The Intra-Industry Trade between Portugal- European Union, Portugal-Spain, Portugal-France, Portugal – Germany, Portugal- Ireland, Portugal-Greece, and Portugal -Netherlands : A Dynamic Panel Data Analysis (1996-2000)

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Abstract

One of the objectives of this paper is to verify if the estimated models of intra-industry trade (IIT), horizontal intra-industry trade (HIIT) and vertical intra-industry trade (VIIT) give a different results for the different partners in analysing. We divided the partners in two groups: the more developed (Germany, France and Netherlands) and the less developed (Greece, Spain and Ireland). We also considered Portugal's main trade partners (Spain and Germany) by one hand and the others partners by the other end.

The second objective is to test if there is a relationship between HII and comparative advantages, on the one hand, and between VIIT and comparative advantages on the other hand

The third propose is to estimate IIT,HIIT and VIIT models with GMM-System . We will use the Arellano and Bond (1991) m-statistics for testing serial correlation and the Sargan statistic to test the null hypothesis of instruments validity. To estimate the models we will use the Blundell and Bond (1998,2000) methodology.

We also present the tables with the evolution of the IIT,HIIT, and VIIT for the period 1995-2002.

Key words: intra-industry trade, horizontal intra-industry trade, vertical intra-industry trade ,human capital, comparative advantages, panel data, GMM system estimator

JEL Subject Code: F12, C33, L60

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1.Introduction

This paper examine intra-industry trade (IIT), horizontal IIT (HIIT) and vertical IIT (VIIT) between Portugal, and six partners using a balanced panel with twenty one industries. We chose these six partners because they include the Portugal's main trade partners (Spain, and Germany), the more developed European countries(France, Germany, and Netherlands) and the less developed European countries(Greece, Spain, and Ireland). In this paper we follow the methodology of Arrellano and Bond(1991), Blundell and Bond(1998,2000) and Arellano(2003). We apply a dynamic panel data approach using GMM-System estimator to international trade.

On types of trade flows IIT can be measured on three distinct bases: (i) on a multilateral basis[2] ; (ii) on a specific group of countries (i.e. with other industrial countries or with developing countries) and (iii) on a bilateral basis. We measure Portuguese IIT on total trade with a specific group of industrial countries (European partners), but we return to the tradition of bilateral IIT studies initiated by Loertscher and Wolter (1980) and Bergstrand (1983), although «… there are no strong theoretical grounds for automatically measuring on a bilateral basis. Clearly many of the models of ITT thus far developed are two-country cases; but these have been used for expositional convenience» (Greenaway and Milner, 1986, p.128).

We have already studied IIT, HIIT and VIIT using a static panel data approach (Faustino, 2003). The impact of these kind of applied work has been limited due to the difficulty in finding exogenous variables than can be regarded a priori as being uncorrelated with the individual effects (industry-specific effects). In static panel data model we use Pooled OLS, Fixed Effects (FE) and Random Effects (RE) estimators. The problems arise because in these models there are serial correlation, heteroskedasticity and endogeneity of some explanatory variables and the estimators used do not take this into account. The solution for these econometric problems was found by Blundell and Bond (1998, 2000) that developed the GMM system estimator.[3] The GMM system estimator is a system containing both first-differenced and levels equations. In addition to using instruments in levels for equations in first differences it uses instruments in first differences for equations in levels (Cf Arellano and Bover, 1995).

In dynamic panel data models the GMM System estimator eliminates the unobserved industry-specific effects through the equations in first-differences. The GMM System estimator also controls for the endogeneity of the explanatory variables. A standard assumption on the initial conditions allows the use of the endogenous lagged variables for two or more periods as valid instruments if there is no serial correlation (Cf. Blundel and Bond,1998, 2000). If we assume that the first differences of the variables are orthogonal to the industry-specific effects, this allows in addition the use of laggd first differences of

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[2] The most empirical studies of IIT use a multilateral measure of it. The idea is that «… one may expect to generate IIT on a multilateral basis with or without two-away trade on a bilateral basis» (Geenaway and Milner, 1986, p.128). However «The possibility that multilateral measured IIT may be an expression of geographical aggregation, analogous to categorical aggregation, may be greater   and of grater significance…» (idem).

