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Trade types with Developed and Developing Countries
What can we learn from Spanish data?

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Abstract

In this paper, we investigate the nature of Spanish intra-industry trade and find that intra-industry trade with CEEC, Asian and Mediterranean countries has increased considerably since the middle of the Nineties. The second aim of the paper is to study if the comparative advantage argument also explains vertical intra-.industry trade between different income countries. According to OLS estimations, technological differences do increase DVIIT while physical capital differences decreases it. Results obtained applying Heckman method support the idea that differences in physical capital reduce the probability of IIT to occur but the level of vertical and horizontal IIT is better explained by the proximity of partners, the similarity in development level and size of market than by differences in physical capital endowments. The variables considered, mostly country-specific do have the same impact on vertical and horizontal IIT with emergent countries.

1. Introduction

An important feature of international trade is the rapid growth of the intra-industry trade and especially the trade of vertical differentiated products. In the last decades empirical and theoretical research has focused on the determinants of vertical intra-industry trade. According to this literature countries specialize in a quality segment depending on their comparative advantage. Consequently, differences in factor endowments enhance vertical intra-industry trade, just like inter-industry trade.

Thus, this type of two-way trade develops increasingly between high-income countries and emergent countries but only few studies have analysed the determinants of intra-industry trade with this kind of trading partners, mainly because these flows were negligible until the second half of the Nineties. The purpose of this paper is to examine Spanish intra-industry trade for the period 1988-2000 and to study if the comparative advantage explanation allows for a good understanding of the vertical intra-industry-trade between unequal partners.

This paper is organized as follows: the next section introduces the theoretical framework of the empirical model tested further on. Section 3 briefly describes the level of intra-industry trade for Spain. Section 4 presents the empirical model and section 5 contains the econometric results. Finally, the last section summarises the main conclusions.

2. Theoretical Framework

Production under increasing returns to scale, together with the hypothesis of consumers' preferences for variety, justify that similar products could be both exported and imported (Krugman, 1979; Lancaster 1980; Helpman, 1981). These arguments also explain why intra-industry trade generally takes place among similar and rich countries. Helpman and Krugman (1985) provide the first explanation for intra-industry trade (IIT) between unequal partners by adding differences in endowments to the previous explanations. Since differentiated products are supposed to be more capital-intensive, the volume of intra-industry trade will be larger, the larger the intensity in capital relative to labour of the trading partners is. As a larger market allows for economies of scale to occur, similar and large markets will also lead to more intra-industry trade. Finally, the more different their capital-labour ratios, the lower intra-industry trade will be.

But products can be differentiated horizontally or vertically. In the first case, products differ in their design, colour or other attributes but not intrinsically. In the second case, products are differentiated by their quality. According to Falvey (1981) and Falvey and Kierzkowski (1987), vertically differentiated products are the result of different production functions: low quality products may be labour-intensive, while high quality products might be capital-intensive. Consequently, differences in factor endowments are expected to enhance vertical IIT as in the Heckscher-Ohlin model (H-O). Vertical differentiated products can also be produced by more or less qualified employees (Gabszewicz *et al.* 1997). More in line with the Ricardian models, countries can also have a comparative advantage in a quality segment due to technology differences (Flam and Helpman, 1987) or differences in research and development expenditures (Gabszewicz *et al.* 1981).

3. Measurement of the Intra-industry Trade

Levels of IIT between Spain and 188 countries were calculated for the period 1988-2000 at the 8-digit level of disaggregation of the EU's Combined Nomenclature (CN). Data were

obtained from COMEXT, Eurostat's database. Then, product categories were adapted to the 15 industries of the NACE Clio R 25 classification.

We use the Adjusted Grubel-Lloyd Index (1975), following Greenaway and Milner (1983). We define the volume of intra-industry trade (*IIT*) between Spain and country *j* for each 8-digit product *p* as the overlap between Spanish exports *X* and imports *M*. For each industry *k*, IIT is obtained as the sum of IIT volume at the product level:

$$IIT_k^j = \sum_{p \in k} IIT_p^j = \sum_{p \in k} 2\min(X_p^j; M_p^j)$$

The Adjusted Grubel-Lloyd Index (*AGL*) is therefore the share of IIT in total volume of trade:

$$AGL_k^j = \frac{IIT_k^j}{X_k^j + M_k^j} * 100 = \frac{\sum_{p \in k} 2\min(X_p^j; M_p^j)}{\sum_{p \in k} X_p^j + M_p^j} * 100$$

This measure of IIT allows for both geographic and industry aggregation (*k* can either be the total or any level of classification)[2].

Abd-el-Rahman (1986) assumes that differences in unit value calculated per tonne reflect differences in quality and Greenaway *et al.* (1994) and Fontagné *et al.* (1987) use this methodology to differentiate between vertical and horizontal intra-industry trade. Therefore, if the export and import unit values differ less than ±α percent, products are considered similar or horizontally differentiated. Otherwise, that is if unit values of export and import differ substantially, this flow is considered as trade of vertically differentiated products. Unit values of export (*UV(X)*) and import (*UV(M)*) are calculated at the most disaggregated level *p* and for each overlap bilateral flow. Then, IIT of vertical differentiated products (*DVIIT*) and IIT of horizontal differentiated products (*DHIIT*) are obtained as follows:

$$IIT_p^j = DHIIT_k^j \text{ if } UV(X_p^j)/UV(M_p^j) \in [1-\alpha; 1+\alpha]$$

$$IIT_p^j = DVIIT_k^j \text{ if } UV(X_p^j)/UV(M_p^j) \notin [1-\alpha; 1+\alpha]$$

where the parameter α is an arbitrarily fixed threshold (usually equal to 0.15 or 0.25).

In the case of developing countries, the level of IIT could be concentrated in relatively few groups of products, while the total trade might be insignificant. According to Nillson (1999), the AGL which is unscaled in nature doesn't reflect the absolute level of IIT and can lead to biased estimations. Nillson suggested using the average level of intra-industry trade per product traded as an alternative measure for suitable comparisons of the extent of IIT between small and large countries.

Table I displays the correlation coefficient between all measures. The volume of IIT is highly correlated with IIT volume per product traded (96%) while the correlation with each of these variables with the AGL index is much lower (respectively 78% and 82%). As a consequence, using IIT volume or IIT volume per product traded as the explained variable in the estimations should lead to the same results, while explaining the AGL index could introduce

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[2] Even if estimations are performed at the country level, we calculate the intensity of IIT by regions (reg) in order to summarize the most stylized facts in graphs.

some important differences in the results. Turning to the value of the parameter α that should be used, when a difference in unit values of more or less 15% is used vertical intra-industry trade volume is correlated at 99% with the measure of vertical IIT when a margin of 25% is used. Similar results are obtained for the horizontal intra-industry trade, indicating that the choice of one of these two values for α, though arbitrary, should not have any substantial effects on the estimation's results. Hence, we will use the IIT volume and a margin of 25%.

3 Levels of the Spanish Intra-industry Trade

Graph I summarizes the importance of each type of trade between Spain and the different regions. The regions we consider are EU, OECD, ACP (African-Caribbean Pacific Countries), Latin America, Developing Asian Countries, NIC (Asian New Industrialised Countries), CEEC (Central and Eastern European Countries), NIS (New Independent States, former URSS), MNA (Mediterranean and Northern African Countries), Middle Eastern Countries.

