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The Growth of Trade under Heterogeneity in East Asia: An Empirical Evidence*

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Abstract

It is notable that the trade in East Asian countries has increased more than proportionately to the growth of economy. The purpose of the paper is to test statistically that the recent trade expansion is induced by development of international fragmentation of production. This paper constructs an index of Vertical Intra-industry Trade (VIIT) as a proxy to measure the fragmentation of production. The paper, using the indices, presents that the share of VIIT has been rising in East Asian countries as well as NAFTA and EU countries. Based on Gravity equation, it also presents that a rising share of VIIT is an indispensable factor for explaining the recent expansion of trade among East Asian countries. The estimated results in the paper suggest that the agreement to remove and harmonize institutional impediments among East Asian countries is important for further expansion of trade within the region.

JER Classification: F10, F14, F15, F20

Key Words: Fragmentation, Intra-industry Trade, Vertical IIT, Heterogeneity

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1. Introduction

In recent years, international trade is increasing more than proportionately to the increase in economic size. The increase in trade has particularly been pronounced since 1990 among East Asian countries. In 2003, the ratio of intraregional trade to total trade of East Asian countries was higher than the North American Free Trade Agreement's (NAFTA's) 45% and close to the EU's 60%. Such a drastic expansion of the intraregional trade among East Asian countries is a noteworthy feature characterizing the international economy in recent years.

Many theoretical analyses have found that the fragmentation causes the expansion in international trade in recent years. It is thought that fragmentation of the international location of production plants causes the expansion of intra-industry trade, and in turn causes international trade to grow at a higher pace than the increase in income levels¹. The expansion of trade between the U.S., Canada, and Mexico under NAFTA, and between West European countries and East European countries under the expanding EU gives evidences that support such theoretical analysis. Many previous studies including Athukorala (2006), Ng and Yeats (2001) and Yeats (2001) analyze the causes of trade expansion and fragmentation, They have provided statistical evidences to present that the increase of fragmentation is a cause of recent increase of trade volume in the world. Empirical studies present statistical data that the expansion of trade in East Asia accompanies with a rise of "Vertical Intra-industry Trade" (VIIT). Some studies demonstrate that VIIT of East Asian countries closely related to foreign

1 Refer to Jones and Kierzkowski (2001), Jones and Marjit (2001), and Yi (2003).

direct investment (FDI). Others studies, for the case of the machinery industry, present that even apart from FDI, a broad production - distribution network formed among East Asian countries is a major cause of the expansion of VIIT.²

While several studies have analyzed the causes of the expansion of trade by taking up EU countries, NAFTA countries, and East Asian countries separately, they have not made a comparison of East Asian countries with NAFTA and EU countries. In other word, few studies made a comparative analysis to test whether the factors causing the increase of trade in East Asia are different from those for the other regions. There exists a great disparity in restrictive measures on trade as well as goods and factor prices among East Asian countries. In short, East Asian countries are more heterogeneous in economic and legal conditions than EU or NAFTA countries. A large heterogeneity in factor prices among East Asian countries is a driving force to expand the trade through international production fragmentation in the region. It is different from homogeneous factor prices among EU countries.

It is difficult to measure the effect of international fragmentation of production on international trade by a single numerical index since the trade under fragmentation consists of different trade in parts and components and is determined by quite different factors. VIIT, which is defined by simultaneous import and export of parts, components and final goods with different factor intensity within the same product category, constitutes an intermediate category between “horizontal intra-industry trade” (HIIT) defined by simultaneous import and export of

² Refer to Ishido et al. (2003, 2005) and Kimura and Ando (2005) for the studies based on Japanese firm-level data.

final goods with same factor intensity in the same product category and inter-industrial trade. Although VIIT is not exactly same as fragmentation, the former is useful as a proxy to characterize the latter in a numerical figure since the fragmentation accompanies the simultaneous import and export of products in the same category with different factor intensity. The main purpose of this paper is to construct the indices of VIIT between two major trading partners in the world and examine statistically by using them what effect fragmentation has on the expansion of trade in East Asian countries.

We also find that East Asian countries have a disparity of institutional factors which impede the fragmentation of production across the countries. Unlike NAFTA and EU, East Asian countries as a whole have not formed a regional trade arrangement yet. The less institutional impediments are important to provide conditions that are more favorable for VIIT than for HIIT or inter-industry trade within East Asian countries

This paper consists of the following sections. Section 2 constructs VIIT index between major trading partners in the world and compares VIIT of East Asian countries with that of the countries in other regions. Section 3 statistically tests whether the expansion of world trade relates to the expansion of VIIT, and whether any additional effect of VIIT on the trade can be observed in East Asian countries. Section 4 discusses the importance of East Asian countries to eliminate institutional impediments and develop fragmentation of production. The last section mentions pros and cons of East Asian countries to form regional economic integration.

