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Participations in Global Value Chains and Service-link Costs in Emerging ASEAN Economies

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Abstract

This paper aims to examine the participations in global value chains (GVCs) on emerging ASEAN economies by using the UNCTAD-Eora value-added-trade database, and to investigate a major factor that makes the difference in GVCs participations by using the fragmentation model, in particular, with a focus on the factor of service-link costs. The statistical observations demonstrated that the GVCs participations in ASEAN economies has made great progresses during the 1990s along with their per capita GDP growth, and also that there has been a large gap in the degree of GVCs participations between the forerunners and the latecomers in ASEAN economies. The empirical estimation of the fragmentation model could identify the quantitative linkage between GVCs participations and “logistics performances” representing service-link costs in emerging ASEAN economies. Since the logistics performances are one of manageable factors for countries’ strategies, there should still be the policy space for ASEAN latecomers to catch up with the forerunners in GVCs integrations.

Key words: Global value chains, Service-link costs, Logistics performances, ASEAN forerunners and latecomers, fragmentation model

JEL Classification: F12, F13, F14, O53

1. Introduction

The global value chains (GVCs) have been one of the popular trends in global economic activities over the past two decades. The GVCs are, according to UNCTAD (2013), characterized by the fragmentation of production processes and the international dispersion of tasks and activities among the economies with diversified development stages, which have led to the emergence of borderless production networks. The GVCs are usually considered to have contributed to boosting income, since the hyper-specialization enhances efficiency and productivity, and the durable firm-to-firm relationships promote the diffusion of technology and access to inputs along the chains. World Bank (2020), for instance, estimated that a 1 percent increase in GVC participations would boost per capita income by more than 1 percent, or much more than the 0.2 percent income gain from standard trade.

The GVCs are a concept taken up by different schools of economic theory, development studies and international business disciplines. From the perspective of economic analysis, Kimura (2006) described the GVCs in East Asia by using the terminology of “International Production and Distribution Networks”, and by extracting 18 stylized facts common to such networks based on a number of studies using international trade data, micro-data of Japanese multinational-enterprises, and casual observations. One of the important findings by Kimura (2006) is that the mechanics of the East Asian production networks are represented by the “vertical” division of labor in intra-industries among a number of countries characterized by different income levels, and that the mechanics are typically found in such sophisticated manufacturing industries as machinery, which involve a large number of multi-layered vertical production processes.

From the theoretical perspective, Kimura (2006) argued that this vertical mechanics in East Asia could be well-illustrated by the “fragmentation theory”. The “fragmentation” was clearly defined by Deardorff (2001): the splitting of a production process into two or more steps that can be undertaken in different locations, but that lead to the same final product. The theoretical rationale for the “fragmentation” was provided by Jones and Kierzkowski (1990, 2005). They argued that a firm’s decision on whether to fragment production processes or not depends on the differences in location advantages (e.g. the differences in factor prices like wages) and the levels of the “service-link costs”, which are costs to link remotely-located production blocks (e.g. costs of transportation, telecommunication and coordination). The greater disparity in factor prices between countries may encourage the use of several international locations for production blocks,

and the decline in the service-link costs of production blocks may further facilitate the process of fragmentation at international levels.

In this context, the economies of the Association of Southeast Asian Nations (ASEAN) have been one of the major targets for GVCs participations and involvements with fragmentation mechanics, under such backgrounds as their large differences in factor prices with different development stages and the reductions of service-link costs with the promotion of free trade and infrastructure development under the ASEAN Economic Community. Among ASEAN members, forerunners such as Malaysia and Thailand have been main players in GVCs involvements, and even latecomers like Cambodia, Lao PDR and Myanmar have started joining GVCs though their participations have been still lagged behind forerunners.

The degree of GVCs participations and involvements has become easier to be measured quantitatively in the nation-wide level, since the “value-added-trade” data were developed in recent times by several international organizations. The database has represented a fundamental step forward in understanding GVCs trade: the database makes it possible to identify the contributions of domestic and foreign value added embedded in gross exports, and also the industrial and country-wise origins of creating value added in exports. Since the GVCs pattern is usually expressed as “importing to export,” or I2E, as Baldwin and Lopez-Gonzalez (2013) described, the intensity of GVCs participations could be measured by the contribution ratio of foreign value added to gross exports that the “value-added-trade” data provides.

This paper investigates the degree of GVCs participations on emerging ASEAN economies by using the value-added-trade database. The GVCs participations are examined by the contribution ratio of foreign value added to gross exports that is obtained by the value-added-trade data. The paper also identifies the difference in GVCs participations between the forerunners and latecomers in ASEAN, and examines a factor that makes the difference by using the fragmentation model (a modified version of the gravity-trade-model), in particular, with a focus on the factor of service-link costs. The major contribution of this study is to clarify a quantitative linkage between GVCs participations and service-link costs, focusing on emerging ASEAN economies with great momentum and potential of GVCs involvements.

The rest of the paper is structured as follows. Section 2 illustrates the degree of GVCs participations and involvements with a focus on emerging ASEAN economies. Section 3 conducts an econometric study by estimating the fragmentation model to investigate a quantitative linkage between GVCs participations and service-link costs. Section 4 summarizes and concludes.

2. GVCs Participations in ASEAN

This section illustrates the degree of GVCs participations and involvements in emerging ASEAN economies by using the value-added-trade database. The GVCs participation measures, according to World Bank (2016), differentiate between buyer- and seller-related ones: the GVCs participations on the buying side is indicated by the percentage of the foreign value added embodied in gross exports; and those on the selling side are shown by the percentage of the value of domestic inputs exported to third countries and used in their exports in gross exports. This study adopts the buyer-related measure, since for emerging ASEAN economies it makes sense to evaluate their GVCs participations from a user's perspective of foreign value added for its own exports. A key role of GVCs in industrial and economic development is boosting the competitiveness of the exports of emerging-market economies by facilitating the combination of foreign technology with their own labor, capital, and technology. In this sense, imports of intermediate inputs containing foreign technology are important for competitiveness. Thus an economy's ability to participate in GVCs depends as much on its capacity to import world-class inputs efficiently as its capacity to export.

The value-added-trade data is retrieved from the "UNCTAD-Eora value-added-trade database"¹. This database provides the country/sector by country matrix of value-added trade for 1990-2017, so that the gross exports of countries and their sectors could be decomposed of home countries' value added and foreign countries' value added with each country origin. By using this database, this section elucidates the GVCs participations of emerging ASEAN economies by manufacturing industries², in terms of the foreign value added embodied in gross exports as the percentage of gross exports. This section also exhibits the foreign value added of emerging ASEAN economies by foreign country origins, in terms of the percentage of the total foreign value added. This study targets emerging ASEAN countries listed by the following eight countries: Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Thailand and Vietnam. Brunei Darussalam and Singapore are excluded from this study's sample, since they belong to the high-income group according to the World Bank classification.³

Figure 1 displays the GVCs participations of emerging ASEAN economies by total

¹ See the website: <https://worldmrio.com/unctadgvc/>.

