Does East Asian Integration Keep Up with the European Pattern? Empirical Evidence from Intra-Industry Trade in Europe and East Asia

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This paper examines development of inter/intra-industry trade in Europe and East Asia. In order to quantify the level of intra-industry trade (IIT), a bias-corrected Grubel and Lloyd index is used. The finding is that IIT is more evident in intra-European trade than in intra-East Asian trade, while dynamics toward IIT have been increasingly more important in trade between East Asian economies. Vertical intra-industry trade and horizontal intra-industry trade are compared, and their share in intraregional trade in both regions is measured. The paper finds that IIT in East Asia is characterized by vertical intra-industry trade. In order to identify determinants of IIT in Europe and East Asia, a regression analysis is used, which finds that conventional determinants of IIT explain a large part of IIT in Europe, while they do not for East Asian countries. In East Asia, IIT takes place between developed countries in the region.

JEL classification: F14, F15

I. INTRODUCTION

European integration has provided a reference for successful economic integration, not only from an institutional perspective—regionalism—but also in terms of actual market integration termed as "regionalization". European economic integration has been the subject of numerous analyses and has provided broad fields for the experimentation of economic integration theory. In East Asia, economic integration took place much later than it did in Europe. East Asian economies have been increasingly interdependent through regional trade and investment. They constitute one of three major economic poles in international trade, together with Europe and North America.[1] Increasing awareness of regional trade development in the East Asia prompts an attempt to compare economic integration in East Asia with that seen in Europe. Economic integration models of

[1]International trade has been evolving along the basis of the three poles consisting of North America, East Asia, and Europe. For arguments in this regard and empirical observations, see respectively, Omae (1985) and Gaulier et al. (2004).

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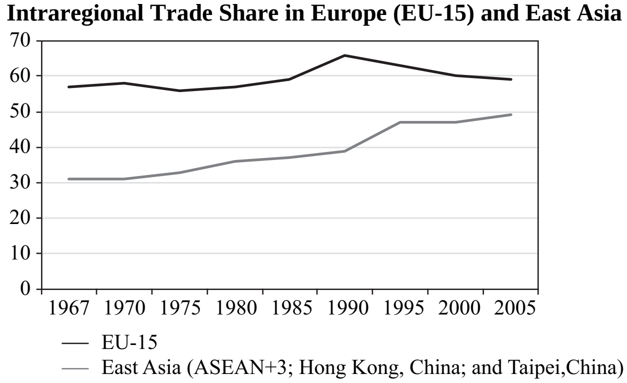
these two regions are considerably different in several aspects. One of the most fundamental differences is that trade relations among East Asian economies have not been based on a preferential trade regime, while trade among European countries has taken place within the framework of such regime, the European Union (EU). In this regard, it is noteworthy that a considerable part of East Asian countries' trade is now conducted among them. The emergence of trade regionalization in East Asia has led economists to conduct empirical studies based on quantifying intraregional trade share, and European integration has provided a benchmark for these comparative analyses.

Figure 1. **Intraregional Trade Share in Europe (EU-15) and East Asia (percent)**



Source: Author's own calculation based on CEPII-Chelem data.

In fact, intraregional trade share is a direct raw indicator that allows for comparing different levels of economic integration among regions. However, while this measure allows a simple and direct comparison on regionalization, it does not provide information on trade structure and sectoral evolution. Its shortcomings as an analytical measure are mainly due to its aggregation feature. Two supplementary methods can be proposed. The first one consists of sectoral analyses such as revealed comparative advantage (RCA). RCA is based on the popular assumption that international trade flows are determined by differences in factor endowments among countries in the Heckscher-Ohlin-Samuelson (HOS) framework.

The second method—which will be the subject of research in this paper—stems from empirical observations from the 1960s in which trade has occurred increasingly within the same industries. This intra-industry trade (IIT) based on product differentiation has characterized trade between developed countries. The theoretical arguments from the HOS framework do not provide a proper explanation on this new type of trade. From the late 1970s onward, new trade theories appeared, which were based on economies of scale and monopolistic competition to explain IIT. Drawing a distinction between interindustry trade and

IIT gives a more detailed analytical tool for comparative analysis on regionalization.

This paper asks two principal questions on regional trade structure in Europe and East Asia. How are both regions' intraregional trades different in inter/intra-industry relation? What are the main determinants of IIT in Europe and East Asia? To answer these questions this paper is organized as follows. Section I presents the theoretical arguments on IIT and an overview of the regional context related to inter/intra-industry trade. Section II presents in detail the measure of IIT (Grubel and Lloyd index) and measures IIT levels of European and East Asian countries at both static and dynamic (evolution) levels. The empirical measures are refined in order to distinguish vertical intra-industry trade (VIIT) and horizontal intra-industry trade (HIIT). The final section conducts empirical analyses based on regression models to determine driving factors of IIT in Europe and in East Asia.

II. THEORETICAL DEVELOPMENT OF INTRA-INDUSTRY TRADE

A. Shifts of Research Interests from Interindustry Trade to Intra-Industry Trade

The HOS model explains international trade by differences in factor endowments between countries, which are the origin of comparative advantages. Along the same line, the Vinerian framework assumes implicitly that countries' production and trade occur according to their sectoral comparative advantages, which implies interindustry trade (Viner 1950, Robson 1987). However, in the late 1960s an increasing number of observations of trade within same industries was observed, especially between developed countries. This brought about shifts of research focus from interindustry trade to IIT. Trade theories associated with the HOS model did not explain why countries exchange similar products. Even when trade flows are observed at a highly disaggregated level, comparative advantage-based arguments did not explain IIT. Focusing on the rise of IIT, trade research has been reoriented from country-specific determinants of trade to industry-specific determinants such as increasing returns to scale, monopolistic competition, and external economies (Dixit and Stiglitz 1977, Krugman 1979, Lancaster 1980).

A large number of empirical studies confirm increasing IIT share in total trade from the 1960s (Hesse 1974, Grubel and Lloyd 1975, Aquino 1978). This upward trend is particularly remarkable as the period 1959–1970 is marked by the important growth of international trade supported by trade liberalization. The growing presence of IIT is often investigated in close relation to adjustment costs caused by economic integration (Balassa 1966, Krugman and Venables 1996).

There is a consensus that a high level of IIT makes easier industrial adjustment related to economic integration, termed *smooth adjustment hypothesis* (Brülhart and Elliott 1999). This is one of important factors in explaining how the previous European integration could be successful as compared to economic integration between developing countries.

B. Regionalization and Inter/Intra-Industry Trade

1. The European Context

Before discussing in detail empirical method and investigation, it would be helpful to examine briefly the European and East Asian context of trade regionalization. Largely composed of developed countries, the EU has constituted a relatively homogeneous region in terms of development level. Due to this feature, it was assumed that intraregional trade in Europe is intra-industry rather than interindustry. This assumption has been the subject of a number of empirical studies that confirms that intra-European trade has a higher share of IIT than intraregional trade of any other region. Bonzom et al. (2006) argue that the EU's intraregional trade is characteristic of substitution between consumer goods. With respect to investment, European firms have tended to locate their production base within the EU through *horizontal* FDI rather than *vertical* FDI.

Indeed, a number of studies advance that the high level of IIT in Europe had mitigated adjustment costs of European industries in the process of integration (Greenaway and Hine 1991, Grant et al. 1993, Brülhart and Elliott 1999). In this regard, this paper presents two explanatory arguments as follows: first, when a country has already considerable exports and imports in the same industries with its potential preferential trade agreement (PTA) partner, it is more likely that the country will experience an increase in both exports and imports in the same industries with its PTA partner by establishing the PTA. This would reduce the possibility of potential conflicts between winning and losing industries. Second, industrial adjustment costs between similar industries are less expensive than between industries without industrial links.

