Production Networks in East Asia:

Export Varieties and Trading Partners*

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Abstract

This paper takes a first step towards an understanding of the mechanism of the diversification of export varieties and trading partners by focusing on intra-East Asian machinery trade. The examination of changes in the composition of export varieties and partner countries and the empirical analysis by decomposing the gravity equation into the number of varieties and the average trade value per variety are conducted. These product-line level analyses suggest that different natures between final products and parts and components and the economic development level of exporter country are important factors behind the diversification of export varieties and trading partners.

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1. Introduction

The development of international production and distribution networks in East Asia has stimulated a number of empirical studies on its nature and characteristics as well as discussions on policy implications of its existence. Previous studies have accumulated empirical facts using international trade data; however, the dynamics of intra-East Asian trade growth have attracted attention only from the perspective of trade value. This paper provides new insights for the expansion and deepening of intra-East Asian machinery trade from not only the perspective of trade value but also the diversification of export varieties and trading partners. The product-line level analyses highlight different trade patterns within the region between machinery final products and parts and components and active participation of developing countries in terms of the diversified range of varieties and trading partners, which cannot be fully clarified by looking only at the trade value.

The recent empirical studies on international trade flows shed light on intensive and extensive margins of export growth; specifically, whether countries expand quantities of each variety (the intensive margin) or widen a set of export varieties (the extensive margin) as exports grow. The role of a wider set of export varieties, as opposed to larger quantities of long-standing varieties, has been found to be dominant in a number of studies. To illustrate, Hummels and Klenow (2005) investigate how large economies export more than small economies and find that the extensive margin accounts for 60 percent of the greater exports of larger economies in their sample of 126 exporting countries. Kehoe and Ruhl (2002) study five major trade liberalization episodes and find that the reductions of trade barriers lead to a substantial increase in the share of trade accounted for by goods that were little traded before the liberalization, which can be interpreted as the evidence of extensive margin growth.

As another aspect of the diversification in bilateral trade flows, Evenett and Venables (2002) document the important phenomenon that exporters now sell goods to a wider set of trading partners than in the past, which leads to the decline over time in the number of zeros

observed in bilateral trade matrices.[1] They find a measurable impact of the sales of long-standing goods to new trading partners on export growth for 23 developing countries, by decomposing export growth into not only changes in product lines exported but also changes in export destination countries.

In the vein of this emerging literature on the diversification in bilateral trade flows, this paper takes a first step towards an understanding of the mechanism of the diversification of export varieties and trading partners by focusing on the expansion and deepening of intra-East Asian machinery trade. The purpose of this paper is twofold. First, this paper aims to record stylized facts on the diversification of export varieties and trading partners for intra-East Asian machinery trade. Second, this paper aims to obtain clues about factors behind product diversification in bilateral trade flows, which cannot be picked up by the standard international trade theories. To achieve these objectives, two existing analytical tools are utilized. For the descriptive analysis, the export growth decomposition methodology is employed, along the lines of Evenett and Venables (2002). As more formal analysis, the gravity model is applied to not just the aggregate value of exports but its components, the number of export varieties and the average value of exports per variety. Estimates are then compared between the components of the aggregate export value as well as between machinery final products and parts and components.

Among a number of interesting findings, the novel empirical approach of this paper reveals three notable facts on international production networks in East Asia. First, as trade costs increase with distance, all the adjustments in the aggregate export value occur through the decreasing number of export varieties for machinery final products. In contrast, a wide range of parts and components in small quantities are more likely to be traded between countries even at a long distance. Second, the larger the wage differential between countries, the wider range of

[1] Haveman and Hummels (2004) and Helpman et al. (2007) also highlight the prevalence of zero flows in the context of the adequacy of standard specifications of the gravity equation.

varieties as well as the larger quantities of each variety are exported with each other. Third, the number of varieties exported from a country depends on the economic development level of the exporter itself only, while the quantities shipped for each variety are associated with the economic development level of the importer.

The rest of this paper proceeds as follows: the next section outlines the features of international trade in East Asia. Employing the export growth decomposition methodology, Section 3 lists up notable facts on the diversification of export varieties and trading partners for intra-East Asian machinery trade. Taking into account the findings of the descriptive analysis, Section 4 reconsiders the mechanism of diversification of export varieties and trading partners. Section 5 utilizes the gravity model to obtain clues to an understanding of the mechanism of product diversification in bilateral trade flows. And the last section concludes.

2. Evolution of Production Networks in East Asia

Since the beginning of the 1990s, East Asian countries have expanded and deepened intra-regional trade relationships, particularly in machinery parts and components trade. Although the formation of international production and distribution networks has not been limited to the machinery sector, the machinery industry is by far the most important, both quantitatively and qualitatively, and extends the most sophisticated networks across East Asia and other regions (See Fukao et al. 2003; Athukorala and Yamashita 2006; Kimura 2006).

The intra-East Asian export value expanded by a factor of 2.3 in real terms, while the world export value increased double from 1993 to 2005.[2] In particular, the intra-East Asian export value of machinery parts and components rapidly increased fourfold. The intra-East Asian share in the total value of machinery parts and components trade has risen from 15% to 24%. Of the total growth in intra-East Asian export value, 65% is accounted for by changes in

[2] "East Asia" here includes China, Hong Kong, Indonesia, Japan, Malaysia, the Philippines, Rep. of Korea, Singapore, and Thailand. See Appendix A.1 for data sources.

machinery exports as a whole, about three fourths of which, 49% is accounted for by changes in machinery parts and components exports.

A striking feature of intra-East Asian machinery parts and components trade is the increasing importance of developing countries in the region. Transactions by China and ASEAN4 countries (i.e. Indonesia, Malaysia, the Philippines, and Thailand) have been accelerated with massive inward foreign direct investment and trade liberalization and facilitation. The share of exports from China and ASEAN4 in intra-East Asian machinery parts and components trade has risen from 22% in 1993 to 46% in 2005. Notable increase is in the share of transactions within China and ASEAN4, which has risen from 2% to 13%.

The existing empirical studies focus on the dynamics of intra-East Asian trade growth only from the viewpoint of trade value. The descriptive and empirical analyses of this paper, however, provide new insights for the explosive expansion of intra-East Asian machinery parts and components trade and the increasing importance of transactions by developing countries in the region, from the perspective of the diversification of export varieties and trading partners.

3. Facts on Export Varieties and Trading Partners in Intra-East Asian Machinery Trade

This section starts by describing the method employed so as to count the number of export varieties and export partner countries as well as decomposing export growth into changes in the composition of varieties and partners, along the lines of Evenett and Venables (2002). The following subsections present the results of export growth decomposition analysis on intra-East Asian machinery trade.

3.1. Export Growth Decomposition Methodology

In the descriptive analysis of this section, two periods are considered: one three-year period at the beginning of the sample, 1993-95 and the other three-year period at the end, 2003-05. To

deal with potential idiosyncrasies at a product-line level, this paper works with conservative measures rather than a simple year-wise counting of export varieties. A variety is regarded as exported in a particular period if it is exported from a country of interest to any of other East Asian countries in all three years of the period.