[3] The GMM system estimator that we report was computed using DPD for OX(see Doornik, Arellano, and Bond 2002).

variables for one or two periods[4] as instruments for equations in levels (Cf. Arellano and Bover, 1995, Blundell and Bond, 1998, 2000). The validity of instruments is tested using a Sargan test of the over-identifying restrictions and serial correlation .First-order and second-order serial correlation in the first-differenced residuals is tested using m1 and m2 statistics (Arellano and Bond, 1991). The GMM system estimator is consistent if there is no second-order serial correlation in residuals (m2 statistic). The dynamic panel data model is valid if the estimator is consistent and the instruments are valid.

In empirical studies of IIT is not be usual the dynamic panel data analysis. However in recent studies of intra-industry, production functions, firms´growth , productivity spillovers from foreign direct investment or from multinational corporations, most of them use a dynamic panel data model (see, for example, Arellano and Bond, 1991, Blundell and Bond, 2000, Goddard et. al. , 2002 , Proença et. al. 2002, Benfratello and Sembenelli, 2003, Oliveira and Fortunato, 2005). The results presented in this paper are generally consistent with the predictions of the theory of intra-industry trade. We also demonstrated that better results can be achieved using a GMM system estimator, rather than Fixed Effects or Random Effects estimators. With the GMM system, we have consistent parameters estimates even in presence of measurement error, omitted variables, and endogenous right-hand-side variables. So, despite it would be dangerous to generalize, we can say that we obtain more reasonable results using the GMM system estimator in the context of empirical intra-industry trade research.

The remainder of the paper is organized as follows. The next section reviews the theoretical literature of IIT models. In the third section we present, the indexes, the explanatory variables and the sources . In section four we analyze ITT, HIIT and VIIT between Portugal and six partners over 1995-2002. In section five we estimate the dynamic panel data models of IIT HIIT and VIIT. The final section concludes.

2. Previous Literature

Essentially we have two types of trade: inter-industry trade and intra-industry trade (mainly trade of differentiated products)[5]. We used to accept that only traditional theories of comparative advantage (Ricardian trade theory and Heckscher-Ohlin trade theory), based on constant returns to scale, homogeneous product and perfect competition could explain inter-industry trade. The IIT was explained by scale economies, product differentiation and imperfect competition. There was also a wide acceptance of the idea that IIT was a phenomenon more intense between countries with similar income levels,a similarity reinforced by the economic integration process.

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[4] If variables are measured without error the number of moment conditions increases and first differences lagged t-2 become valid instruments for the equations in levels. Further lagged differences can be shown to be redundant if all available moment conditions for the equations in first differences are exploited (Cf. Blundell and Bond, 2000)

[5] Falvey(1981) explains the simultaneous existence of vertical IIT and inter-industry trade.E. Helpman and P. Krugman (1985) build up a model which generates both inter and intra-industry trade. The model incorporates factor endowments, decreasing costs and horizontal product differentiation. So, it is known as the Chamberlin-Heckscher-Ohlin model. Recently, D. Davis (1995)provides a Heckscher-Ohlin-Ricardo framework that gives a unified account of inter-industry and intra-industry trade and where decreasing costs are not necessary for intra-industry trade. There are also some models of IIT in homogeneous products (e.g. Brander, 1981 ; Brander and Krugman, 1983).

The pioneering work in intra-industry models is due to Krugman (1979,1980), Lancaster (1980), Helpman(1981) and Eaton and Kierzkowski(1984). All these models consider that products are horizontally differentiated – different varieties of a product are of a similar quality - although the varieties of the same product my be distinguished in terms of their actual characteristics or perceived characteristics. Neo-Chamberlinian models, such as Krugman models, consider the assumption that all varieties enter the utility function symmetrically. By contrast, the neo-Hotelling model, for example the Lancaster model is, assumes asymmetry. In the former, the consumers are assumed to endeavor to consume as many different varieties of a given product as possible ("love of variety approach"). In the latter, different consumers have different preferences for alternative varieties of a given commodity and each consumer prefers one variety to all others ("favorite variety approach"). But no unique ranking would be agreed to by all consumers.