2. The East Asian Context

The East Asian context is quite different from the European one. With the exception of Japan, the East Asian countries are mostly developing countries. Their development levels are relatively disparate. Economic integration has gone forward not by expanding regional common markets, but by production networks of firms intending to reduce their production cost by taking advantage of countries' comparative advantages. It has taken place with successive industrialization of regional economies. This gives an image of a chain reaction in which the life cycle of industries and neighboring effects play important roles in the diffusion of economic development. Termed as the "flying geese model", this process of successive developments explains the life cycle of specific industries in the development process as well as the relocation of industries from one country to another.[2]

Figure 2. **Flying Geese Model of Industrial Development**

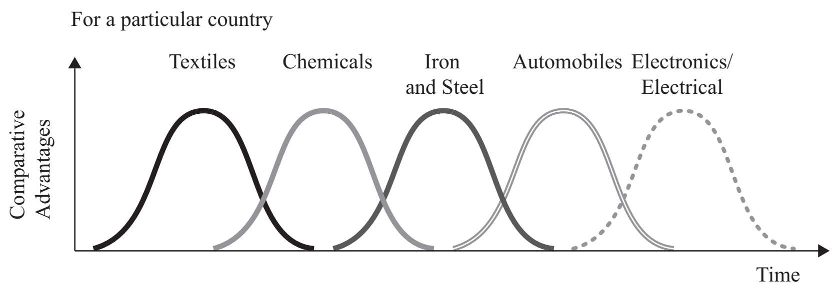
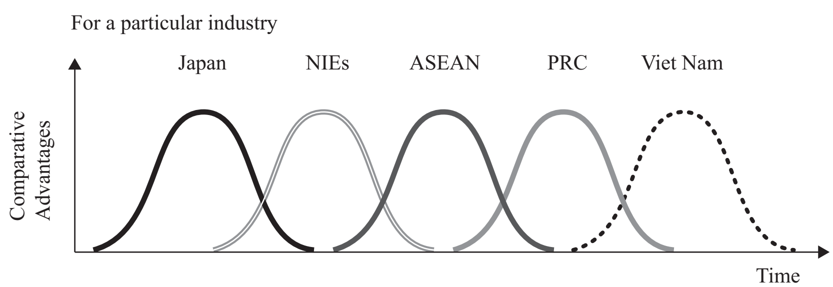


Figure 3. **Industry's Flying Geese Model in Different Countries**



ASEAN = Association of Southeast Asian Nations, NIEs = newly industrialized economies.
PRC = People's Republic of China.
Source: Kojima (2000).

There are several factors that have led East Asian countries to successive industrialization. The two most important factors among them are as follows. First, East Asian countries—particularly in the northeastern part of the region—have a relatively low endowment of natural resources, and have developed manufacturing export sectors destined for the markets of developed countries. This export-oriented development model was later adopted by Southeast Asian countries (Johnson 1987). Second, the appreciation of the Japanese yen—for instance, from the Plaza Accord in 1986—was also the main driving factor for the relocation of labor-intensive industries from Japan to the other East Asian countries. The Republic of Korea and Taipei,China experienced also a

[2]The "flying geese model" was promoted primarily as a description of the life cycle of specific industries in the development process (Akamatsu 1962). The model was extended to explain the dynamic structure of industries and the relocation of industries from one country to another. For further arguments on the flying geese model, see Kojima (2000).

progressive appreciation of their currencies, and following the Japanese industrial relocation pattern, they shifted production to Southeast Asian countries.[3]

The trade structures of the East Asian countries have shown a pattern of successive development on a sectoral basis between countries whose industrial development levels are different. Faced with industrial catch-up of the less developed countries, the more developed ones respond by moving up the industrial ladder. Their industrial specialization goes toward more capital- and technology-intensive industries, leaving the labor-intensive ones to the less developed countries. Rana (1990) gives empirical support to this argument, conducting analysis of revealed comparative advantage on East Asian exports for the period 1965–1984. He finds that the dynamic trend of this model is especially prominent in the period after 1973.

Complementarity in production process tends to encourage vertical FDI that fragments production process at the regional level. Accordingly, intraregional trade in East Asia had been dominated by interindustry trade or vertical intra-industry assembly processes. However, several studies advance that since the second half of the 1980s, a trade and investment nexus has contributed to creating more opportunities of IIT in East Asia (Chen 1990, Urata 1990).

III. MEASURES OF INTRA-INDUSTRY TRADE

A. Grubel and Lloyd Index

1. Definition

Most commonly used measure of IIT is the Grubel and Lloyd (GL) index (Grubel and Lloyd 1975). The index is based on sectoral trade balance share relative to sectoral trade.

$$GL_j = 1 - \frac{\left|X_j - M_j\right|}{X_j + M_j} \tag{1}$$

where X_j and M_j are, respectively, export and import in industry j.

This index consists of comparing the sectoral net trade (X_j–M_j) with the sectoral total trade (X_j+M_j) of industry j of a country. The upper limit of the index is 1, which means that the sectoral export matches exactly with the sectoral import. At the national level, the index can be aggregated in the following way.

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[3]According to Bernard and Ravenhill (1995), appreciation of East Asian currencies was 40% for the Japanese yen in 1985–1987; 28% for the Taipei,China dollar in 1985–1987; and 17% for the Korean won in 1986–1988.

$$GL_i = 1 - \frac{\sum_{j=1}^{n} \left| X_j - M_j \right|}{\sum_{j=1}^{n} \left(X_j + M_j \right)} \tag{2}$$

where n refers to a number of industries of country i.

GL_i indicates the level of IIT of country i with the rest of the world. However, shortcomings of the index are gradually found, especially in its empirical use. Three possible bias of GL index are prsented here: sectoral, geographic, and trade balance-associated bias.[4]

2. Possible Bias in Using GL Index

(i) Sectoral Bias

Sectoral bias stems from an insufficient disaggregation in classifying trade data. When using a less detailed nomenclature, it is likely that more products are grouped in the same industry. This gives rise to an upward biased GL index, and more trade appears to be IIT in nature. This problem can be largely resolved using trade data at a more disaggregated level.

Closely related to data disaggregation, another problem that may arise is the following: when trade takes place between intermediate goods (e.g., engine) and final goods (e.g., vehicle) that belong to the same industry (e.g., motor industry), this trade can be regarded as IIT, even though they are *stricto sensu* interindustry trade. There is a need to redefine each industry and to distinguish the horizontal IIT (HIIT) from the vertical IIT (VIIT). The VIIT is related to the international division of production process that develops according to comparative advantage. This leads to the development of a threefold distinction: interindustry trade, VIIT, and HIIT instead of the dichotomous distinction of inter/intra-industry trade. Strictly speaking, only the HIIT is authentic IIT based on product differentiation and substitution of products. However, including VIIT in IIT is also relevant, considering that VIIT represents industrial linkage in the same sector.

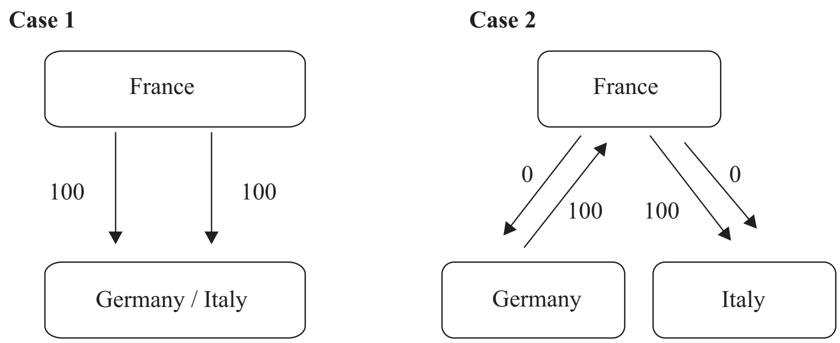
(ii) Geographical Bias

Geographical bias occurs when several countries are grouped as a unit before calculating the IIT share. Taking an example of European countries, when IIT of France is calculated with the rest of the European countries (EU-15 minus France, therefore, EU-14), using trade flows between France and the EU-14

[4]For a literature review on intra-industry trade, see Fontagné and Freudenberg (1997) and Lloyd (2002).

typically creates a geographical bias. Figure 3 illustrates the bias in a simple schema. In the case 1, trade between France and "Germany–Italy" as a unit in a particular product, trade is intra-industry. However, if one examines trade flows on a bilateral basis as shown in case 2, this is not the case. France exports only to Italy and imports only from Germany.

Figure 4. **Example of Geographical Bias**



Source: Adapted from Fontagné and Freudenberg (1997).

To avoid the geographical bias, GL index can be obtained in the following way.

$$GL_i = 1 - \frac{\sum_{k=1}^{m}\sum_{j=1}^{n}\left|X_{ikj} - M_{ikj}\right|}{\sum_{k=1}^{m}\sum_{j=1}^{n}\left(X_{ikj} + M_{ikj}\right)} \qquad (3)$$

X_{ikj} = country i's export in industry j to country k
M_{ikj} = country i's import in industry j from country k
N = number of industries
M = number of trading partner countries

The GL index of countries in a same region can be aggregated to indicate a regional average level of IIT in the following manner.

$$GL_{regional} = 1 - \frac{\sum_{i=1}^{m}\sum_{k=1}^{m}\sum_{j=1}^{n}\left|X_{ikj} - M_{ikj}\right|}{\sum_{i=1}^{m}\sum_{k=1}^{m}\sum_{j=1}^{n}\left(X_{ikj} + M_{ikj}\right)} \qquad (4)$$

(iii) Trade Balance-Associated Bias

The GL index ranges from 0 to 1. However, as long as trade is unbalanced, the index is biased downward. Unless trade is balanced over all sectors, the sum of sectoral trade unbalance can increase without limit and as a result, the trade appears to be interindustry using the index. This consideration is particularly important in empirical investigation, because some countries have huge trade imbalance that is compensated by capital transfer.[5]

Grubel and Lloyd recognize this bias and propose a method to correct it by subtracting the unbalanced part of trade from the total trade as shown in equation (5).

$$GL_i^{ccrrige} = 1 - \frac{\sum_{j=1}^{n} \left| X_j - M_j \right|}{\sum_{j=1}^{n} \left(X_j + M_j \right) - \left| \sum_{j=1}^{n} \left(X_j - M_j \right) \right|} \quad (5)$$

The corrected GL index indicates a level of IIT in the absence of trade unbalance and does not represent any more crossed trade share in total trade, but in balanced trade.