Intra-industry trade (IIT) takes up a great proportion of the Spanish trade with the EU but also represents more and more of its trade with OECD, CEEC, NIC of Asia and MNA countries. In 2000 IIT represented 33% of the total volume of trade with the EU, 13,4% with the other countries of the OCDE, 13% with CEEC, 6,2 % with NIC of Asia and 4,9 % with MNA. For all the regions IIT consists mainly in vertical differentiated products except with CEEC and EU members for which each type of trade represents the same proportion. This fact implies that quality is the main concern for competitiveness. Manufactured products are more differentiated in nature but the industry with the highest level of IIT differs from one region to another. All these facts are supported by data presented in Table II for the year 2000.

Graph II displays the level of IIT between Spain and 188 countries and their GDP per capita for two years: 1996 and 2000. It is obvious that low-income countries have a relatively low level of IIT with Spain. But the relation between these two variables is not so straightforward if countries with an intermediate or high income per capita are considered.

4. Hypothesis of the Model

It is generally assumed in the literature that IIT, like the total volume of trade, is positively correlated with averages of country size (proxied by GNP) and negatively correlated with the trade barriers that may exist among them (for example transportation costs represented by geographical distance). It is also assumed that IIT is negatively related to differences in factor endowments (proxied by differences in per capita GDP) and positively related with capital intensity (proxied by average per capita GDP). When the different natures of IIT are taken into account, some of these variables are likely to have a different impact and some additional factors should be added. We discuss below the hypothesis for each of the variables:

Differences in per capita income between Spain and its trading partner (DifGDPpc$_j$): This variable is the most important one since its influence is not clearly established. In line with the model developed by Falvey and Kierkowski (1987), differences in factor endowments would enhance the trade of vertical differentiated products (comparative advantage explanation). The effect of this variable should be positive on the two-way trade of horizontal differentiated products.

Average per capita income of Spain and its trading partner (AVGDPpc$_j$): Since demand for variety is assumed to increase with income, both types of IIT are assumed to be positively related with the average per capita income.

Differences in GDP between Spain and its trading partner (DifGDP$_j$): A big difference in economic size reflects both differences in demand and in supply sizes and is supposed to reduce any kind of IIT.

Average GDP of Spain and its trading partner (AvGDP$_j$): This variable is a measure of market sizes. In the line of the Linder hypothesis, external markets can be considered as an extension of the internal market and local demand stimulates the innovation of products. In the context of the Chamberlin model, the preference for varieties of consumers is high and a large market indicates a more diverse demand for differentiated goods. Economic size also reflects the supply potential and, therefore, the export potential in general, but more likely differentiated goods since the production of these goods is under increasing returns to scale. The average economic size is, thus, expected to increase the volume of trade.

Differences in government expenditures between Spain and its trading partner (difG): This variable is used as a proxy of public services. The idea behind is that public services contribute to increase the efficiency of private firms, particularly in the case of horizontally differentiated goods since competitiveness is not only based on prices but also on other attributes like quality of inputs, service quality, etc. We expect a positive sign for HIIT while the effect on VIIT is undetermined.

Average government expenditures of Spain and its trading partner (G): Again, we include the average value of government expenditure since the same differences can occur for different levels of expenditure. This variable should have a *positive impact on IIT* regardless of the definition used.

Distance (dist$_{j,}$): the geographical distance (in km) between the Spanish capital (Madrid) and the capital of country *j* is a proxy for transportation costs that is supposed to reduce any kind of trade.

GINI index of the trading partner (GINI$_j$): The higher the Gini index, the more egalitarian is the income distribution of the trading partner. The predicted sign is negative for VIIT since a more unequal distribution of income will favour the demand for a larger spectrum of quality products and positive for HIIT since demand for horizontal differentiated products is a major concern for medium and high-income households.

Trading blocks: We include a dummy that takes the value 1 if the trading partner belongs to the European Union and 0 if not. Since trade barriers should reduce any kind of trade we expect that trading partners who maintain lower tariffs and non-tariff barriers should face higher levels of trade of any kind. Since the EU (and thus Spain) grants a preferential access to developing countries depending on their development level and their region of origin, we seek to capture the effect of tariffs and non-tariff barriers by the means of dummies for the 11 main regions considered by the common trade policy. Thus, due to multicollinearity problems (these groups present similar GDP already taken into account or belong to the same geographical region as reflected by distance) all these dummies could not be taken into account in the estimation.

Common language: we also introduce a dummy that captures the effect of language differences that takes the value 1 if Spanish is the official language of the trading partner and 0 if not.

Number of flows considered: Some industries produce more differentiated goods than others and some of them produce more horizontal than vertical goods. In order to account for these country-industry specificities, and following Aturupane (1999) we introduce the number of flows registered at the 8-digit level in each industry between Spain and country j.

Three alternative specifications (model 3, 4, 5) have been tested in order to capture more accurately the effect of demand, as well as endowments like physical capital, human capital and technology capital. Thus, GDP per capita not only reflects a supply side phenomenon but also an income effect. Besides, we replace this variable by more direct proxies for factor endowment differences, namely physical capital per capita (INV), technological capital per capita (R&D) and human capital (expenditure in education). We also introduce differences in consumer expenditure in order to reflect the side phenomenon demand (see Table III for a list of variables).

5. Econometric Results

In the model, the explained variable is alternatively total intra-industry trade volume of trade (IIT_{kj}), vertical ($DVIIT_{kj}$) and horizontal ($DHIIT_{kj}$) intra-industry trade in order to identify differences in their determinants, where *j* represents the Spanish trade partner and *k* the industry according to the NACE CLIOR25 nomenclature. The model is tested in its logarithmic form. We first present the results for the cross-section analysis for the year 1996 estimated by the OLS method followed by the results of the Heckman procedure[3].

5.1. Cross-section Analysis with the OLS Method

The outstanding feature of the OLS estimations (Tables IV.A-C) is the robustness of the results, with most of them significant at the 1 percent level and a high level adjusted R-squared (ranging from 0.65 for DVIIT to 0.83 for total IIT). In general, variables show the expected signs or are not significant. Concerning the variables, which, in our opinion, have the same influence on any kind of trade like *DifGDP* and *AvGDP*, they show the expected signs, namely negative and positive. Sharing the same border seems to increase any kind of trade. Also, Spanish intra-industry trade with the EU members is higher than expected and dummies for industries are generally significant and positive for IIT and VIIT but in most cases negative and significant for DHIIT.

The impact of distance is always negative and very significant. Whereas not presented here, estimations performed for the volume of inter-industry-trade show that the effect of distance is higher in this case than for IIT in general, showing that transportation costs matter more for homogeneous products where prices are relevant. More surprising is the fact that distance seems to have a more negative effect on DHIIT than on DVIIT. These results can be explained by the fact that the countries nearest to Spain are also the countries that share the same tastes for goods, and are therefore countries that are more willing to engage in DHIIT with Spain. When GDP per capita is substituted by other proxies for endowments (model 3, 4, 5), the effect of distance increases drastically reflecting the fact that the countries farther away are also those with lower income per capita or with an income per capita very different from that of Spain.

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[3] Panel data estimations of each type of IIT and tobit estimations on panel data for the AGL index have also been carried out. Results didn't really differ and were omitted due to space requirements. The results are available on request.

