International production networks in ASEAN economies

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III. International Production Networks in ASEAN Economies

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Asia has in the recent decades been and will in the upcoming decades be a growth center in the world. For its future, the Asian Development Bank (ADB) presented the scenario called the "Asian century", in which Asian share of global GDP will nearly double from 27 percent in 2010 to 51 percent by 2050 (see ADB (2011)). One of the driving forces for Asian economic growth has been and will be *de facto* economic integration through forming international production networks (hereafter IPNs) especially in manufacturing sectors. In contrast with Europe, Asia includes countries with quite different historical, cultural, and political background and at different development stages. In addition, there is no top-level management to substitute for WTO discipline, as pointed out by Baldwin (2006). However, the economic integration in Asia has voluntarily developed through creating and enlarging IPNs by effectively taking advantage of different location advantages with diversified development stage.

Kimura (2006) described the features of IPNs in East Asia in such ways of active foreign direct investment, development of cross-border production sharing or fragmentation, sophisticated disintegration of production activities, and the formation of industrial agglomeration, particularly in machinery industries. In his paper, the "18 facts" on IPNs in East Asia were identified based on a number of studies using international trade data, micro-data of Japanese multinational-enterprises (hereafter MNEs), and casual observations. One of the important messages in his paper is that the mechanics of such production networks in East Asia must basically follow "fragmentation theory", which was first proposed in Jones and Kierzkowski (1990 and 2005). It states that a firm's decision on whether to fragment or not depends on the differences in location advantages and the levels of the "service-link costs", which are costs to link remotely-located production blocks. The large differences in location advantages and the lower the service-link costs encourage firms to facilitate the fragmentation.

Under these backgrounds, this chapter examines the IPN development mainly by focusing on ASEAN economies, which have occupied the core part of East Asian networks. The chapter is structured as follows: Section 1 presents the conceptual framework with key literature related to the theory of agglomeration and fragmentation for elucidating the mechanism of IPNs in East Asia; Section 2 provides empirical evidence on the recent evolution of the IPNs focusing on ASEAN economies through

the analyses of intra-ASEAN trade and Japanese MNEs activities; Section 3 investigates economic dynamic impacts of the IPNs participation by examining value-added-trade patterns; and Section 4 summarizes the analytical outcomes and concludes.

1. Conceptual Framework for IPNs

This section represents the conceptual framework with key literature related to the theory of agglomeration and fragmentation for elucidating the mechanism of IPNs.[1] We first pick up two representative kinds of theories: agglomeration and fragmentation theory, and then try to figure out the realities of the IPNs in East Asia by the combination form of agglomeration and fragmentation.

1.1 Agglomeration versus Fragmentation

The agglomeration theory, usually known as the "new economic geography", was advocated in Krugman (1991) and Krugman and Venables (1990). The theory focused on the interaction among increasing returns, transportation costs, and the movement of productive factors, for elucidating "agglomeration", with the origin of clusters itself being a naturally occurring phenomenon. Their model described the forces for agglomeration as backward linkage (the firms locate close to a large market) and forward linkage (the workers live close to a large market). Then, the model demonstrated that the fall of transportation costs allows manufacturing firms to agglomerate in the "core" region, and to transport manufactured goods to the agricultural "periphery" region. In this sense, their model greatly contributed to understanding the development of industrial clusters.

The fragmentation theory was presented by Jones and Kierzkowski (1990 and 2005) rather as an alternative framework to the agglomeration theory. Their model was characterized in such a way that the increasing returns come mainly from the services required to link disparate fragments of a production process, not from the factory floor as supposed by Krugman and Venables (1990). Their model depicted: a production process consists of a number of blocks that can be fragmented in different geographic regions, even to a variety of countries; the incentive to do so is provided by the different skills or factor combinations required in various fragments, and the variety of factor prices and/or factor skills available in different locations (location advantages); but extra costs are involved – those of transportation, but also of finance, co-ordination, communication, etc, so-called service-link costs; then, lowering the service-link costs

[1] The essence of this section relies on Taguchi *et al.* (2013).

encourages “fragmentation”.

In a sense, the theory of “fragmentation” seems to be rather contradictory to the theory of “agglomeration”, in the sense that according to the former theory, lowering transportation costs leads to not agglomeration but dis-agglomeration – a dispersal of productive activity to locations, i.e., a better fit of the separate fragments to location advantages. Then we have to discuss how to describe the reality of the IPNs in East Asia by using the confronting theories of “agglomeration” and/or “fragmentation” in next section.

1.2 Agglomeration of Fragments

If lowering transportation costs bring about the confronting momentums, agglomeration and fragmentation, as shown in previous section, the question will be which of momentums would be dominant in a specific area, namely, in East Asia. Hayakawa et al. (2011) provided suggestive evidence in this issue, by comparing the case of East Asia with that of Europe. They conducted an empirical investigation of the difference in spatial relationship in the electric machinery production between East Asian countries and European ones by utilizing spatial econometric analysis. They found that a dispersed industrial distribution in East Asia is contrasted with a concentrated distribution in Europe, and that while the production of the industry in a country is positively correlated with that of neighboring countries in East Asia, there is no spatial correlation in Europe. They attributed this contrast between East Asia and Europe to the difference in intra-regional disparities in location advantages such as factor prices between East Asia and Europe: large disparity in East Asia and small one in Europe. Thus, Hayakawa et al. (2011) implied that the fragmentation effect is more dominant in East Asia than in Europe.

While the large disparity in location advantages and the fall of service-link costs have facilitated the fragmentation momentum in East Asia, the agglomeration one still seems to have been working in East Asia, as Kimura (2006) stated in his “18 facts” that agglomeration or industrial clusters have begun to be formulated in East Asia. Then, next question is how we can understand the reality of East Asia in which both momentums of fragmentation and agglomeration are working, in another word, what the ultimate combination form of fragmentation and agglomeration is in East Asia.

