



**School of Economics and Management**

TECHNICAL UNIVERSITY OF LISBON

Department of Economics

**Yushi Yoshida, Nuno Carlos Leitão and Horácio Faustino**

***Intra-Industry Trade between Japan and European Countries: a Closer Look at the Quality Gap in VIIT***

**WP 53/2008/DE/SOCIUS**

---

**WORKING PAPERS**

ISSN N° 0874-4548



# **Intra-Industry Trade between Japan and European Countries: A Closer Look at the Quality Gap in VIIT**

Nov 2008

Yushi Yoshida\*

*Faculty of Economics, Kyushu Sangyo University, Japan*

Nuno Carlos Leitão

*ESGS, Polytechnic Institute of Santarem, Portugal*

Horácio C. Faustino

*ISEG, Technical University of Lisbon, Portugal*

## **Abstract**

In this paper, we provide an overview of the development of intra-industry (IIT) trade between Japan and various European countries, including both old and new EU members, as well as emerging Eastern European countries. For the measurement of intra-industry trade, we construct a vertical intra-industry trade (VIIT) measure for various margins of unit price ratios, in addition to a Grubel-Lloyd index. By varying the margins from zero to significantly large values, the share of VIIT in total IIT changes from unity to zero, corresponding to the distributional characteristics of VIIT for each European country. Our empirical model attempts to explain the distributional characteristics of VIIT through foreign direct investments and country characteristics, in addition to traditional determinants of IIT, such as differences in GDP per capita, average GDP, and smaller and larger GDPs.

Our sample covers 1988 to 2004 for bilateral trade between Japan and 31 European countries. Our econometric methodology for this panel data uses fixed-effect model estimation for static IIT. We find that intra-industry trade between European countries and Japan increases with their corresponding GDPs. Our preliminary results indicate that it is important to measure a wider range of quality based on relative prices rather than the traditional ratio used in the literature.

Keywords: Intra-Industry Trade; Japan-Europe; Quality; Vertical IIT.

JEL Classification Codes: F14

---

\* Yushi Yoshida (corresponding author):, Faculty of Economics, Kyushu Sangyo University, 2-3-1 Matsukadai, Higashi-ku, Fukuoka, 813-8503 Japan. [yushi@ip.kyusan-u.ac.jp](mailto:yushi@ip.kyusan-u.ac.jp). We would like to thank Eleonora Pierucci and Hung-Yi Chen for their suggestions and also participants at the INFER conference in Evora.

## 1. Introduction

In this paper, we provide an overview of the development of intra-industry trade (IIT) between Japan and various European countries, including both old and new EU members, as well as emerging Eastern European countries. The formation of stronger economic ties between European countries due to the creation and expansion of the EU contributed to an increase in intra-industry trade for European countries, even with respect to non-European countries. In contrast, according to factor proportion theory's predictions regarding trade volume (Krugman, 1979; Lancaster, 1980), intra-industry trade increases with an increase in the similarity of two economies, resulting in more *horizontal IIT* (differentiated products of same quality). The price ratio of exports to imports in this horizontal IIT category is expected to be close to unity. This phenomenon should be more likely observed between older EU member countries and Japan. On the other hand, a country may export a product whose quality is different from its corresponding import, as in the North-South trade model of Flam and Helpman (1987) and Falvey and Kierzkowski (1987). In this case, we observe *vertical IIT*, with price ratios of export to import deviating from unity. We expect to find this vertical IIT in trade between Japan and less-developed European countries. In addition, emerging economies in Eastern Europe provide opportunities for foreign direct investments, resulting in increasing parts and components trade between subsidiary and parent firms, or *intra-firm trade*. This also suggests vertical IIT between emerging European countries and Japan.

For the measurement of vertical intra-industry trade, the threshold values of 15 and 25 percent differences in the relative price of exports and imports are used extensively to disentangle vertical IIT from horizontal IIT<sup>1</sup> in the empirical literature. Although this strategy can successfully distinguish between horizontal IIT (HIIT) and vertical IIT (VIIT), VIIT measured in this way embraces origins of both quality differentiation and components trade. A priori price differentials between export prices and import prices are likely to be wider for intra-firm trade. For multinational firms, typical intra-firm trade involves parts and components going in one direction and finished or assembled products

---

<sup>1</sup> For example, see Greenaway et al. (1994) and Fukao et al. (2003).

going in a different direction.

For the above reasons, we construct VIIT for various margins of unit price ratios, in addition to a Grubel-Lloyd index. By varying margins from zero to significantly large values, the share of VIIT in total IIT changes from unity to zero, corresponding to the distributional characteristics of VIIT for each European country. Our empirical model attempts to explain the distributional characteristics of VIIT through foreign direct investments and country characteristics, in addition to traditional determinants of IIT such as differences in GDP per capita, average GDPs, and both smaller and larger GDPs.

Our sample covers 1988 to 2004 for bilateral trade between Japan and 31 European countries (six emerging countries are included only after 1993). Our econometric methodology for the panel data includes fixed-effects estimation for static IIT. Empirical results reveal that the set of economic variables influence older EU members *symmetrically* across the entire range of relative prices, while influencing new EU members *asymmetrically*, i.e., only at higher relative prices for Japanese exports. Our results indicate that it is important to measure a wider quality range based on relative prices, rather than the traditional ratios used in the literature.

The paper proceeds as follows. In the next section, we briefly review the literature on intra-industry trade, focusing especially on vertical intra-industry trade. Section 3 presents an overview of recent developments in the Japan-Europe economic relationship. The data and empirical methodology are described in section 4. Empirical results are presented in section 5. The final section discusses the results and concludes.

## **2. Literature Review**

The literature on IIT began to appear in the 1960s with Verdoorn (1960) and Balassa (1965, 1966). These authors became aware that certain developed countries exported and imported products within the same product categories. This phenomenon occurred in the years following the European Economic Community's (EEC) formation. The phenomenon only started to receive increased attention, however, after Grubel and Lloyd (1975) introduced an index to measure IIT. Following these studies, there was wide acceptance of the idea

that IIT was more intense between countries with similar income levels, a similarity reinforced by economic integration processes. Thus, the traditional Heckscher-Ohlin model could not explain this type of trade between similarly endowed countries.

The main breakthrough in the theoretical explanation of IIT occurred in the late 1970s. The pioneering work on intra-industry models was that of Krugman (1979, 1980), Lancaster (1980), Helpman (1981), and Eaton and Kierzkowski (1984). These models consider products that are horizontally differentiated – i.e., different product varieties are of similar quality - although varieties of the same product may be distinguished in terms of their actual or perceived characteristics. In these models, each variety is produced with increasing returns to scale, and when countries open themselves to trade, similarity of demand leads to intra-industry trade. Hence, HIIT is more likely to be observed between countries with similar factor endowments, and cannot be explained by traditional Heckscher-Ohlin trade theories.

This theoretical work was synthesized in Helpman and Krugman (1985) as Chamberlin-Heckscher-Ohlin model. This is a model that combines monopolistic competition with the Heckscher-Ohlin theory, incorporating factor endowment differences, horizontal product differentiation, and increasing returns to scale. The Helpman and Krugman (1985) model generates the following country-specific hypothesis: the larger the difference in factor endowments between countries, the smaller (larger) the extent of HIIT (intra-industry trade). As horizontal product differentiation considers different varieties to be of the same quality but with different characteristics, varieties may be produced with similar factor intensity.