Considering the most important variable, *DifGDPpc$_j$*, it affects negatively any kind of IIT, reflecting, that the more similar the endowments are, the higher the level of IIT. This result is not surprising and in line with Nillson (1999), considering unequal partners as was done in this study. This result is more surprising for vertical differentiated products, since imports and exports of similar products differentiated by their quality are expected to increase with differences in factor endowments, while the effect should be the opposite for horizontal differentiated products. The works of Mora (2002) for intra-EU trade and of Blanes and Martin (2000) for the Spanish case show that vertical differentiated products can be explained by the comparative advantage explication in the line of the H-O and Ricardian models. Differences in human capital or technological capital, though, have a more obvious positive effect on DVIIT than physical capital differences. In Blanes and Martin (2000) differences in GDP per capita have a negative influence on any kind of intra-industry trade, whether OECD trading partners are considered or a larger sample of both developed and developing countries are considered. Crespo and Fontoura (2004) observed that the traditional determinants of trade ought to explain the Portuguese volume of vertical intra-industry trade when considering a sample of 46 countries. Thus, the authors also include the interaction between the Gini variable and per capita income differences. We are sceptical about this multiplicative variable since its expected influence is not clear and we are unable to determine if the negative sign it displays goes in the sense of the comparative advantage theory or, on the contrary, gives arguments against it.

Conclusions from model 1 and 2 show that differences in per capita income are against the comparative advantage explanation of DVIIT. In order to confirm this conclusion we aim to verify if GDP per capita is a good proxy for capital difference or if a more refined measure of endowment could shed light on the vertical explanation (model 3, 4 and 5). Differences in consumer expenditure do not display the expected sign since they affect positively any kind of IIT, while a higher average in consumer expenditure results in less intra-industry trade. We think that this unexpected result is due to the fact that inter-industry trade is the most excellent trade between Spain and countries that are really different from a demand size perspective. This intuition is partly confirmed by the fact that, if we use consumer expenditure per capita instead of total expenditure in consumer goods, the variables don't seem significant.

On the other hand, models 3, 4 and 5 capture more accurately the effect of supply factors. For any kind of IIT, differences in investment expenditure have a negative influence and we do not observe any difference between the influences of this variable on vertical or horizontal differentiated goods. Differences in research and development expenditure increase IIT and DV IIT, while this effect is less clear in the case of DH IIT (the coefficients are not always significant). The influence of technology differences seems to be confirmed here. The differences in human capital factor endowments measured by differences in spending on education per capita have a negative effect on each type of intra-industry trade. The differences on government expenditures do not have a stable influence on any kind of intra-industry flow.

To sum up, the results from the OLS estimations do not confirm the impact of human capital differences on DV or DH IIT, certainly due to the bad quality of the proxy used. The most important result is that technological differences unambiguously enhance intra-industry trade while differences in physical capital have a significant negative effect on both types of intra-industry trade. Without forgetting the important results obtained from models 3, 4 and 5, we further on focus on model 1 since we seek to find more evidence for or against the comparative advantage explanation of vertical intra-industry trade, as far as differences in physical capital are concerned (model 1).

More consistent results have been studied considering the heterogeneity of countries. In Table V we present the estimation of model 1 for EU countries on the one hand, and other selected countries namely countries from OECD, Asia, Latin America, MNA and CEEC on the other hand. The obtained results are significant. In this case, the differences in GDP per capita still influence negatively DVIIT for others countries (and thus overall IIT), but are not significant for HIIT, nor can they explain significantly vertical intra-industry trade with the EU. Another important feature is, that a high GINI index enhances any kind of IIT in the case of other countries while it reduces IIT in the case of the EU. These results confirm our initial intuition that determinants of IIT differ slightly if we consider similar countries or unequal partners.

5.2. Cross-section Estimation with the Heckman Method

One problem of the estimations proposed in the previous section is that we don't take into account the flows that present a zero value, since we use the logarithmic transformation of the IIT volume. We argue that we should consider the determinants of overall IIT when considering the difference between determinants of vertical *versus* horizontal IIT. That is, explaining variables (both country and industry-specific effects) may explain the fact that countries engage in IIT but could influence in a different way the fact that these two-way flows concern horizontal or vertical differentiated products. Since these shares are very low in some case, and we think that the determinants of IIT could differ strongly if countries share specific characteristics, we decided to use the Heckman estimation method that allows taking into account this selection effect. It consists in estimating separately a probit equation and an ordinary least squares equation. Thus, prior to the estimation of equation above for DV IIT and DH IIT, we define a binary variable D_{ij} according to the following scheme:

$$D_{kj} = \begin{cases} 1 & if & IIT_{kj} \neq 0 \\ 0 & f & IIT_{kj} = 0 \end{cases} \ldots$$

This variable takes the value 1 if total intra-industry trade exists and 0 in the opposite case. Using D_{ij} as the dependent variable, we estimate the probit equation:

$$Pr(D_{kj} = 1 / z_{kj}) = F(\beta' z_{kj})$$

The statistically significant variables will contribute to explain exclusively the probability of appearance of intra-industry trade flows. The next step consists in studying the determinants of DV IIT and DH IIT, provided that IIT_{ij} is different from zero. We should take into account the bias introduced due to the elimination of the zero observations from the sample when specifying the model, that is

$$E(DVIIT_{kj} / ITT_{kj} \neq 0) = \delta' z_{kj} + E(u_{kj} / ITT_{kj} \neq 0)$$

Where z_{kj} represents the set of explanatory variables defined in the previous section for the industry k and country j and the second term of the right-hand side of the equation is proportional to the inverse of the Mills ratio. The estimation of this inverse is obtained from the probit model estimated in the first stage of the analysis. Estimations have been carried out for two different sets of countries: first, all countries, and then MNA, CEEC, NIC of ASIA and OCDE countries, excluding EU and countries with the lowest income. Table V displays the results for both, probit estimation (selection equation) and OLS estimation.

We analyse first the results of the probit estimations that explain the probability for IIT to occur. Since we use the same variables (model 1) as for the OLS estimation for positive IIT volume, the results of the probit estimation in table VI are directly comparable with model 1 in table IV.A. All the variables show the expected sign or are not significant indicating that the variables used explain more accurately the level of IIT volume than the reason why some bilateral flows consist in inter or intra-industry trade. This is particularly the case for

differences in market size (GDP), that are not significant, and the average income per capita, which is significant and has a positive sign only when EU countries are included. The results also suggest that IIT is more likely than expected, the higher the aggregate level of income. The indicator of differences in factor endowments has a significant negative sign, which implies that some degree of similarity in endowments is a condition for IIT to occur. With regard to the remaining variables, nor distance nor the GINI index have a significant impact on the probability to engage in IIT.

In the second stage of the estimation we explain the level of vertical or horizontal intra-industry trade. Here, different patterns are achieved since differences in market size have a negative and significant impact on the volume of IIT (regardless of its nature) but differences in factor endowments don't have a significant effect in determining the level of IIT. Thus, distance, GINI and the dummies for contiguity and EU membership present the expected signs, while they fail to explain the probability of IIT to occur.

6. Conclusions

In this paper, we have studied the nature of Spanish intra-industry trade and found that intra-industry trade with CEEC, Asian and Mediterranean countries has increased considerably since the middle of the Nineties. The second aim of the paper was to determine how a comparative advantage affects DVIIT. According to OLS estimations, technological differences increase DVIIT, while physical capital differences lead to its decrease. Results obtained with the Heckman method support the idea that differences in physical capital play a role for IIT to occur but the level of vertical and horizontal IIT is better explained by the proximity of partners, the similarity in development level and size of market. Furthermore, our results suggest that the variables considered, mostly country-specific, have the same impact on vertical and horizontal IIT with emergent countries.