3. Empirical Results

The GL index of 118 manufacturing industries (ISIC 4-digit level, codes 1510–3720) over the period 1970–2005 using the CEPII-Chelem database. Agricultural sectors and minerals as well as crude oil and gas are excluded, because products of these sectors are less differentiable than those of manufacturing sectors. "Europe"[6] consists of 15 European countries, and because of data availability, Belgium and Luxembourg are considered as an integrated unit. "East Asia"[7] refers to 13 East Asian countries including Cambodia and the Lao People's Democratic Republic, which are considered as a single unit in the database.

[5]For example, the United Kingdom and Spain have recorded every year huge trade deficit, while Germany has had important trade surplus.

[6]Europe: Austria, Belgium-Luxembourg, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

[7]East Asia: Cambodia-Lao People's Democratic Republic; the People's Republic of China; Hong Kong, China; Indonesia; Japan; the Republic of Korea; Malaysia; the Philippines; Singapore; Thailand; Taipei,China; and Viet Nam.

Tables 1 and 2 present the GL index of European and East Asian countries over the period 1975–2005 at 10-year intervals. The index is based on equation (5), which is constructed to avoid geographical (calculated on bilateral basis) and trade balance-associated bias.

Table 1. **Grubel and Lloyd (corrected) Index on European Countries' Intraregional Trade**

	1975	1985	1995	2005
Austria	0.37	0.43	0.40	0.48
Belgium–Luxembourg	0.44	0.51	0.58	0.64
Denmark	0.25	0.32	0.39	0.43
Finland	0.17	0.3	0.36	0.34
France	0.44	0.46	0.53	0.55
Germany	0.52	0.58	0.57	0.66
Greece	0.08	0.12	0.12	0.13
Ireland	0.17	0.33	0.45	0.38
Italy	0.37	0.41	0.47	0.46
Netherlands	0.42	0.47	0.55	0.64
Portugal	0.19	0.28	0.30	0.28
Spain	0.23	0.4	0.4	0.43
Sweden	0.33	0.45	0.46	0.49
United Kingdom	0.38	0.40	0.52	0.47
Simple Average	0.31	0.39	0.43	0.46

Source: Author's own calculation based on CEPII-Chelem database.

Table 2. **Grubel and Lloyd (corrected) Index on East Asian Countries' Intraregional Trade**

	1975	1985	1995	2005
Cambodia–Lao People's Democratic Republic	0	0	0.01	0.06
China, People's Rep. of	0.1	0.11	0.27	0.4
Korea, Rep. of	0.23	0.34	0.48	0.61
Hong Kong, China	0.11	0.17	0.17	0.11
Indonesia	0.05	0.13	0.25	0.42
Japan	0.2	0.28	0.4	0.49
Malaysia	0.12	0.17	0.4	0.48
Philippines	0.13	0.18	0.21	0.45
Singapore	0.23	0.26	0.47	0.46
Taipei,China	0.33	0.39	0.5	0.59
Thailand	0.18	0.12	0.3	0.44
Viet Nam	0.03	0.01	0.05	0.14
Simple Average	0.14	0.18	0.29	0.39

Source: Author's own calculation based on CEPII-Chelem database.

In Europe, France, Belgium–Luxembourg, Germany, and the Netherlands form a group of countries whose levels of IIT are important. More than half of their intraregional trade appears as IIT. In East Asia, Japan; the Republic of Korea; and Taipei,China show relatively high GL indexes. It is noteworthy that the European countries are featured by their high GL index over all periods, compared to the East Asian ones. However, the gap in GL index between two regions has been considerably reduced. In 2005, the Republic of Korea; Malaysia; Singapore; and Taipei,China are marked by GL indexes higher than the average GL index (simple) of the European countries.[8]

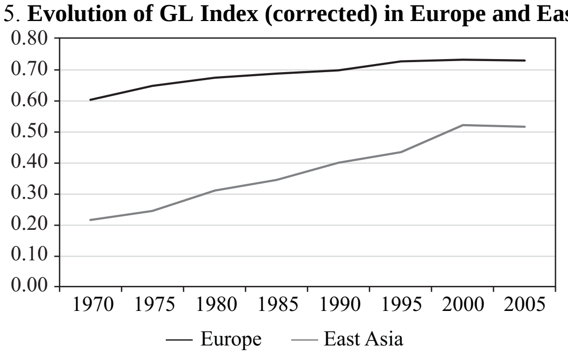
The countries' index can be aggregated at a regional level to indicate regional average GL index. These regional average indexes are obtained by combining equation (4) on regional aggregation and equation (5) on trade unbalance correction. Table 2 presents the regional GL index of Europe and East Asia over the period 1970–2005 at 5-year intervals. It appears clearly that the European records about IIT are much superior to the East Asian ones. The GL index (corrected) of Europe was 0.60 in 1970, which is almost three times higher than that of East Asia. The indexes have increased in both regions. The index of Europe has been relatively stable since the early 1990s at 0.70–0.73, while the East Asian index continued to rise, reaching 0.52 in 2000. This finding indicates that East Asian intraregional trade has become interindustry, as illustrated in the flying geese model.

Table 3. **Grubel and Lloyd Index of Europe and East Asia, 1970–2005**

		1970	1975	1980	1985	1990	1995	2000	2005
Europe	1)	0.58	0.61	0.65	0.66	0.69	0.71	0.72	0.71
	2)	0.60	0.65	0.67	0.69	0.70	0.73	0.73	0.73
East Asia	1)	0.21	0.24	0.29	0.31	0.38	0.42	0.50	0.50
	2)	0.22	0.24	0.31	0.35	0.40	0.43	0.52	0.51

GL = Grubel and Lloyd index.
Note: 1) GL index based on equation (4) (non-corrected GL index).
2) GL index based on a combination of equations (4) and (5) (corrected GL index).
Source: Author's calculation based on CEPII-Chelem database.

Figure 5. **Evolution of GL Index (corrected) in Europe and East Asia**



GL = Grubel and Lloyd index.
Source: Author's illustration based on the results of Table 3.

It is noticeable that the change in GL index is much more important in East Asia than in Europe. The index of East Asia recorded a 132% increase for the

[8]Simple average (sum of indexes over countries of the region, divided by number of countries) has only an indicative role and is hardly used as an overall index, because it does not reflect each country's trade volume.

period 1970–2005, while that of Europe increased only 23%. This comparative figure illustrates that intraregional trade in East Asia has been moving toward IIT, while intra-European trade arrived at stationary phase in IIT development in the middle of the 1990s.[9]

Relatively high values of IIT in the previous tables may be due to insufficient disaggregation of data used in this research.[10] However, other previous empirical studies—with more disaggregated and sector-focused data, but with less extended coverage in terms of countries and years—confirm the same pattern of evolution that has taken place in East Asia (Fukasaku, Fukao et al. 2003, Wakasugi 2007).

B. Evolution of Intra-Industry Trade

This sub-section presents measures to quantify change in IIT level, and uses them to indicate change in IIT in Europe and East Asia.

1. Measures on Change in IIT Level: Measures Derived from the GL Index

Change (dynamic) in IIT level over a period can be measured by the difference between two GL indexes of different times in the following simple way.

$$\Delta GL = GL_t - GL_{t-n} = \left(1 - \frac{\sum_{j=1}^{n}\left|X_j - M_j\right|}{\sum_{j=1}^{n}\left(X_j + M_j\right)}\right)_t - \left(1 - \frac{\sum_{j=1}^{n}\left|X_j - M_j\right|}{\sum_{j=1}^{n}\left(X_j + M_j\right)}\right)_{t-n} \quad (8)$$

where t and n refer to end year and to time interval, respectively.