Linder (1961) considered consumers' tastes to be conditioned by their income levels. These tastes yield specific demands for products, and this demand structure generates a production response. Hence, countries with similar per-capita incomes will have similar demand structures, and will therefore export similar goods, resulting in greater HIIT. According to Linder's (1961) hypothesis, a negative relationship between income differences and VIIT is to be expected. Less developed countries with lower per-capita incomes specialize in (and export) low-quality products (varieties), whereas the more developed

countries with higher per-capita incomes specialize in (and export) high-quality products (varieties of the same product). So, Linder's theory proposes that the higher the difference in per-capita income, the greater the VIIT. As similarity in demand determines the similarity of the goods traded, Linder (1961) implicitly proposes the following country-specific hypothesis: the more different two countries' factor endowments, the smaller (greater) the extent of HIIT (VIIT).

The main references for VIIT models are Falvey (1981), Shaked and Sutton (1984), Falvey and Kierzkowski (1987), and Flam and Helpman (1987). The essentials of these models can be summarized as follows: Vertical product differentiation means that different varieties are of different quality and, in terms of demand, and we assume that consumers rank alternative varieties according to product quality.

For example, Falvey and Kierzkowski (1987, p.144), following the Linder hypothesis, consider that "a significant element in explaining vertical product differentiation will be unequal incomes." Inequalities in income distribution ensure that both countries will demand all the available qualities. Thus, a large difference in income levels increases the share of VIIT, as income differences generate dissimilarity in demand. On the supply side, the model incorporates technological differences and product quality linked to capital intensity in production. The framework of the Flam and Helpman (1987) model is similar, though here it is technological differences (labor productivity) that explain VIIT. The conclusions are similar: the most productive country, where wages are highest, will export the highest-quality product varieties.

Empirical studies on this topic may be synthesized as follows. Helpman (1987) tested three predictions based on the Helpman and Krugman (1985) model, using data from fourteen OECD countries, with his results suggesting the confirmation of the theory. Hummels and Levinsohn (1995) also concluded that the theory was confirmed using a panel data analysis with similar tests to Helpman's. When country-specific fixed effects (country-pair dummies) were used, however, these authors concluded that most of the variation in IIT share for all OECD country pairs of was explained by country-pair specific factors. This result contradicts the results of Helpman (1987). Hummels and Levinsohn (1995) concluded that their results were inconsistent with Helpman and

Krugman's (1985) model, and questioned the empirical success of monopolistic competition models. Cies'lik (2005) notes that Hummels and Levinsohn did not derive their estimating equations directly from the Helpman-Krugman framework. Cies'lik's solution demonstrates a positive relationship between IIT and the sums of capital-labor ratios. The introduction of this control variable by Cies'lik changes the estimation results and yields a negative relationship between IIT and capital-labor ratio differences, as predicted by Helpman and Krugman.

As the IIT index does not account for intra-firm trade, Egger, Egger and Greenaway (2007) quantify the bias of the Grubel and Lloyd index associated with multinationals' repatriated profit flows. The product cycle theory developed by Vernon (1966) divides the life cycle of new products into three stages: new product stage, maturing product stage, and standardized product stage. The country source of exports shifts throughout the life cycle of a product, and foreign direct investment (FDI) has a decisive role in this dynamic process. In the final product stage, technology becomes available to the less-developed countries through FDI. This allows these countries to export low-quality differentiated products to developed countries, while importing high-quality product varieties from these countries at the same time. Thus, Vernon's theory suggests a positive relationship between VIIT and per-capita income differences, as well as between VIIT and FDI.

### **3. The Development of Japan-Europe Trade over the Last Two Decades**

Before we investigate the determinants of IIT between Japan and various European countries in our regression analysis, we first overview recent developments in the trade relationship between Japan and Europe.

## Japanese Perspectives

**Table1. Japanese Total Trade by Partner Country**

(Trillion Yen)

Year	World	USA	China	Europe(31)	EU15+	NewEU10	NonEU4
1988	58.0	16.9 (0.29)	2.5 (0.04)	12.0 (0.21)	11.0 (0.19)	0.1 (0.00)	0.9 (0.02)
1989	66.8	19.5 (0.29)	2.7 (0.04)	13.6 (0.20)	12.5 (0.19)	0.1 (0.00)	1.0 (0.01)
1990	75.4	20.7 (0.27)	2.6 (0.03)	16.3 (0.22)	15.1 (0.20)	0.2 (0.00)	1.1 (0.01)
1991	74.4	19.5 (0.26)	3.1 (0.04)	15.5 (0.21)	14.4 (0.19)	0.2 (0.00)	0.9 (0.01)
1992	72.6	18.8 (0.26)	3.7 (0.05)	14.5 (0.20)	13.8 (0.19)	0.2 (0.00)	0.6 (0.01)
1993	67.1	17.9 (0.27)	4.2 (0.06)	12.0 (0.18)	11.2 (0.17)	0.2 (0.00)	0.7 (0.01)
1994	68.7	18.5 (0.27)	4.7 (0.07)	11.7 (0.17)	11.0 (0.16)	0.1 (0.00)	0.6 (0.01)
1995	73.2	18.4 (0.25)	5.5 (0.07)	12.8 (0.17)	12.0 (0.16)	0.1 (0.00)	0.7 (0.01)
1996	82.8	20.8 (0.25)	6.8 (0.08)	13.9 (0.17)	13.1 (0.16)	0.2 (0.00)	0.7 (0.01)
1997	92.1	23.3 (0.25)	7.7 (0.08)	15.5 (0.17)	14.4 (0.16)	0.2 (0.00)	0.9 (0.01)
1998	87.4	24.3 (0.28)	7.5 (0.09)	16.4 (0.19)	15.4 (0.18)	0.3 (0.00)	0.8 (0.01)
1999	82.9	22.3 (0.27)	7.6 (0.09)	15.1 (0.18)	14.2 (0.17)	0.3 (0.00)	0.6 (0.01)
2000	92.7	23.2 (0.25)	9.2 (0.10)	15.3 (0.16)	14.3 (0.15)	0.3 (0.00)	0.7 (0.01)
2001	91.5	22.4 (0.24)	10.8 (0.12)	15.1 (0.16)	14.0 (0.15)	0.4 (0.00)	0.7 (0.01)
2002	94.4	22.1 (0.23)	12.7 (0.13)	15.0 (0.16)	13.9 (0.15)	0.4 (0.00)	0.7 (0.01)
2003	98.9	20.2 (0.20)	15.4 (0.16)	16.3 (0.16)	14.9 (0.15)	0.5 (0.00)	0.9 (0.01)
2004	110.4	20.5 (0.19)	18.2 (0.16)	18.0 (0.16)	16.2 (0.15)	0.6 (0.01)	1.2 (0.01)
2005	122.6	21.9 (0.18)	20.8 (0.17)	18.6 (0.15)	16.3 (0.13)	0.8 (0.01)	1.5 (0.01)

Note: Figures are the sum of export and import between Japan and its partner country/region. Figures in parentheses are the share of region in the world. EU15+ is original EU 15 member countries before 2004 plus Switzerland and Norway. NewEU10 consists of new 10 member countries joined EU in 2004. NonEU4 includes Bulgaria, Romania, Russia and Turkey.

Source: Author's calculation based on the *Japan Custom data*.

Table 1 shows Japan's total trade, the sum of Japanese exports and imports, by its trading partners' country/region. Japan's total trade increased two-fold over last 18 years, from 1988 to 2005. For individual countries/regions, total trade values also increased for all regions. In terms of share, however, both the US and Europe lost share due to a sharp rise in total trade with China, i.e., an eight-fold increase over the period. Within European countries, new EU members gained (although only by little) a higher share, while old EU members lost trade share with Japan by about six percentage points. Non-members of the EU demonstrated a slight decline in share in our sample. Among those experiencing a share increase in total trade with Japan were Ireland (0.25 percentage point increase), Hungary (0.16), Czech (0.16),



Spain (0.08), Turkey (0.06), Netherlands (0.04), Norway (0.03), Poland (0.03), Slovakia (0.03), Estonia (0.03), Luxemburg (0.01), Malta (0.01), Latvia (0.01), and Lithuania (0.01).