Although the forces of fragmentation and agglomeration are confronting at the firm level, both may go together at the industry level. Jones and Kierzkowski (2005) argued that a melding of the two strands of argument – agglomeration and dis-agglomeration may be created in such a way of a subsequent “agglomeration of fragments” from

different industries with fragments that nonetheless require similar relative quantities and qualities of productive inputs[2]; and that the agglomeration of fragments comes from the Marshall's externalities especially in terms of the advantage of thick markets for specialized skills. Amiti (2005) demonstrated theoretically the similar kind of "agglomeration of fragments". Namely, it showed that, in some range of trade costs, finished goods firms are concentrated in one country, and another country has the agglomeration of intermediate goods firms. Kimura (2006) clarified the two kinds of channels for generating the concentration of fragmented production blocks: first, local minimal points of service-link costs tend to attract a large number of fragmented production blocks; second, the concentration of production blocks is coming from the close relationship between the service-link costs in arm's-length fragmentation and geographical proximity.[3]

In sum, under lowering service-link costs, fragmentation would go on as far as location advantages differ, whereas the fragments covering wide sectors might agglomerate due to the externalities. If national border created the differences in location advantages, an ultimate form might be a combination of fragmentation across countries and agglomeration of fragments within a country. The next section will provide empirical evidences for the fragmentation and the agglomeration of fragments in ASEAN economies.

2. Empirical Evidence on ASEAN IPNs

This section provides empirical evidence on the recent evolution of the IPNs –the progress of the fragmentation and the agglomeration of fragments focusing on ASEAN economies.[4] Kimura (2006) categorized the facts related to the IPNs into three types: facts that are identified by international trade data, facts that are confirmed by micro-data for multinational enterprises, and facts that are found by case studies and casual observations. Among these categories, we herein focus on the facts drawn from international trade data in terms of intra-trade for examining the progress of fragmentation, and on the facts from the micro-data of Japanese MNEs for representing

[2] As the example of agglomerated fragments with a wide array of sectors, they referred to computer chips from computers to a wide range of uses ranging from toasters to automobiles.

[3] To analyze the firm's behavior in East Asia, Kimura and Ando (2005) proposed a concept of "two-dimensional fragmentation"; geographical fragmentation and organizational (arm's-length) fragmentation. Kimura (2006) pointed out that the arm's-length fragmentation requires geographical proximity due to its service-link cost in searching for business partners, consulting detailed specs of products, controlling product quality and delivery timing, and so on.

[4] The essence of this section relies on Taguchi et al. (2013).

the agglomeration of fragments, in ASEAN economies.

2.1 Fragmentation: Evidence from Intra-ASEAN Trade

The international trade data do not present the whole structure of the IPNs, in the sense that they do not detect who is trading with whom, i.e. the firm's activity for fragmentation itself. The data, however, provide a lot of useful information on the cross-border flows of goods including parts and components, which contributes to the secondary approach to the IPNs. It is because the IPNs in terms of fragmentation are associated with active back-and-forth international transactions of intermediate goods. Just as Kimura (2006) observed explosive increases in intra East-Asian trade in his "18 facts", we herein investigate the trends in intra-ASEAN trade since the 1990s, and examine the trade in machinery parts and components as well as the total trade, since the machinery industry occupies the major parts in the IPNs. We use the "Direction of Trade Statistics" of International Monetary Fund for the total trade, while using the "United Nations Commodity Trade Statistics Database" for the trade of machinery parts and components.

Table 1 represents that the intra-ASEAN trade ratio on the total trade has gone up from 17.0 % in 1990 to 25.6% in 2010.[5] It should be noted that the intra-trade ratio of Mekong region within ASEAN has rapidly risen from 8.7% in 1990 to 32.3% in 2010. When we focus on the trade in machinery parts and components that reflects fragmentation more closely[6], the intra-ASEAN trade ratio reached 25.0% in 2000, but slightly declined to 24.3%, whereas the intra-trade ratio of Mekong region within ASEAN has continued to increase from 0.2% in 1990 to 16.8% in 2010. The trends in intra-trade ratios differ a bit according to the major components of machinery parts: motor vehicle parts and accessories, telecommunication equipment parts and accessories, and electrical apparatus for making and breaking electrical circuits. The common trends are, however, the more active growth in the intra-trade in Mekong region within ASEAN than in ASEAN itself.

Table 2 indicates the growth of intra-trade in terms of exports in ASEAN. Consistently with the trend in intra-trade ratio, the intra-trade in ASEAN has showed a definite growth since the 1990s, but its growth of Mekong region is exceeding that of ASEAN in both the total trade and the trade of machinery parts and components. The main contribution is coming from both Thailand exports to Vietnam and Vietnam

[5] Regarding with the intraregional trade ratios in various regions, Kawai (2009) showed that the ones of East Asia, the area in North American Free Trade Agreement (NAFTA) and the European Union were 54%, 43% and 57% in 2007, respectively.

[6] As for the definition of "machinery parts and components", see the note No 3 of Table 1.

exports to Thailand in the case of the trade of machinery parts and components. Among the machinery parts and components, there is some contrast in the contribution to intra-trade growth: the motor vehicle parts and accessories show the dominance of Thailand exports to Vietnam, whereas the telecommunication equipment parts and accessories represent the dominance of Vietnam exports to Thailand, and the electrical apparatus for making and breaking electrical circuits reveal the contribution of both Thailand exports to Vietnam and Vietnam exports to Thailand.

In sum, the evolution of the IPNs in ASEAN, in particular, Mekong region could be identified typically from the rise in intra-regional trade of machinery parts and components. Such a rise in Mekong region comes from especially the growth of their two-way trade between Thailand and Vietnam. The issues to be cleared for the further extension of the IPNs in ASEAN such as regional connectivity to reduce service-link costs will be discussed in the subsequent chapters.

2.2 Agglomeration of Fragments: Evidence from Japanese MNEs' Activities

This section investigates the "agglomeration of fragments" for selected ASEAN economies: Thailand, Indonesia and Vietnam. The phenomena of the agglomeration can often be observed by the proliferation of industrial estates and industrial parks. If firms agglomerated in a specific industrial estate produce some fragments in a long-ranged supply-chain for creating a final product, the firms' activities such as sales-output are supposed to be linked with those of firms in the other industrial estate. When national border creates the differences in location advantages, the fragmentation may expand beyond the national border. In this case, the sales-outputs in industrial estates in one country may be correlated with the other ones in the other country. We herein examine the correlation of the sales-trends across industrial estates, using the firm-level data for the foreign affiliates of Japanese manufacturing firms.