As the first export growth decomposition analysis, export varieties are classified into (i) the "existing" variety exported in both the first and the last periods, (ii) the "disappearing" variety initially exported in the first period but no longer exported, and (iii) the "new" variety not exported in the first period but in the last period, regardless of export partner countries. To simplify the description, let $V^{ij}_{k,1993-95}$ and $V^{ij}_{k,2003-05}$ the average value of country *i*'s exports of variety *k* to country *j* in the periods 1993-95 and 2003-05, respectively. For the varieties exported from country *i*, let E^i, D^i, and N^i the set of existing, disappearing, and new varieties, respectively. In addition to the counting of varieties falling in each of the categories, the extent to which country *i*'s export growth is attributed to the changes in the export value of existing varieties, the "death" of disappearing varieties, or the "birth" of new varieties is examined. The total growth in country *i*'s export value is decomposed as follows:

$$\frac{\sum_j \sum_k V^{ij}_{k,2003-05} - \sum_j \sum_k V^{ij}_{k,1993-95}}{\sum_j \sum_k V^{ij}_{k,1993-95}} = \frac{\sum_j \sum_{k\in E^i} V^{ij}_{k,2003-05} - \sum_j \sum_{k\in E^i} V^{ij}_{k,1993-95}}{\sum_j \sum_k V^{ij}_{k,1993-95}} - \frac{\sum_j \sum_{k\in D^i} V^{ij}_{k,1993-95}}{\sum_j \sum_k V^{ij}_{k,1993-95}} + \frac{\sum_j \sum_{k\in N^i} V^{ij}_{k,2003-05}}{\sum_j \sum_k V^{ij}_{k,1993-95}}. \quad (1)$$

To examine individual bilateral trade flows, the measure for counting export varieties and (1) are applied without summing up over export partner country *j*.

As the second export growth decomposition analysis, the changes in the composition of export partner countries are examined. We now only focus on the set of existing varieties according to the measure for counting bilaterally exported varieties B^i, where $B^i \subseteq E^i$. A variety is regarded as "bilaterally" exported in a period if it is exported from a country of

interest to a particular country in all three years of the period. Partner countries are classified into the existing, disappearing, and new partner countries. Instead of the counting of varieties in the former analysis, the average number of export partner countries falling in each of the categories for country *i* is calculated. In addition, the extent to which country *i*'s export growth is attributed to changes in the export value to existing partners, the "stop" of exports to disappearing partners, or the "start" of exports to new partners is examined.

For the export growth decomposition analysis on intra-East Asian machinery trade, this paper uses bilateral trade data at the six-digit level of Harmonized System (HS) 1992 from 1993 to 2005.[3] The HS six-digit level is the highest disaggregated level of trade data that is internationally comparable and publicly available. There exist 1,124 product-lines at the six-digit level of HS 1992 just for machinery industry and 5,040 product-lines for all industries. Note that the term "variety" in the descriptive and empirical analyses of this paper means a product-line at the HS six-digit level.

We focus on bilateral trade flows among nine East Asian countries, namely China, Hong Kong, Indonesia, Japan, Malaysia, the Philippines, Rep. of Korea, Singapore, and Thailand. The machinery industry of interest in this paper includes general machinery (HS84), electric machinery (HS85), transport equipment (HS86-89), and precision machinery (HS90-92). The HS classification codes are grouped into final products and parts and components, following Ando and Kimura (2005).

3.2. Diversification of Export Varieties

Table 1 looks at the changing set of varieties exported from each country to the East Asian region, regardless of individual export partner countries. The figures are compared between machinery final products and parts and components. The first three rows of the table report the value and the real growth of intra-East Asian machinery exports from 1993-95 to 2003-05 for

[3] See Appendix A.1 for data sources.

each country on the top of columns. The next five rows record the number of varieties exported from each country in the first and last periods, which is classified into the existing, disappearing, and new varieties. The last three rows record the share of contribution of varieties of each category to the intra-East Asian machinery export growth for each country.

For further reference, Table 2 compares the number and the export growth contribution of existing varieties with different definitions. A narrow definition of the existing variety, which defines the set of varieties continuously exported throughout 1993-2005 as the existing variety, is introduced.

These tables reveal the following features of intra-East Asian machinery trade, from the perspective of the diversification of export varieties. First, compared to final products, a wide range of machinery parts and components relative to the maximal possible number of product lines (436 varieties) have been exported from each country to the region. The number of varieties exported from most countries except Indonesia and the Philippines already has reached a high level in 1993-95 and remained close to the upper bound. At the same time, most countries except the Philippines achieve higher growth in the intra-East Asian export value of machinery parts and components than that of final products. These results indicate that the explosive expansion of intra-East Asian machinery parts and components trade has been accelerated through transactions of diversified range of varieties.

Second, among nine East Asian countries, Indonesia and the Philippines, which exported the narrowest range of varieties initially in 1993-95, experienced outstanding increases in the number of varieties as well as in the value of intra-East Asian machinery exports from 1993-95 to 2003-05. Meanwhile, the number of varieties exported from Hong Kong, Japan and other countries have peaked out or declined.[4] As for machinery final products, the decline in the export value and that in the number of export varieties simultaneously occurred for those

[4] Strictly speaking, even though we observe that the number of export varieties peaks out at the six-digit level, it remains possible that the transaction of a new variety may be started within a six-digit category of which any other varieties have been already exported.

countries. The contrasting pattern across countries, especially true for final products, can be interpreted as a reflection of production shifts from higher-income countries to developing countries within the region.

Third, the total intra-East Asian machinery export growth for each country is mostly attributed to massive quantities of existing varieties or the death of old varieties (more than 90%), even for Indonesia with the notably frequent birth of new varieties. The set of existing varieties continuously exported from each country throughout 1993-2005 constitutes a strict subset of the set of existing varieties exported in both the first and last periods. For machinery parts and components, there is really not much difference between the export growth contributions of existing varieties with different definitions, which means that economically important existing varieties of parts and components are mostly exported without interruption throughout the decade. In contrast, for final products, we can observe the considerable discrepancy in the export growth contribution between existing varieties with different definitions.[5] These results can be interpreted as indicating that more stable transactional relationships have been built within the region for machinery parts and components trade, while the transaction of final products is more sensitive to changing market conditions in the region.

3.3. Diversification of Trading Partners

Table 3 looks at the changing set of export partner countries to which each country exported within East Asia. The rows of the table correspond to those of Table 1 except decomposing by partner country instead of variety.

First, the average number of export partner countries is uniformly larger in both first and last periods for intra-East Asian trade of machinery parts and components than those of final products. Combined with the first characteristic in the last subsection, this result indicates that

[5] Amiti and Freund (2007) conclude that the intensive margin accounts for more than 95% of China's export growth. Note, however, that they only look at the beginning and end of their sample, raising a suspicion about the dependence of the results on a particular pair of periods.

intra-East Asian machinery parts and components trade has expanded with active back-and-forth transactions of a wide range of varieties across East Asia.