**Table2 . Japanese FDI into European countries**

	<u>pre-1987</u>	<u>1988-1991</u>	<u>1992-1995</u>	<u>1996-1999</u>	<u>2000-2003</u>
Austria	19	7	5	5	4
Belgium	58	19	14	11	22
Denmark	9	5	2	2	6
France	100	66	43	38	54
Germany	220	121	64	55	79
Greece	6	1	1	2	1
Ireland	5	11	6	10	5
Italy	45	37	20	22	21
Luxembourg	5	5	3	0	1
Netherlands	91	81	51	49	44
Norway	7	3	0	3	1
Portugal	7	7	3	3	4
Spain	32	28	24	15	18
Sweden	18	5	9	8	11
UK	221	157	86	115	98
Bulgaria	1	0	1	0	0
Czech	0	4	14	7	29
Estonia	0	0	1	0	2
Finland	5	0	4	2	3
Hungary	0	6	13	12	16
Latvia	0	0	0	0	1
Poland	0	4	14	19	17
Romania	0	1	0	2	6
Russia	0	7	12	11	8
Slovakia	0	0	3	5	4
Slovenia	0	0	1	2	1
Switzerland	22	10	2	4	8
Turkey	2	3	8	3	7

Note: Figures in the first column show the accumulated number of overseas establishments by Japanese parent corporations. Figures in other columns are the number of newly established overseas subsidiaries during the period.

(Source: author's calculation based on the *Overseas Japanese Corporations*, 2005)

Next, Table 2 shows Japanese FDI in European countries between 1988 and 2003 in terms of the number of newly established subsidiaries. From this table, we observe two distinguishing features of Japanese foreign direct investment to European countries. First, there are continuous FDI inflows to a

subgroup of old EU members, namely, Belgium, France, Germany, Italy, Netherlands, Spain, and UK. In the case of the UK, the largest recipient of Japanese FDI, there were already over 200 Japanese subsidiaries prior to 1987, and the UK continued to receive about 28 new establishments per year, on average. Second, we observe a rapid increase in FDI flows to some emerging European economies in recent years. For the Czech Republic, Hungary, Poland, and Russia, there was no establishment of Japanese subsidiaries prior to 1987. In the most recent six to nine years, however, Japanese FDI inflows to these countries exceed inflows to the older EU members not mentioned above.

### ***The European Perspectives***

EU-Japan trade relations began to develop in the 1970s. The early 1970s were characterized by the first boom in Foreign Direct Investment (FDI) by Japanese companies into Europe. Hostility towards Japanese trade practices began at around the same time, resulting in Voluntary Export Restraints on the Japanese side.

In the 1980s, trade between Japan and EU countries consisted essentially of industrial products. In 1990, the trade deficit decreased between these partners. According to *Eurostat* in 2006, the EU exported 515.07 million euros worth of goods to Japan, and imported 461.19 million euros worth of goods.

In 1991, the *EC-Japan Joint Declaration* was signed as an institutional framework for the EU- Japan relationship. International trade between the two partners was historically strong, and favored Japan. In this context, it is important to note that Japan and the EU reached a Mutual Recognition Agreement on pharmaceuticals, chemicals, electrical products, and telecommunications equipment in 2002, followed in 2003 by the *Agreement on Cooperation on Anti-Competitive Activities*.

Table 3 shows the distribution of FDI inflows in millions of dollars. We select two regions (World and European Union) and four countries (United States of America, Japan, Portugal, and China). The data shows that EU members have become more attractive targets for foreign investors than has the United States.

According to Table 3, the European Union attracted 46% of world FDI

inflows in 2003, whereas the USA attracted 10%, China 9.7%, and Japan only a residual 1.1%. Portugal and Japan have similar rankings, and their shares increased over the 1996-2003 period. In 2003, however, Japan's economy managed to attract FDI inflows of approximately 6.3 billion dollars. China demonstrates similar shares of FDI inflows in 1996 (10.4%) and 2003 (9.7%).

Table 3 also indicates that foreign direct investment inflows in the world economy increased over the 1996-2000 period, but decreased after this year. The same trend has been observed to the European Union.

**Table 3. FDI Inflows for 1996-2003 (Millions of dollars)**

Regions	1996	1997	1998	1999	2000	2001	2002	2003
World	386,140	481,911	690,905	1,086,750	1,387,953	817,574	716,128	557,869
European Union	110,376 (0.286)	127,888 (0.265)	249,931 (0.362)	479,372 (0.441)	671,417 (0.484)	357,441 (0.437)	420,433 (0.587)	253,728 (0.455)
Portugal	1488 (0.004)	2477 (0.005)	3144 (0.005)	1234 (0.001)	6787 (0.005)	5892 (0.007)	1767 (0.002)	8593 (0.015)
USA	84,455 (0.219)	103,398 (0.215)	174,434 (0.252)	283,376 (0.261)	314,007 (0.226)	159,461 (0.195)	71,331 (0.100)	53,146 (0.095)
Japan	228 (0.001)	3,225 (0.007)	3,192 (0.005)	12,741 (0.012)	8,323 (0.006)	6,241 (0.008)	9,239 (0.013)	6,324 (0.011)

Note: Figures in parentheses are the share of the region's FDI inflow in the World FDI.

Source: UNCTAD. *World Investment Report* (2002, 2003, 2004, 2005, 2006)

Table 4 shows trade balances in millions of euros. We select the trade balance with the European Union for four countries (United States of America, Japan, Portugal, and China). The data shows that the EU and Portugal have a trade deficit. The same is true for the United States. Table 4 also indicates that the trade relationships between the EU and Japan have increased over the period

of analysis. The same is true of China.

**Table 4. The Trade balance between the European Union and four selected countries**

(Million of euros)								
Regions	1996	1997	1998	1999	2000	2001	2002	2003
Portugal	-8.34	-9.74	-12.7	-14.46	-16.88	-17.18	-15.07	-13.65
USA	-153.45	-185.61	-235.41	-343.82	-517.26	-501.40	-568.67	-702.43
Japan	48.64	72.49	95.89	100.97	107.82	60.36	83.66	78.27
China	9.62	35.64	38.87	26.10	25.17	22.51	25.80	81.99