Data Processing for Industrial Estates

As data sources, we use two kinds: the "Basic Survey on Overseas Business Activities" by Ministry of Economy, Trade and Industry, Government of Japan, and "Overseas Japanese Companies Data" by Toyo Keizai Inc.. The "total sales" of overseas affiliates of Japanese companies[7] are obtained by the former data. Thus, as an initial step, we get their time-series data from 2001 to 2010 by the 16 industrial categories.[8] This sample includes 864 firms in Thailand, 400 firms in Indonesia, and 247 firms in

[7] The definition of the "overseas affiliates of Japanese companies" is shown in http://www.meti.go.jp/english/statistics/tyo/kaigaizi/pdf/h2c423engt.pdf.

[8] The 16 categories of manufacturing are denoted in Table 3 in terms of two digit classification.

Vietnam. As a second step, each firm is classified according to industrial estates, thereby requiring its location information. We identify the location address of each firm sample by matching the former data without location information and the latter data (Toyo Keizai) with location information by using company's name. Through this procedure, the samples are reduced into 595 firms in Thailand, 291 firms in Indonesia and 134 firms in Vietnam, since some of samples suffer mismatching of both data, and also since some of the sample firms do not belong to an industrial estate. We restrict industrial estates only to those in which more than five sample firms are identified, since few samples often create the instability of the data trend for industrial estates. As a result, our sample includes 265 firms in 18 industrial estates of Thailand, 76 firms in five industrial estates of Indonesia, and 55 firms in six industrial estates of Vietnam.

We aggregate these sample firms' total sales according to the 16 industrial categories of manufacturing, and also according to industrial estates and three countries aggregating industrial estates, thereby constructing a panel data of the total sales with the 16 industrial categories of manufacturing for the period from 2001 to 2010 by each industrial estate and by three countries aggregating industrial estates (see Table 3).

We modify the data for the "total sales" of sample firms by deflating the nominal GDP in the countries they belong to. It is because the trends in sales have often been affected by macroeconomic conditions such as the global financial economic crisis in 2008 and domestic inflation. The real correlation of sales trends of industrial estates across the countries can be verified only when the influences from such factors as macroeconomic variables are removed for the correlation estimation.

Correlation of Sales Trends

Table 4 reports the correlation coefficients of the sales trends of industrial estates across three countries through the panel estimation. At the level aggregated into countries, we can see the highest correlation, 0.7 between Thailand and Vietnam, followed by 0.5 between Indonesia and Vietnam, and 0.1 between Thailand and Indonesia. The higher correlation between Thailand and Vietnam followed by the one between Indonesia and Vietnam may imply the existence of the "agglomeration of fragments" in both countries. And the difference in the correlation, namely the difference in the degree of fragmentation may simply reflect the difference in one of the fragmentation factors, i.e., the difference in location advantages. The difference in location advantages is typically shown by the gap in GDP per capita among about 5,000 US dollars in Thailand, about 3,000 in Indonesia and around 1,000 in Vietnam.[9] Its

[9] According to the World Economic Outlook Database of International Monetary Fund (October 2013),

largest gap between Thailand and Vietnam appears to have propelled the fragmentation to largest extent.

As for the level of industrial estates, it should be noted that the correlation coefficients between aggregated Thailand and each industrial estates in Vietnam are highly positive in all of the combinations and rather stronger than those between aggregated Vietnam and each industrial estates in Thailand. From this observation, we may say that the close linkage between Thailand and Vietnam is coming from the more heavily dependence of the sales activities of Vietnamese industrial estates on manufacturing production in Thailand. It should also be noted that even under the less correlation at the aggregated-country level like the one between Thailand and Indonesia, there have been several combinations with high sales-correlation between individual industrial estates.

In sum, the "agglomeration of fragments" among selected ASEAN countries, especially between Thailand and Vietnam, could be observed from the high correlation of the sales trends across industrial estates. The observation on "agglomeration of fragments" implies the win-win relationship in industrial activities among ASEAN economies, since industrial activities in agglomerated form in one country are connected with those in the other country through fragmentation linkage where the industries of one country grow up when those of the other country grow up. It is nothing but this win-win economic linkage in ASEAN that justifies the facilitation of regional cooperation frameworks such as ASEAN Economic Community and the Greater Mekong Sub-region (GMS).

3. Dynamic Economic Impacts of IPN Participation

This section investigates the economic impacts of IPN participation by examining value-added-trade patterns focusing on Asian developing countries. Our concern is whether a developing economy, especially a latecomer's economy, can really enjoy the improvement of its economic performance in case that the economy accepts and participates in IPNs. The World Investment Report 2013 published by UNCTAD (hereafter WIR (2013)) presented the comprehensive analyses on global value chains[10] in its Chapter IV, including the impacts of value chains in terms of local-value capture, job creation, technology dissemination as direct effects as well as of upgrading and building long-term productive capabilities. Our contributions are to focus the impact

the GDP per capita in 2010 of Thailand, Indonesia and Vietnam are 4,740 US dollars, 2,986 US dollars, and 1,298 US dollars, respectively.

[10] In this report, the terminology of "global value chains" is used as the same content as IPN.

analyses on Asian developing economies and to describe the dynamic economic impacts of the IPNs there from the perspective of their GDP contributions. We first clarify analytical framework by value added trade, present a hypothesis on the IPN development path, provide empirical evidence, and finally summarize.

3.1 Analytical Framework by Value Added Trade

The data of value added trade, which have recently been developed by several international organizations, enable us to examine the IPNs from another angle, i.e., the origin of value added creation in exports and its contribution to GDP.

The structure of value added trade is described in a simplified form in Figure 1. We suppose that raw materials, parts and components extracted and produced in Country A are exported to Country B for their processing and manufacturing by 10 units, and then re-exported to Country C for their final demand by 25 units. The ordinary account of gross exports is totaled into 35 units (10 units in Country A plus 25 units in Country B). The new account named "value added trade" makes it possible to divide gross exports into their domestic value added and foreign (imported) value added, and thus to extract net value added exports from gross exports. In this case, the total exports of value added are 25 units (10 units in Country A plus 15 units in Country B). We also know the double account of total gross exports as 10 units (35 units minus 25 units). According to WIR (2013), at the global level, about 5 trillion dollars of the 19 trillion dollars in 2010 world exports are "double counted" in global trade figures.

