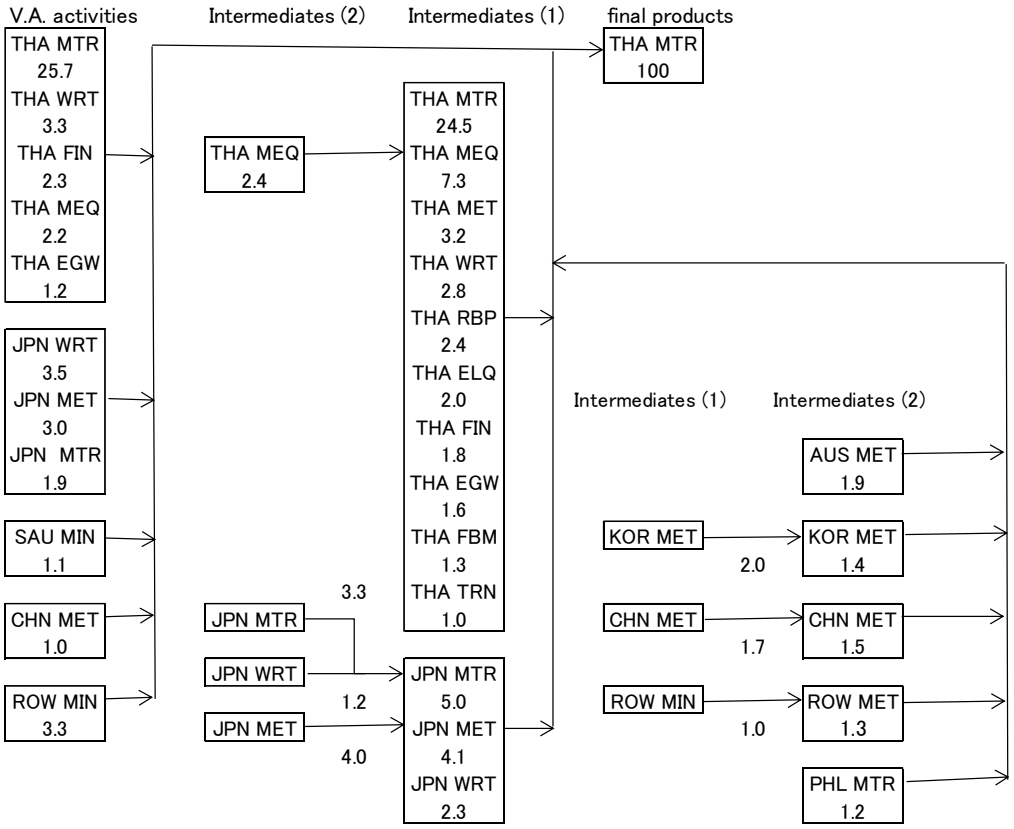
Source: Calculated from the OECD ICIO table, 2011

Figure 1 VS share by Country (2011)



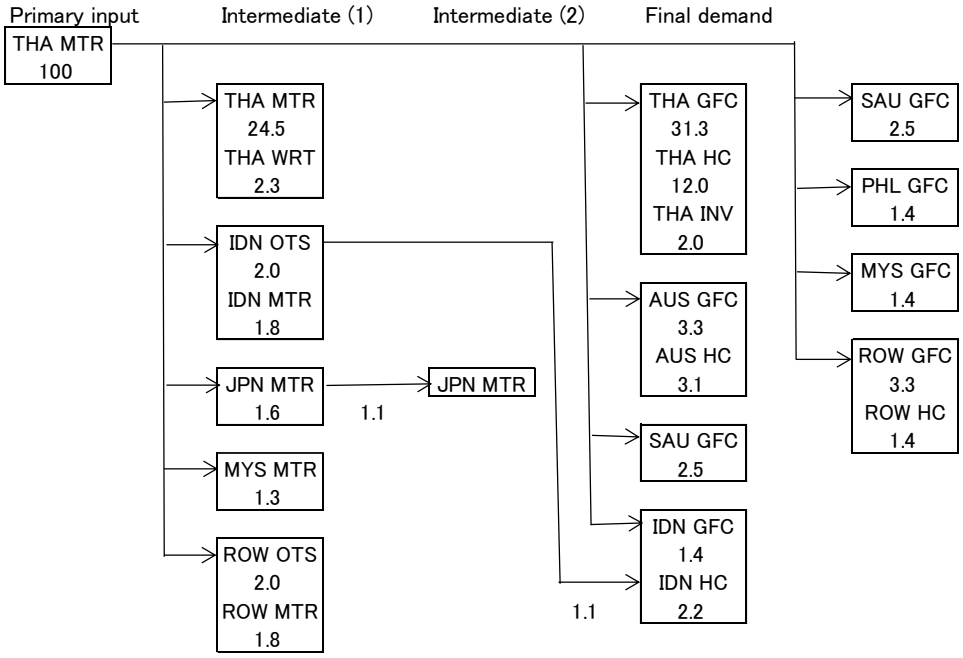
Source: Calculated from the OECD ICIO table, 2011