7. References

[1] Abd-el-Rahman, K..S. (1986) "Réexamen de la définition y mesure des échanges croisés de produits similaires entre les nations" *Revue Économique* **1**, Paris.

[2] Aturupane, C., Djankov, S., and B. Hoekman (1999) "Horizontal and Vertical Intra-Industry Trade between Eastern Europe and the European Union" *Weltwirtschaftliches Archiv* **135(1),** 62-81.

[3] Blanes, J. V., and C. Martin (2000) "The Nature and Causes of Intra-Industry Trade: Back to the Comparative Advantage Explanation? The Case of Spain" *Weltwirtschaftliches Archiv* **136 (3),** 423-441.

[4] Crespo, N., and P. Fontoura (2004) "Intra-industry Trade by Types: What can we learn from Portuguese Data?' *Review of World Economic,* **140(I),** 52-79.

[5] Diaz Mora, C. (2002) "The role of Comparative Adventage in Trade within Industries: A Panel Data Approach for European Union" *Wetwirtschaftliches Archiv* **138 (2),** 291-315.

[6] Falvey, R.E. (1981) "Commercial Policy and Intra-Industry Trade" *Journal of International Economic*s **11**, 495-511.

[7] Falvey R.E. and Kierzkowski, H. (1987) "Product Quality, Intra-Industry Trade and (Im)Perfect Competition" in *Protection and Competition in International Trade* by H. Kierzkowski, Ed., Clarendon Press: Oxford, 143-161.

[8] Flam, H., and E. Helpman (1987) 'Vertical Product Differentiation and North-South Trade" *American Economic Review* **77(5)**, 810-822.

[9] Fontagné, L., and M. Freudenberg (1997) "Intra-industry trade: methodological issues reconsidered" CEPII Working Paper **97-01**.

[10] Fontagné, L., Freudenberg, M., and N. Peridy (1998) "Commerce international et structures de marché: une vérification empirique" *Economie y Statistiques* **135**, 1998-4, 147-167.

[11] Gabszewicz, J., Shaked, A., and J. Sutton (1981) "International Trade in Differentiated Products" *International Economic Review* **22(3),** 527-534.

[12] Greenaway, D., Hine, R. C. and C. Milner (1994) "Country-Specific Factors and the Pattern of Horizontal and Vertical Intra-Industry Trade in UK" *Weltwirtschaftliches Archiv* **130 (1)**, 77-100.

[13] Greenaway, D., Hine, R. C., and C. Milner (1995) "Vertical and Horizontal Intra-Industry Trade: a Cross-Industry Analysis for the United Kingdom" *The Economic Journal* **105**, 1505-1518.

[14] Grubel, H.G., and P.J. Lloyd (1975) *Intra-Industry Trade*, London: The Macmillan Press Ltd.

[15] Helpman, E. (1981) "International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition" *Journal of International Economics* **11(3)**, 305-340.

[16] Helpman, E., and P.R. Krugman (1985) *Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition and International Economy*, Cambridge (Mass.): MIT Press.

[17] Krugman, P. R. (1980) "Scale Economies, Product Differentiation, and the Pattern of Trade" *American Economic Review* **70**, 950-959.

[18] Lancaster, K. (1980) "Intra-industry trade under Perfect Monopolistic Competition" *Journal of International Economics* **10(2)**, 151-175.

[19] Martin, A., and V. Orts (2001) "A Two-Stage Analysis of Monopolistic Competition Models of Intra-Industry Trade" *Investigaciones Económicas* **25(2)**, 315-333.

[20] Martin, J.A., and V. Orts (2002) "Vertical Specialization and Intra-Industry Trade: The role of Factor Endowments" *Weltwirtschaftliches Archiv* **138(2)**, 340-65
[21] Nilsson, L. (1999) "Two-way Trade between Unequal Partners: The EU and the Developing Countries" *Weltwirtschaftliches Archiv*. **135(1)**, 102-125
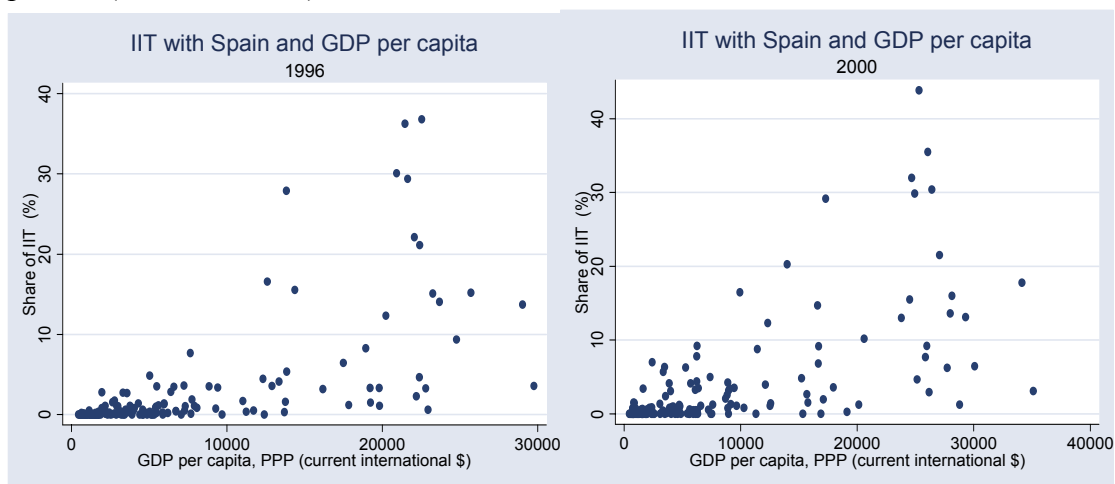
8. Appendix of Tables and Graphs