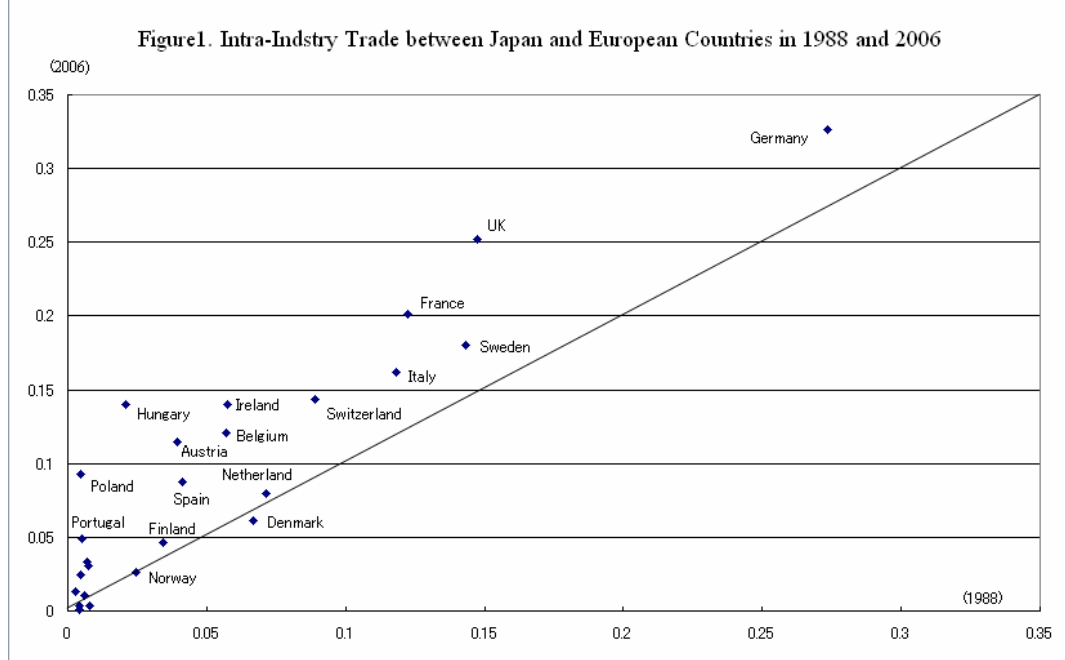
Source: *Eurostat (2008)*

### ***Intra-Industry Trade between European Countries and Japan***

Given these trade and FDI developments between European countries and Japan, we ask to what degree intra-industry trade is important for overall trade. In Figure 1, we plot the Grubel-Lloyd index for each European country with respect to Japan for 1988 and 2006. The diagonal is a 45 degree line. Any countries above the diagonal line experienced an increase in intra-industry trade with Japan during this period, while any countries below the diagonal experienced a decrease.

We note that further distances from the origin indicate more vertical intra-industry trade. We observe that the five largest intra-industry trade countries consist of only old EU members, namely, Germany, UK, France, Sweden, and Italy.

We should also note, however, that further vertical distances from the diagonal line indicate larger increases in vertical intra-industry trade. For this measure, we observe that some European emerging economies experienced large increases in intra-industry trade with Japan, especially Hungary and Poland.



#### 4. Data and Empirical Methods

International trade data are taken from the Japan Custom, Ministry of Finance. Statistics for Japan's international trade are classified by a 9-digit code, in which the first 6-digits correspond to international standard Harmonized Classification (HS) codes. We aggregated the values of the original 9-digit trade codes into an HS 6-digit classification, with the unit price at HS 6-digits calculated using the weights of trade values at the 9-digit level.

##### *Grubel and Lloyd indexes*

Grubel and Lloyd (1975) define ITT for industry  $k$  between country  $i$  and  $j$  as the difference between the industry's trade balance and the total trade of industry. In order to make the index comparable across industries and countries, the index is normalized by total industry trade.

$$IIT_{ijk} = \frac{(X_{ijk} + M_{ijk}) - |X_{ijk} - M_{ijk}|}{(X_{ijk} + M_{ijk})} \quad (1)$$

$$IIT_{ij} = \sum_k IIT_{ijk} = \sum_k \left( \frac{(X_{ijk} + M_{ijk}) - |X_{ijk} - M_{ijk}|}{(X_{ijk} + M_{ijk})} \right) \quad (2)$$

In order to measure the overall extent of IIT in total bilateral trade, the index in (1) is summed over all industries. The index in (2) is equal to 1 if all trade is intra-industry trade, and is equal to 0 if all trade is inter-industry trade. Grubel and Lloyd [1975, p.22] proposed a measure that adjusts the country IIT index (IIT calculated for all individual industries) by introducing aggregate trade imbalance. They argue that their measure would be biased downward when there is an overall trade imbalance.

Aquino [1978,p.280] also argued that an adjusted measure is required, but argue for a more disaggregated measure, meaning that the Grubel and Lloyd method is inadequate. Following Aquino, we need to incorporate an appropriate imbalance effect. The imbalancing effect must be equi-proportional for all industries. Thus, the Aquino adjustment (at the 5-digit level) estimates “what the values of exports and imports of each commodity would have been if total exports had been equal to total imports.”

Greenaway and Milner (1986) and Helpman (1987) argued against the Aquino adjustment on both theoretical and empirical grounds. Following Greenaway and Milner (1986), we do not model trade imbalance as a control variable, though feel that this merits further investigation.

### ***HIIT and VIIT indexes***

To determine horizontal and vertical intra-industry trade, the Grubel and Lloyd we use the indices and methodology of Abel-el-Rahaman (1991) and Greenaway et al. (1994) are used. The ratio of export to import unit values,  $p_{ijk}$ , is used to disentangle HIIT from VIIT. We divide the entire set of industries into two subsets:  $K_h$ , the set of industries with  $p_{ijk} \in [1/(1+\alpha), 1+\alpha]$  and  $K_v$ , the set of industries with  $p_{ijk} < 1/(1+\alpha)$  or  $p_{ijk} > 1+\alpha$ <sup>2</sup>. The HIIT index is therefore defined as:

---

<sup>2</sup> Many researches use  $1-\alpha$  for the lower bound. However, this measure is not symmetric for obvious reason. We prefer to use the symmetric measure given in Fontagué and Freudenberg (1997).

$$HIIT(\alpha) = \sum_{k \in K_h} IIT_{ijk} , \quad (3)$$

The index of VIIT is defined as follows:

$$VIIT(\alpha) = \sum_{k \in K_v} IIT_{ijk} , \quad (4)$$

If  $p_{ijk} < 1/(1+\alpha)$ , an exporting country exports lower quality products. If  $p_{ijk} > 1+\alpha$ , an exporting country exports higher quality products.

The relative unit value for each component of IIT is calculated at the Harmonized System 6-digit level in order to be classified as either HIIT or VIIT. In order to capture wider relative price differences between European countries, we use values of 0.05, 0.15, 0.25, 0.35, 0.5, 1, 2, and 3 for  $\alpha$ . The VIIT, so defined, can be useful for disentangling horizontal VIIT from other types of VIIT. However, the VIIT index is a mixture of two distinct types of intra-industry trade, from the perspective of one country. For example for  $\alpha=3$ , we can observe one type of exported product where prices are less than 25 percent of the prices for imported products in the same category. At the same time, there are other types of exported products that are four times more expensive than imported products in the same category. These products, possessing distinctly different characteristics, are pooled together in the same VIIT index.

### ***Quality-Based VIIT Index***

In the following empirical examination, we further disentangle the traditional VIIT index into  $VIIT^H(\alpha)$  and  $VIIT^L(\alpha)$ , where  $\alpha$  is strictly positive. The subset  $K^H(\alpha)$  is defined as industries with  $p_{ijk} < 1/(1+\alpha)$ , and the subset  $K^L(\alpha)$  is the set of industries with  $p_{ijk} > 1+\alpha$ . It is noteworthy that  $K^H(\alpha_0) \subseteq K^H(\alpha_1)$  if  $\alpha_0 > \alpha_1$  and  $K^L(\alpha_0) \supseteq K^L(\alpha_1)$  if  $\alpha_0 > \alpha_1$ . If, for  $VIIT^H(\alpha)$ , the relative price of export products to import products is equal or greater than  $(1+\alpha)$ , we call this high-quality VIIT. For  $VIIT^L(\alpha)$ , the relative price of export products to import products must be equal to or less than  $1/(1+\alpha)$  to be included in this index as in (4), and we call this low-quality VIIT.