2. Structural Change of Trade in East Asia

2.1 Fragmentation and Vertical Intra-Industry Trade

The modularization of production processes and international fragmentation of production are mentioned as causes for the drastic increase in international trade in recent years. FDI, which has become brisk in recent years, is a cause for the increase in such fragmentation. Empirical studies indicate that the increase in Japanese trade closely relates to the increase in overseas production based on direct investment from Japan³. It is not necessary, however, that fragmentation is caused only by FDI. It is pointed out that the fragmentation within the East Asian region in recent years has been accelerated by various cost-reducing factors.⁴. Such cost reductions will be achieved through technological innovation, liberalization of trade and capital transaction, and harmonization of institutional factors as well as a rise of production efficiency due to the industrial development in East Asian countries.

It is thought that an increase of fragmentation of production is a cause for expanding trade volume in the following process. First, it increases international transactions of parts and intermediate goods. As shown in Figure 1, when the production processes, which used to be

3 Ishido et al. (2003) show that there is a significant positive relationship between the production by local enterprises based on direct investment from Japan and the VIIT in the trade with that country, using the data of 43 countries of Japan's trade partners.

4 They refer to "Service Link Costs", meaning the cost required for linking the divided production processes. This includes transportation and communication costs, customs duties, and various expenses for overcoming institutional differences.

completed within one plant or one country, become divided across the boarder, parts and intermediate goods are necessarily traded across the national boundary.

Figure 1

Second, there is an increase in trade volume due to the specialization of production through the realization of economy of scale. In most cases, modularized production processes achieve economy of scale. Consequently, the division of labor in manufacturing the parts and intermediate goods according to the comparative advantage raises the efficiency of production. Parts and intermediate goods produced in the most efficient region are supplied for a greater number of users in the world market. Those used to be supplied before only for specific trading partners in the specific regions become goods supplied for several types of users in the world market. This generates an opportunity to expand the trade volume.

Two-way trade in parts and intermediate goods belonging to the same industry is defined as intra-industry trade (IIT). The traditional argument concerning IIT has been used as a theory to explain the expansion in trade volume among developed countries. Typical case of IIT concerns trade in final goods belonging to the same industry category with different brand and quality. This type of IIT, however, is not adequate in explaining the recently increasing volume of trade. It refers to the value chain between the countries as depicted in Figure 1. We find some attempts to characterize the recent trade pattern by dividing IIT into HIIT that is defined by the

two-way trade of differentiated final goods belonging to the same industry category and VIIT that is defined by the two-way trade in parts, intermediate goods and final goods belonging to the same industrial category with different factor intensity.

IIT between country j and country k is denoted as follows:

$$IIT^{jk} = \frac{2 \sum_i \min(X^{jk}_i, M^{jk}_i)}{\sum_i (X^{jk}_i + M^{jk}_i)} \quad (1)$$

where i refers to industrial category. X^{jk}_i means export of goods belonging to industry i from country j to country k , and M^{jk}_i means import by country j of goods belonging to industry i from country k .

In this paper, we divide IIT into HIIT and VIIT: the former is the trade of goods belonging to the same industrial category whose unit values are very similar between exported and imported goods, and the latter is the trade of goods belonging to the same industrial category whose unit values are somewhat different between exported and imported goods. More specifically, we define HIIT if the ratio of the unit value of export goods to that of import goods belonging to the same industry category is within the range from $1/(1+0.25)$ to $(1+0.25)$, and VIIT if the ratio is either smaller than $1/(1+0.25)$ or larger than $(1+0.25)$ ⁵. That is,

- (i) The two-way trade of goods belonging to industry i is defined as HIIT,

⁵ The definition here of HIIT and VIIT is based on Greenway, Hine, and Milner (1994, 1995), and Fontagne and Freundenberg (1997)

$$\text{if } \frac{1}{1+0.25} \leq \frac{UV_i^E}{UV_i^M} \leq 1+0.25$$

(ii) The two-way trade of goods belonging to industry i is defined as VIIT,

$$\text{if } \frac{UV_i^E}{UV_i^M} \leq \frac{1}{1+0.25} \text{ or } \frac{UV_i^E}{UV_i^M} \geq 1+0.25$$

where UV_i^E and UV_i^M express the unit values of export goods and import goods belonging to the industry i . If traded goods defined as HIIT are denoted by the number $[1,m]$ and those defined as VIIT are denoted by $[m+1,n]$, The shares of IIT, HIIT and VIIT are expressed respectively as follows:

$$IIT^{jk} = \frac{2 \sum_{i=1}^m \min(X^{jk_i}, M^{jk_i}) + 2 \sum_{i=m+1}^n \min(X^{jk_i}, M^{jk_i})}{\sum_{i=1}^n (X^{jk_i} + M^{jk_i})} \quad (2)$$

$$HIIT^{jk} = \frac{2 \sum_{i=1}^m \min(X^{jk_i}, M^{jk_i})}{\sum_{i=1}^n (X^{jk_i} + M^{jk_i})} \quad (2')$$

$$VIIT^{jk} = \frac{2 \sum_{i=m+1}^n \min(X^{jk_i}, M^{jk_i})}{\sum_{i=1}^n (X^{jk_i} + M^{jk_i})} \quad (2'')$$

Although VIIT refers to trade of goods belonging to the same industrial category, we

can assume that, reflecting the different intensity of production factor between different production stages, international division of labor is in place even within the same industry category. In this case, unit value between export and import goods will be different since they reflect their different factor intensity.