² This study focuses on manufacturing sectors since GVCs activities and fragmentation phenomena are typically observed in their sectors.

³ See the website: <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519>.

manufacturing and seven manufacturing sectors: food and Beverages (hereafter, food), textiles and wearing apparel (textile), wood and paper (wood), petroleum, chemical and non-metallic mineral products (chemical), metal products (metal), electrical and machinery (machinery), and transport equipment (transport), based on the UNCTAD-Eora database classification.⁴ The figure is described with the vertical axis being the foreign value added share out of gross exports (representing the degree of GVCs participations) and with the horizontal axis being per capita GDP in real term (showing the development stage of the economies). The data for per capita GDP in real term is taken from UNCTAD Stat database by the series named “US dollars at constant prices (2010) per capita”.⁵

The main observations from Figure 1 are summarized as follows. First, the foreign value added share is positively correlated with per capita GDP in total manufacturing and seven manufacturing sectors. This observation is consistent with the argument by World Bank (2020): a 1 percent increase in GVCs participations would boost per capita income by more than 1 percent. There is also a large gap in GVCs participations between the forerunners of ASEAN (like Malaysia and Thailand) and the latecomers (like Myanmar, Cambodia and Lao PDR). Second, the gaps in GVCs participations between the forerunners and the latecomers differs in manufacturing sectors: the gaps are rather moderate in traditional industries such as food and wood products, while the gap are extreme in sophisticated industries such as metal products, machinery and transport equipment.

Figure 2 shows the foreign value added of emerging ASEAN economies by country origins. The point observed commonly to eight sample economies is a clear contrast: the decreasing trends in the shares of Japan, the US and Taiwan, and the increasing trend in China. Another point to be noted is that the intra-regional linkages among ASEAN economies have been strengthened in terms of the increasing trends in the shares of the foreign value added from ASEAN economies, such as Cambodia from Thailand, Indonesia from Malaysia, Lao PDR from Thailand, Malaysia from Indonesia, Thailand from Malaysia and Vietnam from Malaysia.

To sum up in this section, the GVCs participations in ASEAN economies has made great progresses during the 1990s along with their per capita GDP growth. There has been, however, a large gap in the degree of GVCs participations between the forerunners and

⁴ The classification above applies to Cambodia, Lao PDR and Myanmar in the UNCTAD-Eora database. The other five countries have another detailed commodity classification in the database, and the classification is transformed into the seven classification above, based on the SITC Revision 3 Product Code. See Appendix.

⁵ See the website: <https://unctadstat.unctad.org/EN/>.

the latecomers in ASEAN economies. At the same time, the country-origins of foreign value added have changed from Japan, the US and Taiwan to China and ASEAN countries themselves.

3. GVCs Participations and Service-link Costs in ASEAN

The previous section identified the difference in GVCs participations between the forerunners and latecomers in ASEAN. Then this section examines a factor that makes the difference by using the fragmentation model, in particular, with a focus on the factor of service-link costs. This section first reviews the previous empirical studies of fragmentation model, clarifies the methodology and data, represents the estimation outcomes and discusses them.

3.1 Fragmentation Model: Previous Empirical Studies

As was mentioned in the introduction, the fragmentation theory was proposed by Jones and Kierzkowski (1990, 2005). They argue that the greater disparity in factor prices between countries may encourage the use of several international locations for production blocks (saving marginal costs of operation), and that the decline of the service costs of production blocks may further facilitate the process of fragmentation even at international levels (lowering fixed costs). Thus the fragmentation theory demonstrates that the differences in factor prices and the service-link costs are the two key variables to explain international production networks.

Regarding empirics for the fragmentation theory, there have been intensive studies not only for East Asia but also for the other areas of the world: focusing on the fragmentation among European Union countries (e.g. Baldone et al., 2001; Egger and Egger, 2003), those between the U.S. and Mexico (e.g. Hanson et al., 2005), and those among East Asian countries (e.g. Ng and Yeats, 2001; Ando, 2006; Kimura et al., 2007; Taguchi and Ni Lar, 2015 and 2016). Among these empirical works, it was Kimura et al. (2007) that applied a gravity trade model for examining the fragmentation of machinery industries in East Asia, while contrasting the East Asian vertical fragmentation model with the Europe model, i.e., the horizontal product differential model established by Krugman (1980) and Helpman and Krugman (1985). For explaining the fragmentation, Kimura et al. (2007) modified a gravity model by adding the absolute value of gap in GDP per capita between trading countries as a proxy for location-advantage disparity, i.e., one of the fragmentation factors. Then, it proved that this modified gravity model for

fragmentation only applied to the case of East Asia, not to that of Europe. Taguchi and Ni Lar (2015) further developed the modified gravity model proposed by Kimura et al. (2007) by adding a variable capturing the extent of logistics performances in order to examine the role of service-links, i.e., another factor of fragmentation. Taguchi and Ni Lar (2015) still focused on machinery industries, but targeted the area of Mekong region including such latecomers as Cambodia, Lao PDR and Myanmar for identifying the factor to prevent the production networks from extending in that region. Through the analysis based on the fragmentation model, it finally found that the high service-link costs of Cambodia and Myanmar had prevented normal trade flows from Thailand to both of these countries. Taguchi and Ni Lar (2016) also examined the suitability of the fragmentation model by applying the fully-modified gravity trade model of Taguchi and Ni Lar (2015) to all the manufacturing industries in East Asia by including the two factors of fragmentation: the differences in location advantages and the levels of service-link costs. Their empirics found that the fragmentation model best fits the industries of chemicals, steel and machinery, and implied that these industries involve a large number of multi-layered vertical production processes so that the mechanics of fragmentation can be working well.

3.2 Specification of Estimation Model

This study, following Taguchi and Ni Lar (2015 and 2016), applies the fragmentation model with the fully-modified gravity trade model including the differences in location advantages and the levels of service-link costs. The analytical contribution of this study is to adopt the foreign value added in exports as the dependent variable in the model so that the degree of GVCs participations could be directly examined. All of the previous studies used gross trade values as the explained variable in the model, which usually contains simple trade flows between two countries not related to GVCs activities. The key explaining variable in the fragmentation model is the one representing service-link costs. This study's estimation equips two kinds of proxy variables for service-link costs: country-specific dummies and Logistics Performance Index (hereafter LPI, explained later on). Then the critical question in the estimation is to what extent the LPI has the interpretability of the differences in GVCs participations among emerging ASEAN economies. The equations for estimation are specified as follows.

$$\ln FVA_{ijt} = \alpha_0 + \alpha_1 * \ln (GDP_{it} * GDP_{jt}) + \alpha_2 * \ln GAP_{ijt} + \alpha_3 * \ln DIS_{ij} + \alpha_4 * \ln REX_{ijt} + \alpha_5 * D_i + \varepsilon_{ijt} \quad (1)$$

$$\ln FVA_{ijt} = \alpha_0 + \alpha_1 * \ln (GDP_{it} * GDP_{jt}) + \alpha_2 * \ln GAP_{ijt} + \alpha_3 * \ln DIS_{ij} + \alpha_4 * \ln REX_{ijt} + \alpha_5 * LPI_{it} + \varepsilon_{ijt} \quad (2)$$

Where the subscript *i*, *j* and *t* denote host countries (receiving foreign value added in exports), origin countries (offering foreign value added in exports), and trading years; FVA is foreign value added in exports; GDP is gross domestic product; GAP is the gap in per capita GDP between host countries *i* and origin countries *j*; DIS is the geographical distance between the capital cities of countries *i* and *j*; REX is the real exchange rate in the bilateral term between countries *i* and *j*; D is the country-specific dummy; LPI is logistics performance index; ε is an error term; $\alpha_0 \dots \alpha_5$ are a constant term and the coefficient of each explanatory variable; and \ln shows a logarithm form.