[high quality VIIT (for  $p_{ijk} > 1+\alpha > 1$ )]

$$VIIT^H(\alpha) = \sum_{k \in K^H} IIT_{ijk} \quad (5)$$

[low quality VIIT (for  $p_{ijk} < 1/(1 + \alpha) < 1$ )]

$$VIIT^L(\alpha) = \sum_{k \in K^L} IIT_{ijk} \quad (6)$$

For the purpose of clear exposition, we use the relative price,  $p$ , instead of the margin,  $\alpha$ , to indicate the threshold value for defining vertical intra-industry trade, as in equation (7):

$$VIIT(p) = \begin{cases} \sum_{k \in K^H} IIT_{ijk} & \text{if } p > 1 \\ \sum_{k \in K^L} IIT_{ijk} & \text{if } p < 1 \end{cases} \quad (7)$$

### ***Explanatory Variables***

In order to analyze country-specific determinants of IIT and VIIT, we use the following explanatory variables:

- LD\_PCGDP is the logarithm of the absolute difference in GDP per capita (PPP, in constant 2005 international dollars) between Japan and each European trading partner.

$$LD\_PCGDP_{jt} = \log |PCGDP_{jt} - PCGDP_{JPN,t}|$$

Falvey and Kierzkowski (1987) suggest that this relationship will be positive for the VIIT model, while Loertscher and Wolter (1980) and Greenaway et al. (1994) provide empirical support for a negative relationship between the per-capita income difference and HIIT. Linder (1961) argues that countries with similar demand will trade similar products. Thus, the Linder hypothesis suggests a negative relationship in the IIT model (See also, Falvey and Kierzkowski, 1987; Helpman, 1987; and Hummels and Levinsohn, 1995). The underlying hypothesis is that the similarity in incomes implies a greater similarity in demand. Thus, the more similar are two countries, the larger will be their IIT; the greater the difference in GDP per-capita, the less will be their IIT. Based on



Helpman (1987), Greenaway et al. (1994) use this variable to test the effects of factor endowment differences on HIIT and VIIT.

- LGDP\_AVE is the logarithm of the average GDP (PPP, in constant 2005 international dollars) of Japan and its European trading partners.

$$LGDP\_AVE_{jt} = \log\left\{\frac{1}{2}(GDP_{jt} + GDP_{JPN,t})\right\}$$

This is a proxy for the overall economic dimension, and a positive sign is expected (Loertscher and Wolter, 1980; Greenaway et al., 1994).

- LGDP\_MIN is the logarithm of the lower GDP value (PPP, in constant 2005 international dollars) between Japan and its European partners.

$$LGDP\_MIN_{jt} = \min(\log GDP_{jt}, \log GDP_{JPN,t})$$

This variable is included to control for relative size effects. According to Helpman (1987) and Hummels and Levinsohn (1995), a positive sign for IIT and VIIT is expected.

- LGDP\_MAX is the logarithm of the higher GDP value (PPP, constant 2005 international dollars) between Japan and its European partners.

$$LGDP\_MAX_{jt} = \max(\log GDP_{jt}, \log GDP_{JPN,t})$$

This variable is also included to control for relative size effects. A negative sign is expected (Helpman, 1987; Hummels and Levinsohn, 1995).

-JPNFDI is the accumulated number of Japanese foreign subsidiary establishments in a given European country.

-LDIST is the logarithm of the great circle distance between the capital of European country and Tokyo<sup>3</sup>.

### ***Estimation Equations***

Extending the cross-country analyses of Helpman (1987) and Hummels and Levinsohn (1995) to panel data, we estimate the following equation:

---

<sup>3</sup> In a preliminary version of this paper, we also used a random effects model, which can include time-invariant variables such as distance between two counties. However, a Hausman test indicated inconsistency with the random-effects model. Therefore, this distance variable is suppressed from the results tables below.

$$IIT_{jt} = \lambda_j + \alpha_1 LGDP\_MAX_{jt} + \alpha_2 LGDP\_MIN_{jt} + \alpha_3 LGDP\_AVE_{jt} + \alpha_4 LD\_PCGDP_{jt} + \alpha_5 JPNFDI_{jt} + \alpha_6 LDIST_j + \varepsilon_{jt} \quad (8)$$

Following Greenaway et al. (1994), we also estimate various margins,  $\alpha$ , of VIIT indices for the following equation. We choose the value of  $\alpha$  to cover a much wider range of values than traditional values used in this type of study; they are, specifically, 0.05, 0.15, 0.25, 0.35, 0.50, 0.75, 1.00, 2.00, and 3.00. In terms of the relative price,  $p$ , of exports and imports, the values are 0.25, 0.33, 0.5, 0.57, 0.67, 0.74, 0.8, 0.87, 0.95, 1.05, 1.15, 1.25, 1.35, 1.5, 1.75, 2, 3, and 4.

$$VIIT(p)_{jt} = \lambda_j + \beta_1 LGDP\_MAX_{jt} + \beta_2 LGDP\_MIN_{jt} + \beta_3 LGDP\_AVE_{jt} + \beta_4 LD\_PCGDP_{jt} + \beta_5 JPNFDI_{jt} + \beta_6 LDIST_j + \varepsilon_{jt} \quad (9)$$

We therefore run regressions with 19 different dependent variables, using the same set of explanatory variables. Our interest in this study is to examine whether the set of economic forces differentially influences intra-industry trade at different ranges of the relative prices of exports and imports.

### ***Transformation of the Dependent Variable***

The Grubel-Lloyd IIT index is constructed to fall between 0 and 1. Using this index as the dependent variable in a regression violates the assumption that the error term will follow a normal distribution function. One way to handle this problem is to transform the original data so that the error term follows a normal distribution. The logistic transformation is widely used as a solution to this problem, for example in Hummels and Levinsohn (1995).

When the original data contains a zero value, however, the transformed value is undefined, as the logistic transformation takes the logarithmic form<sup>4</sup>. To get around this problem of undefined values, we use a Box-Cox transformation in place of the log part of the logistic transformation, following Yoshida (2008). We call the following transformation (10) the Box-Cox Logistic transformation and denote it by BCL()<sup>5</sup>.

<sup>4</sup> Researchers may inattentively classify these zero values as missing values. This will, in turn, lead to biased estimates by censoring the lowest values of the original variable and causing the sample to be smaller.

<sup>5</sup> In this version of this paper, we choose  $\lambda$  to be 0.1.

$$BCL(y) = \frac{\left(\frac{y}{1-y}\right)^\lambda - 1}{\lambda} \quad \lambda \in (0,1] \quad (10)$$

## 5. Empirical Results

We divided the 31 European countries into two groups, *Old EU* and *New EU*: (1) the relatively more advanced countries, including the 15 old members of EU, Norway, and Switzerland; and (2) emerging and developing economies, including the 12 new members of the EU, Russia, and Turkey<sup>6</sup>. Table 5 and Table 6 present the results for the *Old EU* group. In Table 5, we present the results of estimating VIIT for relatively lower price ratios of export to imports. Table 6 presents the results for panel estimation of VIIT for relatively higher price ratios of exports to imports. The results for the *New EU* group are presented in Tables 7 and 8 similarly.

First, the model's fitness is relatively higher for the *Old EU* countries, regardless of any values of  $p$ . This is a little surprising since most of theoretical models predict VIIT occurs between a higher income country and a lower income country. For the *New EU* countries, the adjusted  $R^2$  is substantially lower for lower values of  $p$ , i.e., the price of Japanese exports are lower than the price of imports. This result is quite consistent with theoretical predictions, since quality models only concern the case in which developing economies export lower-quality products. This asymmetry in higher and lower quality Japanese exports is also reflected in the estimated coefficients with statistical significance.