Figure 2.a Flow of downstream transactions: Motor vehicle sector in Thailand (2011)



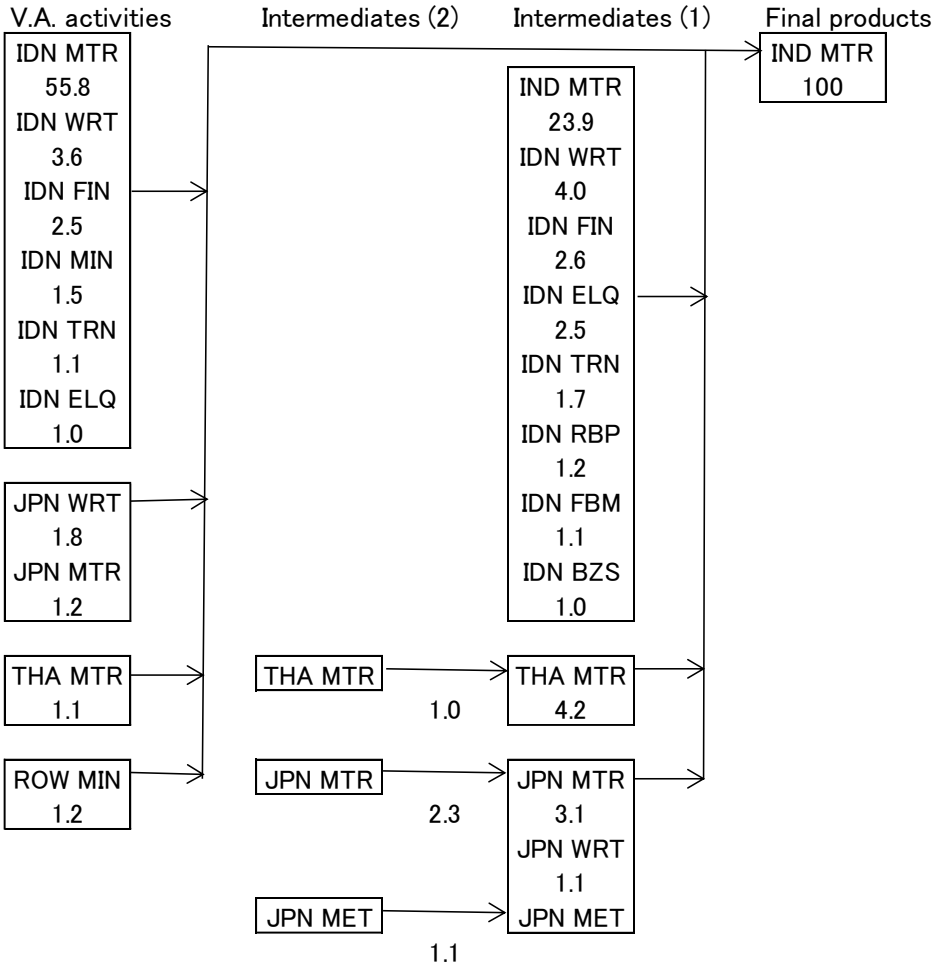
Source: Calculated from the OECD ICIO table, 2011