Regarding with value added trade statistics, value added in trade can be estimated on the basis of international input-output tables that depict the economic interactions between countries. Due to the growing demand for analyses, several institutions such as UNCTAD, OECD, WTO, IDE-JETRO, have sought to compile value added trade using different methodologies.[11] WIR (2013) utilized the UNCTAD-Eora GVC Database built by UNCTAD in s collaboration with the Eora project. This study uses "OECD-WTO Trade in Value Added (TiVA) database", because the database is only one that is open to the public since May 21, 2013.[12]

By using the data on value added trade, we can extract the following key variables to analyze the structure of the IPNs: 1) Foreign value added as a share of gross exports (FVX), 2) Domestic value added as a share of gross exports (DVX), and 3) Domestic value added in exports as a ratio of GDP (DVY). This study focuses all the exports on those of manufacturing sectors. We interpret FVX as a proxy of the IPN participation

[11] There has also been a trial to unify the methodologies to estimate value added trade. See, for instance, Koopman (2012).

[12] It can be downloaded through http://stats.oecd.org/.

ratio, since the foreign value added incorporated into exports is a form of a multi-stage trade process in the IPNs from the upstream perspective. WIR (2013), however, added the exported value added incorporated in third-country exports from the downward perspective. This study does not include the latter element in IPN participation for the following two reasons. First, the OECD-WTO TiVA database does not classify the portion of exported value added embedded in third-country exports. Second, the downward element in IPN is sometimes dominant also in a group of countries exporting natural resources and raw materials. This study is, however, targeting the conventional IPNs in manufacturing sectors in Asian countries, and not targeting the IPNs in commodity-exporting group. The DVY is an indicator to measure the extent to which trade contributes to the GDP of a country.

3.2 Hypothesis on IPN Development Path

We next present a hypothesis on the IPN development path, which illustrates the dynamic evolution process of the IPNs in the context of the framework above by value added trade (see Figure 1).[13] At the early stage before IPN participation, an economy stays at high DVX and low DVY, in which most of exports are domestically produced and their contribution to GDP is small. When an economy participate in IPN, it moves to the stage with low DVX and high DVY, since an economy's production for its exports have to depend highly on imports of parts, components and machineries from foreign countries, whereas its absolute production value for exports contributes a lot to its rising GDP. At the matured stage of IPN involvement, an economy can enjoy a combination of high DVX and high DVY; its production for exports continues to contribute to GDP growth, and at the same time, the dependence on imports for its exports declines due to the upgrade of domestic productive capacities.

The process of enhancing local productive capacities may involve a number of mechanisms: the key exporting industries may provide opportunities for local industries to participate in IPNs, which will leads to generating additional value added through local sourcing within and across industries; and/or the key exporting industries themselves may attain their industrial upgrading through technology dissemination and skill building, which will improve their productivity and will facilitate their entries and expansions towards higher valued sectors. It should be noted that the IPN development path is not always realized automatically and its achievements differ according to the characteristic of the IPN and the involved countries. Government policies also matter to optimize the economic contributions of the IPN participation and involvement.

[13] The essence of the hypothesis comes from the description of WIR (2013).

Based on this hypothesis on IPN development path, we extract empirical evidence from the following perspectives. The first one is the relationship between IPN participation and its GDP contribution. It can be examined by estimating a linear-positive correlation between FVX and DVY. The second one is the association between the contribution of domestic value added to exports and development stages. It can be addressed by estimating a correlation between DVX and per capita GDP (hereafter PCY). As the hypothesis shows, the DVX will follow not one-off moves but such a sequence of moves as high, low and high ones along development process, thereby creating "smile curve".[14] The empirical evidence will be presented in the next sub-section.

3.3 Empirical Evidence on IPN Dynamic Impacts

Before presenting the empirical evidence based on the perspectives fore-mentioned, we clarify the data available for sample countries and periods. Regarding with the data for value added trade of "Gross exports", "Foreign value added content of gross exports" and "Domestic value added embodied in gross exports", the OECD-WTO TiVA database that we use confines sample countries to 24 developing countries and sample years to 5 years of 1995, 2000, 2005, 2008 and 2009. We adopt all of 24 countries for total-sample estimation and also 8 Asian developing countries for Asian-sample estimation: Cambodia, China, India, Indonesia, Malaysia, Philippines, Thailand and Vietnam. As for sample years, we exclude the year of 2009 that was seriously influenced by the world Lehman Shock. In all variables, we extract manufacturing sectors from 15 to 37 in the code of the International Standard Industrial Classification of All Economic Activities Rev.3.1. The data of GDP and per capita GDP are retrieved from "World Economic Outlook Database October 2013" by International Monetary Funds in terms of "Gross domestic product, current prices, U.S. dollars" and "Gross domestic product per capita, current prices, U.S. dollars", and selected by the same countries and years as the data of value added trade. In sum, we construct panel data with 24 developing countries and 8 Asian countries for 4 years of 1995, 2000, 2005 and 2008, to conduct the following panel estimation.

Regarding with the first perspective, namely, the relationship between IPT participation and its GDP contribution, Table 5 reported the estimation outcomes (Figure 3 described simply their relationship). In panel estimation, we usually assume a country-specific effect, and adopt either fixed-effect model or random-effect one

[14] The "smile curve" originated from Baldwin (2012) in the different context of firm-level analysis, which described the connection between manufacturing stages and stage's share of product's total value added.

according to its correlation with the explanatory variable (the former in case of the existence of the correlation and the latter in its absence). Based on the statistics of the Wu-Hausman test (see Hausman (1978)), which is used to help choose between these two models, we adopt random-effect model. Under this model, we could get an expected outcome, i.e., a positive correlation at 99 percent significant level between DVY and FVX in both total sample estimation and Asian sample estimation. Thus, it suggested that an economy's participation in IPNs allows an absolute domestic value added for exports to contribute to GDP growth.

As for the second perspective, namely, the association between the contribution of domestic value added to exports and development stages, Table 6 denoted the estimation outcomes (Figure 4 described simply their relationship). We also adopt random-effect model following the Wu-Hausman test results. In both total and Asian quadratic estimation, we could obtain also expected results: the coefficient of PCY is significantly negative; the one of a square of PCY is discernibly positive; and the turning points in PCY are 14,559 dollar in total estimation and 5,651 in Asian estimation. Thus, the U-shape, smile curves were identified in the development path of domestic value added contribution to exports. In particular, it should be noted that Asian estimation outcome was not valid in linear regression, only valid in quadratic equation with all coefficients being significant at 99 percent level, and that the turning point of per capita GDP, 5,651 dollar is highly reasonable level.