However, it is argued that this measure derived directly from the GL index does not show change in inter/intra-industry relation in trade flows. GL index is a static measure in the sense that it captures IIT share of total trade at a specific time. Given that change in trade flows involves a dynamic adjustment on both interindustry and IIT, measuring change in IIT level should reflect the interaction between two types of trade. In some cases, an increase in IIT measured by equation (8) can hide an important increase in interindustry trade. Noticing this potential flaw, Hamilton and Kniest (1991) suggest that observing a high level of IIT for a particular year gives no prediction on the change in trade pattern toward interindustry or intra-industry. They show that an increase in "interindustry" trade

[9]However, the evolution of indexes is indicative and should be interpreted with other measures to be presented in the following section.

[10]This seems inevitable, considering the wide scope of the research, which includes 182 pairs of European countries and 132 pairs of East Asian countries, in trade of 118 industries, over the period 1970–2005.

in an industry can appear as an increase of the GL index, if it contributes to reducing trade unbalance in the industry. Juxtaposing GL indexes of different times gives information on trade structure over time, but it does not lead to a conclusion on what direction (interindustry versus intra-industry trade) trade pattern has changed over a period. This observation leads to the following section about changes in trade structure in terms of IIT.

2. Marginal Intra-Industry Trade

The change in IIT level, termed “marginal intra-industry trade (MIIT)” can be calculated by different measures. The most commonly used measure is Brülhart A index developed by Brülhart (1994).

$$A\ (MIIT) = 1 - \frac{\left|(X_t - X_{t-n}) - (M_t - M_{t-n})\right|}{\left|X_t - X_{t-n}\right| + \left|M_t - M_{t-n}\right|} = 1 - \frac{\left|\Delta X - \Delta M\right|}{\left|\Delta X\right| + \left|\Delta M\right|} \quad (9)$$

where t and n refer to end year and to time interval, respectively.

The index varies between 0 and 1. A value of 0 indicates that change in trade pattern takes place in completely interindustry direction and a value of 1 means inversely that marginal change in trade occurs in completely intra-industry direction. The Brülhart A index is not biased downward according to disaggregation level (Mursed and Noonan 1994).

The sectoral Brülhart A index can be aggregated over all industries ($j=1..., k$), following equation (10) to obtain a weighted average. A_{tot} is weighted average of MIIT over all industries.

$$A_{tot} = \sum_{j=1}^{k} w_j A_j \quad \text{where} \quad w_j = \frac{\left|\Delta X_j\right| + \left|\Delta M_j\right|}{\sum_{j=1}^{k}\left(\left|\Delta X_j\right| + \left|\Delta M_j\right|\right)} \quad (10)$$

where j = industry and k = total number of industries.

As in the case of GL index, the A indexes of countries can be summed following equation (11) to constitute a regional weighted average Brülhart A index, as in the case of GL index.

$$A_{tot-region} = \sum_{i=1}^{n}\sum_{j=1}^{k} w_{j/region} A_j \quad \text{where} \quad w_{j/region} = \frac{\left|\Delta X_j\right| + \left|\Delta M_j\right|}{\sum_{i=1}^{n}\sum_{j=1}^{k}\left(\left|\Delta X_j\right| + \left|\Delta M_j\right|\right)} \quad (11)$$

where j = industry

k = total number of industries

i = country

n = total number of countries

As for the interpretation of the index, above all, its limit should be noticed. The index informs the direction (interindustry versus intra-industry) of change in trade pattern, but it does not show change in GL index, which captures IIT level at a specific time. This suggests that the Brülhart A index can be used for a complementary purpose of a comparison between GL indexes over time. If the difference of GL indexes from two different years—as presented in the equation 8—is positive and only if Brülhart A index is close to 1, can one conclude that the trade pattern has been changing in intra-industry direction with increasing IIT.

3. Empirical Results

From the same data set used in computing the GL index, the Brülhart A index of European and East Asian countries is computed over the period 1970–2005 at 5-year intervals. Tables 4 and 5 present the result.

Table 4. **Brülhart A Index (marginal intra-industry trade) for European Countries, 1970–2005**

	1970–1975	1975–1980	1980–1985	1985–1990	1990–1995	1995–2000	2000–2005
Germany	0.55	0.58	0.62	0.65	0.49	0.48	0.58
Austria	0.42	0.55	0.35	0.65	0.52	0.49	0.57
Belgium–Luxembourg	0.59	0.59	0.48	0.67	0.53	0.48	0.58
Denmark	0.34	0.44	0.23	0.49	0.41	0.41	0.51
Spain	0.2	0.27	0.29	0.45	0.36	0.28	0.36
Finland	0.33	0.33	0.27	0.39	0.33	0.3	0.46
France	0.61	0.6	0.6	0.71	0.6	0.61	0.68
Greece	0.19	0.24	0.18	0.19	0.22	0.25	0.28
Ireland	0.4	0.42	0.31	0.43	0.32	0.4	0.3
Italy	0.44	0.45	0.39	0.53	0.47	0.38	0.5
Netherlands	0.53	0.56	0.56	0.64	0.51	0.51	0.56
Portugal	0.22	0.24	0.19	0.36	0.42	0.41	0.49
United Kingdom	0.51	0.6	0.44	0.63	0.55	0.55	0.51
Sweden	0.39	0.49	0.38	0.48	0.43	0.45	0.48
Simple Average	0.41	0.45	0.38	0.52	0.44	0.43	0.49
Weighted Average	0.51	0.53	0.47	0.6	0.49	0.46	0.54

Source: Author's calculation based on the CEPII-Chelem database.

Table 5. **Brülhart A Index (marginal intra-industry trade) for East Asian Countries, 1970–2005**

	1970–1975	1975–1980	1980–1985	1985–1990	1990–1995	1995–2000	2000–2005
Cambodia–Lao People's Democratic Republic	0.04	0.00	0.00	0.17	0.05	0.04	0.05
China, People's Rep. of	0.00	0.1	0.13	0.33	0.24	0.42	0.4
Korea, Rep. of	0.03	0.09	0.19	0.21	0.46	0.69	0.91
Hong Kong, China	0.14	0.21	0.64	0.46	0.21	0.44	0.27
Indonesia	0.05	0.04	0.13	0.14	0.25	0.46	0.38
Japan	0.15	0.21	0.26	0.34	0.33	0.54	0.59
Malaysia	0.26	0.26	0.52	0.54	0.59	0.93	0.93
Philippines	0.03	0.14	0.25	0.22	0.24	0.56	0.68
Singapore	0.17	0.18	0.58	0.43	0.53	0.63	0.29
Taipei,China	0.02	0.03	0.04	0.03	0.06	0.13	0.13
Thailand	0.06	0.17	0.3	0.15	0.34	0.58	0.55
Viet Nam	0.03	0.02	0.01	0.03	0.08	0.16	0.15
Simple Average	0.08	0.12	0.25	0.25	0.28	0.46	0.44
Weighted Average	0.17	0.24	0.31	0.39	0.43	0.65	0.61

Source: Author's calculation based on the CEPII-Chelem database.

In Table 4, with the exception of Greece, Ireland, and Spain, most of the European countries have their indexes in a band of 0.35–0.65 over most periods. This means that the marginal trade (trade dynamics) occurs in both interindustry and intra-industry directions. The move toward IIT is most noticeable during the period 1985–1990 where the European Economic Community's Single Market Program was under way. IIT-oriented development appears clearly in France (1970–2005); Germany (1970–1990, 2000–2005); the Netherlands (1970–2005); and in the United Kingdom (1970–1980, 1985–2005). Greece, Ireland, and Spain show marginal trade toward interindustry direction over all periods.

The East Asian case presented in Table 5 shows a very different one from the European case. The distribution of Brülhart A indexes is uneven between countries and periods. All East Asian countries had very low indexes far from being equivalent to European ones during the early period; the weighted regional average index was 0.17 in the period 1970–1975, which was only one third of the European average. For the first two periods, 1970–1975 and 1975–1980, all East Asian countries had shown trade dynamics oriented toward interindustry trade. The absence of large developed countries (except Japan) in the region is the main reason that explains low indexes during the early periods. However, their marginal trade steadily oriented toward IIT. This trend was first observed in Hong Kong, China and Singapore in the early 1980s and it then appeared in other countries. With respect to this evolution, it should be noticed that East Asia is not a homogeneous region in terms of economic development. While less developed countries such as Cambodia–Lao People's Democratic Republic and Viet Nam have not experienced strong moves toward IIT, relatively more developed countries such as Japan and the newly industrialized economies have clearly shown their trade orientation toward IIT since the early 1990s.

The evolution of the respective regional average indexes draws attention. The European average (weighted) index has not significantly varied over all periods. It has remained in a band of 0.46–0.60. This means that average marginal trade occurred more or less evenly in both interindustry and intra-industry directions over all subperiods. In contrast, the East Asian average (weighted) index has been growing over all periods except for the period 2000–2005 where a slight fall was marked. The average index was 0.17 in the period 1970–1975 and reached 0.65 during the period 1995–2000, an increase of 285%. It is noteworthy that the East Asian average is higher than European average for the recent two periods, 1995–2000 and 2000–2005.