In these models each variety is produced under decreasing costs and when the countries open to the trade the similarity of the demands leads to intra-industry trade. So, HIIT is more likely between countries with similar factor endowments and can not be explained by traditional trade theories.

In the vertical differentiation, different varieties are of different qualities and it is assumed that consumers rank alternative varieties according to product quality. Falvey (1981), Falvey and Kierzkowski (1984), Shaked and Sutton (1984) and Flam and Helpman (1987) introduced the vertical differentiation models. It is generally accepted that VIIT can be explained by traditional theories of comparative advantage. (See, for theoretical and empirical work, Greenaway and Milner,1986, Greenaway, Hine and Milner,1994, 1995,Tharakan and Kerstens,1995, Blanes and Martin ,2000). The relative labor abundant countries have comparative advantage in labor-intensive products (lower quality varieties) and relative capital abundant countries have comparative advantage in capital-intensive products(higher quality varieties). So, according to comparative advantage law, the first countries will export the labor-intensive varieties and the other countries will export the capital-intensive varieties. [6]

The difference between HIIT and VIIT[7] is important for another reason – the adjustment costs. It is generally accepted that the adjustment costs of a given specialization change or, in response to integration processes, are lower if horizontal product differentiation is predominant. The reason is that quality of varieties is similar, so we have similar factor intensity and lower costs of factor adjustment when the trade expands.

3. Presentation of the Indexes and the Explanatory Variables

Grubel and Lloyd indexes

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[6] Or in terms of the factor content version of Heckscher-Ohlin theorem for n goods and factors: the capital content of the net exports of the relative capital abundant country will be higher in relation to the net exports of the other country (see Vanek, 1968). As D. Davis (1995, p. 205) stressed, there is an assumption that " goods are distinguished on the demand side according to perceived quality, and on the production side by the fact that high quality goods are produced under conditions of greater capital intensity". So, we exclude from vertical IIT goods (varieties) produced under the same factor proportions. Otherwise, horizontal IIT may assume identical factor intensity.

[7] Greenaway, Hine and Milner(1995) refers to four types of model of IIT in differentiated products "(i)large numbers case of vertical IIT (e.g. Falvey, 1981); (ii)small numbers case of vertical IIT (e.g. Shaked and Sutton,1984); (iii) large numbers case of horizontal IIT (e.g. Helpman, 1981);(iv)small numbers cade of horizontal IIT (e.g. Eaton and Kierzkowski, 1984)".

Grubel and Lloyd (1975) define ITT as the difference between the trade balance of industry i and the total trade of this same industry.

In order to make the comparison easier between industries or countries, the index is presented as a ratio where the denominator is total trade.

$$B_i = 1 - \frac{|X_i - M_I|}{(X_i + M_i)} \quad \Leftrightarrow \quad B_i = \frac{(X_i + M_i) - |X_i - M_i|}{(X_i + M_i)} \tag{1}$$

The index is equal to 1 if we have intra-industry trade. If Bi is equal 0 all trade is inter-industry trade.

Source: INE- National Institute of Statistics (Trade Statistics)

The HIIT and VIIT indexes

To determine the horizontal and vertical intra-industry trade we used the Grubel and Lloyd indexes and the methodology of Abel-el-Rahaman (1991), and Greenaway et. al.(1994)

$$HIIT = \frac{RH}{(X_i + M_i)} \tag{2}$$

HITT- Horizontal intra-industry trade index

RH- Total horizontal intra-industry trade

TT_{ij} - Relative unit values of exports and imports is used to disentangle HITT and VIIT [8]

If $TT_{ij} \in [0,85;1,15]$, we have horizontal IIT

$$VIIT = \frac{RV}{(X_i + M_i)} \tag{3}$$

VIIT- Vertical intra- industry index

RV- Total vertical intra-industry trade.