The detailed description of each variable is as follows. Regarding the FVA (foreign value added in exports), the data are taken from the UNCTAD-Eora value-added-trade database shown in Section 2, and expressed as thousand US dollar terms. The estimation focuses on manufacturing sectors, targeting total manufacturing and machinery industry (the sum of “machinery” and “transport” in Section 2). The machinery industry typically represents a large number of multi-layered vertical production processes as the mode of fragmentation, as Kimura (2006) argued.

The GDP data are retrieved from the World Economic Outlook (WEO) database (October 2019) of the International Monetary Fund (IMF) by the series of “current prices US dollars”.⁶ This variable is expressed by the joint product of the GDPs of host countries and origin ones. Since the variable is set based on an ordinary gravity trade model, the coefficient α_1 is expected to have a positive sign.

The GAP represents the differences in location advantages (factor prices) between host countries and origin ones, as one of the fragmentation factors. This study uses “GDP per capita” as a proxy for the location advantages, as in Kimura et al. (2007), considering that the GDP per capita reflects the total level of factor prices in an economy. The data of GDP per capita are taken from the WEO by the series of “current prices US dollars”. Then the GAP is calculated by the GDP per capita of host countries divided by that of origin countries. Since the lower factor prices indicated by the lower GDP per capita attract the more of fragmented production blocks, the coefficient of the GAP α_2 is expected to have a negative sign.

The DIS, the geographical distance, which is used usually in an ordinary gravity trade model, is considered to represent one of elements of service-link costs. The distance

⁶ See the website: <https://www.imf.org/en/Data>.

between capital cities is measured by the Great Circle Distance Between Cities on Map (Fromto).⁷ Then the coefficient α_3 is expected to have a negative sign.

The REX, a bilateral real exchange rate, is introduced as a multilateral time-varying price resistance term, which is usually required by the gravity trade model with recent theoretical foundations. Anderson and van Wincoop (2003) suggested the use of country-specific fixed effects as the method to account for the multilateral price term in the cross-section. In a panel setting, however, the multilateral price term would be time varying. One way to control for price changes is to introduce, similarly to Rose (2000) and Vandebussche and Zanardi (2010), the bilateral real exchange rate that varies over time and tracks price changes. The REX is computed by using consumer prices (CPI) and bilateral nominal exchange rates (ER), which are retrieved from the WEO, as follows.

$$(\text{CPI}_{\text{host c.}} / \text{ER}_{\text{host c. currency per US Dollar}}) / (\text{CPI}_{\text{origin c.}} / \text{ER}_{\text{origin c. currency per US Dollar}})$$

The coefficient of the REX α_4 is expected to have a positive sign.

The last variables, D and LPI, are the proxy variables for service-link costs with the greatest concerns in this study. The D, country-specific dummies, is considered to represent the total service-link costs except the distance factor of DIS, which could be a major source to create the differences in GVCs participations among emerging ASEAN economies. The dummy variable takes a value of 1 (and 0 otherwise) if the host country belongs to one of seven ASEAN countries: Cambodia, Lao PDR, Malaysia, Myanmar, the Philippines, Thailand and Vietnam, with Indonesia in a middle position being a benchmark country. Thus the signs of dummy coefficients α_5 range from negative values to positive ones. The LPI is, on the other hand, rather a specific index to materialize service-link costs. The data of the index is retrieved from the Logistics Performance Index presented by the World Bank.⁸ The index could be a proxy variable since it includes the comprehensive performances of customs, infrastructure, international shipment, logistics competence, tracking and tracing and timeliness. The index takes the number ranging from 1 (very low in the performances) to 5 (very high), and since service-link costs correspond to the reverse of the index, the LPI coefficient α_5 is expected to have a positive sign. Then the analytical question here is to what extent the LPI could explain the differences in country-specific dummies D that reflect the variation of GVCs participations among emerging ASEAN economies.

⁷ See the website: <https://www.distancefromto.net/>.

⁸ See the website: <https://lpi.worldbank.org/>.

3.3 Sample Data and Estimation Methodology

The sample economies and period are set as follows. The host countries are the eight countries from emerging ASEAN as in Section 2, and the origin countries / economies of foreign value added are selected as the eight ASEAN countries and their major seven trading partners: China, Germany, India, Japan, Korea, Taiwan and the US. The foreign value added the host countries receive from the sampled origin economies cover 60-80 percent out of the total foreign value added they receive from the world in 2017.⁹ As for the sample period, the study selects such discrete years as 2007, 2010, 2012, 2014, 2016 and 2017 due to the constraint of data availability of the LPI.¹⁰ The study then constructs panel data for six years with the combinations between host countries and origin economies ($6 * 8 * 14 = 672$) for the estimation. The FVA, the product of GDP, GAP, DIS and REX are transformed in logarithm to avoid scale-heterogeneity problem.

The estimation method this study applies is a pooled censored regression model (Tobit model) to avoid the problem of sample selection bias in the panel data. The Ordinary Least Square supposes that a dependent variable be observed as a continuous and unrestricted scale. The foreign value added as a dependent variable that this study samples, however, are only partially observed at positive values or zero values. Thus, we adopt the Tobit model with a dependent variable left-censored at zero and with the normal distribution for the error term.

3.4 Estimation Outcomes and Discussions

Table 1 reports the estimation outcomes of the fragmentation model in the cases of total manufacturing and machinery industry. Both cases show the similar results with the same directions of the coefficients' signs, although their magnitudes are different between two cases. Focusing on the equation (1) and (2), the coefficients of all the explanatory variables except the bilateral real exchange rate (REX) have the expected signs: the product of GDP and the geographical distance (DIS) have significant coefficients with positive and negative signs, respectively, which are consistent with the ordinary gravity trade model. The GAP representing the differences in factor prices has a significantly negative coefficient, which is consistent with the fragmentation model. The REX

⁹ The coverage in Myanmar as a host country is below 60 percent since she had ever received economic sanctions from western countries and diversified her trade partners.