Figure 2.b Flow of upstream transactions: Motor vehicle sector in Thailand (2011)



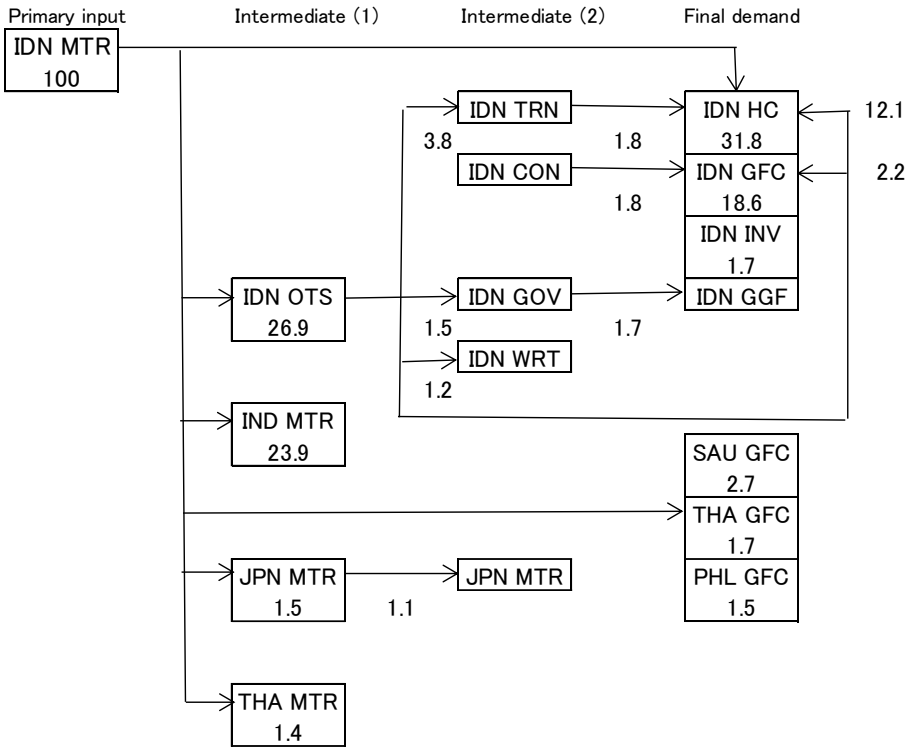
Source: Calculated from the OECD ICIO table, 2011

Figure 3.a Flow of downstream transactions: Motor vehicle sector in Indonesia (2011)