GRAPH I: Adjusted Grubel-Lloyd Index by regions (Vertical and Horizontal Intra-industry trade, 1988-2000).
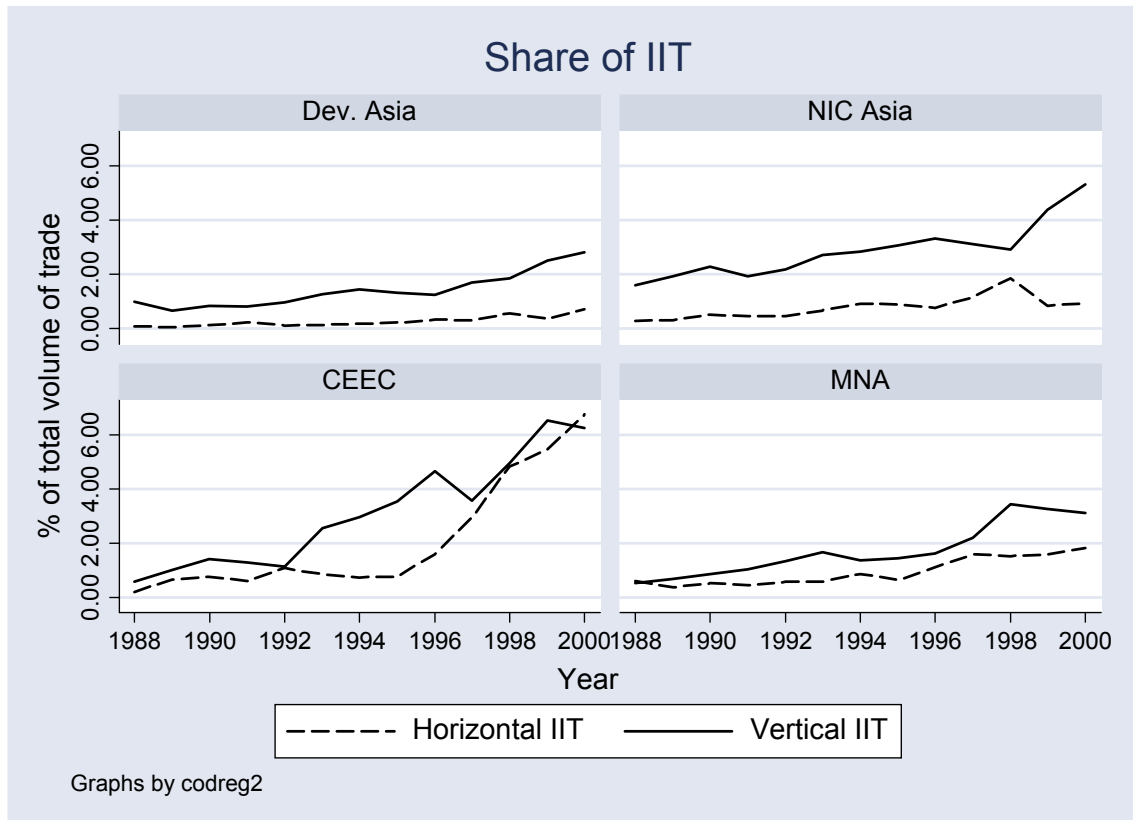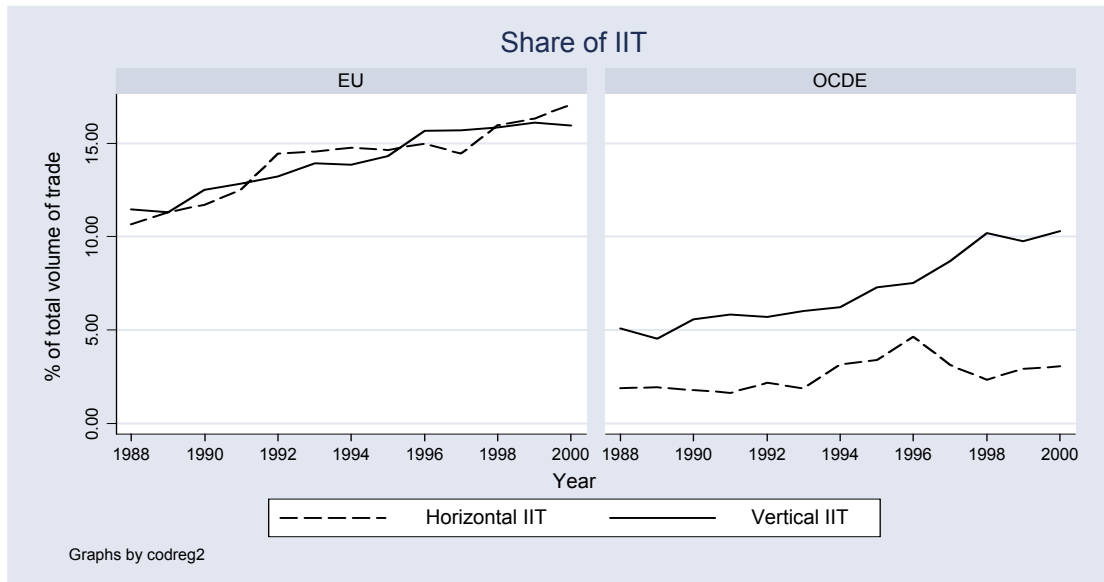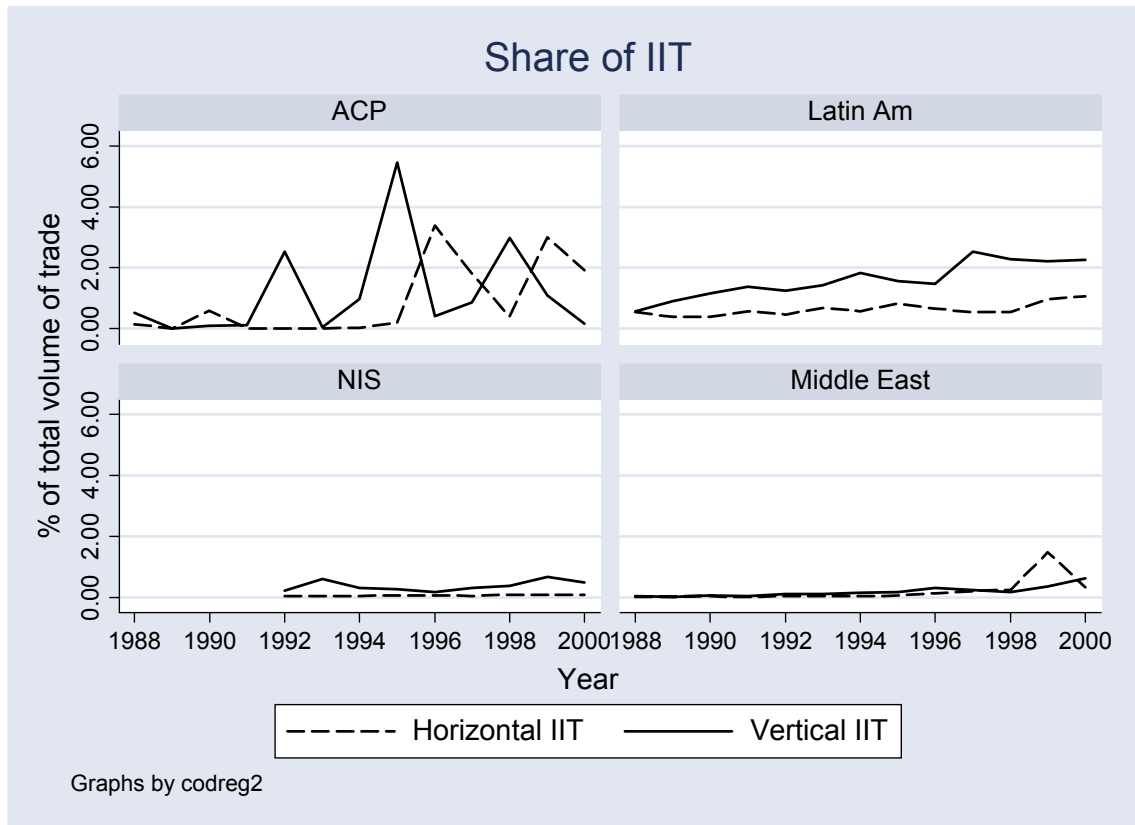
Source: See Table I

GRAPH II: Spanish Intra-industry trade with 188 countries and GDP per capita of the trading partner (1996 and 2000).