From these findings, it can be concluded that the regionalization of the East Asian economies—increasing share of intra-East Asian trade and investment—found its momentum in interindustry trade during its early periods, but it has been increasingly driven by IIT, especially since the 1990s. However, as examined previously, intraregional trade in East Asia still takes on less intra-industry features than intra-European trade, which reflects a *legacy* of the flying geese model.

IV. EVOLUTION OF MEASURES ON INTRA-INDUSTRY TRADE

A. Vertical and Horizontal Intra-Industry Trade

The GL index measures IIT level through crossed trade share between exports and imports. A sufficiently high disaggregation of trade flow data can prevent upward sectoral bias, which is caused by counting trade between different products in the same industry. In fact, this type of trade is based on division of work and within-industry comparative advantages and takes place in firms' vertically integrated production processes. Intrafirm trade represents a good deal of this VIIT. This has to be distinguished from HIIT, which consists of trade between differentiated products (e.g., German-produced cars versus French-produced cars). Actually, VIIT has interindustry features, because it is based on different factor endowments between countries, which leads them to be specialized according to their comparative advantages (Falvey 1981). Even so, VIIT is trade between subsectors in a vertical production chain and is different from purely interindustry trade, for example, trade of cereal against cars. Hence, trade can be divided into the following three types: interindustry trade, VIIT, and HIIT.

It is difficult to distinguish VIIT and HIIT directly from aggregate trade data. Abd-le-Rahman (1991) assumes that a unit value of exports and imports represents a quality of product and therefore can be used as criteria for determining levels of differentiation. If the quality of traded products is similar—in other words, an export's unit value and that of an import in an industry are similar—traded products can be considered as similar products.[11] From this assumption, Abd-le-Rahman develops an indirect method based on a comparison between unit value of sectoral export and that of sectoral import. Equation (12) formulates Abd-le-Rahman's method. If the ratio of an export's unit value to that of imports in an industry is located between in a band of (1-α)–(1+α), the trade in the industry is considered as HIIT.[12]

$$1-\alpha \leq \frac{UV_{ij}^{X}}{UV_{ij}^{M}} \leq 1+\alpha \qquad (12)$$

where UV_{ij}^{X} = unit value of country *i*'s export in industry *j*
UV_{ij}^{M} = unit value of country *i*'s import in industry *j*
α = coefficient to determine similarity of products[13]

B. Measures on Inter/intra-Industry Trade: One-way Trade and Crossed Trade

The definition of IIT is based on actual trade pattern in which trade in an industry occurs in crossed ways ("two-way trade"). If sectoral trade takes place in one way ("one-way trade"), this trade is considered as interindustry trade. One-way trade and crossed trade can be distinguished by a formula as follow (Fontagné and Freudenberg 1997).[14]

$$\frac{Min(X_{ii'j}, M_{ii'j})}{Max(X_{ii'j}, M_{ii'j})} \geq \beta \qquad (13)$$

where $Min(X_{ii'j}, M_{ii'j})$ = minority trade (export or import) in industry *j* between countries *i* and *i'*
$Max(X_{ii'j}, M_{ii'j})$ = majority trade (export or import) in industry *j* between countries *i* and *i'*
β = coefficient to determine one-way and two-way trade[15]

[11]The product's unit value is calculated from export and import volumes divided by their quantity (ton).
[12]This method, developed by Abd-el-Rahman (1991), is adopted by several empirical studies to measure IIT of European countries (Greenaway et al. 1994, Fontagné and Freudenberg 1997).
[13]The lower the value of α used, the more strictly HIIT is defined.
[14]For recent studies based on the above method, see Fukao et al. (2003).
[15]The higher the value of β used, the more strictly IIT is defined.

If the ratio of the minority flow to the majority flow in an industry does not exceed a specific value β, the trade in this industry is considered as one-way, referring to interindustry trade. If the ratio is higher than β, the trade is said to be two-way, which means IIT. Combining equations (12) and (13), trade can be divided into three types: one-way trade, vertically differentiated two-way trade (VIIT), and horizontally differentiated two-way trade (HIIT). Figure 5 summarizes the process of distinction.

Figure 6. **Method of Distinction between One-way Trade, Vertically Differentiated Two-way Trade, and Horizontally Differentiated Two-way Trade**

How can bilateral trade be defined at the product level?		
Does the minority flow represent at least β of the majority flows?	Similarity of export and import unit values: Do export and import unit values differ less than α?	
	Yes (horizontal differentiation)	No (vertical differentiation)
Yes	Two-way trade in similar products	Two-way trade in vertically differentiated products
No	One-way trade	

↓ ↓

$$\frac{Min(X_{ii'j}, M_{ii'j})}{Max(X_{ii'j}, M_{ii'j})} \geq \beta \qquad 1-\alpha \leq \frac{UV_{ij}^{X}}{UV_{ij}^{M}} \leq 1+\alpha$$

Note: Abd-el-Rahman (1991), Greenaway et al. (1994), and Fontagné and Freudenberg (1997) use 0.1 and 0.15, respectively, for values of α and β. Due to limitations in data availability (especially those of developing countries in East Asia in a coherent way), 0.2 and 0.25, respectively, are used for values of α and β.

Source: Adapted from Fontagné and Freudenberg (1997).

C. Empirical Results

To calculate export and import unit values, the World Bank database (Nicita and Olarreaga 2006) on 28 manufacturing industries (ISIC 3-digit level) is used. Despite a relatively high aggregation of data and limited sectoral coverage, this empirical test is new in the following three aspects. First, intraregional trade is recorded on a bilateral basis (trade flows between two countries), while other studies often use one country's trade with the rest of countries grouped as a bloc (e.g., France's trade with the EU), which causes geographical bias. Second, the three types of trade were calculated not only at the country level, but also at the regional level for comparative purposes. Finally, the most recent available and coherent data (data for 2004) over 15 European countries and 10 East Asian countries are used. Due to lack of available data, data for 2003 for Thailand are used, and some countries (Cambodia–Lao People's Democratic Republic) are excluded from the test.

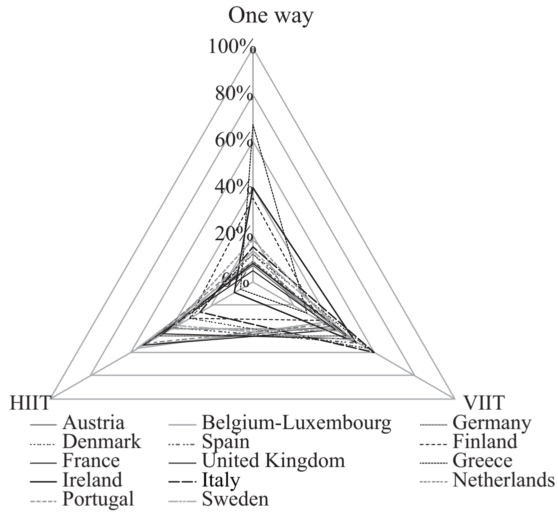
Tables 6 and 7 present the results of the analysis. As for intraregional trade in Europe, IIT appears prominent. Two-way trade (both VIIT and HIIT) represents 89% of all trade over 28 manufacturing industries in 2004, while one-way trade (interindustry trade) account only for 11%. HIIT (44%) is as much important as VIIT (45%). Turning to individual countries, interindustry trade share appears relatively high in Greece (67%), Finland (36%), and Portugal (18%); in contrast, it is low in France (5%), Austria (7%), Germany (8%), and the United Kingdom (8%). It is noteworthy that most European countries have higher level of HIIT in a band of 0.35–0.55. Exceptions are Greece (6%), Ireland (9%), and Italy (26%).

Table 6. **Share of Trade Types in Intraregional Trade in Europe, 2004**

	One-way Trade	**Two-way Trade**	
		VIIT	HIIT
Austria	0.07	0.38	0.54
Belgium–Luxembourg	0.09	0.35	0.57
Germany	0.08	0.46	0.46
Denmark	0.12	0.57	0.31
Spain	0.09	0.52	0.39
Finland	0.36	0.33	0.31
France	0.05	0.41	0.54
United Kingdom	0.08	0.49	0.44
Greece	0.67	0.27	0.06
Ireland	0.40	0.51	0.09
Italy	0.15	0.60	0.26
Netherlands	0.12	0.36	0.52
Portugal	0.18	0.42	0.40
Sweden	0.13	0.50	0.37
Simple Average	0.19	0.44	0.38
Weighted Average	0.11	0.45	0.44

Source: Author's calculation based on the database of Nicita and Olarreaga (2006).