Second, the average number of export partner countries uniformly increased for machinery parts and components, except for Japan which remained at a high level (more than seven partners on average out of eight). The average number of new partners for Indonesia with relatively small number of export partners initially in 1993-95 is the largest in the region. For final products, on the other hand, the average number of export partners as well as the export value declined for Japan and Hong Kong, while other countries expanded the range of export partners. As with the second characteristic in the last subsection, this contrasting pattern across countries can be interpreted as a reflection of production shifts to developing countries.

Third, the sales of existing varieties to new export partners account for a non-negligible portion of the growth in the intra-East Asian machinery exports, compared to the export growth contribution of new varieties recorded in Table 1. The expansion of intra-East Asian machinery trade seems to be driven by the sales of existing varieties to new export partner countries, rather than by the birth of new varieties exported from each country, indicating that exports can expand by entering new markets with existing varieties. Indeed, the number and the export growth contribution of new varieties are more likely to be significant for bilateral transactions within the region than the overall intra-East Asian exports from each country. Bilateral transactions among China and ASEAN4 countries, particularly those including Indonesia or the Philippines initially with a limited number of export varieties, achieve a striking growth not only in terms of the increased value of exports but also the increasing number of export varieties.

4. Theoretical Consideration for the Diversification in Intra-East Asian Machinery Trade

The descriptive analysis in the last section sheds light on two interesting phenomena of the

diversification of export varieties and trading partners for intra-East Asian machinery trade at the HS six-digit level. One phenomenon is different trade patterns within the region between machinery final products and parts and components. Every country in the region has actively engaged in not one-way but back-and-forth transactions of a diversified range of machinery parts and components, whereas the number of export varieties and the average number of export partners of higher-income countries have declined for final products. From a different aspect, more stable transactional relationships have been built within the region for machinery parts and components trade, whereas the transaction of final products seems to be more sensitive to changing market conditions in the region. The other phenomenon is active participation of developing countries in intra-East Asian machinery trade. The number of varieties of both machinery final products and parts and components exported from developing countries has largely increased along with the increase in export value. The data for the average number of export partner countries shows the same tendency.

This section discusses how and whether the existing international trade theories including the traditional comparative advantage theories and the new international trade models explain rationale for these two interesting phenomena of the diversification observed for intra-East Asian machinery trade. First of all, active participation of developing countries in intra-East Asian machinery trade can be partly accounted for by the reductions in tariffs and non-tariff barriers, as predicted by Ricardian models (Dornbusch et al. 1977; Yi 2003). The trade liberalization of semiconductor-related parts and components in the 1990s under the scheme of the Information Technology Agreement (ITA)[6] as well as the extensive use of the duty drawback system in developing countries enables network-forming multinationals, particularly electric machinery firms, to spread fragmented production processes more efficiently across East Asia. As for a significant increase in the number of varieties bilaterally traded among ASEAN4 countries, ASEAN member countries have made significant progress in

[6] As for the ITA, see the web page of the World Trade Organization (WTO) (http://www.wto.org/english/tratop_e/inftec_e/inftec_e.htm).

lowering intra-regional tariffs through the Common Effective Preferential Tariff (CEPT) scheme for an ASEAN Free Trade Area (AFTA) during the period of interest. Tariffs on goods traded within the ASEAN region mostly have been reduced to 0-5% by 2002 for the original six ASEAN signatories.[7] The utilization of CEPT can facilitate transactions of new varieties of not only parts and components but also final products within the region.[8] The following free trade agreements (FTAs) in the region, particularly those between Japan/Korea/China and ASEAN, seem to further contribute to the development of production networks in the region. Note that trade liberalization and facilitation policies may reduce fixed costs as well as variable costs of exporting to a given partner country through promoting business activities.

Second, a large increase in the number of varieties exported from developing countries can also be partly captured by horizontal product differentiation models (Krugman 1980; Helpman and Krugman 1985), which predict that a large economy is more likely to export a wider range of varieties at the product-line level. The findings of the descriptive analysis in the last section, however, suggest that the start of exports of new varieties is affected by the economic development level of exporter country, rather than its economic size. The linkage between the diversification of export varieties and productivity growth has attracted attention in the way that trade contributes to economic growth, with the development of endogenous growth models (Grossman and Helpman 1991). The reverse causality, how the level of economic development affects the range of export varieties, appears to be non-negligible.

At last but very important, the observed fact that countries with different levels of economic development have engaged in active back-and-forth transactions of a wide range of machinery parts and components across East Asia does not seem to be fully explained within the framework of horizontal product differentiation models. In those models, differentiated products

[7] As for the AFTA and the CEPT scheme, see the web page of the ASEAN Secretariat (http://www.aseansec.org/).

[8] JETRO White Paper 2007 (JETRO 2007: 135-47) presents the present status of utilization of the CEPT scheme as well as other FTAs in the region (http://www.jetro.go.jp/en/stats/white_paper/).

are assumed to be produced with physical/human-capital-intensive technology in which developed countries have comparative advantage. In addition, although the descriptive analysis sheds light on the difference in the stability of transactional relationship between machinery final products and parts and components, the existing models do not distinguish their different natures.

To deal with these notable observations, it appears that reorganized theoretical consideration is necessary. At least, to account for the different intra-regional trade patterns between machinery final products and parts and components, prime features of East Asian economy should be taken into consideration, such as active foreign direct investments, development of cross-border production sharing or fragmentation, and the formation of industrial agglomeration (See Kimura 2006). The diversity of the East Asian region promotes opportunities for multinationals to locate fragmented production processes in different locations with different location advantages all over the region.[9] Suppose that a factory with a long value chain from upstream to downstream located in a developed country fragments and shifts unskilled-labor-intensive assembly line to a developing country to save the production cost, which possibly leads to the decline in the number of varieties of final products exported from the home country as well as the birth of new varieties in the host country. On another front, geographic spread of multinationals all over the region may facilitates transactions of a range of parts and components even between developing countries. As the formation of agglomeration boosts arm's-length transactions and enhances the competitiveness of the suppliers located in the industrial clusters across the region, parts and components sourced from globally competitive suppliers across borders result in the diversified combinations of trading partners.

5. Decomposition of the Gravity Equation

We now realize that the standard international trade theories cannot capture the whole picture of

[9] Fragmentation theory started with the seminal work of Jones and Kierzkowski (1990).

the diversification of export varieties and trading partners in intra-East Asian machinery trade. It is, however, beyond the scope of this paper to develop an alternative theoretical model so as to predict the number and the range of bilaterally exported varieties. This paper instead utilizes a powerful empirical framework for bilateral trade flows, i.e., the gravity model, to obtain clues to an understanding the mechanism of the diversification of export varieties and trading partners observed for intra-East Asian machinery trade.