We find some studies that used VIIT as an instrument to measure the change of trade pattern. Aturupane, Djankov, and Hoekman (1999) presented an intra-industry trade index between East European countries and the EU. Hu and Ma (1999) calculated IIT between China and its major trade partners, and Durkin and Krygier (2000) showed HIIT and VIIT between the U.S. and OECD countries. They ascertained that VIIT has increased in and after the 1990s.

It is difficult to measure in what degree the development of production fragmentation is actually proceeding. Although fragmentation and VIIT are not exactly same, both are closely related. A part of international trade caused by fragmentation is included in VIIT as well as a part of VIIT is included in the trade caused by fragmentation. Here, we regard VIIT as a proxy variable to denote numerically the share of international trade caused by fragmentation.

2.2 Measurement of VIIT in East Asia

We compare VIIT of East Asian countries with VIIT of NAFTA or EU countries. For the statistical comparison, we will take up major trading countries in the world and calculate three types of index: IIT, HIIT, and VIIT. It is not easy tasks to measure IIT, HIIT and VIIT since quantity figures are not necessarily available for some categories of parts and components

in trade data of many countries. Our measurement of the indices is underestimated in some extent because we excluded such unavailable categories from measurement. The statistical data for measuring the indices are based on value and quantity of imports and exports in six digits of HS Classification from “UN ComTrade”. Table 1, showing the indices of HIIT and VIIT of Australia, Canada, China, Germany, France, Hungary, India, Indonesia, Italy, Japan, Korea, Malaysia, Mexico, Singapore, Sweden, UK, and the U.S. measured by trade data in two periods: 1995/96 and 2003/04. It shows that VIIT in most countries has increased between two periods, and that VIIT in East Asian countries is as high as NAFTA and EU countries in 2000s.

Table 1

3. VIIT and the Growth of Trade

3.1 Equation for Estimation and Hypotheses

Previous studies suggest that it is difficult to explain the expansion in trade of East Asian countries by the increased import demand accompanying the increased income in the countries. It is expected that a large increase of trade among those countries has been accelerated by the structural change of trade pattern due to fragmentation. The purpose of this section is to measure how largely the trade between two countries is increased by fragmentation. We assume that a rising share of VIIT caused by an increase of fragmentation has a significant effect on the increase of trade. To test it, we use the gravity equation that is a traditional model

for estimating bilateral trade volume. According to the gravity equation, we define the trade volume between country j and country k by equation (3):

$$TTV_t^{jk} = A_0 \frac{(GDP_t^j GDP_t^k)^{\alpha_1} \cdot (PGDP_t^j \cdot PGDP_t^k)^{\alpha_2}}{(Distance^{jk})^{\alpha_3}} \cdot [S^{jk}]^\gamma \quad (3)$$

where TTV_t^{jk} denotes the summation of exports and imports between country j and country k , that is $X^{jk} + M^{jk}$. GDP_t^j , GDP_t^k , $PGDP_t^j$ and $PGDP_t^k$ indicate the size of economy and GDP per capita of country j and country k , respectively. $Distance^{jk}$ indicates the distance between country j and country k . S^{jk} expresses the factors to characterize the trade cost and trade pattern between two countries including the existence of a bilateral agreement, the difference in language, and the geographical adjacency of boundary, and the share of VIIT between two countries. We assume that the figures of VIIT used for estimation hold a time lag from the period t to avoid the problem of endogeneity of explanatory variables.

We statistically test whether the coefficient of VIIT, a proxy variable showing the structural change in trade, is positive with a statistical significance and whether the effect of rising share of VIIT on the increase of trade volume is peculiar to East Asian countries in comparison with other countries. To this end, from equation (3) we derive the model for estimating the bilateral trade volume between two countries as follows:

$$\ln TTV_t^{jk} = \alpha_0 + \alpha_1(\ln GDP_t^j + \ln GDP_t^k) + \alpha_2(\ln PGDP_t^j + \ln PGDP_t^k) + \alpha_3 \ln Distance^{jk} + (\gamma_0 + \sum_{r=1}^3 \gamma_r D_r^{jk}) \ln VIIT^{jk} + u^{jk} + \varepsilon_t^{jk} \quad (4)$$

where D_r^{jk} represents a dummy variable showing the region-specific factor between country j and country k. Here, we assume that if both countries belong to East Asia, NAFTA, or EU, the dummy variable takes the following value, respectively:

$$D_1^{jk} = \begin{cases} 1, & \text{if } j \text{ \& } k \text{ both are East Asian countries} \\ 0, & \text{otherwise} \end{cases}$$

$$D_2^{jk} = \begin{cases} 1, & \text{if } j \text{ \& } k \text{ both are NAFTA countries} \\ 0, & \text{otherwise} \end{cases}$$

$$D_3^{jk} = \begin{cases} 1, & \text{if } j \text{ \& } k \text{ both are EU members} \\ 0, & \text{otherwise} \end{cases}$$

In equation (3) u^{jk} shows the fixed effects on the trade volume between country j and country k which includes all other factors peculiar to the bilateral relationship, such as a bilateral trade agreement, adjacency of boundaries, difference in language than the share of VIIT.