If $TT_{ij} \prec 0,85$ V $TT_{ij} \succ 1,15$ we have vertical IIT. $TT_{ij} \prec 0,85$, we have inferior VIIT (lower quality). $TT_{ij} \succ 1,15$, we have superior VIIT (higher quality).

The HIIT and VIIT are calculated with desegregation of 5 digits CAE (Economic Activities Classification. The CAE classification is similar to NACE classification).

Source:INE (Trade Statistics)

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[8] $TT_{ij} = \dfrac{\dfrac{X_{ij}}{QX_{ij}}}{\dfrac{M_{ij}}{QM_{ij}}}$

X_{ij} - Values of exports of sub sector j of sector i ; M_{ij} - Values of imports of sub sector j of sector I ; QX_{ij} - Quantities of exports of sub sector j of sector i ; QM_{ij} - Quantities of imports of sub sector j of sector i

Explanatory variables

PD1(Horizontal Product Differentiation): the variable proxy is the Hufbauer index, i.e. variation of export unit values. $H = \dfrac{\sigma_{ij}}{\overline{x}_{ij}}$ where σ_{ij} = standard deviation of export unit values, and $\overline{x}_{ij}$ = unweighted mean of those unit values (see Greenaway and Milner,1986 pp.116-117)

PD2 (Horizontal ProductDifferentiation): number of five digit CAE categories in each two digit industry;

HC1 (Human Capital): share of non-manual employment in total employment of industry ;

HC2 (Human Capital): weight of professionals with qualification plus professionals with semi-qualification in total employment of industry ;

L*(non-qualified labor): weight of non-qualified workers in total employment;

K/L (Intensity of physical capital): the variable proxy is the ratio between the non-salaries returns and total employment of industry (Cf. Hirsch, 1974 and Balassa, 1978);

HCS/L *(Intensity of human capital)*: the variable proxy is the difference between salaries and medium salary of non-qualified workers, divided by the opportunity cost of capital (Cf. Branson and Monoyios,1977) [9];

VPD (Vertical product differentiation): % of the professionals with qualification. This proxy is similar to HC1;

PROD (Productivity): is the value added by employer

MES1(Minimum Efficient Scale) : The first variable proxy is a measure of relative value added by the four largest firms. Instead of value added we used the sales of the firms.[10]

MES$_2$ (Minimum Efficient Scale): the second variable proxy is the average size of establishment [11] ;

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[9] Intensity of Human Capital (Stock) : $\dfrac{HCS}{L_i} = \dfrac{W_i - W_i^*}{r}$

Wi = Average salary of industry ; W_i^* = Average salary of non-qualified workers; r = opportunity cost of capital.

[10] $MES1 = \dfrac{\dfrac{V4}{L4}}{\dfrac{V_i}{L_i}}$

V_4 = Value added of the four firms; L_4 = Employment of the four firms; V_i = Value added of the industry ; L_i = Employment in industry

[11] $MES_2 = \dfrac{VBP_i}{E_i}$

VBP_i = Value of production of industry i ; E_i = number of firms in industry i .

CONC1 (it is the first index of Industrial Concentration): it is a four-firm concentration ratio, i.e. it is a percentage of industry sales of the four largest firms of industry ;

CONC2 (it is the second index of Industrial Concentration): it is a percentage of industry sales of the four largest firms in total sales plus imports of industry [12].