Second, the coefficients for both GDP of the larger size economy,  $LGDP\_MAX$ , and of the smaller size economy,  $LGDP\_MIN$ , are always positive (and for many values of  $p$  they are also statistically significant). This cuts against the theoretical predictions of Hummels and Levinsohn (1995). The positive coefficients for  $LGDP\_MAX$ , however, might be caused by our particular sampling of countries. Since one of every pair of countries in this

---

<sup>6</sup> We also conducted panel regressions including all 31 European countries; however, stark differences in estimated coefficients between the two groups support our approach of not pooling all countries together. The regression result of pooled groups can be obtained from the authors upon request.

paper is Japan, *LGDP\_MAX* always represents log of Japan's GDP. Therefore, the results indicate that VIIT increases along with the growth of Japanese GDP.

Moreover, the effects are quite different between the two groups and across different ranges of relative prices. For more the advanced countries in *Old EU*, statistically significant positive coefficients of *LGDP\_MAX* are more prominent for intra-industry trade, in which the prices of Japanese exports are relatively higher. Statistically significant coefficients for *LGDP\_MIN* are found for all Japanese lower quality exports, and in only one case for higher quality Japanese exports. On the other hand, for the developing European economies in *New EU*, neither GDP variables are statistically significant for Japanese lower quality exports. Both GDP variables, however, are positive and statistically significant for the entire range of relative prices for higher quality Japanese exports.

For *LGDP\_AVE*, the estimated coefficients are not statistically significant in most cases for the *Old EU* countries, or for Japanese lower quality exports in the *New EU* countries. When the estimated coefficients for *LGDP\_AVE* are statistically significant, the sign is negative.

Third, for the estimates of the log of absolute differences in per capita GDP between Japan and European countries, *LD\_PCGDP* is positive when coefficients are statistically significant. These results are consistent with Falvey and Kierzkowski (1987). However, there are exceptions for two notable *Old EU* countries. For the extreme values of relative prices,  $p=0.25$  and  $p=4.00$ , the coefficient is negative and statistically significant at the five percent level. At first glance, this seems to be consistent with the Linder hypothesis; however, the products' qualities are quite different. This result indicates that Japan engages in more intra-industry trade with European economies that have similar GDP per capita when there are substantial differences in relative prices.

Fourth, Japanese foreign direct investment increases the degree of VIIT with old members of the EU when there are substantial differences in relative prices, while Japanese FDI seems not to affect VIIT with new members of the EU.

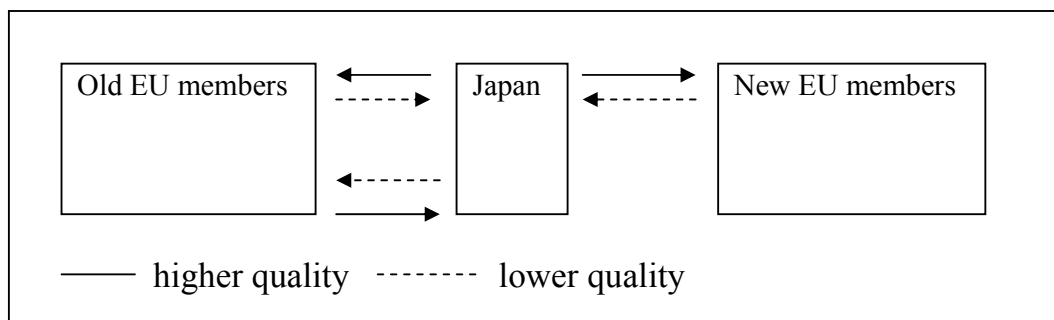
## **6. Discussions and Conclusions**

In this paper we provide an overview of the development of intra-industry (IIT) trade in Japan with respect to various European countries, including both old and new EU members as well as emerging Eastern European countries. For the measurement of intra-industry trade, we construct vertical intra-industry trade (VIIT) measures at various margins of unit price ratios, in addition to a Grubel-Lloyd index. By varying margins from zero to significantly large values, the share of VIIT in total IIT changes from unity to zero, corresponding to the distributional characteristics of VIIT for each European country. Our empirical model attempts to explain the distributional characteristics of VIIT through foreign direct investments and country characteristics, in addition to traditional determinants of IIT like differences in GDP per capita, average GDPs, and both the smaller and the larger of pairs' GDPs.

Our sample covers 1988 to 2004 for bilateral trade between Japan and 31 European countries (Six emerging countries are only included after 1993). In addition to IIT for entire industries, we also examine IIT indices for aggregate industries. For our econometric methodology with panel data, we use fixed-effects estimation for static IIT.

Our empirical evidence points to two noteworthy findings that need to be articulated more thoroughly. One finding is that the set of economic variables influence old EU members *symmetrically* across the entire range of relative prices, while influencing new EU members *asymmetrically* and only for higher relative prices of Japanese exports.

**Figure 2. Asymmetry in Japan-EU Trade**



The other finding is that, at extreme values of relative prices (i.e.,  $p=0.25$

and  $p=4.00$ ), the estimated coefficients are often statistically significant, even when the estimated coefficients for mid-range relative prices are not statistically significant. This is more prominent for the *old EU+2* countries. This result calls for further investigation; however, this is a good example of a situation in which VIITs defined by different ranges of relative prices demonstrate quite distinct responses to a specific set of economic variables. It is important to note that previous studies' definitions of the VIIT index with traditional ranges of relative prices may have missed distinctly different VIIT behavior at large margins. Our results indicate that it is important to measure a wider quality range based on relative prices rather than just relying on the traditional ratios used in the literature.

## References:

- Abd-el-Rahaman, K. "Firms' Competitive and National Comparative Advantages as Joint Determinants of Trade Composition," *Weltwirtschaftliches Archiv* 127, 1 (1991):83-97.
- Badinger, H. and F. Breuss, "What Has Determined the Rapid Post-War Growth of Intra-EU Trade?" *Weltwirtschaftliches Archiv* 140, 1 (2004): 31-51.
- Balassa, B. "Trade Liberalisation and Revealed Comparative Advantage," *Manchester School of Economic and Social Studies*, 33, 2, May, 1965, pp. 99-123.
- Balassa, B. "Tariff Reductions and Trade in Manufactures among Industrial Countries," *American Economic Review*, 56, 3, June, 1966, pp.466-73
- Bergstrand, J., "The Heckscher-Ohlin-Samuelson Model, the Linder Hypothesis and the Determinants of Bilateral Intra-Industry Trade," *The Economic Journal*, 100 (December) 1990: 1216-1229.
- Cies'lik, A., "Intraindustry Trade and Relative Factor Endowments," *Review of International Economics* 13,5 (2005):904-926.
- Davis, D. R. "Intra-Industry Trade: A Heckscher-Ohlin-Ricardo Approach," *Journal of International Economics* , 39, 3/4, November, 1995, pp. 201-226.
- Egger, H. P. Egger and D. Greenaway "Intra-Industry Trade with Multinational Firms", *European Economic Review*, 51 (8), 2007, pp. 1959-1984.
- Falvey, R., "Commercial Policy and Intra-Industry Trade," *Journal of International Economics*, 11, 4 (1981): 495-511.
- Falvey, R. and H. Kierzkowski, "Product Quality, Intra-Industry Trade and (Im)Perfect Competition," in H. Kierzkowski (ed.), *Protection and Competition in International Trade. Essays in Honor of W.M. Corden* , Oxford, United States: Basil Blackwell ( 1987): 143-161.
- Flam, H. and E. Helpman, "Vertical Product Differentiation and North-South Trade," *American Economic Review* 77, 5 (1987): 810-822.
- Fertó, Imre and A. Soós "Treating Trade Statistics Inaccuracies: the case of intra-industry trade", *Applied Economic Letters*, 2008, pp.1-6 (on line)
- Fontagué, L. and M. Freudenberg, "Intra-Industry Trade: Methodological Issues Reconsidered," *CEPR Discussion Paper* 1959.
- Fukao, Kyoji, Hikari Ishido, and Keiko Ito, "Vertical Intra-Industry Trade and Foreign Direct Investment in East Asia," *Journal of the Japanese and International Economics* 17, (2003), pp.486-506.
- Greenaway, D., R. Hine, and C. Milner, "Country-Specific Factors and the Pattern of Horizontal and Vertical Intra-Industry Trade in the UK," *Weltwirtschaftliches Archiv*, 130, 1 (1994):77-100.
- Greenaway, D., R. Hine, and C. Milner, "Vertical and Horizontal Intra-Industry Trade: A Cross Industry Analysis for the United Kingdom," *The Economic Journal*, 105, 433, November (1995):1505-1518.