Source: See Table I

Table I: List of variables

Variable	Definition	Source
Trade volume		Comext, Eustostat database
CGDP	GDP, PPP (current international $)	WDI database
RGDP	GDP, PPP (constant 1995 international $)	WDI database
Distance	Distance in km between capitals	CEPII database
CConsum	Final consumption expenditure (current LCU)	WDI database
rconsum.	Final consumption expenditure (constant LCU)	WDI database
CInvest	Gross capital formation (current LCU)	WDI database
RInvest	Gross capital formation (constant LCU)	WDI database
CGovern.	General government final consumption expenditure (current LCU)	WDI database
RGovern..	General government final consumption expenditure (constant LCU)	WDI database
R & D	Research and development expenditure (% of GDP)	WDI database
Education	Public spending on education, total (% of GDP)	WDI database
Gini	Gini Index	WDI database
# flows	Number of 8 digit products traded	Comext, Eustostat database
Contiguity	1 if partners share the same border	CEPII database
CodeEU	1 if partner belongs to the EU (15)	CEPII database

Table II: Correlations between alternative measures of trade types (Spanish trade, 1996).

|Year 1996 #obs: 188 For all products	IIT volume	DVIIT volume (α=.25)	DHIIT volume (α=.25)	DVIIT volume (α=.15)	DHIIT volume (α=.15)	IIT Volume /n^o of products traded	IIT AGL	DVIIT AGL (α=.25)	DHIIT AGL (α=.25)	DVIIT AGL (α=.15)	DHIIT AGL (α=.15)
IIT volume	1.000										
DVIIT volume (α=.25)	0.9818	1.000									
DHIIT volume (α=.25)	0.9822	0.9287	1.000								
DVIIT volume (α=.15)	0.9804	0.9991	0.9269	1.000							
DHIIT volume (α=.15)	0.9351	0.8524	0.9834	0.8471	1.000						
IIT Volume / n^o of products traded	0.9588	0.9454	0.9377	0.9453	0.8871	1.000					

IIT AGL	**0.7761**	**0.7815**	**0.7430**	**0.7899**	**0.6735**	**0.8275**	**1.000**			
DVIIT AGL (α=.25)	**0.7177**	**0.7529**	**0.6572**	**0.7579**	**0.5736**	**0.7246**	**0.9103**	**1.000**		
DHIIT AGL (α=.25)	**0.6955**	**0.6702**	**0.6956**	**0.6806**	**0.6527**	**0.7822**	**0.9105**	**0.6578**	**1.000**	
DVIIT AGL (α=.15)	**0.7373**	**0.7702**	**0.6784**	**0.7791**	**0.5884**	**0.7454**	**0.9286**	**0.9900**	**0.7011**	**1.000**
DHIIT AGL (α=.15)	**0.5819**	**0.5397**	**0.6027**	**0.5445**	**0.5909**	**0.6884**	**0.7854**	**0.4738**	**0.9562**	**0.4997**	**1.000**

Notes: *IIT*: volume of intra-industry trade; *DVIIT*: IIT of vertical differentiated products; *DHIIT*: IIT of horizontal differentiated products; *AGL:* Adjusted Grubel-Lloyd Index

Table III.A: Adjusted Grubel Lloyd Index by industry: Spain's trade with lower income countries.

2000 (% of total volume of trade)	ACP			Dev, Asia			Latin Am			MNA		
NACE CLIO R25	IIT	DH	DV	IIT	DH	DV	IIT	DH	DV	IIT	DH	DV
01 Agricultural, forestry and fishery products	0,1	0,0	0,1	2,8	1,4	1,4	1,6	0,1	1,5	0,9	0,5	0,3
06 Fuel and power products	0,0	0,0	0,0	0,1	0,0	0,1	0,3	0,2	0,2	0,1	0,0	0,1
13 Ferrous and non-ferrous ores and metals	0,3	0,0	0,3	4,1	1,9	2,2	0,7	0,1	0,6	1,3	0,3	1,1
15 Non-metallic minerals and mineral products	0,1	0,0	0,1	3,7	0,5	3,2	3,9	1,1	2,8	3,1	1,0	2,2
17 Chemical products	1,2	1,1	0,1	5,2	2,5	2,7	6,7	3,3	3,3	5,0	2,0	3,0
19 Metal products	0,4	0,0	0,4	5,8	2,4	3,4	3,2	0,1	3,1	4,1	0,2	3,9
21 Agricultural and industrial machinery	0,6	0,1	0,5	6,1	1,3	4,7	5,3	0,6	4,6	3,4	0,6	2,8
23 Office and data processing machines, precision and optical instruments	1,3	0,3	1,0	15,2	8,9	6,3	4,7	0,5	4,3	6,5	1,2	5,3
25 Electrical goods	0,2	0,1	0,2	11,7	8,2	3,5	9,6	1,1	8,5	6,5	1,1	5,4
28 Transport equipment	21,1	20,4	0,7	3,6	1,2	2,4	17,4	2,5	14,9	7,4	5,1	2,4
36 Food, beverages, tobacco	0,3	0,1	0,2	0,8	0,2	0,6	2,9	1,2	1,7	1,3	0,4	0,9
42 Textiles and clothing, leather and footwear	1,1	0,0	1,0	13,8	4,1	9,7	0,9	0,1	0,8	4,4	0,9	3,4
47 Paper and printing products	0,1	0,0	0,1	1,5	0,4	1,0	3,0	0,3	2,7	5,1	0,8	4,3
48 Other manufactured products	0,4	0,1	0,3	12,8	2,0	10,7	4,3	0,5	3,8	9,5	1,2	8,3
49 Rubber and plastic products	0,4	0,0	0,4	22,0	10,1	12,0	3,8	2,5	1,4	7,8	2,3	5,5
Total	**2,1**	**1,9**	**0,2**	**4,9**	**1,8**	**3,1**	**3,5**	**0,7**	**2,8**	**3,3**	**1,1**	**2,3**

Table III.B: Adjusted Grubel Lloyd Index by industry: Spain's trade with intermediate and high-income countries.

2000 (% of total volume of trade)	EU			OCDE			CEEC			NIC Asia					
NACE CLIO R25	IIT	DH	DV	IIT	DH	DV	IIT	DH	DV	IIT	DH	DV			
01 Agricultural, forestry and fishery products	9,5	3,9	5,6	0,9	0,1	0,8	0,5	0,2	0,3	0,3	0,1	0,2			
06 Fuel and power products	19,6	12,3	7,3	0,5	0,3	0,2	0,1	0,0	0,0	0,3	0,0	0,3			
13 Ferrous and non-ferrous ores and metals	27,1	19,4	7,7	3,2	1,6	1,6	0,7	0,5	0,3	2,9	2,0	0,9			
15 Non-metallic minerals and minerals products	21,8	5,6	16,2	3,4	1,0	2,3	6,2	0,7	5,6	2,1	0,2	1,9			
17 Chemical products	36,0	14,9	21,1	17,9	2,2	15,6	6,8	1,1	5,8	6,6	3,2	3,4			
19 Metal products	37,5	13,6	24,0	17,5	2,6	14,8	12,0	4,3	7,7	6,5	0,9	5,6			
21 Agricultural and industrial machinery	26,5	10,1	16,4	17,8	3,5	14,3	13,6	2,5	11,2	6,8	0,9	5,9			
23 Office and data processing machines, precision and optical instruments	21,2	4,7	16,5	12,3	2,0	10,3	12,7	6,3	6,3	7,4	0,4	7,0			
25 Electrical goods	36,8	11,6	25,2	21,0	3,4	17,6	8,7	3,1	5,6	9,5	2,1	7,4			
28 Transport equipment	45,6	31,5	14,1	20,2	6,7	13,4	23,8	16,6	7,2	4,6	0,2	4,5			
36 Food, beverages, tobacco	15,9	7,0	8,9	2,7	0,8	1,9	1,2	0,3	0,9	3,1	0,1	3,0			
42 Textiles and clothing, leather and footwear	32,4	7,9	24,6	9,1	2,2	6,9	8,0	3,0	5,0	6,3	0,4	5,9			
47 Paper and printing products	29,1	9,2	19,9	15,0	3,7	11,3	9,8	4,0	5,8	6,4	0,9	5,5			
48 Other manufactured products	40,4	12,2	28,2	23,9	2,4	21,5	16,1	3,3	12,8	11,3	1,6	9,8			
49 Rubber and plastic products	48,4	31,0	17,4	21,3	12,6	8,7	24,1	14,0	10,0	22,0	10,1	12,0	8,8	3,0	5,8
Total	**33,0**	**17,1**	**16,0**	**13,4**	**3,1**	**10,3**	**13,0**	**6,7**	**6,3**	**4,9**	**1,8**	**3,1**	**6,2**	**0,9**	**5,3**