¹⁰ The UNCTAD-Eora value-added-trade database have the data range by 2017, and the LPI data in 2018 is applied to the data as 2017, since the LPI does not have the data in 2017.

coefficients, however, opposite signs between the equation (1) and (2), probably because the price mechanism does not fully work in the value-chain activities under emerging-market economies.

As for the proxy variables of service-link costs, the equation (1) exhibits the wide range of the magnitudes of country-specific dummies' coefficients with Indonesia in a middle position being a benchmark country: from Myanmar (-7.757 in total manufacturing and -10.242 in machinery industry) to Malaysia (2.476 in total manufacturing and 3.121 in machinery industry). The estimated dummy-coefficients also demonstrates a clear contrast in the degree of GVCs participations between ASEAN latecomers (Myanmar, Lao PDR and Cambodia) and forerunners (Malaysia, Thailand and Philippines). In the equation (2), on the other hand, the coefficients of the LPI in both total manufacturing and machinery industry have significantly positive signs consistent with the fragmentation model. It suggests that the differences in logistics performances significantly create the gap of GVCs participations among emerging ASEAN economies. Both results lead to the question on the degree of the LPI contribution to the differences in country-specific dummies that reflect the variation of GVCs participations.

Table 2 reveals factor analyses of service-link costs represented by country-specific dummies and the LPI in total manufacturing and machinery industry: the column (a) redisplay the coefficients of country-specific dummies; the LPI deviations from the benchmark in the column (c) are calculated by subtracting Indonesia's LPI from each country's LPI on the period average in the column (b); the LPI contributions to the differences in the FVA in the column (d) are then worked out by multiplying the LPI deviation with the estimated coefficient (5.348 in total manufacturing and 6.660 in machinery industry) in Table 1; in the column (e) the LPI contributions in the column (d) are divided by the coefficients of country-specific dummies in the column (a) for their comparisons; and the LPI contributions are transformed from logarithm term to value term in the column (f).

The results in the column (e) suggests that the logistics performances almost account for the total level of service-link costs, since the ratios of the LPI deviations relative to the coefficients of country-specific dummies are around unity in the countries in the both edge-sides except Myanmar in total manufacturing and machinery industry. It means that the logistics performances of the host countries are a major source to create the differences in GVCs participations among emerging ASEAN economies. The column (f) reveals the large deviations of foreign value added in the value term from that of benchmark country (Indonesia): from 0.020 times in Myanmar to 11.312 times in Malaysia in total manufacturing, and from 0.008 in Myanmar to 20.515 in Malaysia in machinery industry.

The deviations are more acute in machinery industry, since the industry seems to require sophisticated technologies for its settings.

The Myanmar's deviation from the benchmark is still large even if her logistics performances are taken into account, which account only for the half of her country-dummy magnitude in the column (e). This finding is also confirmed in the estimation result of the equation (3) in Table 1, which shows that the Myanmar country-specific dummy still has a significantly negative coefficient even under the inclusion of the LPI variable in the equation. It is speculated that Myanmar still has the "subsequent complications" from the economic sanctions: Myanmar had ever received the sanctions from western countries until 2013, and it might take a time for the recovery of her domestic production capacities.

To sum up, the fragmentation model could identify the quantitative linkage between logistics performances and GVCs participations in emerging ASEAN economies. This outcome is also consistent with the analyses by World Bank (2016 and 2020) that GVCs integrations are highly sensitive to logistics performances. As the logistics performances are one of manageable variables for countries' strategies, there should still be the policy space for ASEAN latecomers to catch up with the forerunners in GVCs integration.

4. Concluding Remarks

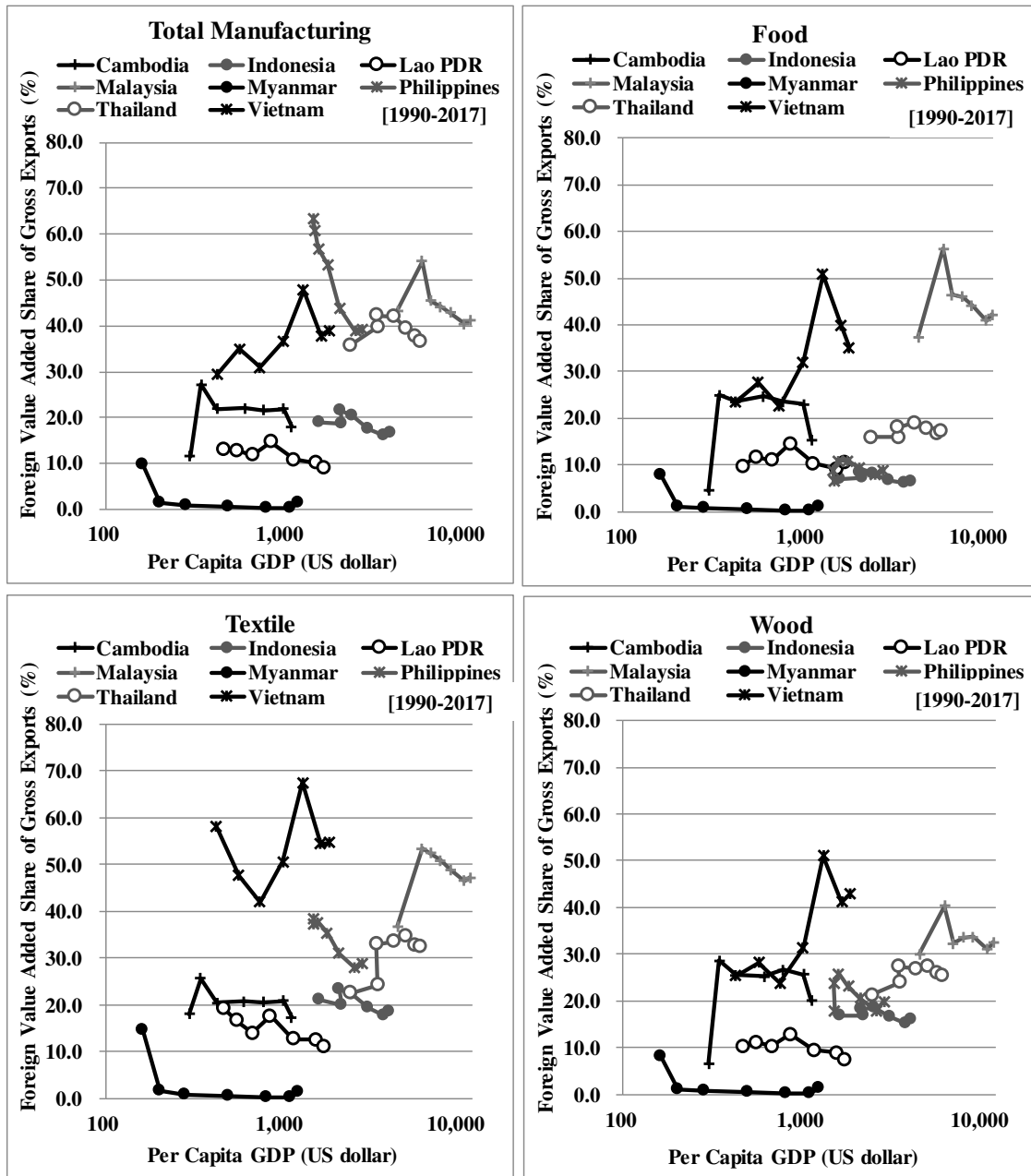
This paper investigated the degree of GVCs participations on emerging ASEAN economies by using the UNCTAD-Eora value-added-trade database. The study also examined a major factor that makes the difference in GVCs participations by using the fragmentation model, in particular, with a focus on the factor of service-link costs. The major contribution of this study was to clarify a quantitative linkage between GVCs participations and service-link costs, focusing on emerging ASEAN economies with great momentum and potential of GVCs integrations.