Specifically, this paper estimates the usual gravity equation for the aggregate value of exports and its two components, the number of export varieties and the average value of exports per variety. We immediately know that the number of export varieties and the average export value per variety are not approximated by precisely the same gravity relationship. By comparing estimates for two components of the aggregate export value as well as examining the different patterns of estimated coefficients between machinery final products and parts and components, this paper attempts to tease out clues about factors behind product diversification in bilateral trade flows, which cannot be picked up by the standard international trade theories.

5.1. Model Specification

According to the usual gravity equation for bilateral trade flows, the following equation is to be estimated as a benchmark:

$$\ln EX_{ijt} = \beta_0 + \beta_1 (\ln EXGDP_{it}) + \beta_2 (\ln IMGDP_{jt}) + \beta_3 (\ln Distance_{ij}) + \beta_4 (Language_{ij}) + \varepsilon_{ijt}, \quad (2)$$

where EX_{ijt} is the aggregate value of bilateral exports from country i to country j in year t, and $EXGDP_{it}$, $IMGDP_{jt}$, $Distance_{ij}$, $Language_{ij}$ denote exporter i's GDP, importer j's GDP, geographic distance between exporter i and importer j, and a dummy variable for common official language, respectively.[10] $Distance_{ij}$ and $Language_{ij}$ are included in the equation as

[10] As this paper focuses on intra-East Asian machinery trade, we would prefer value added of machinery industry of its own (ideally, disaggregated by product type) to GDP as a variable indicating the size of economic activities of machinery industry. Due to lack of data publicly

proxies for (time-invariant) bilateral trade costs.

The aggregate export value is decomposed into two components, $EX_{ijt} = \#EX_{ijt}\ AveEX_{ijt}$, where $\#EX_{ijt}$ and $AveEX_{ijt}$ are the number of export varieties and the average value of exports per variety, respectively.[11] Taking natural logarithms of both sides,

$$\ln EX_{ijt} = \ln \#EX_{ijt} + \ln AveEX_{ijt}, \tag{3}$$

which allows us to also estimate the usual gravity equation for bilateral trade flows, (2) for each of the two components of the aggregate export value. To the best of my knowledge, this way of empirical analysis to reconsider the gravity equation by decomposing the aggregate trade value is originally employed by Bernard et al. (2007). While they examine the export variety composition at the firm level, this paper first utilizes this technique at the country level, focusing on the role of export varieties in bilateral trade flows.

This paper estimates two versions of the gravity equation besides (2). In the second gravity equation, the absolute value of the difference in per capita GDP between exporter *i* and importer *j*, $DPCGDP_{ijt}$ is included as a proxy for wage differential, which may reflect different factor intensity, or production technology, and factor endowment. These differences in production conditions are presumed to encourage cross-border production sharing.

$$\ln EX_{ijt} = \beta_0 + \beta_1 (\ln EXGDP_{it}) + \beta_2 (\ln IMGDP_{jt}) + \beta_3 (\ln DPCGDP_{ijt}) + \beta_4 (\ln Distance_{ij}) + \beta_5 (Language_{ij}) + \varepsilon_{ijt}. \tag{4}$$

In the third gravity equation, $DPCGDP_{ijt}$ is replaced with exporter *i*'s per capita GDP, $EXPCGDP_{it}$ and importer *j*'s per capita GDP, $IMPCGDP_{jt}$. These are intended to capture the factors associated with the level of economic development. The effect of exporter's per capita GDP is presumed to operate through the number of export varieties, as is clear from the

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available, we have no alternative but to employ GDP as a proxy for economic size of machinery industry. Although the sample size is reduced, I also conduct the gravity equation estimation employing data for value added of manufacturing industry in place of GDP. Still, the results do not differ substantially.

[11] Although the latter component, the average export value per variety, depends on not only quantities shipped but also unit-prices charged for the varieties, further investigation into the role of unit-prices for bilateral trade flows is beyond the scope of this paper.

descriptive analysis in Section 3. Firms of high-income economies are more likely to be able to domestically produce and export a wide range of varieties due to technological advantage. As for importer's per capita GDP, some may argue that residents or firms of high-income economies are more likely to demand or procure a wide range of varieties.

$$\ln EX_{ijt} = \beta_0 + \beta_1 (\ln EXGDP_{it}) + \beta_2 (\ln IMGDP_{jt}) + \beta_3 (\ln EXPCGDP_{it}) + \beta_4 (\ln IMPCGDP_{jt}) + \beta_5 (\ln Distance_{ij}) + \beta_6 (Language_{ij}) + \varepsilon_{ijt}. \quad (5)$$

Additionally, to allow for non-linearity of the elasticity of the number of export varieties to exporter's per capita GDP, a quadratic term of $EXPCGDP_{it}$ is included. The number of export varieties could peak out or even decline if the exporter reaches a certain level of economic development, as observed in the descriptive analysis.

All equations, (2), (4), and (5) are to be estimated by the ordinary least squares (OLS), using pooled cross-section time-series data for intra-East Asian bilateral machinery trade. The estimates for three different periods, 1994-96, 1997-2000, and 2001-04 are to be compared. By the properties of the OLS, the coefficient for the aggregate export value equals the sum of those for its two components, which allows the comparison of the contribution of each of the components of the aggregate export value to the usual gravity relationship. To examine the different trade patterns between machinery final products and parts and components, the equations are estimated separately for each of those as well as machinery trade as a whole. Whether the trade patterns are different is tested by conducting the Wald test. Focusing on the effect of distance on bilateral trade flows, the null hypothesis of the Wald test is the equality of the coefficient for distance between the equations.[12]

The sample of the data used in the estimation encompasses nine East Asian countries as in the descriptive analysis in Section 3, that is to say, (up to) 72 exporter-importer pairs.

[12] To perform the Wald test, the seemingly unrelated regression (SUR) estimation is used, accounting for the correlation between the error terms of the equations of machinery final products and parts and components. Except the result of the Wald test, the coefficients and standard errors estimated by separately applying the OLS to each of the equations are reported in this paper because the set of regressors in both equations are identical.

Data of intra-East Asian bilateral trade flows for machinery final products and parts and components from 1994 to 2004 are the same as those used in the descriptive analysis. The aggregate value of uni-directional bilateral exports of machinery final products and parts and components, and its two components, the number of export varieties and the average value of exports per variety are used as the dependent variables in the estimation.[13] The number of bilaterally exported varieties is counted according to the measure mentioned in Section 3.1, which means that data are obtained for 11 three-year periods from 1993-95 to 2003-05.[14] The data of the number of export varieties for a particular three-year period is regarded as data for the middle year of the period to match all the (time-variant) regressors. The summary statistics for the number of bilaterally exported varieties are reported in Table 4.[15]

5.2. Estimation Results

Table 5, 6, and 7 provide estimates of (2), (4), and (5) for intra-East Asian bilateral machinery trade in each of the three periods, 1994-96, 1997-2000, and 2001-04. The estimates for the aggregate value of bilateral exports, and its components, the number of export varieties and the average export value per variety are reported side-by-side. The pattern of estimated coefficients is compared between machinery final products and parts and components.