TABLE IV.A : OLS estimation of total volume of intra-industry trade

TOTAL ITT	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	-52.33***	-54.11***	-16.71	23.75***	-2.498
	(4.464)	(4.288)	(11.93)	(3.802)	(1.73)
Dif CGDP	-0.511***	-0.643***	-3.169***		
	(0.081)	(0.075)	(0.524)		
Avr. CGDP	2.258***	2.527***	5.399***		
	(0.163)	(0.153)	(0.466)		
Dif CGDP pc	-0.432*	-0.208**			
	(0.136)	(0.107)			
Avr. CGDP pc	2.749***	2.223***			
	(0.33)	(0.278)			
Distance	-0.813***	-0.614***	-3.020***	-2.264***	-0.523***
	(0.097)	(0.090)	(0.303)	(0.351)	(0.174)
Dif Consum			0.948***	-0.322	0.573***
			(0.342)	(0.394)	(0.315)
Dif Invest.			-1.588***	-1.059***	-0.536***
			(0.182)	(0.207)	(0.200)
Dif Invest Lag			0.672**	0.222	
			(0.333)	(0.327)	
Dif Govern.					-1.032***
					(0.630)
Avr Consum.			-3.329***	-3.479***	-0.132
			(1.005)	(1.189)	(0.630)
Avr Invest.			5.748***	6.365***	
			(0.753)	(0.839)	
Avr Invest.Lag					1.394***
					(0.247)
Avr Govern.			-2.709***	-1.388*	0.253
			(0.744)	(0.893)	(0.599)
R & D			0.303***	0.472***	0.172*
			(0.117)	(0.159)	(0.111)
Education			0.241**	-0.501**	
			(0.132)	(0.219)	
Education Lag					-0.090
					(0.207)
Gini	0.016*		-0.099***	-0.004	0.064***
	(0.009)		(0.019)	(0.20)	(0.016)
# flows	0.004***	0.004***	0.0006	0.003***	0.005***
	(0.0004)	(0.0004)	(0.0006)	(0.0006)	(0.0005)
Contiguity	1.126***	1.267***	-0.353	1.934***	2.117***
	(0.354)	(0.364)	(0.483)	(0.522)	(0.498)
CodeEU	1.249***	1.658***	2.244***	3.563***	2.185***
	(0.204)	(0.202)	(0.348)	(0.399)	(0.274)
Dummy Sector	Sig[a]	Sig[a]	Sig	Sig[a]	Sig[b]
# of obs.	827	1016	317	317	461
Adj. R-squared	0.7531	0.7171	0.8347	0.7607	0.7393

[*]siginificative at 10%, [**]significative at 5% and [***]significative at 1%
[a]all sectors are significative positive at 1% except sector 6 which is negative at level 10%
[b]all sectors are significative positive except sector 6 and sector 42
Source: See Table I

TABLE IV.B: OLS Estimation of Vertical Intra-industry trade

DV ITT	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	-49.74***	-52.68***	-14.37	24.37***	-1.6368
	(4.562)	(4.351)	(12.18)	(3.866)	(1.675)
Dif CGDP	-0.521***	-0.637***	-3.171***		
	(0.081)	(0.075)	(0.534)		
Avr. CGDP	2.031***	2.393***	5.333***		
	(0.169)	(0.156)	(0.475)		
Dif CGDP pc	-0.303**	-0.118			
	(0.139)	(0.108)			
Avr. CGDP pc	2.972***	2.343***			
	(0.327)	(0.284)			
Distance	-0.799***	-0.627***	-2.991***	-2.244***	-0.466***
	(0.100)	(0.093)	(0.310)	(0.356)	(0.168)
Dif Consum			1.284***	0.013	0.624**
			(0.351)	(0.400)	(0.303)
Dif Invest.			-1.626***	-1.097***	
			(0.188)	(0.213)	
Dif Invest Lag					-0.559***
					(0.192)
Dif Govern.			0.591*	0.134	-0.916***
			(0.339)	(0.331)	(0.235)
Avr Consum.			-4.104***	-4.244***	0.003
			(1.028)	(1.206)	(0.607)
Avr Invest.			5.874***	6.513***	
			(0.772)	(0.912)	
Avr Invest.Lag					1.383***
					(0.238)
Avr Govern.			-2.318***	-1.025	-0.072
			(0.760)	(0.851)	(0.567)
R & D			0.332***	0.497***	0.158*
			(0.135)	(0.160)	(0.106)
Education			0.163	-0.411**	
			(0.192)	(0.222)	
Education Lag					0.034
					(0.200)
Gini	0.022**		-0.103***	-0.008	0.059***
	(0.009)		(0.019)	(0.020)	(0.015)
# flows	0.004***	0.004***	0.0008	0.003***	0.005***
	(0.0004)	(0.0004)	(0.0006)	(0.0006)	(0.0005)
Contiguity	0.969***	1.116***	-0.625	1.637***	1.916***
	(0.360)	(0.366)	(0.492)	(0.528)	(0.478)
CodeEU	1.190***	1.570***	1.965***	3.291***	2.008***
	(0.209)	(0.206)	(0.359)	(0.408)	(0.264)
Dummy Sector	Sig[a]	Sig[b]	Sig	Sig[a]	Sig[a]
# of obs.	800	968	313	313	455
Adj. R-squared	0.7364	0.7062	0.8220	0.7424	0.7155

[*]siginificative at 10%, [**]significative at 5% and [***]significative at 1%
[a]all sectors are significative positive at 1%, only sector 36 at 5% and sector 42 at 10%
[b]all sectors are significative positive at 1%, only sector 13 and 36 at 10%
Source: See Table I