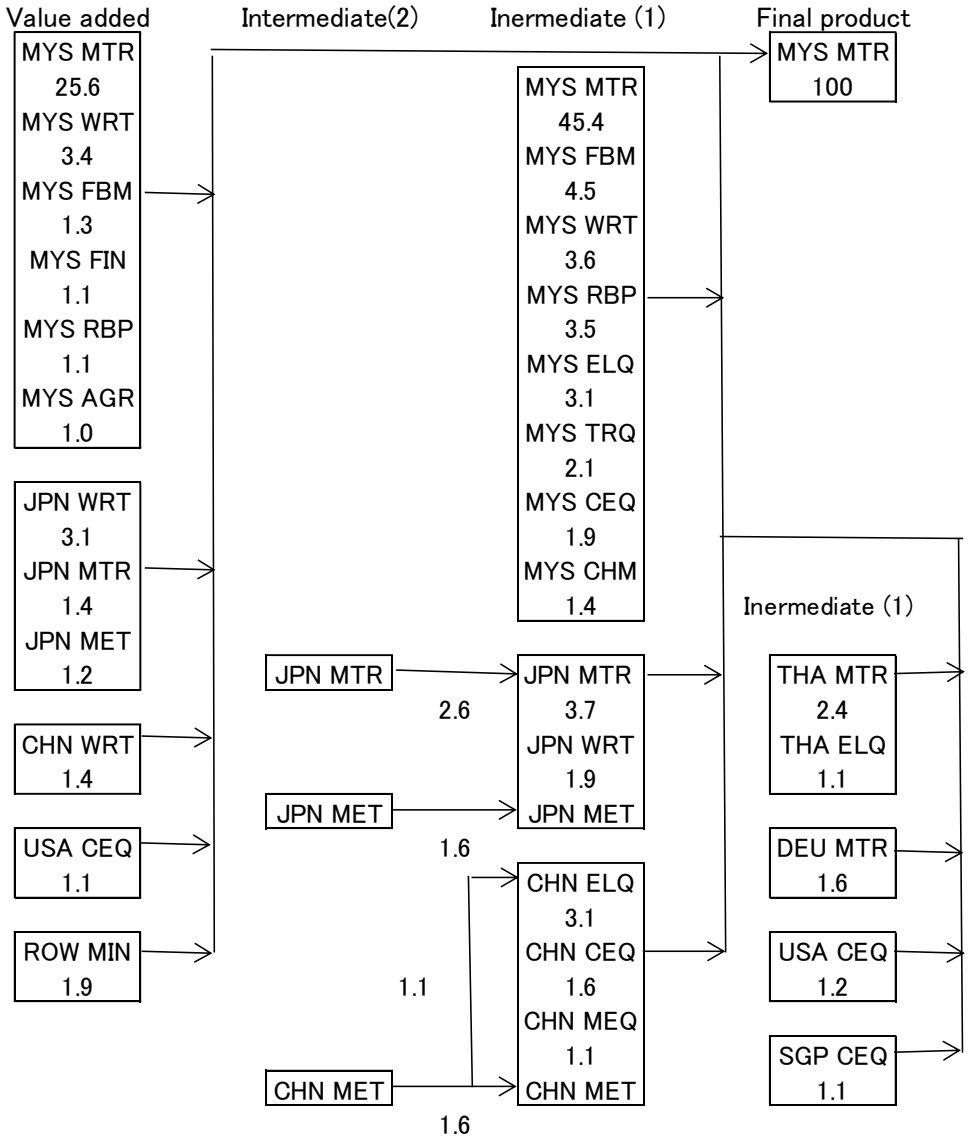
Source: Calculated from the OECD ICIO table, 2011

Figure 3.b Flow of upstream transactions: Motor vehicle sector in Indonesia (2011)



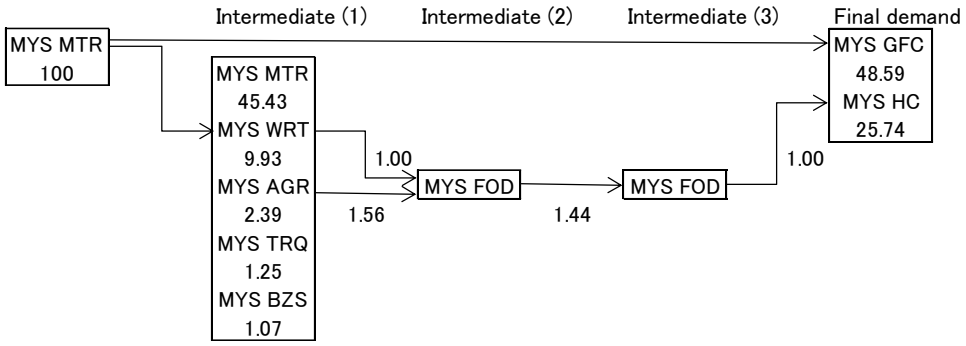
Source: Calculated from the OECD ICIO table, 2011

Figure 4.a Flow of downstream transactions: Motor vehicle sector in Malaysia (2011)