Taking into account the stylized nature of the gravity equation, $\alpha_1 > 0$, $\alpha_2 > 0$, $\alpha_3 < 0$ are expected. After having controlled the trade volume by traditional explanatory variables, we assume the following hypotheses:

Hypothesis 1: $\gamma_0 > 0$. It is expected that the rising share of VIIT in bilateral trade is the factor explaining the increase of the trade volume in recent years.

Hypothesis 2: $\gamma_1, \gamma_2, \gamma_3 > 0$. It is expected that the rising share of VIIT in intra-regional trade among East Asian countries, NAFTA members, and EU members has an additional effect on the increase in trade among these countries.

In addition, the comparison of the estimated coefficients identifies whether or not the effect that VIIT among East Asian countries has on trade volume is greater than the effect that VIIT among NAFTA members and EU members has on trade volume.

Next, we estimate the effect of the changed share of VIIT on the change of trade volume between two periods. The estimation is carried out by using the following equation:

$$\ln\left(\frac{\Delta TTV_t^{jk}}{TTV_t^{jk}}\right) = \beta_0 + \beta_1 \ln \frac{\Delta (GDP_t^j \cdot GDP_t^k)}{(GDP_t^j \cdot GDP_t^k)} + \beta_2 \ln \frac{\Delta (PGDP_t^j \cdot PGDP_t^k)}{(PGDP_t^j \cdot PGDP_t^k)} + (\delta_0 + \sum_{r=1}^3 \delta_r D_r^{jk}) \ln \frac{\Delta VIIT^{jk}}{VIIT^{jk}} + \eta_t^{jk} \quad (5)$$

Hypothesis 3: $\delta_0 > 0$. It is expected that the elasticity of the trade volume to the increase in VIIT is positive.

Hypothesis 4: $\delta_1, \delta_2, \delta_3 > 0$. It is expected that the elasticity of trade volume to the increase in VIIT in among East Asian countries, NAFTA members, or EU members is larger than that among other countries.

In addition, we compare the estimated coefficients to identify whether or not the elasticity of the increase in trade to the increase in VIIT among East Asian countries is greater than the elasticity among NAFTA and EU countries.

3.2 Data and the Estimated Results

For the estimation, we construct the data set of VIIT between two countries. The available statistical data here consist of GDP and GDP per capita in 1996 and 2004, and 402 indices of VIIT calculated by the bilateral trade of 21 countries in two periods of the late 1990s and the early 2000s⁶. The source of trade data is “UN ComTrade”. In our data set, East Asian countries include China, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. NAFTA include Canada, Mexico, and the U.S., and EU include France, Germany, Hungary, Italy, Sweden, and the UK.

We estimate the coefficients in equation (4) based on both OLS and panel data. The terms of fixed effects absorb two country-pair specific factors such as the distance, the national boundary, the difference in language and so on. Only OLS estimation is conducted for equation (5). Table 2 and Table 3 present the estimated results.

⁶ The data cover 21 countries; Australia, Brazil, Canada, China, Germany, France, Hungary, India, Indonesia, Italy, Japan, Korea, Malaysia, Mexico, Philippines, Singapore, Sweden, Thailand, UK, U.S.A. and Vietnam. The total number of the share of VIIT between two countries is 402 because of the unavailability of value and quantity data in industry categories of some country pairs.

Table 2 and Table 3

They are summarized as follows:

(i) After having controlled the standard variables such as the size of economy and the per capita GDP, the effect of a rising share of VIIT has on the world trade volume is positive with a statistically high significance. The estimated results support that a rising share of VIIT leads to an increase in trade volume. (Hypothesis 1)

(ii) The results show with a statistically high significance that the share of VIIT in trade among East Asian countries, NAFTA countries, and EU countries has an additional effect on the increase of the trade volume (Hypothesis 2). With this respect, although the additional effect that the share of VIIT among East Asian countries has on the trade volume (0.6) is not as large as the additional effect in NAFTA countries (0.9), it is larger than the additional effect in EU countries (0.4). That is, the effect that the share of VIIT in East Asian countries has on the trade volume is comparable to the effect on trade caused by the rising share of VIIT in the countries that have achieved regional trade arrangements.

(iii) The elasticity of the increase in the trade volume to the increase in VIIT is positive and significant (0.11). It is certain that the increase in trade volume due to the increase in VIIT is a feature to characterize the world trade in 1990s and 2000s. (Hypothesis 3)

(iv) As to whether the elasticity of the increase in trade to the increase in VIIT is different among East Asian countries, NAFTA countries, and EU countries, a statistically significant

result is not obtained. (Hypothesis 4) The structural change in trade expressed by the increase in VIIT is common, meaning there is no difference between East Asian, NAFTA and EU countries.