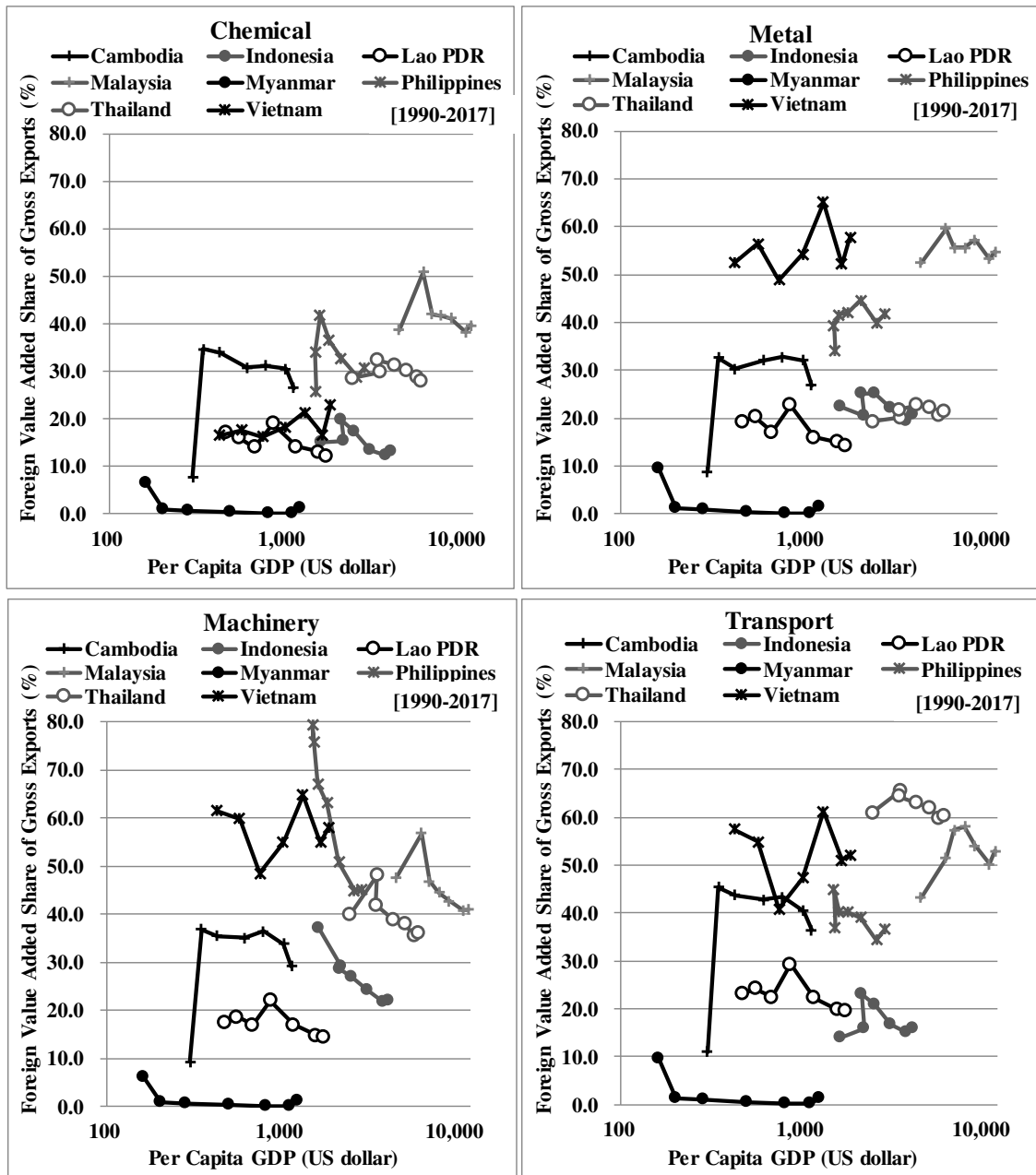
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References

- Anderson JE, van Wincoop E (2003) Gravity with gravitas: A solution to the border puzzle. *American Economic Review* 93, 170–192.
- Ando M (2006) Fragmentation and Vertical Intra-industry Trade in East Asia. *North American Journal of Economics and Finance* 17, 257-281.
- Baldone S, Sdoagati F, Tajoli L (2001) Patterns and Determinants of International Fragmentation of Production: Evidence from Outward Processing Trade between the EU and Central Eastern European Countries. *Weltwirtschaftliches Archiv* 137, 80-104.
- Baldwin R, Lopez-Gonzalez J (2013) Supply-chain trade: A portrait of global patterns and several testable hypotheses. *NBER Working Paper* 18957.
- Deardorff AV (2001) Fragmentation in simple trade models. *North American Journal of Economics and Finance* 12, 121-137.
- Egger H, Egger P (2003) The Determinants of EU Processing Trade. *World Economy* 28, 147-168.
- Hanson G, Mataloni R, Slaughter M (2005) Vertical Production Networks in Multinational Firms. *Review of Economics and Statistics* 87, 664-678.
- Helpman E, Krugman P (1985) *Market Structure and Foreign Trade*. MIT Press, Cambridge.
- Jones RW, Kierzkowski H (1990) The role of services in production and international trade: a theoretical framework. In: Jones R, Krueger (eds) *A The Political Economy of International Trade: Essays in Honor of Robert E. Baldwin*. Basil Blackwell, Oxford.
- Jones RW, Kierzkowski H (2005) International trade and agglomeration: an alternative framework. *Journal of Economics* 10, 1–16.
- Kimura F (2006) International production and distribution networks in East Asia: Eighteen facts, mechanics, and policy implications. *Asian Economic Policy Review* 1, 326-344.
- Kimura F, Takahashi Y, Hayakawa K (2007) Fragmentation and Parts and Components Trade: Comparison between East Asia and Europe. *North American Journal of Economics and Finance* 18, 23-40.
- Krugman P (1980) Scale economies, product differentiation, and the pattern of trade. *American Economic Review* 70, 950–959.
- Ng F, Yeats A (2001) Production Sharing in East Asia: Who does What for Whom, and Why? In: Cheng LK, Kierzkowski H (eds) *Global Production and Trade in East Asia*. Kluwer Academic Publishers, Boston.
- Rose AK (2000) One money, one market: Estimating the effect of common resources on trade. *Economic Policy* 15, 9–45.
- Taguchi H, Ni Lar (2015) Fragmentation and Trade of Machinery Parts and Components in Mekong Region. *The Singapore Economic Review* 60, 1550041-1-21.
- Taguchi H, Ni Lar (2016) Suitability of fragmentation model in East Asia. *Economics Bulletin* 36, 1771-1783.
- UNCTAD (2013) *World Investment Report - Global Value Chains: Investment and Trade for Development*. The United Nations, New York and Geneva.
- Vandenbussche H, Zanardi M (2010) The chilling trade effects of antidumping proliferation. *European Economic Review* 54, 760–777.
- World Bank (2016) *Making Global Value Chains: Work for Development*. The World Bank, Washington DC.
- World Bank (2020) *World Development Report - Trading for Development in the Age of Global Value Chains*. The World Bank, Washington DC.