Figure 6. **Share of Trade Types in Intraregional Trade in Europe, 2004**



HIIT = horizontally differentiated two-way trade, VIIT = vertically differentiated two-way trade.
Source: Author's illustration based on the results of Table 6.

With respect to the East Asian countries, intraregional trade in East Asia appears to have more interindustry trade than that in Europe. This confirms the conclusion of the previous research based on GL index and MIIT. The East Asian countries' weighted average of one-way trade is 29%, almost three times higher than that of European countries. This trend appears clearly in the intraregional trade of Indonesia (45%); the People's Republic of China (42%); and Taipei,China (39%). Unexpectedly, Japan (30%) has also its one-way trade share higher than the regional average. This is mainly due to two reasons. On one hand, the East Asian countries are mostly developing countries and their trade is largely determined by *inter-industrial* comparative advantages. On the other hand, relatively developed countries in East Asia such as Japan, the Republic of Korea, and Singapore have their IIT mostly with developed countries in North America and Europe.

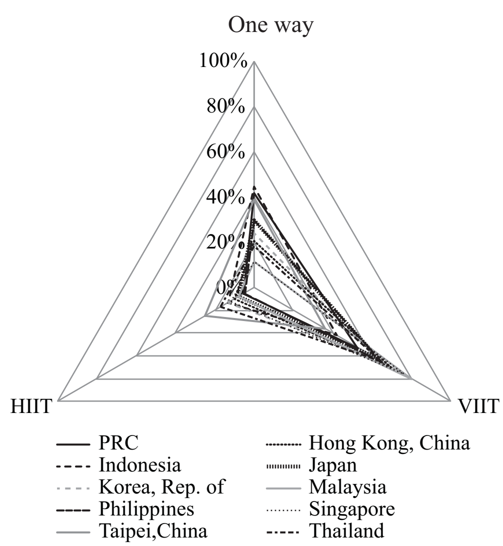
Another contrast to the European case is that in East Asia, VIIT share (61%) is considerably higher than HIIT (10%). The former is the typical trading pattern derived from division of production process and vertical FDI. The prominence of VIIT in intraregional trade illustrates that the trade structure in East Asia reflects features of the flying geese model.

Table 7. **Share of Trade Types in Intraregional Trade in East Asia, 2004**

	One-Way Trade	Two-Way Trade	
		VIIT	HIIT
China, People's Rep. of	0.42	0.53	0.06
Hong Kong, China	0.2	0.7	0.1
Indonesia	0.45	0.42	0.13
Japan	0.3	0.63	0.08
Korea, Rep. of	0.24	0.63	0.13
Malaysia	0.12	0.8	0.08
Philippines	0.3	0.65	0.05
Singapore	0.12	0.76	0.12
Thailand*	0.19	0.65	0.17
Taipei,China	0.39	0.36	0.25
Simple Average	0.27	0.61	0.12
Weighted Average	0.29	0.61	0.1

* For Thailand, 2003 data are used.
HIIT = horizontally differentiated two-way trade, VIIT = vertically differentiated two-way trade.
Source: Author's calculation based on the database of Nicita and Olarreaga (2006).

Figure 7. **Share of Trade Types in Intraregional Trade in East Asia, 2004**



HIIT = horizontally differentiated two-way trade, VIIT = vertically differentiated two-way trade.
Source: Author's illustration based on the results of Table 7.

V. DETERMINANTS OF IIT

The previous sections showed that intraregional trade is largely intra-industry in Europe and interindustry in East Asia. However, the dynamics toward IIT have been observed more strongly in intra-East Asian trade than in intra-European trade, especially since the early 1990s. This section examines various determinants of IIT in Europe and East Asia.

A. Hypothesis on Determinants of IIT

Identifying determinants of IIT begins with several assumptions from the new theories of international trade (Krugman 1979, Lancaster 1980, Brander 1981, Helpman 1987, Feenstra et al. 2001). The most widely shared assumption is that the level of IIT is directly related to the level of gross domestic product (GDP) per capita. To explain this causality, Barker (1977) proposes that the demand for variety of goods (differentiated goods) increases as per capita income increases. In the same vein, Hirsch (1977) illustrates that differentiated products are generally capital-intensive and typical products of rich countries. This argument is taken as axiomatic, which explains the high IIT share in trade between developed countries. Principal determinants of IIT are as follows.

1. Per Capita Income

Given that the demand for differentiated products is more important in developed countries, a country's per capita income, represented by GDP per capita, is supposed to be positively correlated to its IIT level. Less developed countries tend to be specialized in export of less differentiable products and have less import demand for differentiated products.

2. Difference in Factor Endowments/Difference in Consumer Tastes

The two determinants represent different aspects: the difference in factor endowments concerns mainly difference in export composition, while the difference in consumer tastes explains difference in import composition. However, both determinants are often represented by a same proxy variable, difference in GDP per capital between a pair of countries.[16]

Differences in factor endowments lead to development of different comparative advantages, which contribute to interindustry trade. The more two countries are different in factor endowment, the less IIT share they are supposed to have in trade between them.

Differences in consumer tastes are also expected to be negatively correlated to IIT share. Given that IIT is trade between similar goods, the more two countries are different in consumer tastes, the less likely they have important IIT share in trade between them (Linder 1961).

However, interpreting the two determinants empirically requires a cautious approach, because their proxy, difference in GDP per capita, does not inform the level of development of the pair of countries. For example, a pair of developed

[16]This specification is used by Helpman (1987). Helpman and Krugman (1985) consider difference in GDP per capita between a pair of countries as proxy of difference in factor endowments (ratio capital/labor). A number of studies follow their interpretation in the absence of real ratio capital/labor.

countries and a pair of developing countries can have a same value of difference in GDP capita, while the latter is not expected to have a high IIT share. To avoid this shortcoming at the empirical level, it is necessary to pay attention to the composition of country pairs.

3. Difference in Industrial Structure

The difference in industrial structure is expected to be negatively correlated to the level of IIT. If two countries are more similar in industrial structure, it is more likely that trade between them is of intra-industry nature, especially when both are developed countries. Assuming that the industrial structure is reflected by the trade structure (export), the difference in industrial structure can be represented in the following way.

4. Distance

Geographical distance is often used as a proxy variable for transaction cost. While distance is assumed to be negatively related to IIT level, the theoretical models of IIT do not explicitly explain how the distance exerts an influence on IIT between countries. It is assumed that differentiated products are less sensitive to the geographic distance than relatively homogenous products, because the differentiation can create a monopolistic situation for each demand.

5. Trade Orientation

Trade orientation is defined as overall effect of all unidentified factors on trade. Following Balassa (1986), Balassa and Bauwens (1987), Stone and Lee (1995) and Clark and Stanley (1999), a proxy for trade orientation (TO) is defined as residuals (ε) from the following regression.

$$\log\mathrm{PCT} = c + \alpha \log \mathrm{GDPPC} + \beta \log \mathrm{POP} + \varepsilon \qquad (14)$$

where *PCT* = per capita trade
GDPPC = GDP per capita
POP = population

In open economies, *certeris paribus*, a country’s per capita trade can be largely explained by its level of GDP per capita (positive correlation) and by its population (negative correlation). The residual ε that the two variables do not explain can be interpreted as a part related to TO. The share of IIT is expected to be positively correlated to TO.

6. Country Size

It is difficult to explain clearly how country size is related to the level of IIT. Speculative arguments on this relation are as following. Large countries can take advantage of their large domestic markets as outlets for their products. This enables them to have an evenly developed industrial structure, in which each industry can achieve its minimum level of economies of scale. In contrast, small countries are more likely to be specialized in a limited number of industries, which leads them to be oriented to interindustry trade. This argument can be justified in the following two cases. First, for small developed countries, domestic markets are too small to absorb their own production and so, from the beginning of their industrialization, they have aimed to export their products to their larger trading partners. This may lead to interindustry-oriented trade pattern. Second, for small developing countries, their trade is rather interindustry in nature, because their products are essentially primary commodities and low-technology products that are less differentiable.

Country size is often used as a proxy for sectoral economies of scale (Helpman and Krugman 1985), which allows for differentiation of products and IIT (Brülhart 1995).[17] Therefore, *ceteris paribus*, variety of products and the share of IIT are positively related to country size.

However, important country size does not mean that the country has a high level of GDP per capita, which is likely to exert the most decisive influence on the share of IIT (e.g., the People's Republic of China, India). Achieving economies of scale in production of medium- and high-technology products suppose implicitly that producing countries are already rich enough to have sufficient domestic demand on these products. Therefore, country size with economies of scale can be identified only for developed countries, i.e., European countries.