3.4 Summary

This section investigated the dynamic economic impacts of IPN participation by examining value-added-trade patterns focusing on Asian developing countries. Our findings were as follows. First, an economy's participation in IPNs in manufacturing sectors has allowed an absolute domestic value added for exports to contribute to GDP growth. Second, the development path of domestic value added contribution to exports has followed "smile curve" with the bottom being 5,651 dollars in per capita GDP. It means the dynamic process where the initial stage of IPN participation has reduced domestic value added contribution to exports, but it has recovered at mature stage of IPN involvement with upgrading domestic productive capacities.

4. Concluding Remarks

This chapter examined the IPN development mainly by focusing on ASEAN economies. The emphases through the findings and observations can be highlighted as

follows: the IPNs have actually been developed since 1990s in ASEAN, especially in Mekong region with rapid way; the IPN development has been accompanied with win-win relationships of industrial activities among ASEAN economies; and an economy's IPN participation has contributed to its GDP growth with dynamic "smile curve" development path with upgrading industrial capacities. For further penetration of IPNs at the edge of ASEAN, there should be several issues to be cleared such as enhancing regional connectivity. This will be discussed in the subsequent chapters.

References

Amiti, M., 2005. Location of Vertically Linked Industries: Agglomeration versus Comparative Advantage, *European Economic Review*, Vol.49, No.4, pp.809-832.

Asian Development Bank (ADB), 2011. *Asia 2050: Realizing the Asian Century*, ADB, Manila.

Baldwin, R., 2006. Managing the Noodle Bowl: The Fragility of East Asian Regionalism, *CEPR Discussion Paper*, No. 5561.

Baldwin, R., 2012. Global Supply Chains: Why They Emerged, Why They Matter, and Where They Are Going, *CEPR Discussion Paper*, No. 9103.

Hausman, J.A., 1978. Specification Test in Econometrics, *Econometrica*, Vol. 46, No.6.

Hayakawa, K., Zheng, J.I. and Obashi, A., 2011. Spatial Distribution of Industrial Production: A Comparison of East Asia and Europe, *The Developing Economies*, Vol.49, No.4, pp.363-381.

Jones, R.W. and Kierzkowski, H., 1990. The Role of Services in Production and International Trade: A Theoretical Framework, in Jones, R. and Krueger, A. (Eds.), *The Political Economy of International Trade: Essays in Honor of Robert E. Baldwin*, Basil Blackwell, Oxford, pp.31-48.

Jones, R.W. and Kierzkowski, H., 2005. International Trade and Agglomeration: An Alternative Framework, *Journal of Economics*, Vol.10, No.S1, pp.1-16.

Kawai, M., 2009. International exchange and monetary system in East Asia, *Financial Review*, vol. 93, No. 1, pp. 176-194 (Japanese).

Kimura, F., 2006. International Production and Distribution Network in East Asia: Eighteen Facts, Mechanics, and Policy Implication, *Asian Economic Policy Review*, Vol.1, No.2, pp.326-344.

Kimura, F. and Ando, M., 2005. Two-dimensional Fragmentation in East Asia: Conceptual Framework and Empirics, *International Review of Economics and Finance*, Vol.14, No.3, pp.317-348.

Koopman, R., Wang, Z. and Wei, S.J., 2012. Tracing Value-added and Double Counting in Gross Exports, *NBER Working Paper*, No. 18579.

Krugman, P., 1991. Increasing Returns and Economic Geography, *Journal of Political Economy*, Vol.99, No.3, pp.483-499.

Krugman, P. and Venables, A., 1990. Integration and the Competitiveness of the Peripheral Industry, in Bliss, C. and Braga, D.M.J. (Eds.), *Unity with Diversity in the European Economy: The Community's Southern Frontier*, Cambridge University Press, Cambridge, pp.56-75.

Taguchi, H., Matsushima, D. and Hayakawa, K., 2013. The Emerging Production Networks in Mekong Region, *International Journal of Trade and Global Markets*, forthcoming.

UNCTAD, 2013. *World Investment Report - Global Value Chains: Investment and Trade for Development*, UNCTAD.

Table 1 Intra-ASEAN Trade Ratios

%	ASEAN to the world	Mekong region within ASEAN
Total trade		
1990	17.0	8.7
2000	22.7	18.0
2010	25.6	32.3
Machinery parts and components: Total		
1990	21.3	0.2
2000	25.0	8.6
2010	24.3	16.8
Motor vehicle parts and accessories		
1990	1.1	0.3
2000	16.8	4.0
2010	29.7	15.6
Telecommunication equipment parts and accessories		
1990	27.3	0.2
2000	24.9	1.5
2010	17.9	21.9
Electrical apparatus for making and breaking electrical circuits		
1990	26.3	1.3
2000	28.7	20.7
2010	28.4	18.6

Notes:
1. Mekong-region: Cambodia, Lao PDR, Myanmar, Thailand and Vietnam
2. ASEAN: Mekong-region plus Brunei, Indonesia, Malaysia, Philippines and Singapore
3. The identification of "Machinery parts and components" is the same as the one of Kimura et al. (2007): The codes of the SITC Revision 2 are as follows.
7119,71319,71331,71332,7139,7149,7169,71889,72119,72129,72139,72198,72199,7239,72449,72469,72479,7259,72689,7269,72719,72729,72819,72839,72849,7369,73719,73729,74149,7429,7439,74419,7449,74519,74523,74999,759,764,77129,772,77579,77589,77689,77819,77829,77889,784,78539,78689,79199,7929,82119,82199,87429,88119,88121,88129,88411,88529,89949
4. Intra-ASEAN Trade Ratio = (intra-ASEAN exports + intra-ASEAN imports)
/ (ASEAN exports to world + ASEAN imports from world)
Intra-trade ratio of Mekong region within ASEAN
= (intra-Mekong exports + intra-Mekong imports)
/ (Mekong exports to ASEAN + Mekong imports from ASEAN)