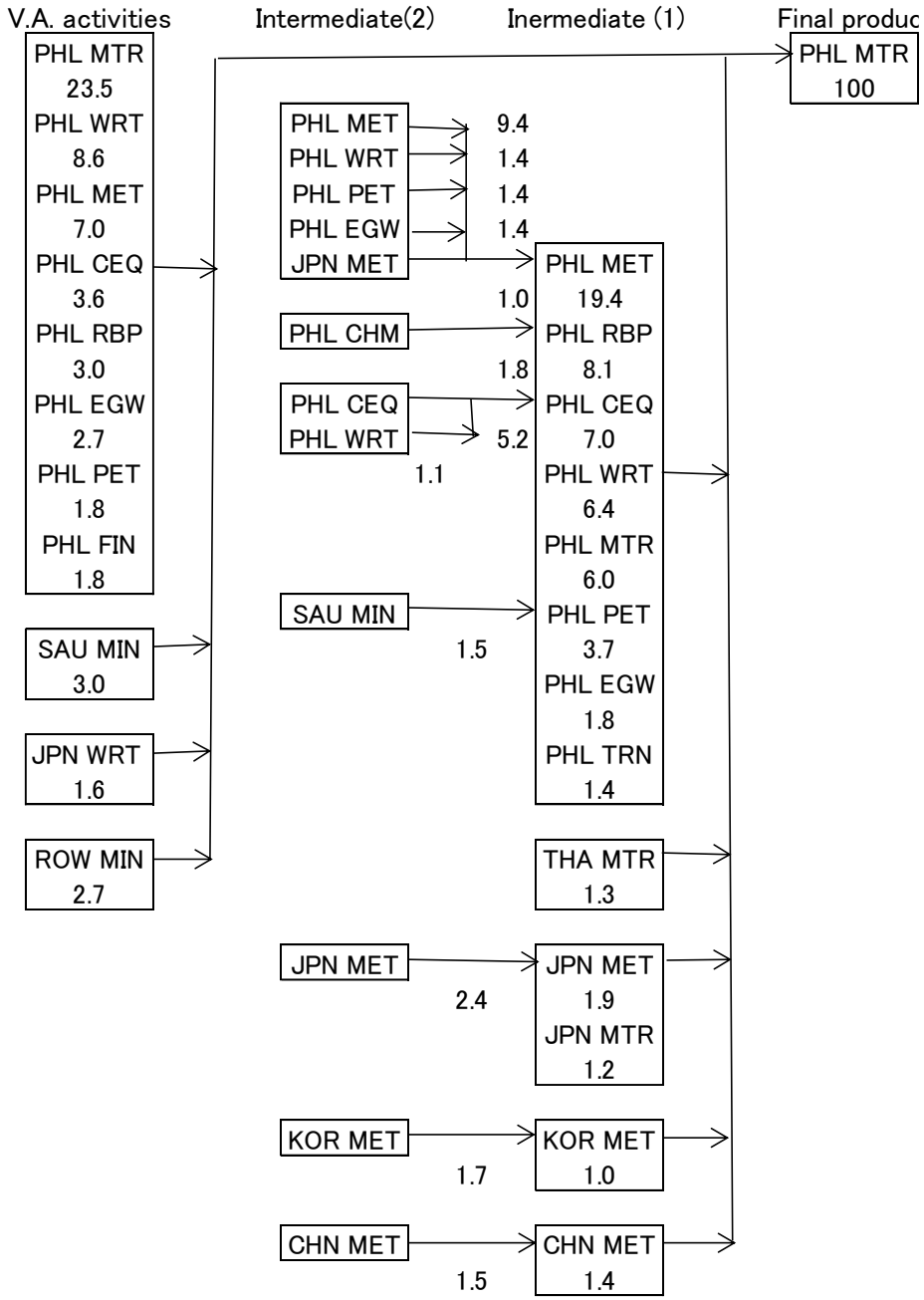
Source: Calculated from the OECD ICIO table, 2011

Figure 4.b Flow of upstream transactions: Motor vehicle sector in Malaysia (2011)