Empirical studies in this section present that the expansion of trade due to the increase in VIIT is observed widely in the world trade, and that the effect of a rising share of VIIT on trade volume among East Asian countries in recent years is almost same as among NAFTA countries, and greater than that among EU countries. As a rising share of VIIT reflects the development of international fragmentation of production, the estimated results suggest that a recent increase in trade among East Asian countries is caused by the development of fragmentation.

4. Impediments to Fragmentation

The international fragmentation of production means that the production process up to final goods is decomposed into a number of production processes having different factor intensities that are located in geographically different countries. As the share of VIIT is defined by the trade in goods in halfway between the trade of goods belonging to different industries with different factor intensity and the trade of differentiated goods within the same industry. Therefore, it is expected that a certain disparity in factor abundance among countries is necessary for VIIT. Larger heterogeneity in factor endowment among East Asian countries is a driving force for a higher share of VIIT. From statistical data we find that the disparity of wage rate and per capita income in East Asian countries is larger than NAFTA and EU countries. In

this sense, the heterogeneity in factor abundance among East Asian countries holds a necessary condition that induces an increase in VIIT.

Needed for increased VIIT is not only the heterogeneity in factor endowment but also low service link costs defined by the cost for connecting the different production plants located in different regions. High service link costs impede the fragmentation of production processes and then lower the share of VIIT. Factors influencing service link costs include both hardware and software. The former refers to the development of infrastructure, such as airports, ports, roads, electric power, telecommunication network etc. The latter refers to (1) such factors as the existence of customs duties, restrictions on imports, and technical barriers for import inspection to impede market access, (2) government restrictions on FDI that impede the international transfer of capital, technology and management know-how, (3) the degree of protection of the intellectual property rights, (4) the lack in better educated human resources. While heterogeneous factor prices induce the fragmentation of production and raise the share of VIIT, the heterogeneity of hardware and software among countries that constitutes a factor raising service link costs conversely impedes the fragmentation and lowers the share of VIIT.

In comparison with NAFTA and EU countries, there still exist high customs duties, restrictions on imports, and technical barriers accompanying inspection procedures for exports and imports impede trade. In addition, at the same time, trade related investment measures (TRIMs) such as foreign exchange restriction, remittance control, export performance requirement, local content requirement and restriction on share holdings in the host countries

exist. For example, Malaysia, Philippines and Thailand hold Local Contents Requirement, Philippines hold Exchange Control. They impede FDI of multinational firms and generate unfavorable environment to local production. Wakasugi (2005) and Fung, et al. (2005) point out that the improvement of software is important for inducing the local production by multinational firms in China. The generation of favorable environment for FDI is necessary for accelerating fragmentation.

It is pointed out that inappropriate protection of intellectual property rights (IPRs) is inclined to impede fragmentation. In theoretical studies, Glass and Saggi (2002) presents that the inadequate protection of IPRs in the South causes the North to give up efforts for generating new technology and the South to use its production factors for imitation. As Table 4 shows, The index of patent protection by Park and Wagh (2002) presents that the enforcement of IPRs is heterogeneous among East Asian countries. In empirical studies, Smith (2001), Maskus and Penubarti (1995), Wakasugi (2005), and Branstetter (2006) point out that the weak protection of IPRs has a possibility to impede not only technology transfer from North to South, but also the expansion of trade and local production through FDI. East Asian countries hold problems to be improved for further developing fragmentation.

Table 4

As for welfare implication of fragmentation, Jones (2003) and Kierzkowski (2003)

mention the changes in price of production factors caused by the increase of fragmentation. They assert that the specialization to manufacturing parts and intermediate goods along with a comparative advantage realizes the change of factor prices of trade partners in two ways. First, it increases the wage rate in countries where labor is a relatively abundant production factor, while it lowers the wage rate in countries where capital is abundant. This eventually equalizes the wage rate between two countries in the long term. The expansion of trade among East Asian countries through a rising share of VIIT is expected to have a positive effect on the income levels in labor abundant countries in East Asia, and on the equalization of income level among these countries. Second, the development of fragmentation compatible to the comparative advantage raises the productivity through a realization of the scale economy, which in turn raises the marginal product of factor. Even assuming that the fragmentation is induced by foreign direct investment, and that a part of the benefit from FDI is refluxed to the investing country as reward of capital, the fragmentation still contributes to a rise of income through the increase in wage rate and job opportunities. In these ways, it is expected that a rising share of VIIT that reflects the development of international fragmentation is beneficial to the improvement of economic welfare in East Asian countries.

5. Concluding Remarks

This paper presents statistical evidences that the share of VIIT has been rising in these years among East Asian countries, although there remain problems in measuring VIIT, in

particular measuring unit value of exports and imports. It also presents that the rising share of VIIT has a significant impact on the expansion of trade among these countries, and that the expansionary effect on trade among East Asian countries is comparable to the effect for NAFTA countries and greater than the effect for EU countries. Since international fragmentation of production leads to a rise of the share of VIIT, we can assume that the recent increase in trade among East Asian countries has been induced by the development of fragmentation.