- Grubel, H. and P. Lloyd, *Intra-industry Trade. The Theory and Measurement of International Trade in Differentiation Products*, London: The Mcmillan Press (1975).
- Helpman, E., "International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition," *Journal of International Economics*, 11,3 (1981):305-40.
- Helpman, E. and P. Krugman, *Market Structure and Foreign Trade*, Brighton, United Kingdom: Harvester Wheatsheaf (1985).
- Helpman, E., "Imperfect Competition and International Trade: Evidence from Fourteen Industrial Countries," *Journal of the Japanese and International Economics*, 1, 1 (1987):62-81.
- Hummels, D. and J. Levinsohn, "Monopolistic Competition and International Trade: Reconsidering the Evidence," *Quarterly Journal of Economics*, 110, 3 (1995):799-36.
- Krugman, P., "Increasing Returns, Monopolistic Competition, and International Trade," *Journal of International Economics* 9, 4 (1979):469-480.
- Krugman, P., "Scale Economies, Product Differentiation, and the Pattern of Trade," *American Economic Review* 70, 5 (1980): 950-959.
- Lancaster, K., "Intra-Industry Trade under Perfect Monopolistic Competition," *Journal of International Economics* 10, 2 (1980):151-170.
- Linder, S., *An Essay on Trade and Transformation*, New York: Wiley (1961).
- Loertscher, R. and F. Wolter, "Determinants of Intra-Industry Trade: Among Countries and across Industries," *Weltwirtschaftliches Archiv* 116, 2 (1980): 289-293.
- Shaked, A. and J. Sutton, "Natural oligopolies and international trade," in H. Kierzkowski (ed.), *Monopolistic Competition and International Trade*. Oxford, United States: Oxford University Press. (1984):34-50.
- Vanek, J., "The factor Proportions Theory: The N-Factor Case," *Kyklos* 21, 4 (1968):749-756.
- Verdoorn, P. "The Intra-Bloc Trade of Benelux," in E. Robinson, (ed.), *Economics Consequences of the Size of Nations*, London: Mcmillan, 1960, pp. 327-68.
- Vernon, R., "International Investment and International Trade in the Product Cycle," *Quarterly Journal of Economics* 80 (1966):190-207.
- Yoshida, Yushi, "Intra-Industry Trade between Japan and Korea: Vertical Intra-Industry Trade or Intra-Firm Trade?," presented at *Korea and the World Economy* conference (2008).
- Zhang, J., A. Witteloostuijn, and C. Zhou, "Chinese Bilateral Intra-Industry Trade: A Panel data Study for 50 Countries in the 1992-2001 Period," *Weltwirtschaftliches Archiv*, 141, 3 (2005):510-40.



**Table5. VIIT for Japanese Lower Quality Exports (Old EU members+2)**

	$\overline{\text{VIIT}(0.25)}$	$\overline{\text{VIIT}(0.33)}$	$\overline{\text{VIIT}(0.50)}$	$\overline{\text{VIIT}(0.57)}$	$\overline{\text{VIIT}(0.67)}$	$\overline{\text{VIIT}(0.74)}$	$\overline{\text{VIIT}(0.80)}$	$\overline{\text{VIIT}(0.87)}$	$\overline{\text{VIIT}(0.95)}$	$\overline{\text{GL Index}}$
Log of max of GDPs: LGDP_MAX	4.6338* (2.4798)	5.2218** (2.5636)	4.0452 (3.3018)	3.5176 (3.0377)	3.3468 (2.9793)	0.3837 (2.6809)	0.8532 (2.6402)	0.6107 (2.3965)	3.8705* (2.2651)	4.8601*** (1.7859)
Log of min of GDPs: LGDP_MIN	0.8469*** (0.2476)	0.9844*** (0.2844)	1.2282*** (0.3231)	1.0644*** (0.2789)	1.1721*** (0.311)	1.0001*** (0.3138)	0.9052*** (0.2961)	0.8294*** (0.2791)	0.8098*** (0.269)	0.6748*** (0.2052)
Average of GDPs: LGDP_AVE	-4.5924* (2.6231)	-5.4858** (2.7708)	-4.84 (3.554)	-3.9451 (3.2852)	-3.8842 (3.2586)	-0.6201 (2.9569)	-0.8957 (2.9124)	-0.7455 (2.6461)	-3.8568 (2.5275)	-4.0743** (1.9815)
Log of absolute difference of par capita LD_PCGDP	-0.034** (0.0161)	-0.0083 (0.0196)	0.0342* (0.02)	0.0409** (0.0187)	0.0375** (0.0179)	0.0345* (0.0178)	0.0298 (0.0184)	0.024 (0.0185)	0.0214 (0.0183)	0.0048 (0.0125)
Accumulated JPN subsidiaries JPNFDI	0.0007* (0.0004)	0.0007* (0.0004)	-0.0005 (0.0007)	-0.0002 (0.0006)	-0.0002 (0.0006)	-0.0005 (0.0006)	-0.0006 (0.0006)	0 (0.0005)	0.0003 (0.0005)	0.0005 (0.0004)
Observations	289	289	289	289	289	289	289	289	289	289
No. of countries	17	17	17	17	17	17	17	17	17	17
adj. R2	0.87	0.87	0.87	0.91	0.91	0.91	0.91	0.91	0.92	0.95

Note: The dependent variable is Box-Cox logistics of Grubel-Lloyd (GL) index and log of VIIT( $p$ ) index where  $p$  indicates the threshold level of relative price of export to import. When  $p$  is less than 1, only products of which relative price is less than or equal to  $p$  are summed in VIIT index. Figures in parentheses are standard errors (heteroskedasticity consistent for fixed-effect model.) The statistical significance of one, five and ten percent are denoted by "\*\*\*\*", "\*\*\*", "\*\*", respectively.