TABLE IV.C: OLS Estimation of Horizontal Intra-industry trade

DH ITT	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	-45.50*** (5.067)	-41.52*** (4.780)	-42.56*** (18.05)	17.33*** (5.959)	0.9604 (2.195)
Dif CGDP	-0.267*** (0.095)	-0.366*** (0.087)	-1.900** (0.939)		
Avr. CGDP	2.049*** (0.189)	1.960*** (0.177)	5.027*** (0.777)		
Dif CGDP pc	-0.299** (0.157)	-0.135 (0.124)			
Avr. CGDP pc	1.759*** (0.368)	1.671*** (0.316)			
Distance	-0.883*** (0.118)	-0.700*** (0.108)	-2.799*** (0.550)	-1.938*** (0.526)	-1.260*** (0.212)
Dif Consum			0.550 (0.492)	-0.958** (0.504)	0.369 (0.392)
Dif Invest.			-1.225*** (0.340)	-0.593** (0.314)	
Dif Invest Lag					-0.060 (0.251)
Dif Govern.			0.145 (0.510)	0.176 (0.406)	-0.985*** (0.293)
Avr Consum.			-2.658* (1.668)	-0.198* (1.848)	-1.897** (0.806)
Avr Invest.			5.100*** (1.470)	3.685** (1.628)	
Avr Invest.Lag					0.967*** (0.313)
Avr Govern.			-2.177** (1.060)	-1.720* (1.111)	2.188*** (0.774)
R & D			0.309* (0.175)	0.272 (0.200)	0.396*** (0.131)
Education			-0.072 (0.244)	-0.541** (0.264)	
Education Lag					-0.824 (0.274)
Gini	0.028*** (0.011)		-0.080*** (0.033)	-0.028 (0.028)	0.103*** (0.020)
# flows	0.003*** (0.0005)	0.003*** (0.0005)	0.0005 (0.0008)	0.003*** (0.0008)	0.005*** (0.0006)
Contiguity	1.543*** (0.381)	1.785*** (0.379)	0.674 (0.68º)	2.476*** (0.618)	1.720*** (0.569)
CodeEU	1.447*** (0.231)	1.568*** (0.223)	2.191*** (0.515)	3.443*** (0.558)	1.719*** (0.330)
Dummy Sector	Sig(a)	Sig(b)	Sig(c)	Sig(b)	Sig(b)
# of obs.	604	715	252	252	383
Adj. R-squared	0.6965	0.6742	0.7518	0.6759	0.6484

[*]siginificative at 10%, [**]significative at 5% and [***]significative at 1%
[a]all sectors are significative positive except sectors 6, 15, 36 Y 42
[b]all sectors are significative positive except sectors 6, 15, 19, 36 Y 42
[cb]all sectors are significative positive except sectors 15, 19, Y 47
Source: See Table I

TABLE V: OLS Estimation for model 1 of total IIT, DVIIT, DHIIT : EU and selected emergent countries

Model 1	TOTAL ITT		DV ITT		DH ITT	
	EU	Emergent countries	EU	Emergent countries	EU	Emergent countries
Intercept	11.006	-30.46***	3.488	-27.33***	35.425	-29.51***
	(17.51)	(5.64)	(16.25)	(6.00)	(26.21)	(6.50)
Dif CGDP	-2.386***	-0.441***	-2.207***	-0.450***	-3.032***	-0.128
	(0.393)	(0.079)	(0.365)	(0.083)	(0.586)	(0.093)
Avr. CGDP	4.819***	1.535***	4.586***	1.360***	5.565***	1.304***
	(0.294)	(0.191)	(0.367)	(0.204)	(0.594)	(0.221)
Dif CGDP pc	-0.086*	-0.396**	-0.069	-0.380**	0.025	-0.108
	(0.480)	(0.185)	(0.448)	(0.197)	(0.730)	(0.223)
Avr. CGDP pc	-3.157*	1.962***	-2.243	2.121***	-5.921**	1.327***
	(1.922)	(0.363)	(1.783)	(0.386)	(2.908)	(0.416)
Distance	-3.322***	-0.469***	-3.309***	-0.521***	-3.535***	-0.604***
	(0.341)	(0.123)	(0.316)	(0.131)	(0.503)	(0.149)
Gini	-0.166***	0.003	-0.177***	0.013	-0.162***	0.014
	(0.030)	(0.009)	(0.028)	(0.010)	(0.045)	(0.012)
# flows	0.0001	0.009***	0.00003	0.009***	0.0001	0.005***
	(0.0006)	(0.0008)	(0.0005)	(0.0009)	(0.0009)	(0.001)
Contiguity	-0.055***	1.267***	-0.047		-0.047	
	(0.336)	(0.364)	(0.312)		(0.312)	
Dummy Sector	Sig[a]	Sig[d]	Sig[b]	Sig[e]	Sig[c]	Sig[f]
# of obs.	194	538	193	516	193	348
Adj. R-squared	0.8485	0.6410	0.8576	0.6104	0.8576	0.5011

[*]siginificative at 10%, [**]significative at 5% and [***]significative at 1%

[a]all sectors are significative positive at 1% except sector 15 at level 10%, and sector 6 which is negative

[b]all sectors are significative positive except sector 15

[c]only sectors 6,13, 17 21, 28 and 49 are significatives,

[d]all sectors are significative positive except sector 36 and 42

[e]all sectors are significative positive except sector 13, 36 and 42

[e]all sectors are significative positive except sector 6 and 42

Source: See Table I

TABLE VI: Estimation (Heckman's method) for model 1 of DVIIT and DHIIT : all countries and selected emergent countries.

Model 1	DV ITT		DH IIT	
	All countries	Emergent countries [d]	All countries	Emergent countries [d]
Intercept	-39.93***	-19.22***	-40.81***	-25.01***
	(4.721)	(5.656)	(5.141)	(6.049)
Dif CGDP	-0.363***	-0.379***	-0.204**	-0.109
	(0.084)	(0.087)	(0.095)	(0.094)
Avr. CGDP	1.164***	1.236***	1.868***	2.038***
	(0.170)	(0.217)	(0.189)	(0.230)
Dif CGDP pc	-0.031	-0.245	-0.175	-0.271
	(0.141)	(0.0164)	(0.155)	(0.175)
Avr. CGDP pc	2.283***	1.390***	1.445***	1.028***
	(0.388)	(0.366)	(0.374)	(0.386)
Distance	-0.657***	-0.517***	-0.800***	-0.520***
	(0.097)	(0.115)	(0.115)	(0.131)
Gini	0.019***	0.010	0.029***	0.011
	(0.008)	(0.009)	(0.010)	(0.303)
# flows	0.004***	0.008***	0.003***	0.006***
	(0.0004)	(0.0009)	(0.0005)	(0.0010)
Contiguity	1.164***		1.611***	
	(0.363)		(0.374)	
Dummy EU	1.327***		1.502***	
	(0.208)		(0.224)	
Dummy Sector	Sig[a]	Sig[c]	Sig[b]	Sig[a]
SELECTION EQUATION				
Intercept	-60.75***	-30.53***	-93.32***	-39.93***
	(23.06)	(4.217)	(30.60)	(4.721)
Dif CGDP	-0.072	0.512	0.311	1.566**
	(0.299)	(0.531)	(0.396)	(0.661)
Avr. CGDP	1.975***	4.889***	2.680***	8.181***
	(0.572)	(1.446)	(0.777)	(1.922)
Dif CGDP pc	-0.483*	-0.705*	-0.608**	-0.866
	(0.281)	(0.299)	(0.301)	(0.349)
Avr. CGDP pc	1.454**	1.101	1.861***	2.014
	(0.648)	(0.727)	(0.701)	(0.843)
Distance	-0.005	-0.199	-0.048	-0.266*
	(0.099)	(0.0134)	(0.124)	(0.163)
Gini	-0.003	0.196**	-0.003	0.163
	(0.006)	(0.010)	(0.009)	(0.151)
# flows	0.024***	0.190***	0.026***	0.022***
	(0.002)	(0.002)	(0.002)	(0.0035)
Contiguity				
Dummy EU	0.057		-0.472	
	(0.517)		(0.570)	
Dummy Sector	Sig	Sig[a]		Sig[a]
# of obs.	1.459	760	1261	613
# of censored obs	659	225	659	225
# of uncensored obs	800	535	602	388

[*]siginificative at 10%, [**]significative at 5% and [***]significative at 1%
[a]all sectors are significative positive at 1% except sector 15 at level 10% except 6,13,21,36,42
[b]all sectors are significative positive except sector 6,15,36,42
[c]only sectors 6,36 and 42
[d] MNA, CEEC. NIC of ASIA and OCDE countries
Source: See Table I