As the development of fragmentation not only leads to the increase of trade, but also a rise of production efficiency and factor reward, the policy to provide a favorable condition for developing fragmentation will be common goal for East Asian countries. The improvement of market access alone is not sufficient to this end. It is desirable to eliminate such institutional factors as impediments for efficient market transactions, restrictions on FDI, and inadequate IPRs that undermine fragmentation of production. In comparison with NAFTA and EU countries, East Asian countries are heterogeneous in these institutional impediments.

In recent years, a number of bilateral FTA negotiations have been conducted among East Asian countries. To date, more than 25 free trade agreements (FTAs) have been concluded or taken effect. Moreover, those under negotiation or being proposed number are more than 35. The elimination of institutional impediments is accelerated by concluding bilateral Economic Partnership Agreements (EPA) among East Asian countries. On the other hand, EPA between two countries may give rise to a complicated trade system vis-à-vis third countries. When these FTAs become effective, it is worried about that bilateral FTAs might constitute a spaghetti bowl

of “Rule of Origin”. To eliminate factors that complicate trade, it is more desirable to push a multilateral agreement under the WTO framework than to accumulate complicated bilateral agreements. In this regards, the formation of East Asian economic integration, while it creates a better environment for fragmentation that leads to further trade expansion and economic development in East Asian countries, will be thought as a second best policy to be explored by the countries in the region.

References

Athukorala, Prema-chandra (2006), "Product Fragmentation and Trade Patterns in East Asia",

Asian Economic Papers (forthcoming)

Aturupane, Chonira, Simeon Djankov, and Bernard Hoekman (1999), "Horizontal and

Vertical Intra-Industry Trade between Eastern Europe and the European Union,"

Weltwirtschaftliches Archiv, Vol.135, No.1

Branstetter, Lee, Raouf Fisman and Fritz Foley (2006), "Do Stronger Intellectual Property

Rights Increase International Technology Transfer?: Empirical Evidence from U.S.

Firm-Level Data," Forthcoming in *Quarterly Journal of Economics*.

Durkin, John T. and Markus Krygier (2000), "Differences in GDP Per Capita and the Share of

Intraindustry Trade: The Role of Vertically Differentiated Trade," *Review of*

International Economics, 8 (4), 760-774.

Fung, K. C., Alicia Galicia-Herrero, Hitomi Iizaka, and Alan Siu (2005), "Hard or Soft?

Institutional Reforms and Infrastructure Spending as Determinants of Foreign Direct

Investment in China," *Japanese Economic Review*, **56** (4), 408-416.

Glass, Amy J. and Kamal Saggi (2002), "Intellectual Property Rights and Foreign Direct

Investment", *Journal of International Economics*, 56, 387-410.

Greenway, David, Robert C. Hine and Chris Milner (1994), "Country-Specific Factors and the

Pattern of Horizontal and Vertical Intra-Industry Trade in the U.K.,"

Weltwirtschaftliches Archiv, vol 130, No. 1.

- Greenway, David ; Robert C. Hine and Chris Milner (1995) “ Vertical and Horizontal Intra- Industry Trade : A Cross Industry Analysis for the U.K.,” *Economic Journal* 105
- Hu, Xiaoling and Yue Ma (1999) ”International Intra-Industry Trade of China,” *Weltwirtschaftliches Archiv*, Vol.135, No.1
- Ishido, Hikaru, Keico Ito, Kyouji Fukao, and Yoshimasa Yoshiike (2003), “Vertical Intra-industry trade and Foreign Direct Investment in East Asia (in Japanese),” *RIETI Discussion Paper Series*, 03-J-009.
- Ishido, Hikaru, Keico Ito, Kyouji Fukao, and Yoshimasa Yoshiike (2005), “Vertical Intra-industry trade and Foreign Direct Investment (in Japanese),” *Japanese Economic Studies*, No.51, 1-32.
- Jones, Ronald W., and Henryk Kierzkowski (2001), “A Framework for Fragmentation,” in *Fragmentation: New Production Patterns in the World Economy* ed. by Sven W. Arndt and Henryk Kierzkowski, Oxford University Press.
- Jones, Ronald W. and Sugata Marjit (2001), ”The Role of International Fragmentation in the Development Process,” *American Economic Review*, vol. 91 no.2, 358-362.
- Kimura, Fukunari and Ando Mitsuyo (2003), ““Fragmentation and Agglomeration Matter: Japanese Multinationals in Latin America and East Asia,” *North American Journal of Economics and Finance* 14, Issue 3, 287-317
- Maskus, Keith E. and Mohan Penubarti (1995), “How Trade-Related are Intellectual Property

Rights?" *Journal of International Economics*, 39, 227-248.

Ng, Francis and Alexander Yeats (2001), "Production Sharing in East Asia: Who does what for whom, and Why?" in Leonard K. Cheng and Henryk Kierzkowski (eds.), *Global Production and Trade in East Asia*, Kluwer Academic Publishers, 63-109.