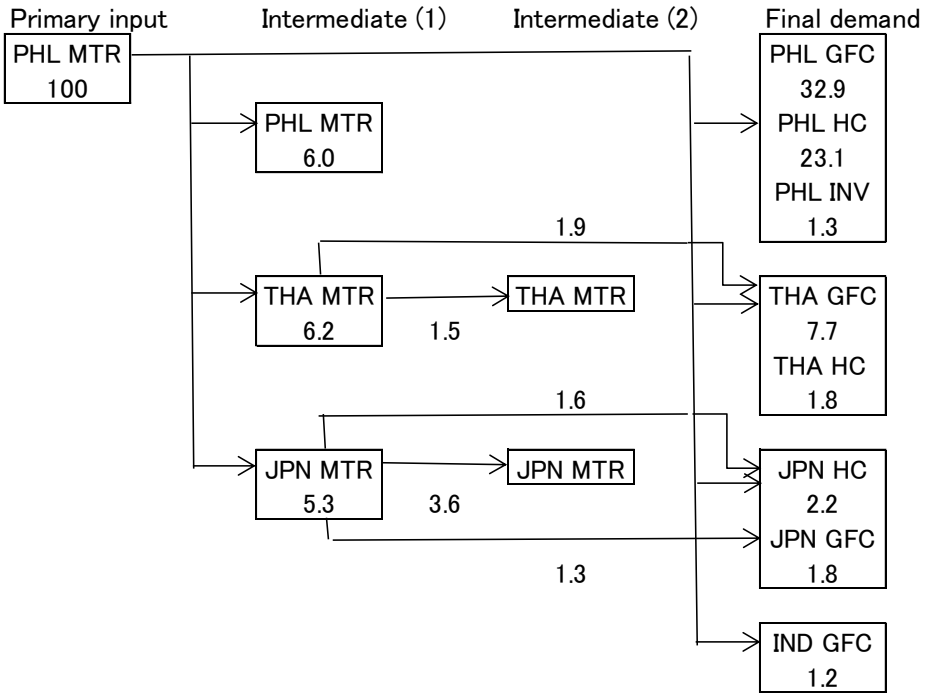
Source: Calculated from the OECD ICIO table, 2011

Figure 5.a Flow of downstream transactions: Motor vehicle sector in the Philippines (2011)