The estimates of the basic gravity equation, (2) are reported in Table 5. The results for all machinery products show that both the number of export varieties and the average export value per variety are approximated by the typical regressors of the gravity equation. As with the aggregate export value, both of its components are positively correlated with the economic size of exporter and importer countries and a dummy variable for common language, and negatively correlated with geographic distance between countries for all the periods. However, once we look into the magnitude of estimated coefficients and the estimates of the other equations as

[13] All the bilateral export values are positive (not censored at zero) in the sample of this paper.
[14] All the numbers of bilaterally exported varieties are not censored either at zero or at the maximal possible number in the sample of this paper.
[15] See Appendix A.2 for the data sources of regressors.

well as examining the difference between estimates for machinery final products and parts and components, it is clear that the number of export varieties and the average export value per variety are not accounted for by precisely the same gravity relationship.

First and foremost, the coefficients for distance are statistically insignificant for the average export value per variety in the final products equations for all the periods. Looking at the estimates for the number of export varieties, the magnitude of the coefficients for distance is larger in the final products equations than in the parts equations. The contrasting pattern of estimated coefficients for distance provides a new insight for the gravity relationship. The null hypothesis of the Wald test is rejected in all the pairs of equations for both the number of export varieties and the average export value per variety. The Wald test confirms that the effects of distance on bilateral trade flows are different between machinery final products and parts and components for intra-East Asian trade.

For machinery final products, as trade costs increase with distance, all the adjustments in the aggregate export value occur through the decreasing number of export varieties. The simplest Krugman model based on consumers' love of variety predicts that all varieties domestically produced are exported to all other markets in equilibrium. In the Krugman model, the increase in trade costs is offset only by smaller quantities shipped for each variety, which is starkly inconsistent with the estimates in this paper. Melitz (2003), on the other hand, provides a theoretical rationale for the relationship between heterogeneous firms' participation in exporting and distance, that is, how the increase in trade costs results in the narrower range of export varieties. The estimates of the final products equations suggest the existence of the fixed costs of exporting assumed as in the Melitz model for machinery final products.

Compared to final products, a wide range of machinery parts and components in small quantities are more likely to be traded between countries even at a long distance. The higher elasticity of the average export value per variety to distance in the parts equations can be interpreted as indicating the higher service-link costs for transactions of machinery parts and

components than those of final products. Service-link costs here should consist of not just transport cost, but coordination cost. As the manufacturing of parts and components requires coordination between production processes, unlike final products, the coordination cost is mounting in response to distance, resulting in smaller quantities shipped for each variety. The lower elasticity of the number of export varieties to distance in the parts equations, on the other hand, can be interpreted as a reflection of a more stable transactional relationship of machinery parts and components than final products. As is evident from the descriptive analysis, the transaction of parts and components is more likely to be continued without interruption. It would appear that the transaction of parts and components is relation-specific because it entails coordination between production processes as mentioned above. A wide range of parts and components could be traded between countries at distance, once the transactional relationship of a given variety is developed, even with the existence of the fixed costs of exporting.

Second, the coefficients for the difference in per capita GDP between exporter and importer, which is employed as a proxy for wage differential, are statistically significant and positively correlated with both the number of export varieties and the average export value per variety for the periods 1994-96 and 1997-2000, as with the aggregate export value (as reported in Table 6). The larger the wage differential between countries, the wider range of varieties and the larger quantities of each variety are exported with each other. As the wage differential may reflect the difference in production conditions which is presumed to encourage cross-border production sharing, this result suggests the prevalence of cross-border production sharing as a driving force for the explosive growth in intra-East Asian machinery trade in terms of both diversified range of varieties and larger quantities.

The magnitude of coefficients for the difference in per capita GDP, however, declines over time for both dependent variables, the coefficients are no longer statistically significant at the five-percent level for the period 2001-04, except the estimate for the number of export varieties in the final products equation. This pattern of estimated coefficients can be interpreted

as indicating that the transactions among developing countries in the region have expanded, although Japan, the highest-income country in the region, initially had a dominant role in intra-East Asian machinery trade.

Third, the coefficients for importer's per capita GDP are statistically insignificant for the number of export varieties in both final products and parts equations for all the periods, unlike the estimates for the average export value per variety (as reported in Table 7). In contrast, the coefficients for exporter's per capita GDP are statistically insignificant for the average value of exports per variety in both final products and parts equations for the periods 1997-2000 and 2001-04, unlike the estimates for the number of export varieties. The contrasting pattern for the estimated coefficients for country's per capita GDP as a proxy for the level of economic development suggests that the number of varieties exported from a country depends on the economic development level of the exporter itself only, while the quantities shipped for each variety are associated with the economic development level of the importer. This result supports the findings of the descriptive analysis which suggests that the number of export varieties and destination countries of intra-East Asian machinery exports from developing countries have greatly increased in the process of economic development.

A related finding is that, compared to the estimates for the average export value per variety, the magnitude of coefficients for importer's GDP is only limited relative to those for exporter's GDP for the number of export varieties in any equation for all the periods. Although the average export value per variety is definitely associated with the characteristics of importer as well as exporter's economic size, the number of export varieties mainly depends on the characteristics of exporter, its economic size and level of economic development.

6. Conclusion

This paper clarifies the facts on international production networks in East Asia from not only the perspective of trade value but also the diversification of export varieties and trading partners.

The descriptive analysis sheds light on two interesting phenomena of the diversification in intra-East Asian machinery trade at the HS six-digit level. One phenomenon is different trade patterns in the region between machinery final products and parts and components. The other is active participation of developing countries in terms of a large increase in the number of export varieties and the average number of export partner countries. This paper points out that, under the benchmark settings, the standard international trade theories cannot fully capture these notable stylized facts; in particular, the fundamental difference between machinery final products and parts and components and the relationship between the level of economic development and the diversification of export varieties.

Instead of developing an alternative theoretical model so as to predict the number and the range of bilaterally exported varieties, this paper utilizes the gravity model to obtain clues about factors behind product diversification in bilateral trade flows, which cannot be picked up by the standard international trade theories. By comparing estimates for the number of export varieties and the average value of exports per variety, as well as examining the different patterns of estimated coefficients between machinery final products and parts and components, the observed phenomena of product diversification are supported more generally.

These product-line level analyses provide valuable clues to an understanding of the mechanism of product diversification in bilateral trade flows. The different natures between final products and parts and components and the economic development level of exporter country seem to be important factors in the diversification of export varieties and trading partners for intra-East Asian machinery trade. It is a subject for a further study to develop a theoretical model incorporating these factors to explain rationale for product diversification in bilateral trade flows. In addition, the notable observations for intra-East Asian machinery trade presented in this paper should be carefully reexamined for a broader range of countries and industries, comparing the diversification pattern of the East Asian economy with that of other parts of the world.