B. Regression Model

1. Data

For a regression analysis on the share of IIT in intraregional trade in Europe and in East Asia, the GL index (bias-corrected one) is used as a dependent variable. It is calculated on a bilateral basis from the same dataset used in Section IIA. The period covers 5 years (2001–2005), giving 900 observations for the European countries (182 country pairs for each year) and 615 observations for the East Asian countries (123 country pairs for each year).

[17]As far as internal economies of scale at the firm level is concerned, minimum efficient scale (MES) is preferred to economic size, i.e., GDP (see Caves et al. 1975). Here, the focus is on external economies of scale.

2. Regression Model

The GL index is regressed against the following independent variables as presented in the equation 15.[18]

$$GL = f\begin{pmatrix} \text{GDPPC}_{\text{EX}}, \text{GDPPC}_{\text{IM}}, \text{GDP}_{\text{EX}}, \text{GDP}_{\text{IM}}, \text{ABS\_DIFF\_GDP}, \\ \text{ABS\_DIFF\_GDPPC, DIFF\_EX\_STR, DIST, TO} \end{pmatrix} \quad (15)$$

Variables (expected coefficient sign)
Dependent variable: *GL* = bias corrected GL index - equation 5
Independent variables: $GDPPC_{EX}$ = GDP per capita of exporting country (+) $GDPPC_{IM}$ = GDP per capita of importing country (+) GDP_{EX} = GDP of exporting country (+) GDP_{IM} = GDP of importing country (+) *ABS_DIFF_GDP* = absolute difference in GDP between a pair of countries (ambiguous) *ABS_DIFF_GDPPC* = absolute difference in GDP per capita between a pair of countries (-) *DIFF_STR_EX* = difference in export structure (-)[19] *DIST* = geographic distance between capitals of two countries (-) *TO* = trade orientation (+) Dummy variables: *COMBORDER* = takes the value 1 if exporter and importer share a common border, 0 (+) otherwise *LANGUAGE* = takes the value 1 if exporter and importer share a common language, 0 (+) otherwise *T+year* = time dummy variables reflecting business cycle *DEU* = Germany *FRA* = France *GBR* = United Kingdom *ITA* = Italy *NIE-1* = newly industrialized economies: Hong Kong, China; the Republic of Korea; Singapore; Taipei,China *NIE-2* = Indonesia, Malaysia, the Philippines, Thailand Country or group dummy variables = *ASEAN, JPN* (Japan)*, CHN* (People's Republic of China)

[18] Log transformation of variables is used for regression analyses.

[19] Difference in export structure (DES) between two countries is calculated over 121 industries (ISIC 3-digit level) from the following formula: $DES = \sum_{k=1}^{n} \left| x_{ik}/X_i - x_{jk}/X_j \right|$

where *xik* = export share in industry *k* of country *I*
xjk = export share in industry *k* of country *j*
*X*i,and *X*j = total exportation of countries *i* and *j*

C. Empirical Results

1. Intra-Industry Trade in Europe

Table 8 summarizes the results of regression analysis on IIT (measured by the GL index) between pairs of European countries over the period 2001–2005.[20]

Values of Adjusted R^2 are constant (0.63–0.64) over several analyses whose results are reported in columns 1–4. Compared to analysis of a year, the panel analysis provides improved statistical significance for some variables such as $GDPPC_{EX}$ and $GDPPC_{IM}$. GDP_{EX} and GDP_{IM} are positively correlated to the level of IIT and their coefficients are statistically significant, consistent with the paper's hypothesis. However, $GDPPC_{EX}$ and $GDPPC_{IM}$ are negatively correlated to the level of IIT, contrary to the hypothesis that per capita income level is positively correlated to IIT. These findings suggest that for European countries, the share of IIT is higher between large and low-income countries.

Differences in GDP and in GDP per capita between a pair of countries tend to have a positive impact on the level of IIT, which contradicts the initial assumption. Both variables *ABS_DIF_GDP* and *ABS_DIFF_GDPPC* have positive and statistically significant coefficients, even though they are relatively low. Difference in export structure, *DIFF_STR_EX*, has a coefficient of –0.95, which is statistically significant and is consistent with expectations. The more similar export structures are between two countries, the higher their level of IIT.

The variable for distance has a negative coefficient, as observed in most analyses using gravity models. Given that a typical coefficient of distance in gravity models is –0.6,[21] the less important effect of distance on IIT conforms to expectations. However, neighborhood turns out to be negatively related to the share of IIT in Europe. Common language and trade orientation do not show statistically significant coefficients, the same with dummy variables on countries. These findings suggest that IIT between European countries is not determined by country-specific factors, but by industry-specific factors.

[20]The same data as were used in Section IIA.3 are used.

[21]According to Leamer and Levinsohn (1994), the typical coefficient of distance in gravity models of trade is –0.6.

Table 8. **Summary of Regression Results on IIT in Europe**

	2001	**2003**	**2005**	**2001-05**
C	–0.19(1.61)	–3.93**(1.61)	–4.14***(1.58)	–1.38**(0.54)
LOG(GDP_{EX})	0.14***(0.05)	0.17***(0.05)	0.19***(0.04)	0.14***(0.02)
LOG(GDP_{IM})	0.14***(0.05)	0.17***(0.05)	0.17***(0.05)	0.16***(0.02)
LOG($GDPPC_{EX}$)	–0.13*(0.07)	0.00(0.07)	–0.01(0.07)	–0.11***(0.02)
LOG($GDPPC_{IM}$)	–0.12*(0.07)	0.00(0.07)	–0.02(0.07)	–0.06**(0.03)
LOG(ABS_DIFF_GDP)	0.06***(0.02)	0.05***(0.02)	0.06***(0.02)	0.05***(0.01)
LOG(ABS_DIFF_GDPPC)	0.04**(0.02)	0.03*(0.02)	0.05***(0.02)	0.03***(0.01)
DIFF_STR_EX	–1.14***(0.35)	–1.05***(0.20)	–1.03***(0.19)	–0.95***(0.09)
TO	–0.01(0.06)	0.00(0.07)	–0.04(0.06)	–0.01(0.03)
LOG(DIST)	–0.24***(0.05)	–0.20***(0.05)	–0.20***(0.04)	–0.24***(0.02)
COMBORDER	–0.15*(0.08)	–0.10(0.08)	–0.09(0.08)	–0.12***(0.03)
LANGUAGE	0.00(0.09)	0.09(0.09)	0.01(0.09)	0.04(0.04)
DUM_DEU_EX	–0.29**(0.11)	–0.36***(0.11)	–0.36***(0.11)	–0.28***(0.05)
DUM_DEU_IM	–0.29**(0.12)	–0.35***(0.11)	–0.35***(0.11)	–0.33***(0.05)
DUM_FRA_EX	–0.31***(0.10)	–0.32***(0.10)	–0.35***(0.10)	–0.27***(0.04)
DUM_FRA_IM	–0.32***(0.11)	–0.32***(0.11)	–0.33***(0.11)	–0.32***(0.05)
DUM_GBR_EX	–0.22**(0.11)	–0.29***(0.10)	–0.35***(0.10)	–0.24***(0.04)
DUM_GBR_IM	–0.23*(0.12)	–0.29**(0.11)	–0.32***(0.11)	–0.29***(0.05)
DUM_ITA_EX	–0.25**(0.10)	–0.29***(0.10)	–0.33***(0.10)	–0.24***(0.04)
DUM_ITA_IM	–0.25**(0.10)	–0.29***(0.10)	–0.31***(0.10)	–0.27***(0.04)
T2005				–0.12***(0.03)
T2004				–0.17***(0.03)
T2003				–0.11***(0.03)
T2002				–0.04(0.02)
Included Observations	182	182	182	908
Adjusted R-squared	0.63	0.63	0.63	0.64
S.E. of Regression	0.23	0.23	0.23	0.23
Durbin-Watson Stat	1.74	1.91	1.77	1.8
Akaike Info Criterion	0.03	0.04	0.00	-0.1
Schwarz Criterion	0.38	0.39	0.36	0.03
F-statistic	16.89	17.46	17.49	71.75
Prob(F-statistic)	0.00	0.00	0.00	0.00

GL = Grubel and Lloyd index, IIT = intra-industry trade.

***, **, and * indicate statistical significance at 1%, 5%, and 10%, respectively.

Note: Standard errors are given in parentheses. Dependent variable: bias-corrected GL index. Method: least squares.

Source: Author's calculation.

Table 9 summarizes how signs of the coefficients conform to initial assumptions. In interpreting the regression results, especially on GDP and GDP per capita related variables, it should be noticed that the European countries are largely developed countries.