**Table6. VIIT for Japanese Higher Quality Exports (Old EU15 Members+2)**

	$\overline{\text{GL Index}}$	$\overline{\text{VIIT}(1.05)}$	$\overline{\text{VIIT}(1.15)}$	$\overline{\text{VIIT}(1.25)}$	$\overline{\text{VIIT}(1.35)}$	$\overline{\text{VIIT}(1.50)}$	$\overline{\text{VIIT}(1.75)}$	$\overline{\text{VIIT}(2.00)}$	$\overline{\text{VIIT}(3.00)}$	$\overline{\text{VIIT}(4.00)}$
Log of max of GDPs: LGDP_MAX	4.8601*** (1.7859)	3.3212 (2.225)	4.0223* (2.2485)	4.5709** (2.2896)	4.8946* (2.6282)	5.0182* (2.846)	4.0521 (2.7053)	1.8683 (2.5175)	8.0611** (3.6395)	8.9144** (4.228)
Log of min of GDPs: LGDP_MIN	0.6748*** (0.2052)	0.2237 (0.3136)	0.3335 (0.322)	0.498 (0.3154)	0.496 (0.34)	0.4771 (0.3415)	0.3281 (0.3295)	0.1538 (0.2773)	0.4634 (0.3225)	0.7896** (0.3263)
Average of GDPs: LGDP_AVE	-4.0743** (1.9815)	-1.5558 (2.4895)	-2.3488 (2.5163)	-3.0106 (2.5483)	-3.1981 (2.8946)	-3.2816 (3.1104)	-2.2028 (2.948)	0.0287 (2.7083)	-6.3489 (3.8696)	-7.8203* (4.4705)
Log of absolute difference of par capita GDPs: LD_PCGDP	0.0048 (0.0125)	-0.0034 (0.0171)	-0.0072 (0.0172)	-0.0069 (0.0164)	-0.0051 (0.0165)	-0.001 (0.0184)	0.0038 (0.0193)	-0.0001 (0.0194)	-0.0319 (0.0223)	-0.0462** (0.0229)
Accumulated JPN subsidiaries JPNFDI	0.0005 (0.0004)	0.0005 (0.0005)	0.0007 (0.0005)	0.0007 (0.0005)	0.0007 (0.0006)	0.0008 (0.0006)	0.0008 (0.0006)	0.0008 (0.0006)	0.0016** (0.0008)	0.0021** (0.001)
Observations	289	289	289	289	289	289	289	289	289	289
No. of countries	17	17	17	17	17	17	17	17	17	17
adj. R2	0.95	0.88	0.87	0.87	0.86	0.86	0.85	0.85	0.79	0.75

Note: The dependent variable is Box-Cox logistics of Grubel-Lloyd (GL) index and log of VIIT(p) index where p indicates the threshold level of relative price of export to import. When p is more than 1, only products of which relative price is more or equal to p are summed in VIIT index. Figures in parenthesis are standard errors (heteroskedasticity consistent for fixed-effect model.) The statistical significance of one, five and ten percent are denoted by "\*\*\*", "\*\*", "\*", respectively.

**Table7. VIIT for Japanese Lower Quality Exports (New EU Members+2)**

	VIIT(0.25)	VIIT(0.33)	VIIT(0.50)	VIIT(0.57)	VIIT(0.67)	VIIT(0.74)	VIIT(0.80)	VIIT(0.87)	VIIT(0.95)	GL Index
Log of max of GDPs: LGDP_MAX	7.7544* (4.6574)	7.6089 (4.6108)	4.2812 (4.4369)	4.165 (4.2354)	3.8648 (4.2099)	5.3336 (3.8326)	5.8186 (3.7655)	6.5603* (3.8423)	7.2335* (3.9364)	3.36 (3.2556)
Log of min of GDPs: LGDP_MIN	3.8119* (1.947)	2.9876 (1.9041)	2.9112 (2.0319)	2.9601 (2.0662)	2.7074 (1.893)	2.3001 (1.8396)	2.3509 (1.8337)	2.3327 (1.8691)	2.264 (1.8913)	2.4436 (1.7841)
Average of GDPs: LGDP_AVE	-3.6235 (5.8757)	-0.9462 (5.6007)	0.2995 (5.7899)	0.5883 (5.6843)	2.3209 (5.5898)	2.3924 (5.4025)	2.0971 (5.3675)	1.564 (5.4475)	0.9169 (5.572)	0.3052 (5.2105)
Log of absolute difference of par capita LD_PCGDP	2.3359 (1.8178)	2.1323 (1.8219)	2.3895 (1.7903)	2.3856 (1.8162)	2.5875* (1.4849)	1.7029 (1.3187)	1.6902 (1.31)	1.5657 (1.3467)	1.4747 (1.3566)	1.7783 (1.2178)
Accumulated JPN subsidiaries JPNFDI	-0.0039 (0.0101)	-0.0088 (0.0104)	0.0019 (0.0114)	0.0032 (0.0115)	0.0006 (0.011)	-0.0009 (0.0103)	-0.0029 (0.0102)	-0.0045 (0.0103)	-0.0036 (0.0103)	0.0059 (0.0079)
Observations	212	212	212	212	212	212	212	212	212	212
No. of countries	14	14	14	14	14	14	14	14	14	14
adj. R2	0.40	0.44	0.42	0.42	0.45	0.49	0.50	0.49	0.47	0.53

Note: The dependent variable is Box-Cox logistics of Grubel-Lloyd (GL) index and log of VIIT(p) index where p indicates the threshold level of relative price of export to import. When p is less than 1, only products of which relative price is less than or equal to p are summed in VIIT index. Figures in parenthesis are standard errors (heteroskedasticity consistent for fixed-effect model.) The statistical significance of one, five and ten percent are denoted by "\*\*\*\*", "\*\*\*", "\*\*", respectively.

**Table8. VIIT for Japanese Higher Quality Exports (New EU Members+2)**

	$\overline{\text{GL Index}}$	$\overline{\text{VIIT}(1.05)}$	$\overline{\text{VIIT}(1.15)}$	$\overline{\text{VIIT}(1.25)}$	$\overline{\text{VIIT}(1.35)}$	$\overline{\text{VIIT}(1.50)}$	$\overline{\text{VIIT}(1.75)}$	$\overline{\text{VIIT}(2.00)}$	$\overline{\text{VIIT}(3.00)}$	$\overline{\text{VIIT}(4.00)}$
Log of max of GDPs: LGDP_MAX	3.36 (3.2556)	8.4831*** (3.2385)	7.6905** (3.2034)	7.5825** (3.1232)	7.3772** (3.124)	8.0639** (3.398)	6.7959** (3.26)	7.4714** (3.3452)	9.1222** (3.7414)	11.9309*** (3.9602)
Log of min of GDPs: LGDP_MIN	2.4436 (1.7841)	3.8451*** (1.4361)	3.775*** (1.4365)	3.8684*** (1.4346)	3.8073*** (1.4386)	5.1458*** (1.5687)	5.1354*** (1.5759)	5.3756*** (1.6265)	3.9909** (1.7551)	3.1789* (1.8007)
Average of GDPs: LGDP_AVE	0.3052 (5.2105)	-7.1057* (4.2199)	-6.2576 (4.182)	-6.4329 (4.0887)	-6.2231 (4.1002)	-8.853** (4.3236)	-7.8977* (4.1945)	-9.0966** (4.3704)	-8.8012** (4.2604)	-7.5187 (4.6538)
Log of absolute difference of par capita LD_PCGDP	1.7783 (1.2178)	2.0571* (1.0658)	2.0043* (1.0692)	1.945* (1.0698)	1.8968* (1.0738)	3.1882** (1.4687)	3.1801** (1.4825)	3.139** (1.502)	0.6801 (1.8151)	-0.0573 (1.7968)
Accumulated JPN subsidiaries JPNFDI	0.0059 (0.0079)	-0.0054 (0.0079)	-0.0052 (0.0078)	-0.0063 (0.0079)	-0.0053 (0.0079)	-0.0082 (0.008)	-0.0075 (0.0081)	-0.0112 (0.0085)	-0.0091 (0.0097)	-0.0192* (0.0103)
Observations	212	212	212	212	212	212	212	212	212	212
No. of countries	14	14	14	14	14	14	14	14	14	14
adj. R2	0.53	0.70	0.70	0.70	0.69	0.69	0.67	0.65	0.60	0.59

Note: The dependent variable is Box-Cox logistics of Grubel-Lloyd (GL) index and log of VIIT(p) index where p indicates the threshold level of relative price of export to import. When p is more than 1, only products of which relative price is more or equal to p are summed in VIIT index. Figures in parenthesis are standard errors (heteroskedasticity consistent for fixed-effect model.) The statistical significance of one, five and ten percent are denoted by "\*\*\*\*", "\*\*\*", "\*\*", respectively.