Sources:
Direction of Trade Statistics in International Monetary Funds
Comtrade: http://comtrade.un.org/db
Taguchi *et al.* (2013)

Table 2 Growth of Intra-ASEAN Trade (Exports)

Total trade		
	Mekong Region	ASEAN
2010/2000	6.1	2.7
2010/1990	60.5	9.7
Contribution rate of growth for 2010/1990 in Mekong Region		
Thailand export to Vietnam	0.31	
Myanmar export to Thailand	0.14	
Thailand export to Cambodia	0.13	
Mashinery parts and components (Total)		
	Mekong Region	ASEAN
2010/2000	2.9	1.7
2010/1990	346.0	9.2
Contribution rate of growth for 2010/1990 in Mekong Region		
Thailand export to Vietnam	0.52	
Vietnam export to Thailand	0.29	
Thailand export to Cambodia	0.07	
Motor vehicle parts and accessories		
	Mekong Region	ASEAN
2010/2000	23.6	6.4
2010/1990	- (1990=0)	109.7
Contribution rate of growth for 2010/1990 in Mekong Region		
Thailand export to Vietnam	0.75	
Thailand export to Lao PDR	0.08	
Vietnam export to Thailand	0.07	
Telecommunication equipment parts and accessories		
	Mekong Region	ASEAN
2010/2000	21.0	1.3
2010/1990	466.3	4.5
Contribution rate of growth for 2010/1990 in Mekong Region		
Vietnam export to Thailand	0.67	
Thailand export to Vietnam	0.08	
Vietnam export to Cambodia	0.07	
Electrical apparatus for making and breaking electrical circuits		
	Mekong Region	ASEAN
2010/2000	3.7	1.5
2010/1990	197.9	10.3
Contribution rate of growth for 2010/1990 in Mekong Region		
Thailand export to Vietnam	0.55	
Vietnam export to Thailand	0.33	
Thailand export to Lao PDR	0.05	

Notes and Sources: See the ones of Table 1

Table 3 Samples of Manufacturing Firms in Industrial Estates

Industries	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	Total
Total of Samples	9	8	3	31	1	8	17	14	20	11	27	11	28	56	107	45	396
Thailand Total	7	4		17	1	4	10	9	16	7	20	8	23	34	78	27	265
304 Ind.	1			2					1						2		6
Amata City		1		1		1					1		1		2	1	8
Amatanakorn				1	1	1	1		1	4	5		2	3	22	4	45
Bangkadi											2		2	1	1	1	7
Bangpakon							2						2		3		7
Bangplee				2										1	2	2	7
Bangpoo	2	2		3		1	5		1		1				1		16
Eastern Seaboard	1			4				1	1		2		1		9	5	24
Gateway									1					1	3		5
Hi-tech								3	1			2		3	5	3	17
Ladkrabang										1	1		1		4	2	9
Laemchabang									1		1		4		4		10
Navanakorn	1			2		1		2	5	1	2	4	5	8	3	5	39
Northern Region									1			1		7	1		10
Rojana	1	1					1		1	1	4	1	2	9	3	3	27
Saharattananakorn	1			1				2	1					1	1	1	8
Siam Eastern							1						1		7		9
Wellgrow				1				1	1		1		2		5		11
Indonesia Total	1	2	1	10		3	5	2	3	2	3	1	4	14	16	9	76
Batamindo				1		1							2	4		1	9
Cikarang		1		1		1			1					1		1	6
EJIP	1	1		1		1	1		1	1	1		1	6	7	3	25
KIIC				3				1						2	3		9
MM2100			1	4			4	1	1	1	2	1	1	1	6	4	27
Vietnem Total	1	2	2	4		1	2	3	1	2	4	2	1	8	13	9	55
Bien Hoa	1	1	1	1									1	2		2	9
Long Binh				1										1	2	1	5
Noi Bai				1			1				1				3	1	7
Nomura Haiphom		1	1							1	1			1	4	2	11
Thang Long						1		2			1	2			4	3	13
Vietnam-Sin				1			1	1	1	1	1			4			10

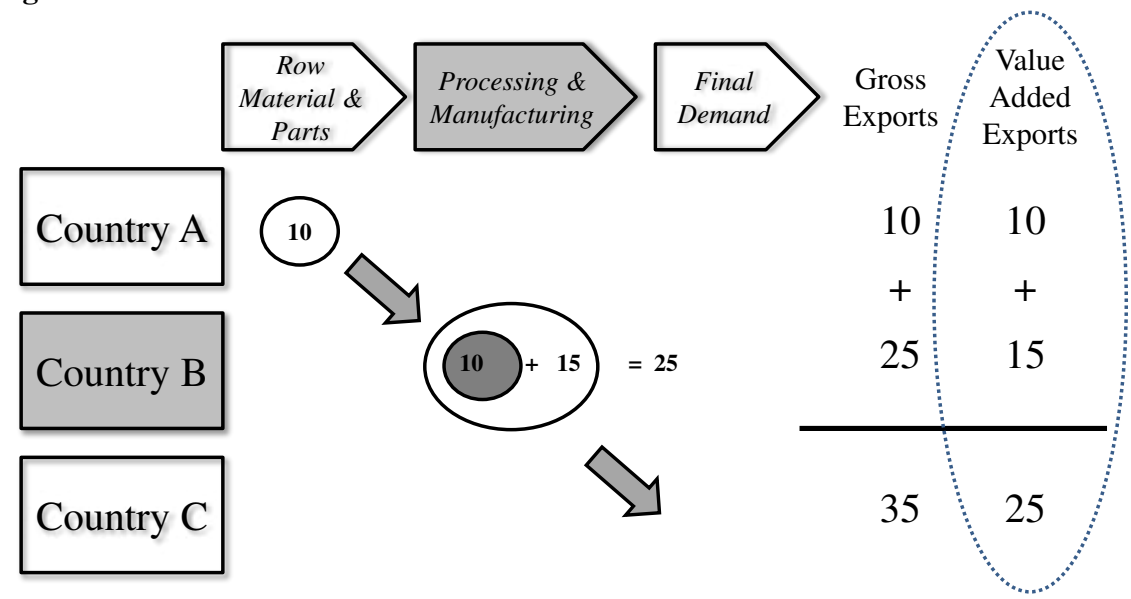
Note: Industrial Classification
04 Manufacture of food and beverages, tobacco, and feed
05 Manufacture of textile mill products
06 Manufacture of lumber and wood products and of pulp, paper and paper products
07 Manufacture of chemical and allied products
08 Manufacture of petroleum and coal products
09 Manufacture of ceramic, stone and clay products
10 Manufacture of iron and steel iron industries
11 Manufacture of non-ferrous metals and products
12 Manufacture of fabricated metal products
13 Manufacture of general-purpose machinery
14 Manufacture of production machinery
15 Manufacture of business oriented machinery
16 Manufacture of electrical machinery, equipment and supplies
17 Manufacture of information and communication electronics equipment and of electronic parts and devices
18 Manufacture of transportation equipment
19 Miscellaneous manufacturing industries
Sources: Taguchi *et al.* (2013)