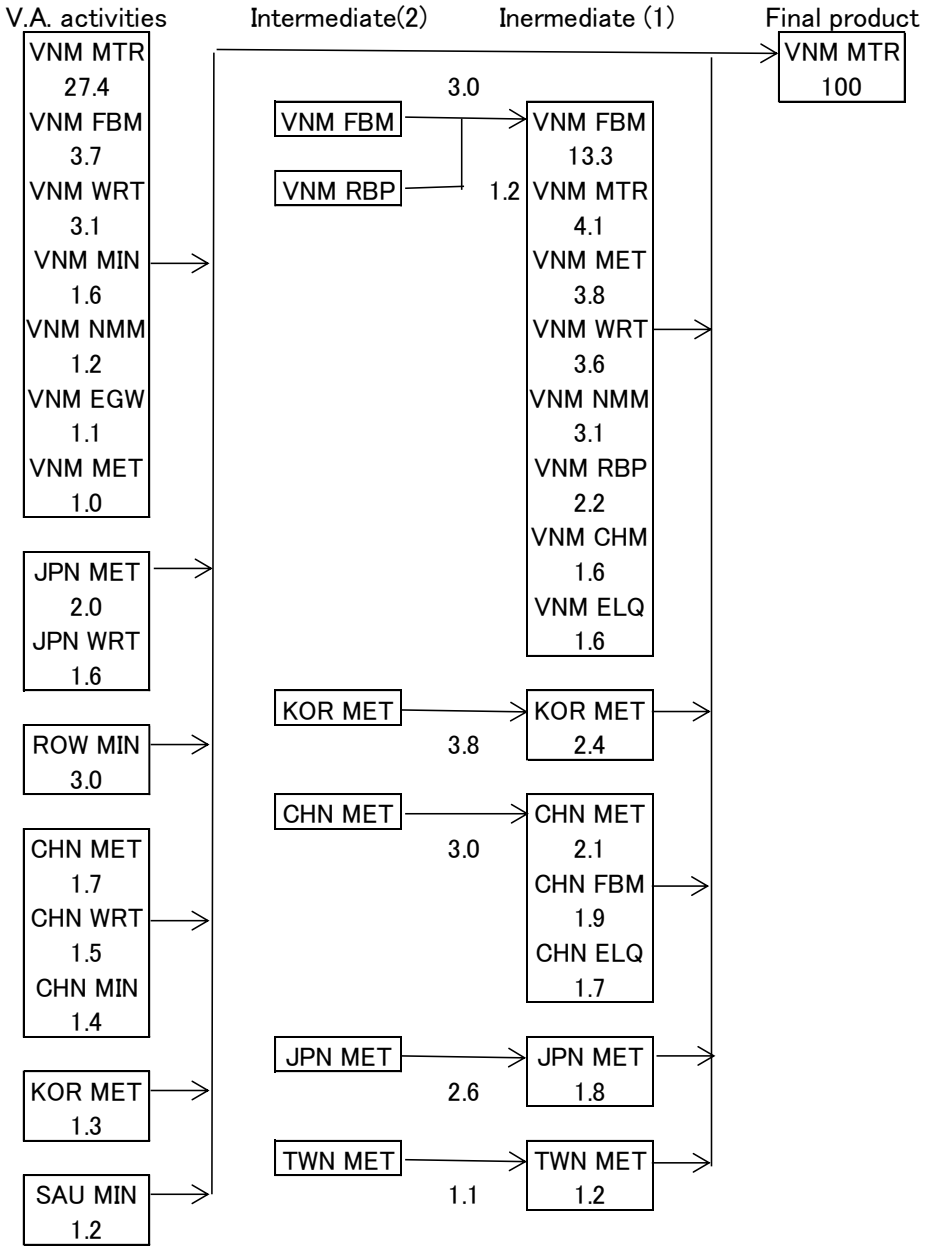
Source: Calculated from the OECD ICIO table, 2011

Figure 5.b Flow of upstream transactions: Motor vehicle sector in the Philippines (2011)



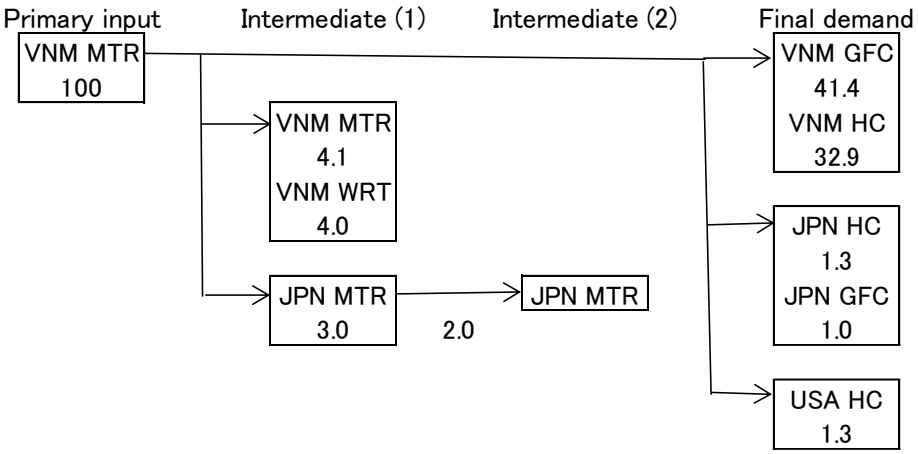
Source: Calculated from the OECD ICIO table, 2011

Figure 6.a Flow of downstream transactions: Motor vehicle sector in Vietnam (2011)



Source: Calculated from the OECD ICIO table, 2011

Figure 6.b Flow of upstream transactions: Motor vehicle sector in Vietnam (2011)



Source: Calculated from the OECD ICIO table, 2011