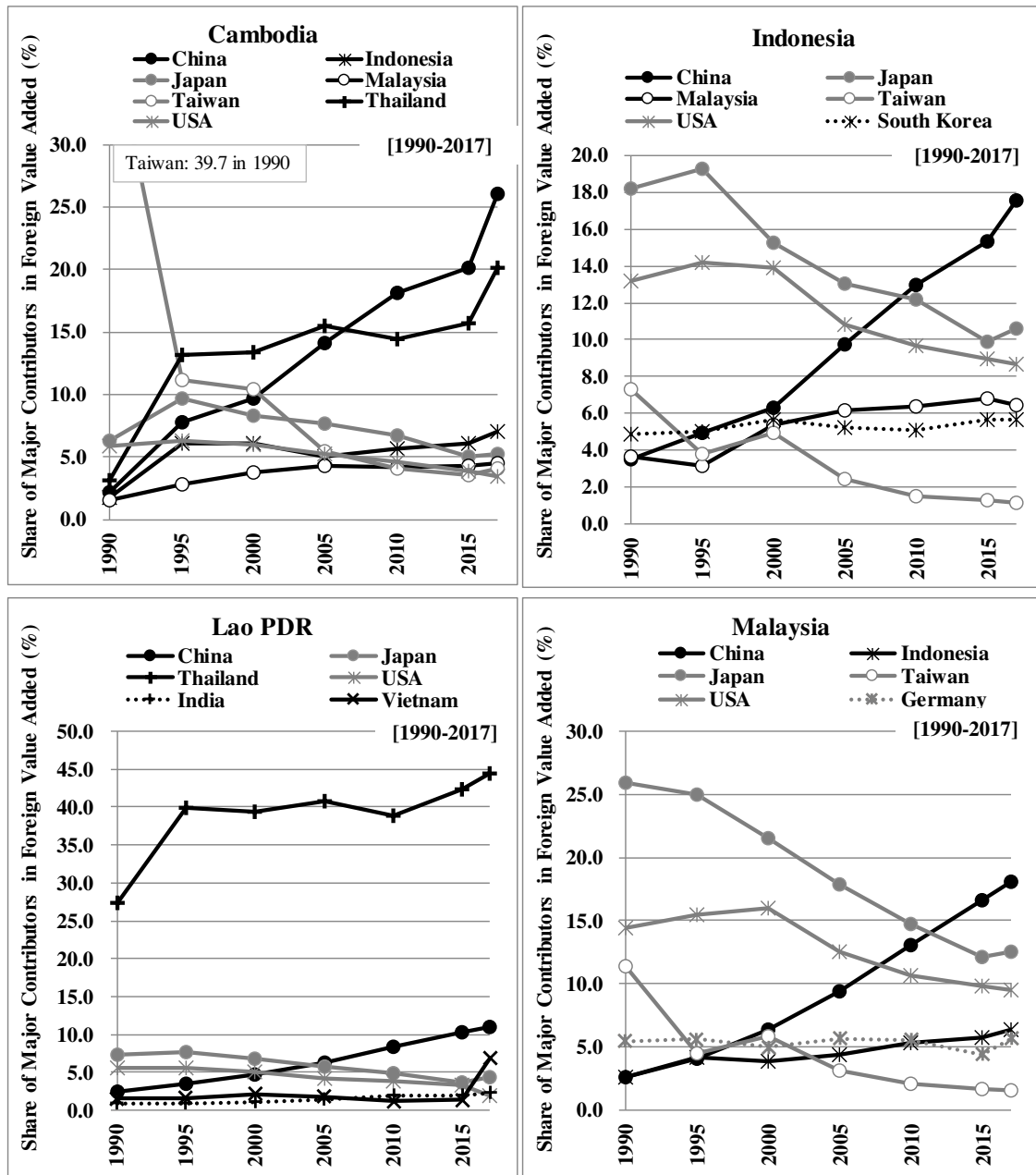
Figure 1 GVCs Participations of Emerging ASEAN by Manufacturing Industries