Sources:
Ministry of Labor (Quadros de Pessoal)[13]
INE- Statistics of firms
Bank of Portugal

4. The IIT, HIIT and VIIT between Portugal and European Union and between Portugal and the six European Partners over 1995-2002

Table A: The Intra-Industry Trade (IIT) indexes for the period 1995-2202

YEAR / Countries	1995	1996	1997	1998	1999	2000	2001	2002
European Union	0,490	0,520	0,544	0,537	0,5400	0,543	0,507	0,589
Spain	0,495	0,492	0,490	0,495	0,525	0,532	0,532	0,574
France	0,453	0,421	0,425	0,489	0,438	0,419	0,487	0,432
Germany	0,438	0,467	0,517	0,555	0,517	0,532	0,575	0,553
Ireland	0,108	0,143	0,106	0,111	0,082	0,089	0,086	0,093
Greece	0,055	0,063	0,076	0,087	0,089	0,084	0,091	0,097
Netherlands	0,364	0,336	0,332	0,329	0,327	0,326	0,318	0,334

Source: Own calculations from INE database.

According to table A, the IIT between Portugal and European Union, Spain, and Germany is over 50% of total trade. The IIT with France (43.2%) and Netherlands (33.4%) also reached significant values. Ireland and Greece present poor values: all trade is almost inter-industry one .

Table B: The Horizontal Intra-Industry Trade (HIIT) indexes for the period 1995-2002

YEAR / Countries	1995	1996	1997	1998	1999	2000	2001	2002
European Union	0,223	0,224	0,255	0,264	0,211	0,087	0,117	0,158
Spain	0,127	0,146	0,072	0,106	0,117	0,136	0,155	0,107
France	0,159	0,078	0,068	0,100	0,141	0,107	0,007	0,140
Germany	0,148	0,271	0,068	0,061	0,068	0,243	0,309	0,247
Ireland	0,006	0,009	0,005	0,003	0,006	0,005	0,002	0,001
Greece	0,012	0,023	0,035	0,011	0,039	0,022	0,017	0,026
Netherlands	0,036	0,043	0,063	0,032	0,044	0,047	0,039	0,028

Source: Own calculations from INE database.

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[12] $CONC2 = \dfrac{V_4}{V_i + M_i}$

The highest values of HIIT are reached in trade between Portugal and Germany, Spain, and France. The HIIT between Portugal and Ireland, Greece, and Netherlands is very low.

Table C: The Vertical Intra-Industry Trade (VIIT) indexes for the period 1995-2002

YEAR ⟍ Countries	1995	1996	1997	1998	1999	2000	2001	2002
European Union	0,266	0,296	0,288	0,272	0,328	0,4558	0,389	0,430
Spain	0,368	0,346	0,417	0,389	0,407	0,388	0,376	0,466
France	0,293	0,343	0,356	0,389	0,297	0,312	0,411	0,291
Germany	0,289	0,196	0,449	0,493	0,449	0,289	0,266	0,306
Ireland	0,102	0,134	0,101	0,107	0,076	0,083	0,008	0,092
Greece	0,043	0,040	0,041	0,075	0,049	0,061	0,073	0,070
Netherlands	0,328	0,293	0,269	0,277	0,283	0,279	0,279	0,306

Source: Own calculations from INE database.

The highest level of VIIT is reached in the bilateral trade with Spain. The bilateral trade with Germany, Netherlands and France also present a significant level of VIIT. When we make a comparison with table B (HIIT) we conclude that IIT is almost VIIT. In 2002 VIIT accounts for 73% of total IIT with European Union and 82% of total IIT with Spain. These values are in accordance with the values expected for a developed country as Portugal.

Main conclusions of this section

The IIT between Portugal and European Union is over 50% for all period in analysis and after 1999 the VIIT is clearly predominant. These values are in accordance with the values expected for a developed country as Portugal. In 2002 VIIT accounts for 73% of total IIT with European Union . For the more developed countries VIIT usually accounts for 80 to 90 percent of total IIT (see Aturupane et.al. ,1999).
The IIT between Portugal and the two main partners (Spain and Germany) is also over 50% of total trade for all period. The IIT between Portugal and France is over 40%. The IIT between Portugal and Greece and between Portugal and Ireland is not significant (closely 10% of total trade). As was expected for a developed country as Portugal the VIIT is, generally, much higher than the HIIT. There is, however, a clear difference between Germany and Spain in the last three years (200-2002). For the all period (1995-2002) the IIT between Portugal and Spain is almost VIIT, but for Germany the weight of HIIT and VIIT is similar for the period 2000-2002.