Appendix

A.1. Trade Data

This paper basically uses bilateral import data at the six-digit level of HS 1992 obtained from the United Nations Commodity Trade Statistics Database (UN Comtrade). For the world export value mentioned in Section 2, since any missing data is not estimated in UN Comtrade, I simply aggregated data for all the countries that reported import statistics both in 1993 and 2005.

As for the intra-East Asian bilateral trade data used in the descriptive and empirical analyses of Section 3 and 5, I modified data as follows: First, data for the Philippines' imports, which only have been reported according to the HS classification since 1996, are replaced by data for exports to the Philippines. The export data are adjusted by the c.i.f./f.o.b. ratio specific to the machinery industry sub-sector and exporter-importer pair, which is calculated using the corresponding data reported according to the Standard International Trade Classification (SITC) Rev.3. Second, since the annual data at the HS six-digit level below $500 (current US$) are not reported before 2000, trade flows below $500 are treated as if there was no trade at all for all the years in the sample. After the cutoff value is applied, all data are deflated by the wholesale price index in the U.S. to obtain a constant dollar series. Note that data for Singapore's imports from Indonesia, which only have been reported since 2003, are not included in the descriptive analysis of Section 3.

A.2. Country-level Data

Data for GDP and per capita GDP (constant 2000 US$) are obtained from the World Bank's World Development Indicators (WDI) Online. Data for the geodesic distance between countries and official language are obtained from the CEPII's distance measures database.

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Table 1: ***Export growth decomposition by variety***

Final products (688 varieties)

	Exporter								
	CHN	HKG	IDN	JPN	KOR	MYS	PHL	SGP	THA
Average value of exports (millions US$)									
1993-95	17,357	3,365	332	49,144	4,777	8,044	510	7,977	3,732
2003-05	54,669	3,206	2,190	44,897	13,072	10,111	4,553	9,194	8,683
Export growth (%) 1993-95 - 2003-05									
	215.0	-4.7	559.5	-8.6	173.7	25.7	793.5	15.3	132.7
# of export varieties									
1993-95	603	611	176	672	591	548	169	621	412
Existing	590	529	152	657	561	513	142	581	363
Disappearing	13	82	24	15	30	35	27	40	49
New	55	12	151	3	48	51	140	23	123
2003-05	645	541	303	660	609	564	282	604	486
% change in # of varieties 1993-95 - 2003-05									
	7.0	-11.5	72.2	-1.8	3.0	2.9	66.9	-2.7	18.0
% of export growth contribution of varieties of each category									
Existing	99.8	-64.8	91.7	-99.5	99.4	99.5	97.3	101.2	96.5
Disappearing	-0.1	-39.6	-1.0	-0.7	-0.4	-1.4	-0.2	-2.2	-1.3
New	0.3	4.4	9.4	0.2	0.9	1.9	2.9	1.0	4.8

Part and components (436 varieties)

	Exporter								
	CHN	HKG	IDN	JPN	KOR	MYS	PHL	SGP	THA
Average value of exports (millions US$)									
1993-95	9,343	6,793	383	60,371	10,910	10,509	2,292	11,735	5,319
2003-05	65,527	10,151	3,167	95,532	46,108	32,467	19,734	23,491	13,871
Export growth (%) 1993-95 - 2003-05									
	601.3	49.4	727.5	58.2	322.6	209.0	760.9	100.2	160.8
# of export varieties									
1993-95	409	414	221	433	401	389	230	420	360
Existing	406	397	214	429	393	385	222	408	351
Disappearing	3	17	7	4	8	4	8	12	9
New	22	5	123	1	18	19	101	9	36
2003-05	428	402	337	430	411	404	323	417	387
% change in # of varieties 1993-95 - 2003-05									
	4.6	-2.9	52.5	-0.7	2.5	3.9	40.4	-0.7	7.5
% of export growth contribution of varieties of each category									
Existing	99.8	100.2	91.4	100.0	100.0	99.6	98.7	100.0	99.0
Disappearing	0.0	-0.2	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1
New	0.2	0.0	8.6	0.0	0.0	0.5	1.3	0.0	1.1

Notes: All values are calculated at constant prices.
Source: Authors' calculation based on the data from UN Comtrade (HS 1992, six-digit).

Table 2: ***Export growth decomposition by variety with the narrowly-defined existing variety***

Final products (688 varieties)

	Exporter								
	CHN	HKG	IDN	JPN	KOR	MYS	PHL	SGP	THA
# of existing varieties									
in both periods	590	529	152	657	561	513	142	581	363
throughout 1993-2005	541	471	120	626	520	447	110	521	305
# of existing varieties throughout 1993-2005 / # of varieties in 1993-95 (%)									
	89.7	77.1	68.2	93.2	88.0	81.6	65.1	83.9	74.0
% of export growth contribution of existing varieties									
in both periods	99.8	64.8	91.7	99.5	99.4	99.5	97.3	101.2	96.5
throughout 1993-2005	61.2	192.8	43.0	118.6	77.5	-2.5	30.6	-12.5	47.9

Part and components (436 varieties)

	Exporter								
	CHN	HKG	IDN	JPN	KOR	MYS	PHL	SGP	THA
# of existing varieties									
in both periods	406	397	214	429	393	385	222	408	351
throughout 1993-2005	396	385	199	422	378	365	203	396	333
# of existing varieties throughout 1993-2005 / # of varieties in 1993-95 (%)									
	96.8	93.0	90.0	97.5	94.3	93.8	88.3	94.3	92.5
% of export growth contribution of existing varieties									
in both periods	99.8	100.2	91.4	100.0	100.0	99.6	98.7	100.0	99.0
throughout 1993-2005	99.4	101.1	91.0	98.7	99.8	98.7	98.5	99.5	98.5

Notes: All values are calculated at constant prices.
Source: Authors' calculation based on the data from UN Comtrade (HS 1992, six-digit).

Table 3: ***Export growth decomposition by partner country (bilaterally exported existing varieties in both periods only)***

Final products

	Exporter								
	CHN	HKG	IDN	JPN	KOR	MYS	PHL	SGP	THA
Average value of exports (millions US$)									
1993-95	17,157	3,205	279	48,770	4,448	7,946	470	7,761	3,604
2003-05	54,273	3,144	1,940	44,676	12,839	10,002	4,235	9,069	8,363
Export growth (%) 1993-95 - 2003-05									
	216.3	-1.9	595.9	-8.4	188.7	25.9	800.3	16.8	132.0
Average # of export partner countries across bilaterally exported existing varieties (up to eight partners)									
1993-95	4.3	4.2	2.1	6.7	4.2	2.5	2.2	4.4	2.8
Existing	4.0	3.2	1.7	6.0	3.4	2.2	1.7	3.6	2.2
Disappearing	0.3	1.0	0.4	0.8	0.7	0.4	0.5	0.8	0.6
New	2.3	0.9	2.0	0.4	1.4	1.4	2.1	1.0	1.8
2003-05	6.3	4.1	3.6	6.3	4.8	3.6	3.8	4.6	4.0
% of export growth contribution of partners of each category									
Existing	90.2	49.7	69.3	-86.6	98.1	56.0	52.8	115.4	70.9
Disappearing	-0.4	-265.5	-0.9	-22.8	-4.0	-8.9	-0.6	-33.3	-2.1
New	10.2	115.9	31.6	9.4	5.8	53.0	47.8	17.9	31.2