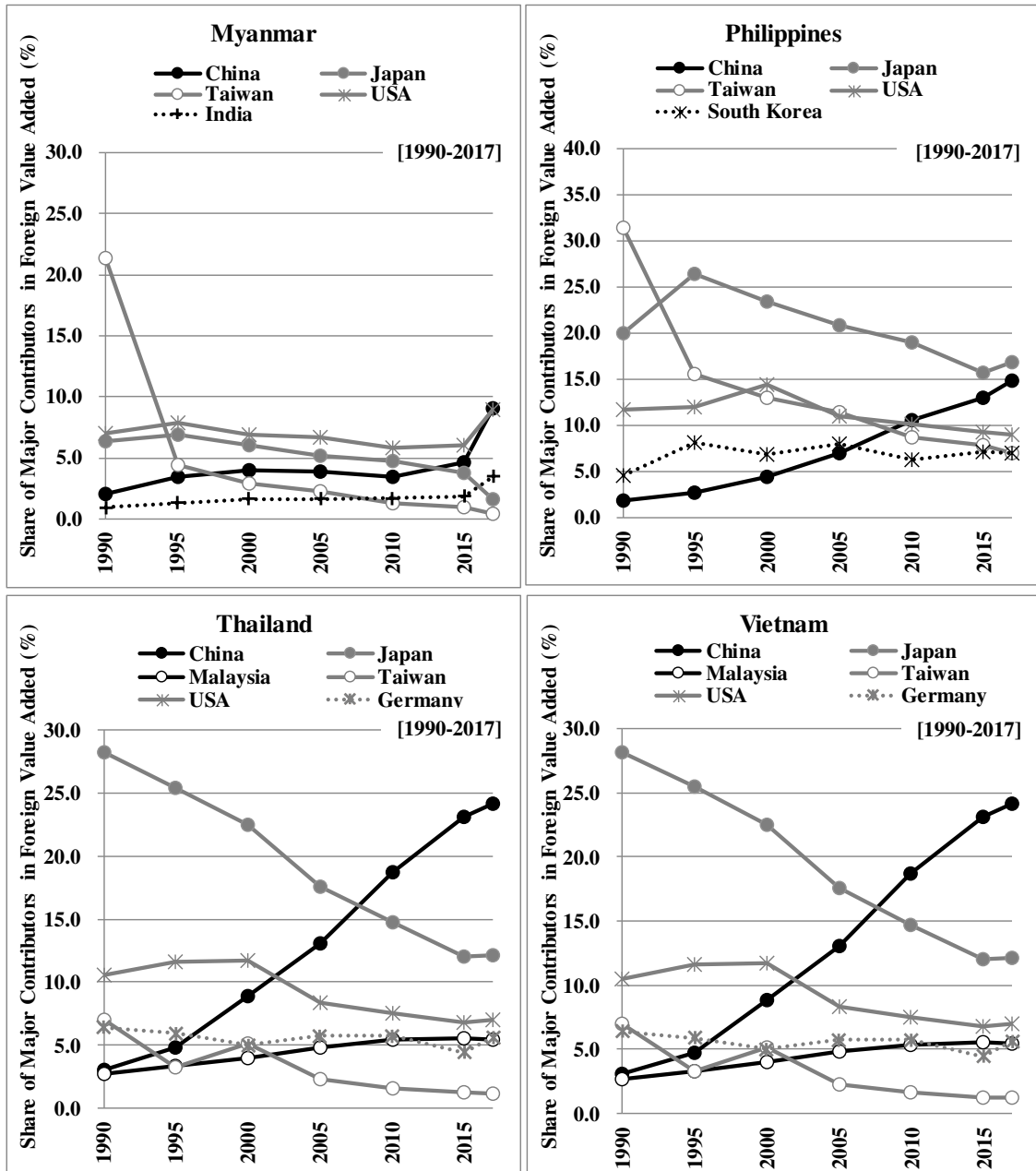




Sources: UNCTAD-Eora value-added-trade database and UNCTAD Stat

Figure 2 Foreign Value added of Emerging ASEAN by Country Origins





Sources: UNCTAD-Eora value-added-trade database

Table 1 Estimation Outcomes of Fragmentation Model
 [Total Manufacturing]

	(1)	(2)	(3)
Const.	9.888 *** (1.021)	9.232 *** (2.047)	5.575 *** (1.373)
ln (GDP_i*GDP_j)	1.014 *** (0.027)	0.954 *** (0.045)	1.118 *** (0.031)
ln GAP	-0.442 *** (0.037)	-0.588 *** (0.064)	-0.336 *** (0.043)
ln DIS	-1.625 *** (0.072)	-1.339 *** (0.130)	-1.559 *** (0.087)
ln REX	0.570 *** (0.213)	-3.133 *** (0.355)	-0.741 *** (0.251)
LPI		5.348 *** (0.239)	2.992 *** (0.179)
Dummy: Myanmar	-7.757 *** (0.196)		-5.037 *** (0.174)
Dummy: Lao PDR	-2.792 *** (0.190)		
Dummy: Cambodia	-1.425 *** (0.189)		
Dummy: Vietnam	-0.113 (0.157)		
Dummy: Philippines	0.688 *** (0.145)		
Dummy: Thailand	1.498 *** (0.143)		
Dummy: Malaysia	2.476 *** (0.143)		
Number of observations	672	672	672

Note: Standard errors are in parentheses. *** denotes statistical significance at 99 percent level.
 Source: Author's estimation

[Machinery Industry]

	(1)	(2)	(3)
Const.	5.375 *** (1.054)	3.610 (2.536)	-1.967 (1.852)
ln (GDP_i*GDP_j)	1.111 *** (0.028)	1.140 *** (0.056)	1.363 *** (0.041)
ln GAP	-0.488 *** (0.038)	-0.476 *** (0.079)	-0.185 *** (0.057)
ln DIS	-1.662 *** (0.073)	-1.253 *** (0.160)	-1.541 *** (0.115)
ln REX	1.080 *** (0.219)	-3.687 *** (0.440)	-0.690 ** (0.339)
LPI		6.660 *** (0.297)	3.993 *** (0.235)
Dummy: Myanmar	-10.242 *** (0.205)		-6.345 *** (0.253)
Dummy: Lao PDR	-3.977 *** (0.192)		
Dummy: Cambodia	-3.371 *** (0.190)		
Dummy: Vietnam	-1.105 *** (0.158)		
Dummy: Philippines	1.676 *** (0.146)		
Dummy: Thailand	1.982 *** (0.143)		
Dummy: Malaysia	3.121 *** (0.143)		
Number of observations	672	672	672

Note: Standard errors are in parentheses. *** and ** denote statistical significance at 99 and 95 percent level, respectively.

Source: Author's estimation

Table 2 Analysis of Service-link Costs

[Total Manufacturing]

	Country's Dummy	LPI [period average]	LPI (b) - Indonesia LPI	(c) * 5.348 [coefficient]	(d) / (a)	Deviation Ratio of FVA exp.(d)
	(a)	(b)	(c)	(d)	(e)	(f)
Myanmar	-7.758	2.261	-0.728	-3.892	0.502	0.020
Lao PDR	-2.792	2.395	-0.593	-3.172	1.136	0.042
Cambodia	-1.425	2.592	-0.397	-2.122	1.489	0.120
Vietnam	-0.114	3.044	0.055	0.296	-	1.344
Indonesia	0	2.989	0	0	-	1
Philippines	0.689	2.937	-0.052	-0.278	-	0.758
Thailand	1.498	3.313	0.324	1.733	1.157	5.658
Malaysia	2.476	3.442	0.454	2.426	0.980	11.312

[Machinery Industry]

	Country's Dummy	LPI [period average]	LPI (b) - Indonesia LPI	(c) * 6.660 [coefficient]	(d) / (a)	Deviation Ratio of FVA exp.(d)
	(a)	(b)	(c)	(d)	(e)	(f)
Myanmar	-10.242	2.261	-0.728	-4.847	0.473	0.008
Lao PDR	-3.977	2.395	-0.593	-3.951	0.993	0.019
Cambodia	-3.371	2.592	-0.397	-2.642	0.784	0.071
Vietnam	-1.105	3.044	0.055	0.369	-	1.446
Indonesia	0	2.989	0	0	-	1
Philippines	1.676	2.937	-0.052	-0.346	-	0.708
Thailand	1.982	3.313	0.324	2.158	1.089	8.657
Malaysia	3.121	3.442	0.454	3.021	0.968	20.515