Table 9. **Coefficient Conformity Table to Initial Assumptions**

Variables with coefficients conforming to the assumptions	GDP_{EX}(+), GDP_{IM}(+), *DIFF_STR_EX*(-), *DIST(-)*
Variables with coefficients contrary to the assumptions	$GDPPC_{EX}$(-), $GDPPC_{IM}$(-), *ABS_DIFF_PIB*(+), *ABS_DIF_PIBPH*(+), *COMBORDER*(-)
Variables with statistically nonsignificant coefficients	TO(-), *LANGUAGE*(+)

Source: Author's summary from Table 8.

2. Intra-industry Trade in East Asia

Table 10 summarizes the results of regression analysis on IIT between the East Asian countries. As mentioned previously, East Asia includes both developed countries and developing ones. This requires a different approach in examining results from the previous European case. Adjusted R^2 are less stable over analyses of different years and lower than those shown in the European case. The panel analysis reported in column 4 reports 0.50 as adjusted R^2 and increased statistical significance of some variables, especially country dummies.

GDP_{EX} and GDP_{IM} have positive and statistically significant coefficients, which are higher than the same coefficients in the analyses on IIT in Europe. However, most of other variables, including difference in export structures, do not report statistically significant coefficients. The only exception is trade orientation with a positive coefficient.

We include several dummy variables indicating possible groupings of countries. These dummies allows for capturing "group effect" on IIT. NIE-1 has a negative coefficient at 1% level, while NIE-2 has a positive coefficient at the 10% level. This means that the trade pattern between NIE-1 has less of an IIT nature than that between NIE-2. However, NIE-1+Japan consisting of the NIE-1 and Japan has a positive and statistically significant coefficient. This illustrates that the trade pattern between individual countries of NIE-1 and Japan is characterized by IIT, while trade between NIE-1 has a low share of IIT. Intra-ASEAN trade takes on more features of IIT than extra-ASEAN trade.

Table 10. **Summary of Regression Results on IIT in East Asia**

	2001	**2003**	**2005**	**2001–2005**
C	–12.07***(1.86)	–8.72***(1.91)	–6.41***(1.93)	–8.88***(0.81)
LOG(GDP_EX)	0.45***(0.08)	0.31***(0.09)	0.30***(0.09)	0.35***(0.04)
LOG(GDP_IM)	0.42***(0.08)	0.28***(0.08)	0.29***(0.09)	0.32***(0.04)
LOG(GDPPC_EX)	0.09(0.08)	0.06(0.09)	–0.01(0.09)	0.04(0.04)
LOG(GDPPC_IM)	0.07(0.09)	0.02(0.10)	–0.03(0.10)	0.01(0.04)
LOG(ABS_DIFF_GDP)	–0.02(0.08)	0.04(0.08)	–0.04(0.08)	0.00(0.03)
LOG(ABS_DIFF_GDPPC)	–0.07(0.06)	–0.03(0.06)	–0.03(0.07)	–0.03(0.03)
DIFF_STR_EX	0.61(0.46)	0.41(0.45)	0.01(0.55)	0.24(0.20)
TO	0.13(0.20)	0.22(0.21)	0.15(0.21)	0.19**(0.09)
LOG(DIST)	0.05(0.11)	–0.01(0.13)	–0.03(0.13)	–0.01(0.05)
COMBORDER	0.09(0.17)	–0.12(0.20)	–0.17(0.20)	–0.08(0.08)
LANGUAGE	0.34**(0.15)	0.35*(0.18)	0.29*(0.18)	0.29***(0.07)
NIE_1	–0.66**(0.28)	–0.78**(0.33)	–0.81**(0.32)	–0.78***(0.14)
NIE_2	0.07(0.20)	0.29(0.23)	0.14(0.23)	0.17*(0.10)
NIE_1_JAPON	0.38(0.35)	0.62(0.36)	0.78**(0.37)	0.67***(0.16)
INTRA_ASEAN	0.38*(0.22)	0.19(0.23)	–0.11(0.22)	0.19*(0.10)
EXTRA_ASEAN	0.13(0.22)	0.13(0.24)	0.07(0.22)	0.13(0.10)
DUM_JPN_EX	–1.86***(0.33)	–1.59***(0.35)	–1.36***(0.34)	–1.64***(0.15)
DUM_JPN_IM	–1.64***(0.42)	–1.32***(0.42)	–1.20***(0.40)	–1.39***(0.17)
DUM_CHN_EX	–0.89***(0.29)	–0.60*(0.33)	–0.63*(0.33)	–0.69***(0.14)
DUM_CHN_IM	–0.94***(0.29)	–0.73**(0.35)	–0.73**(0.35)	–0.80***(0.14)
T2005				–0.15**(0.07)
T2004				–0.06(0.07)
T2003				–0.03(0.07)
T2002				–0.09(0.07)
Included observations	132	132	132	660
Adjusted R-squared	0.58	0.39	0.4	0.5
S.E. of Regression	0.5	0.57	0.56	0.54
Durbin-Watson Stat	2.17	2.28	2.35	2.23
Akaike Info Criterion	1.58	1.87	1.84	1.63
Schwarz Criterion	2.04	2.33	2.3	1.8
F-statistic	10.06	5.21	5.33	28.78
Prob(F-statistic)	0.00	0.00	0.00	0.00

GL = Grubel and Lloyd index, IIT = intra-industry trade.

***, **, and * indicate statistical significance at 1%, 5%, and 10%, respectively.

Note: Standard errors are given in parentheses. Dependent variable: bias-corrected GL index. Method: least squares.

Source: Author’s calculation.

Table 11 summarizes the findings on whether coefficients conform with the initial assumptions. With the exception of GDP_{EX} and GDP_{IM}, most of nondummy variables do not explain IIT between East Asian countries. Surprisingly, it is rather the dummy variables indicating country groupings that show considerable explanatory power. In this regard, NIE_1_JAPAN, NIE_2, and LANGUAGE are prominent. In fact, LANGUAGE indicates mainly Chinese-speaking countries. This confirms that IIT in East Asia takes place principally within the "subgroups" of more developed countries of the region.

Table 11. **Coefficient Conformity Table to Initial Assumptions**

Variables with coefficients conforming to the assumptions	GDP_{EX}(+), GDP_{IM}(+), *LANGUAGE(+)*
Variables with coefficients contrary to the assumptions	
Variables with coefficients contrary to the assumptions	$GDPPC_{EX}$(+), $GDPPC_{IM}$(+), *ABS_DIFF_GDP(+), ABS_DIFF_GDPPC(-), DIFF_STR_EX (-), TO(-), DIST(-), COMBORDER(-), LANGUAGE(+)*
Dummy varaibles (subregional groups) with positive and statistically significant coefficients	*NIE_1_JAPAN*, *NIE_2*, *Intra_ASEAN*

Source: Author's summary from Table 10.

VI. CONCLUSION

This paper reviewed the development of intra-industry trade in Europe and East Asia. Using a Grubel–Lloyd index to measure the share of IIT, it is found that the share of IIT is higher in intra-European trade than in intra-East Asian trade. Given that IIT characterizes trade between developed countries, a higher share of IIT in Europe conforms to expectations.

However, it is notable that the share of IIT has increased faster in East Asia than in Europe. The industrialized countries in East Asia (Japan and the NIEs-1) have a markedly higher GL index on their intraregional trade than the average share of IIT in Europe. This finding suggests that convergence is under way between the two regions in terms of inter/intra-industry trade pattern. Upon quantifying marginal intra-industry trade, which informs about the direction of trade dynamics either to interindustry trade or to IIT, it is observed that the evolution of intra-East Asian trade has been more biased toward IIT than intra-European trade has been since the mid-1990s.

Counting bilateral trade flows and export and import unit values, trade is divided into three types: (i) one-way trade, (ii) two-way trade of vertically differentiated products, and (iii) two-way trade of horizontally differentiated products. Although considered as IIT, the last two types of trade are different in nature. It is assumed that only HIIT is authentic IIT based on differentiation of products. Through the empirical analyses over manufacturing industries, it is found that the share of HIIT in intra-European trade is very high compared to that in intra-East Asian trade. It can be concluded that a large part of IIT in intra-East Asian trade is actually VIIT. Even developed countries in East Asia (Japan and NIEs-1) have a lower share of HIIT in their intraregional trade than the European average share of HIIT. This is because their HIIT is oriented mainly to developed countries in North America and Europe.

To identify the determinants of IIT in Europe and in East Asia, two sets of regression analyses were performed, one for intra-European IIT and the other for intra-East Asian IIT. The two regions have different determinants for their IIT. Although GDP related positively to share of IIT (represented by GL index of intraregional trade) in both regions, the difference in export structures is negatively related to the share of IIT in Europe. This suggests that IIT takes place more between developed countries with a similar industrial structure. In intra-East Asian trade, dummy variables on different groupings of countries have explanatory power to IIT, of which Japan and NIEs-1 is the most remarkable. This suggests that IIT in intra-East Asian trade takes place mainly between developed countries in East Asia.

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