Park, Walter G. and Smita Wagh (2002) "Index of Patent Rights" in *Economic Freedom of the World: 2002 Annual Report*, Chapter 2, pp. 33-43.

Smith, Pamela J. (2001), "How Do Foreign Patent Rights Affect U.S. Exports, Affiliate Sales, and Licenses?" *Journal of International Economics*, 55, 411-439.

Wakasugi, Ryuhei (2005), "The Effects of Chinese Regional Conditions on the Location Choice of Japanese Affiliates," *Japanese Economic Review*, 56 (4), 390-407.

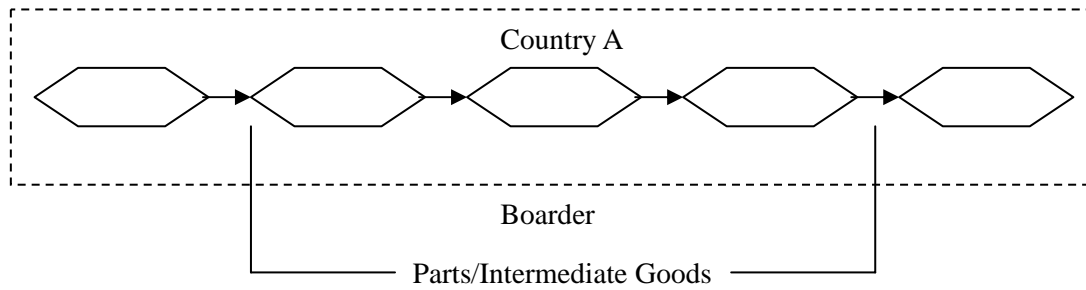
Wakasugi, Ryuhei and Banri Ito (2005), "The Effects of Stronger Intellectual Property Rights on Technology Transfer: Evidence from Japanese Firm-level Data," *KUMQRP Discussion Paper Series DP2005-009*, Keio University Market Quality Research Project.

Yeats, Alexander (2001), "Just How Big is Global Production Sharing?", in Seven W. Arndt and Henryk Kierzkowski (eds), *Fragmentation: New Production Patterns in the World Economy*, Oxford University Press, 108-143.

Yi, Kei-Mu (2003), "Can Vertical Specialization Explain the Growth of World Trade?" *Journal of Political Economy*, vol.111, no.1, 52-102.

Figure 1. Value Chain after Fragmentation

<Before Fragmentation: Value Chain within a plant/country>



<After Fragmentation: Production across countries >

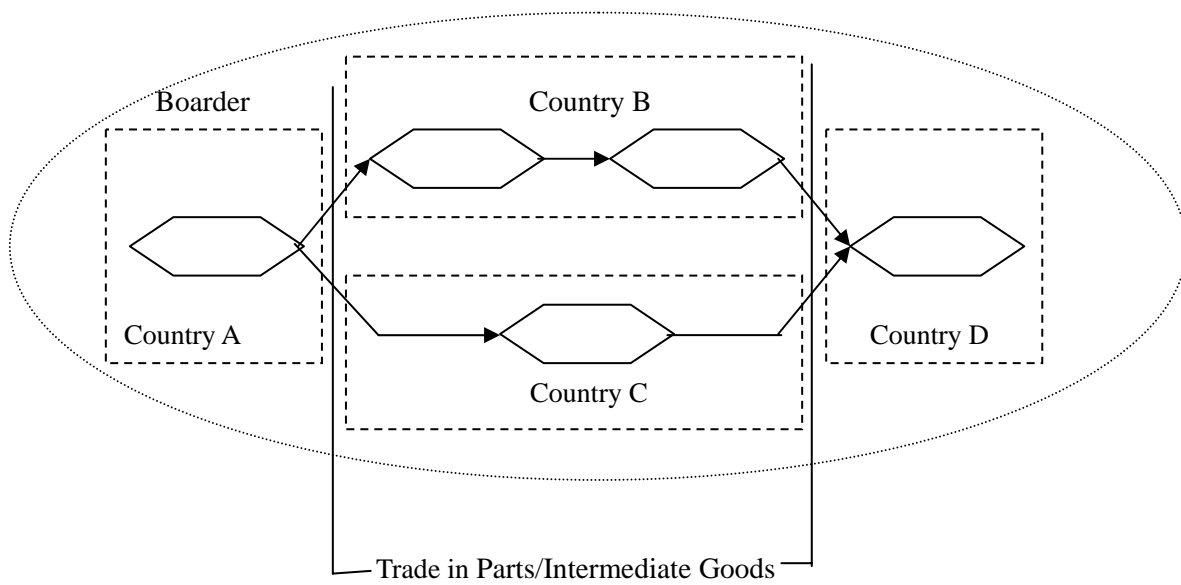


Table 1. The Changes in Shares of Horizontal and Vertical Intra-industry Trade
between Two period: 1995/96 and 2003/04