Source: Author's estimation

Appendix Conversion of Manufacturing Sector's Classifications

Food & Beverages	Indonesia, Philippines	Milled grain and flour; Fish products; Slaughtering, meat products and dairy products; Other food products; Beverage; Tobacco
	Malaysia	Meat & meat products; Dairy products; Preserved fruits & vegetables; Preserved seafood; Oils and fats; Grain mill products; Bakery products; Confectionery; Ice; Other foods; Animal feeds; Wine and spirits; Soft drinks; Tobacco
	Thailand	Canning Preserving of Meat; Dairy Products; Canning of Fruits and Vegetables; Canning Preserving of Fish; Coconut and Palm Oil; Other Vegetable Animal Oils; Rice Milling; Tapioca Milling; Drying and Grinding of Maize; Flour and Other Grain Milling; Sugar; Bakery Products; Noodles and Similar Products; Confectionery; Ice; Monosodium Glutamate; Coffee and Tea Processing; Other Food Products; Animal Feed; Distilling Blending Spirits; Breweries; Soft Drinks; Tobacco Processing; Tobacco Products
	Vietnam	Processed, preserved meat and by-products; Processed vegetable, and animals oils and fats; Milk, butter and other dairy products; Cakes, jams, candy, coca, chocolate products; Processed and preserved fruits and vegetables; Alcohol, beer and liquors; Beer and liquors; Non-alcohol water and soft drinks; Sugar, refined; Coffee, processed; Tea, processed; Cigarettes and other tobacco products; Processed seafood and by products; Rice, processed; Other food manufactures; Animal feeds
Textiles and Wearing Apparel	Indonesia, Philippines	Spinning; Weaving and dyeing; Knitting; Wearing apparel; Other made-up textile products; Leather and leather products
	Malaysia	Yarns & cloth; Knitted fabrics; Other textiles; Wearing apparel; Leather products; Footwear
	Thailand	Spinning; Weaving; Textile Bleaching and Finishing; Made-up Textile Goods; Knitting; Wearing; Apparels Except Footwear; Carpets and Rugs; Cordage Rope and Twine Products; Tanneries Leather Finishing; Leather Products; Footwear Except Rubber
	Vietnam	Weaving of cloths (all kinds); Fibers, thread (all kinds); Ready-made cloth, sheets (all kinds); Carpets Weaving and embroidery of textile-based goods (except carpets); Products of leather tanneries; Leather goods
Wood and Paper	Indonesia, Philippines	Timber; Wooden furniture; Other wooden products; Pulp and paper; Printing and publishing
	Malaysia	Sawmill products; Other wood products; Furniture; Paper & board; Printed products
	Thailand	Pulp Paper and Paperboard; Paper Products; Printing and Publishing; Saws Mills; Wood and Cork Products; Furniture and Fixtures Wood
	Vietnam	Paper pulp and paper products and by products; Processed wood and wood products; Products of printing activities; Products of publishing house
Petroleum, Chemical and Non-Metallic Mineral Products	Indonesia, Philippines	Synthetic resins and fiber; Basic industrial chemicals; Chemical fertilizers and pesticides; Drugs and medicine; Other chemical products; Refined petroleum and its products; Plastic products; Tires and tubes; Other rubber products; Cement and cement products; Glass and glass products; Other non-metallic; mineral products; Non-ferrous metal
	Malaysia	Industrial chemicals; Paints & lacquers; Drugs & medicines; Soap & cleaning preparations; Other chemical products; Petrol & coal products; Processed rubber; Rubber products; Plastic products; China, glass & pottery; Clay products; Cement, lime & plaster; Other non-metal products; Non-ferrous metal
	Thailand	Basic Industrial Chemicals; Synthetic Resins and Plastics; Fertilizer and Pesticides; Paints Varnishes and Lacquers; Drugs and Medicines; Soap and Cleaning Preparations; Cosmetics; Matches; Other Chemical Products; Petroleum Refineries; Other Petroleum Products; Rubber Sheets and Block Rubber; Tyres and Tubes; Other Rubber Products; Plastic Wares; Cement; Concrete and Cement Products; Ceramic and Earthen Wares; Glass and Glass Products; Structural Clay Products; Other Non-metallic Products; Non-ferrous Metal
	Vietnam	Cude oil, natural gas (except exploration); Glass and glass products; Ceramis and by products; Bricks, tiles; Ciment; Concrete, mortar and other cement products; Other building materials; Basic organix chemicals; Basic inorganix chemicals; Chemical fertilizer; Fertilizer; Pesticides; Veterinary; Health medicine; Processed rubber and by products; Soap, detergents; Perfumes and other toilet preparation; Plastic (including semi-plastic products); Other plastic products; Paint; Inl, varnish and other painting materials; Other chemical products; Non-ferrous metals and products(except machinery equipment); Gasoline, lubricants (already refined)
Metal Products	Indonesia, Philippines	Iron and steel; Metal products
	Malaysia	Iron & steel; Other fabricated metal and fixtures; Structural metal products; Other metal products;
	Thailand	Iron and Steel; Secondary Steel Products; Cutlery and Hand Tools; Furniture and Fixtures Metal; Structural Metal; Products; Other Fabricated Metal Products
	Vietnam	Ferrous metals and products
Electrical and Machinery	Indonesia, Philippines	Boilers, Engines and turbines; General machinery; Metal working machinery; Specialized machinery; Heavy Electrical; equipment; Television sets, radios, audios and communication equipment; Electronic computing equipment; Semiconductors and integrated circuits; Other electronics and electronic products; Household electrical equipment; Lighting fixtures, batteries, wiring and others; Precision machines
	Malaysia	Industrial machinery; Household machinery; Radio, TV & com. Equipment; Elect. appliances & houseware; Other electrical machinery Instruments & clocks
	Thailand	Engines and Turbines; Agricultural Machinery; Wood and Metal Working Machinery; Special Industrial Machinery; Office and Household Machinery; Electrical Industrial Machinery; Radio and Television; Household Electrical Appliances; Insulated Wire and Cable; Electric Accumulator & Battery; Other Electrical Apparatuses & Supplies; Scientific Equipments; Photographic & Optical Goods; Watches and Clocks; Recreational and Athletic Equipment
	Vietnam	Health instrument and apparatus; Precise and optics equipment, meter (all kinds); Home appliances and its spare parts; General-purpose machinery; Other general-purpose machinery; Other special-purpose machinery; Electrical machinery; Other electrical machinery and equipment; Machinery used for broadcasting, television and information activities
Transport Equipment	Indonesia, Philippines	Motor vehicles; Motor cycles; Shipbuilding; Other transport equipment
	Malaysia	Ships & boats; Motor vehicles; Cycles & motorcycles; Other transport equipment
	Thailand	Motor Vehicle; Motorcycle, Bicycle & Other Carriages; Repairing of Motor Vehicle; Ship Building; Railway Equipment; Aircraft
	Vietnam	Motor vehicles, motor biles and spare parts; Bicycles and spare parts; Automobiles; Other transport mean

Sources: UNCTAD-Eora value-added-trade database