Table 4 Correlation Coefficients of Sales Trends in Industrial Estates

	Vietnem Total	Bien Hoa	Long Binh	Noi Bai	Nomura Haiphom	Thang Long	Vietnam-Sin	Indonesia Total	Batamindo	Cikarang	EJIP	KIIC	MM2100
Thailand Total	0.7	0.6	0.3	0.9	0.6	0.2	0.4	0.1	-0.2	-0.4	-0.1	-0.3	0.0
304 Ind.	0.8	0.7	-0.2	0.4	0.1	-0.6		0.5	-0.9	-0.9	-0.2	-0.6	-0.6
Amata City	0.2	0.8	0.5	0.5	-0.1	0.1		-0.1	-0.7	0.3	0.5	0.2	-0.2
Amatanakorn	0.0	-0.2	-0.3	0.7	0.9	0.6	-0.2	0.2	-0.1	-0.6	0.0	0.1	0.0
Bangkadi	-0.5	-0.4				0.4		-0.3	0.5		-0.4		-0.2
Bangpakon	0.3	0.0	0.4	0.7	0.1	0.2	0.0	-0.2	-0.1		-0.4	0.8	-0.4
Bangplee	0.2	0.8	0.4	-0.2	0.1	0.8	-0.7	0.6	-0.2	-0.3	0.2	0.0	0.6
Bangpoo	0.3	0.8		0.9			0.2	0.0	0.8	0.4	0.0	0.4	0.0
Eastern Seaboard	0.1	-0.2	0.0	0.7	0.4	-0.4		-0.1	0.0	-0.3	-0.3	-0.3	0.1
Gateway	0.4		-0.7	0.6	0.8	0.6		0.9			-0.3	0.8	-0.3
Hi-tech	-0.2	0.9	0.6	0.4	0.5	0.1	-0.6	0.2	0.1	0.7	0.4	0.3	0.7
Ladkrabang	-0.3	0.0	0.2	0.7	0.1	0.1		0.6	-0.2		0.7	0.0	0.4
Laemchabang	0.4	0.5	-0.5	0.9	0.8	0.6		0.7	0.4	0.8	0.3	0.7	0.2
Navanakorn	0.3	0.0	0.1	0.9	0.4	-0.2	0.6	0.5	0.0	-0.4	0.2	-0.4	0.3
Northern Region	0.4	0.6	0.6	0.7	0.5	0.4	0.6	-0.2	-0.4	-0.1	-0.4	-0.3	0.2
Rojana	0.7	0.5	0.0	-0.2	0.1	0.8	0.3	0.6	-0.2	-0.1	0.2	0.2	0.4
Saharattananakorn	0.6	0.2	0.0	0.3	0.6	0.6	0.7	0.7	-0.4	-0.4	0.1	0.7	0.2
Siam Eastern	0.0	0.1	-0.1	0.9	0.7	0.8	0.1	0.0	0.0		-0.1	0.4	-0.2
Wellgrow	-0.1	-0.4	-0.5	0.4	0.7	0.6		-0.1	0.1	0.2	-0.2	0.2	0.0
Indonesia Total	0.5	0.2	-0.4	0.2	0.9	0.9	-0.2						
Batamindo	-0.4	-0.1	0.1	-0.8		0.0	-0.5						
Cikarang	-0.1	0.2	0.5	-0.8	0.9		-1.0						
EJIP	0.3	0.3	0.1	0.2	0.9	0.7	-0.3						
KIIC	-0.6	0.8	-0.2	-0.6	0.8	0.8	-0.7						
MM2100	0.4	0.9	0.1	-0.4	0.7	0.7	-0.4						

Notes:
The sales trends are the ones of Japanese manufacturing companies' samples in each industrial estate for the period from 2001 to 2010.
The sales are aggregated by industries, denominated by nominal GDP, and compliled into panel data for 2001-2010 in each estate.
Sources: Taguchi *et al.* (2013)