Part and components

	Exporter								
	CHN	HKG	IDN	JPN	KOR	MYS	PHL	SGP	THA
Average value of exports (millions US$)									
1993-95	9,303	6,701	348	60,147	10,847	10,456	2,256	11,701	5,274
2003-05	65,391	10,139	2,722	95,493	46,049	32,341	19,395	23,431	13,655
Export growth (%) 1993-95 - 2003-05									
	602.9	51.3	681.9	58.8	324.5	209.3	759.7	100.3	158.9
Average # of export partner countries across bilaterally exported existing varieties (up to eight partners)									
1993-95	5.1	5.1	2.3	7.3	5.4	3.7	2.6	5.8	3.8
Existing	5.0	4.4	2.1	6.9	5.0	3.4	2.3	5.4	3.4
Disappearing	0.1	0.6	0.2	0.4	0.3	0.3	0.3	0.4	0.4
New	2.1	1.1	2.7	0.2	1.3	1.9	2.5	0.9	2.1
2003-05	7.1	5.6	4.8	7.1	6.4	5.2	4.8	6.3	5.5
% of export growth contribution of partners of each category									
Existing	97.2	82.2	69.6	89.7	92.1	87.3	85.5	92.1	81.7
Disappearing	0.0	-1.4	-0.2	-0.4	-0.1	-0.2	-0.1	-0.6	-0.6
New	2.8	19.2	30.7	10.7	8.0	12.9	14.6	8.5	18.8

Notes: All values are calculated at constant prices.
Source: Authors' calculation based on the data from UN Comtrade (HS 1992, six-digit).

Table 4: ***Summary statistics for the number of bilaterally exported varieties in intra-East Asian machinery trade***

	Observations	Mean	Standard Deviation	Min	Max
All machinery products (1124 varieties)					
All the periods	782	482.0	257.0	19	1021
1993-1995	71	436.0	291.3	19	1021
2003-2005	72	537.3	240.7	96	991
Final products (688 varieties)					
All the periods	782	240.9	158.7	5	618
1993-1995	71	226.5	176.9	5	618
2003-2005	72	268.5	156.0	29	581
Parts and Components (436 varieties)					
All the periods	782	241.0	101.1	14	413
1993-1995	71	209.5	116.9	14	413
2003-2005	72	268.7	87.4	67	410

Table 5: ***Gravity equation estimates for the export value and its components for intra-East Asian machinery trade: baseline results***

	1994-1996			1997-2000			2001-2004		
	Aggregate export value	# of varieties	Average value per variety	Aggregate export value	# of varieties	Average value per variety	Aggregate export value	# of varieties	Average value per variety
All machinery products									
Exporter's GDP	0.868**	0.457**	0.411**	0.707**	0.379**	0.328**	0.667**	0.321**	0.347**
	(0.109)	(0.052)	(0.090)	(0.095)	(0.039)	(0.083)	(0.080)	(0.030)	(0.077)
Importer's GDP	0.388**	0.105*	0.283**	0.401**	0.084*	0.317**	0.478**	0.063*	0.415**
	(0.115)	(0.050)	(0.084)	(0.090)	(0.035)	(0.072)	(0.083)	(0.026)	(0.076)
Distance	-0.791**	-0.366**	-0.425*	-0.668**	-0.310**	-0.359*	-0.603**	-0.257**	-0.346*
	(0.246)	(0.111)	(0.190)	(0.189)	(0.080)	(0.159)	(0.157)	(0.062)	(0.144)
Language	1.464**	0.805**	0.659*	1.354**	0.578**	0.775**	1.340**	0.394**	0.946**
	(0.358)	(0.174)	(0.303)	(0.284)	(0.125)	(0.259)	(0.233)	(0.102)	(0.237)
Obs.	213	213	213	284	284	284	285	285	285
R-squared	0.46	0.50	0.27	0.47	0.57	0.27	0.55	0.60	0.37
Final products									
Exporter's GDP	1.018**	0.573**	0.445**	0.873**	0.497**	0.376**	0.741**	0.431**	0.310**
	(0.109)	(0.062)	(0.084)	(0.096)	(0.048)	(0.075)	(0.074)	(0.040)	(0.070)
Importer's GDP	0.517**	0.115	0.402**	0.524**	0.090*	0.434**	0.564**	0.067	0.496**
	(0.121)	(0.059)	(0.087)	(0.100)	(0.044)	(0.079)	(0.083)	(0.035)	(0.076)
Distance	-0.689**	-0.438**	-0.251	-0.588**	-0.408**	-0.180	-0.511**	-0.356**	-0.155
	(0.259)	(0.130)	(0.195)	(0.205)	(0.103)	(0.157)	(0.158)	(0.082)	(0.137)
Language	1.695**	0.999**	0.696*	1.535**	0.753**	0.782**	1.162**	0.527**	0.635*
	(0.385)	(0.209)	(0.328)	(0.313)	(0.160)	(0.286)	(0.253)	(0.134)	(0.256)
Obs.	213	213	213	284	284	284	285	285	285
R-squared	0.53	0.53	0.34	0.54	0.59	0.36	0.61	0.61	0.42
Parts and components									
Exporter's GDP	0.822**	0.357**	0.465**	0.674**	0.283**	0.392**	0.653**	0.225**	0.427**
	(0.116)	(0.046)	(0.096)	(0.099)	(0.034)	(0.089)	(0.088)	(0.024)	(0.084)
Importer's GDP	0.329**	0.100*	0.229*	0.360**	0.078**	0.282**	0.449**	0.059**	0.390**
	(0.117)	(0.045)	(0.087)	(0.089)	(0.029)	(0.073)	(0.086)	(0.021)	(0.080)
Distance	-0.870**	-0.303**	-0.567**	-0.730**	-0.232**	-0.498**	-0.653**	-0.177**	-0.477**
	(0.251)	(0.097)	(0.201)	(0.194)	(0.065)	(0.172)	(0.171)	(0.048)	(0.162)
Language	1.400**	0.652**	0.748*	1.329**	0.451**	0.877**	1.435**	0.294**	1.141**
	(0.357)	(0.149)	(0.296)	(0.287)	(0.102)	(0.258)	(0.246)	(0.081)	(0.245)
Obs.	213	213	213	284	284	284	285	285	285
R-squared	0.42	0.44	0.29	0.44	0.50	0.29	0.51	0.53	0.38
Wald test (p-value)	0.038	0.000	0.000	0.075	0.000	0.000	0.029	0.000	0.000

Notes: Dependent variable is listed at the top of each column and the regressors are in the first left column. All regressions include a constant term and year dummies, but those coefficient estimates are not reported for brevity. Robust standard errors (clustering by exporter-importer pair) are in parentheses. ** and * indicate significance at the 1% and 5% level. The null hypothesis of the Wald test is that the coefficient for distance is identical between the equations of final products and parts and components.