	1995-96		2003-04	
	HIIT	VIIT	HIIT	VIIT
Australia	14.0	10.8	14.0	12.3
Canada	32.0	17.3	28.4	22.4
China	8.7	18.3	7.9	31.2
France	32.5	27.5	30.9	30.6
Germany	29.2	30.0	30.6	32.4
Hungary	9.7	25.7	16.9	29.9
India	2.6	12.7	9.0	13.2
Indonesia	6.7	7.3	11.3	11.0
Italy	16.9	28.2	17.1	30.4
Japan	6.7	23.9	7.8	24.1
Korea, Rep.	16.8	19.4	17.8	20.1
Malaysia	n.a.	n.a.	9.1	39.1
Mexico	7.1	29.9	3.6	39.1
Singapore	n.a.	n.a.	17.8	49.9
Sweden	16.1	29.0	22.5	28.5
U.K	34.6	29.8	29.1	36.2
U.S.A	22.9	28.6	17.5	30.8

(Notes)

1. HIIT and VIIT denote the share of horizontal intra-industry trade and the share of vertical intra-industry trade, respectively.
2. The figures are calculated by the available data of value and quantity of exports and imports in 1995-96 and 2003-04 from "UN Comtrade".

Table 2. The Effects of Rising Share of VIIT on Increase in Trade: Estimated Results

	OLS(1)		OLS(2)		Panel: Fixed Effects (1)		Panel: Fixed Effects (2)	
GDP	0.637 **	(23.801)	0.696 **	(26.053)	0.574 **	(11.390)	0.607 **	(11.723)
PGDP	-0.022	(-0.804)	0.058 *	(2.248)	0.015	(-0.240)	0.086	(1.424)
VIIT	0.317 **	(6.724)			0.231 **	(4.193)		
VIIT*East Asia Dummy	0.636 **	(12.103)	0.806 **	(16.596)	0.660 **	(8.914)	0.792 **	(11.377)
VIIT*NAFTA Dummy	0.619 **	(5.505)	0.683 **	(5.777)	0.930 **	(7.145)	1.030 **	(7.724)
VIIT*EU Dummy	0.351 **	(6.519)	0.441 **	(8.021)	0.420 **	(6.638)	0.455 **	(6.954)
Time Dummy=1 for 2003/04	0.051	(0.622)	0.142	(1.665)	0.088	(1.263)	0.151 *	(2.120)
Constant	-12.964 **	(-9.658)	-17.102 **	(-13.595)				
N. of Obs	402		402		402		402	
Adjust-R ²	0.808		0.786		0.941		0.861	

(Notes)

1. PGDP denotes per capita GDP.
2. VIIT*East Asia Dummy denotes the multiplication of the VIIT share and the dummy variable for East Asian countries, as same for VIIT*NAFTA Dummy and VIIT*EU Dummy.
3. As for regional dummy, East Asia includes China, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Thailand and Vietnam, NAFTA includes Canada, Mexico and the U.S., and EU includes France, Germany, Hungary, Italy, Sweden and the UK.
4. The figures in the parentheses are t-statistics. * and ** present the statistical significance level of 5% and 1%, respectively.
5. The results estimated on random effects model are omitted.

Table 3. The Elasticity of the Increase in Trade to Rising Share of VIIT: Estimated Results

	OLS(1)		OLS(2)	
∇ GDP/GDP	0.548 **	(4.271)	0.550 **	(4.234)
∇ PGDP/PGDP	1.537 **	(5.787)	1.590 **	(5.939)
∇ VIIT/VIIT	0.113 *	(2.298)		
(∇ VIIT/VIIT)*East Asia Dummy	0.103	(1.217)	0.183 *	(2.352)
(∇ VIIT/VIIT)*NAFTA Dummy	-0.267	(-0.313)	-0.259	(-0.303)
(∇ VIIT/VIIT)*EU Dummy	0.202	(0.490)	0.187	(0.448)
Constant	-0.366 **	(-4.678)	-0.340 **	(-4.344)
N. of Obs	190		190	
Adjust-R ²	0.529		0.508	

(Notes)

1. ∇ GDP/GDP denotes the rate of changes in GDP, as same for ∇ PGDP/PGDP and ∇ VIIT/VIIT.
2. PGDP denotes per capita GDP.
3. VIIT denotes the share of vertical intra-industry trade.
4. ∇ VIIT/VIIT *East Asia Dummy denotes the multiplication of the rate of changes in VIIT and the dummy variable for East Asian countries, as same for ∇ VIIT/VIIT *NAFTA Dummy and ∇ VIIT/VIIT *EU Dummy.
5. As for regional dummy, East Asia includes China, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Thailand and Vietnam, NAFTA includes Canada, Mexico and the U.S., and EU includes France, Germany, Hungary, Italy, Sweden and the UK.
6. The figures in the parentheses are t-statistics. * and ** present the statistical significance level of 5% and 1%, respectively.

Table 4. Index of Patent Protection

	1990	1995	2000
China	n.a.	1.55	2.48
Indonesia	0.33	1.24	2.27
Japan	3.94	3.94	4.19
Singapore	2.57	3.9	4.05
Thailand	1.85	2.24	2.24

(Source) Park and Wagh (2002)

(Note) The score ranges from 0 to 5; a high score implies a stronger IPR system.