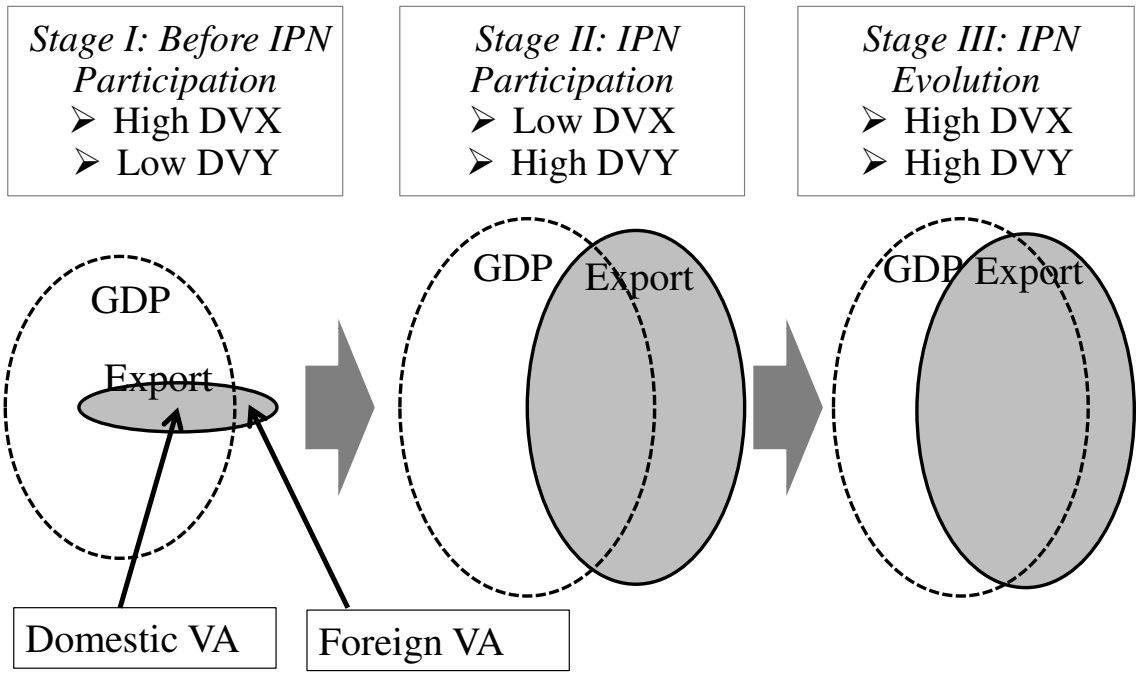
Figure 1 Structure of Value Added Trade



For Country B, Gross Exports (GR) = 25, Domestic VA = 15, Foreign VA = 10
IPN Participation Ratio = FVX (Foreign VA / GR) = 10 /25

Source: Author's description based on UNCTAN (2013)

Figure 2 IPN Development Path



Source: Author's description

Table 5 Estimation on GDP Contribution with IPNs Participation

Variales	DVY	
	Total	Asia
Const.	6.620 ***	3.379
	(3.190)	(0.665)
FVX	0.287 ***	0.379 ***
	(5.996)	(4.011)
Adj R^{**2}	0.270	0.330
Sample size	96	32
<the Wu-Hausman Test>		
Chi-Sq. Statistic	0.112	0.584
Chi-Sq. d.f.	1	1
Prob.	0.736	0.444
Estimation Type	Random	Random

Note:
1) The T-value is shown in parenthese.
2) One, two, or three asterisks indicate that a coefficient estimate is significantly different from zero at 10, 5, or 1% percent level, respectively.
Source: OECD TiVA Data May 2013

Table 6 Estimation on Development Paths of IPNs

Variales	DVX Total		DVX Asia	
Const.	68.663 ***	71.417 ***	65.385 ***	72.581 ***
	(22.338)	(21.060)	(12.274)	-12.346
PCY	$-4.700*10^{-4}$ ***	$-1.453*10^{-3}$ **	$-2.062*10^{-3}$	$-8.815*10^{-3}$ ***
	(-2.710)	(-2.622)	(-1.687)	(-3.597)
PCY^2		$4.990*10^{8}$ *		$7.800*10^{-7}$ ***
		(1.860)		(3.039)
Turning Point		14,559		5,651
Adj R^{**2}	0.063	0.087	0.058	0.265
Sample size	95	95	32	32
<the Wu-Hausman Test>				
Chi-Sq. Statistic	0.975	3.708	0.042	1.919
Chi-Sq. d.f.	1	2	1	2
Prob.	0.323	0.156	0.836	0.383
Estimation Type	Random	Random	Random	Random

Note:
1) The T-value is shown in parenthese.
2) One, two, or three asterisks indicate that a coefficient estimate is significantly different from zero at 10, 5, or 1% percent level, respectively.
Source: OECD TiVA Data May 2013

Figure 3 Linkage between IPNs Participation and GDP Contribution

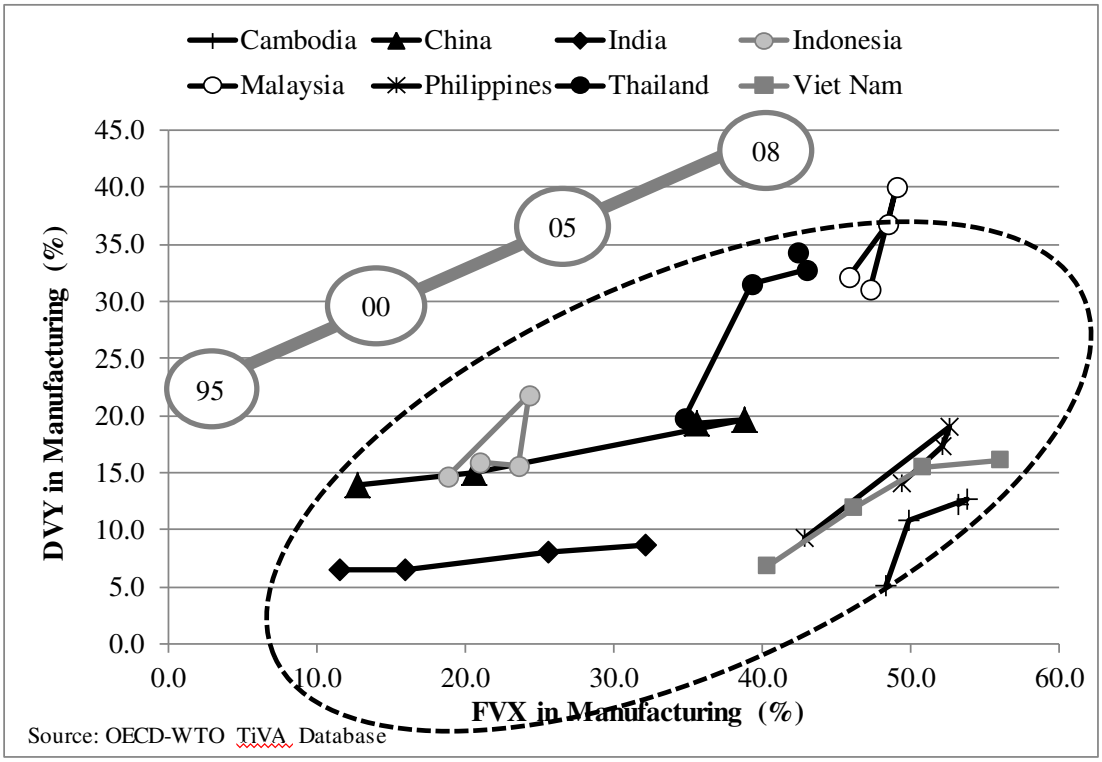


Figure 4 Development Paths of IPNs (Hypothesis of Smile Curve)