Table 6: ***Gravity equation estimates for two components of the export value for intra-East Asian machinery trade: wage differential***

	1994-1996		1997-2000		2001-2004	
	# of varieties	Average value per variety	# of varieties	Average value per variety	# of varieties	Average value per variety
Final products						
Exporter's GDP	0.467**	0.325**	0.438**	0.285**	0.399**	0.288**
	(0.062)	(0.092)	(0.049)	(0.077)	(0.041)	(0.079)
Importer's GDP	0.006	0.280**	0.030	0.342**	0.034	0.475**
	(0.053)	(0.082)	(0.039)	(0.075)	(0.032)	(0.083)
Difference in PCGDP	0.246**	0.278**	0.151**	0.232**	0.097*	0.062
	(0.076)	(0.086)	(0.052)	(0.062)	(0.045)	(0.076)
Distance	-0.332**	-0.131	-0.338**	-0.072	-0.318**	-0.130
	(0.118)	(0.180)	(0.094)	(0.147)	(0.077)	(0.138)
Language	0.704**	0.362	0.591**	0.533	0.431**	0.573*
	(0.203)	(0.351)	(0.161)	(0.296)	(0.134)	(0.272)
Obs.	213	213	284	284	285	285
R-squared	0.63	0.44	0.65	0.46	0.64	0.43
Parts and components						
Exporter's GDP	0.271**	0.294**	0.243**	0.306**	0.207**	0.393**
	(0.044)	(0.096)	(0.031)	(0.093)	(0.025)	(0.087)
Importer's GDP	0.012	0.054	0.037	0.195*	0.041*	0.355**
	(0.037)	(0.084)	(0.023)	(0.080)	(0.019)	(0.092)
Difference in PCGDP	0.198**	0.395**	0.102**	0.219**	0.053	0.102
	(0.059)	(0.085)	(0.037)	(0.082)	(0.028)	(0.098)
Distance	-0.218*	-0.396*	-0.184**	-0.396*	-0.156**	-0.436*
	(0.089)	(0.182)	(0.059)	(0.170)	(0.046)	(0.167)
Language	0.415**	0.273	0.342**	0.642*	0.241**	1.039**
	(0.145)	(0.317)	(0.099)	(0.282)	(0.081)	(0.266)
Obs.	213	213	284	284	285	285
R-squared	0.57	0.47	0.58	0.37	0.56	0.40
Wald test (p-value)	0.000	0.001	0.000	0.000	0.000	0.000

Notes: See notes of Table 5

Table 7: ***Gravity equation estimates for two components of the export value for intra-East Asian machinery trade: the level of economic development***

	1994-1996			1997-2000			2001-2004		
	# of varieties		Average value per variety	# of varieties		Average value per variety	# of varieties		Average value per variety
Final products									
Exporter's GDP	0.448**	0.577**	0.350**	0.400**	0.503**	0.328**	0.361**	0.429**	0.338**
	(0.059)	(0.075)	(0.083)	(0.045)	(0.051)	(0.071)	(0.039)	(0.038)	(0.074)
Importer's GDP	0.079	0.091*	0.214**	0.063	0.070*	0.256**	0.058	0.060*	0.387**
	(0.046)	(0.044)	(0.074)	(0.037)	(0.034)	(0.066)	(0.031)	(0.026)	(0.074)
Exporter's PCGDP	0.326**	3.423**	0.178*	0.253**	3.477**	0.056	0.195**	3.351**	-0.126
	(0.055)	(0.900)	(0.075)	(0.041)	(0.656)	(0.066)	(0.036)	(0.556)	(0.072)
(Exporter's PCGDP)^2		-0.186**			-0.191**			-0.184**	
		(0.053)			(0.039)			(0.032)	
Importer's PCGDP	0.053	0.045	0.456**	0.041	0.034	0.449**	0.004	-0.000	0.307**
	(0.050)	(0.045)	(0.060)	(0.041)	(0.035)	(0.053)	(0.036)	(0.030)	(0.063)
Distance	-0.362**	-0.342**	-0.172	-0.351**	-0.324**	-0.133	-0.320**	-0.291**	-0.152
	(0.103)	(0.099)	(0.141)	(0.082)	(0.074)	(0.110)	(0.068)	(0.058)	(0.118)
Language	0.819**	0.950**	0.346	0.608**	0.689**	0.484*	0.430**	0.468**	0.518**
	(0.148)	(0.160)	(0.243)	(0.111)	(0.109)	(0.190)	(0.099)	(0.089)	(0.183)
Obs.	213	213	213	284	284	284	285	285	285
R-squared	0.71	0.74	0.62	0.74	0.79	0.65	0.73	0.81	0.60
Parts and components									
Exporter's GDP	0.264**	0.358**	0.314**	0.223**	0.281**	0.318**	0.187**	0.223**	0.408**
	(0.042)	(0.055)	(0.080)	(0.030)	(0.037)	(0.084)	(0.023)	(0.024)	(0.084)
Importer's GDP	0.064	0.073*	0.024	0.054*	0.058*	0.133	0.052*	0.053**	0.289**
	(0.036)	(0.034)	(0.073)	(0.025)	(0.024)	(0.077)	(0.020)	(0.019)	(0.093)
Exporter's PCGDP	0.238**	2.494**	0.323**	0.153**	1.988**	0.140	0.104**	1.742**	0.013
	(0.042)	(0.720)	(0.072)	(0.027)	(0.524)	(0.077)	(0.022)	(0.426)	(0.082)
(Exporter's PCGDP)^2		-0.135**			-0.109**			-0.096**	
		(0.042)			(0.031)			(0.024)	
Importer's PCGDP	0.063	0.057	0.481**	0.044	0.040	0.362**	0.007	0.005	0.269**
	(0.039)	(0.035)	(0.059)	(0.028)	(0.025)	(0.072)	(0.023)	(0.021)	(0.084)
Distance	-0.246**	-0.231**	-0.453**	-0.196**	-0.181**	-0.440**	-0.157**	-0.142**	-0.451**
	(0.078)	(0.076)	(0.123)	(0.053)	(0.051)	(0.137)	(0.041)	(0.038)	(0.153)
Language	0.506**	0.602**	0.316	0.352**	0.398**	0.592*	0.239**	0.259**	0.978**
	(0.113)	(0.124)	(0.233)	(0.073)	(0.078)	(0.229)	(0.064)	(0.063)	(0.225)
Obs.	213	213	213	284	284	284	285	285	285
R-squared	0.63	0.67	0.64	0.65	0.70	0.47	0.64	0.71	0.47
Wald test (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: See notes of Table 5.