5. Dynamic panel data models

We estimate de dynamic panel data models with GMM System estimator. This estimator is an alternative to the standard first-differenced GMM estimator. As Blundell and Blond (1998, 2000) proved, with

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[13] Quadros de Pessoal is a data set based on a standardized questionnaire that all firms with wage earners must answer every year.

GMM-System estimator there is virtually no sample bias and much better precision, even in the smaller sample size in contrast to the GMM DIF estimator. We considered an individual effects autoregressive panel data model with endogenous explanatory variables.[14] . Therefore we used m1 and m2 statistics to test for first-order and second-order serial correlation and the Sargan statistic to test the null hypothesis of instruments validity. Identification of the model requires restrictions on the serial correlation properties of the error term and on the properties of the explanatory variables, that may or may not be correlated with industry-specific effects. We considered that explanatory variables are not strictly exogenous with respect to error term. An interesting case , reported by Arellano and Bover (1995) and Blundell and Bond (1998), is where the levels of explanatory variables are correlated with the specific effects but where first differences of these variables (and first difference of the dependent variable) are not correlated with that effects. In this case it allows the use of suitable lagged first differences as instruments for equations in levels. This improves, sometimes crucially, the efficiency of the resulting GMM system estimates.

5.1. Intra-Industry Trade Models

Model $[1]$

$$IIT_{it} = \beta_0 + \beta_1 (PD_1)_{it} + \beta_2 (MES_2)_{it} + \beta_3 (CONC_1)_{it} + \beta_4 PROD_{it} + \delta t + \eta_i + \varepsilon_{it}$$

Where η_i is the unobserved time-invariant industry-specif effects; δt captures a common deterministic trend; ε_{it} is a random disturbance assumed to be normal, independent and identical distributed (IID) with $E(\varepsilon_{it}) = 0$ and $Var(\varepsilon_{it}) = \sigma^2 > 0$.[15]

The model 1 can be rewritten in the following dynamic representation:

$$IIT_{it} = \rho IIT_{it-1} + \beta_1 (PD_1)_{it} - \rho \beta_1 (PD)_{it-1} + \beta_2 (MES_2)_{it} - \rho \beta_2 (MES_2)_{it-1} + \beta_3 (CONC_1)_{it} - \rho \beta_3 (CONC_1)_{it-1}$$
$$+ \beta_4 PROD_{it} - \rho \beta_4 (PROD)_{it-1} + \delta t + \eta_i + \varepsilon_{it}$$

Model $[2]$

$$IIT_{it} = \beta_0 + \beta_1 (PD_2)_{it} + \beta_2 (MES_1)_{it} + \beta_3 (CONC_2)_{it} + \beta_4 PROD_{it} + \delta t + \eta_i + \varepsilon_{it}$$

The model 2 can be rewritten in the following dynamic representation:

$$IIT_{it} = \rho IIT_{it-1} + \beta_1 (PD_2)_{it} - \rho \beta_1 (PD)_{it-1} + \beta_2 (MES_1)_{it} - \rho \beta_2 (MES_1)_{it-1} + \beta_3 (CONC_2)_{it} - \rho \beta_3 (CONC_2)_{it-1}$$
$$+ \beta_4 PROD_{it} - \rho \beta_4 (PROD)_{it-1} + \delta t + \eta_i + \varepsilon_{it}$$

Model $[3]$

$$IIT_{it} = \beta_0 + \beta_1 (HC_1)_{it} + \beta_2 (HC_2)_{it} + \beta_3 (MES_1)_{it} + \beta_4 (CONC_1)_{it} + \beta_5 PROD_{it} + \delta t + \eta_i + \varepsilon_{it}$$

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[14] The assumption of no serial correlation in the error term is essential for the consistency of estimators. It is assumed that if the error term was originally autoregressive, the model has been transformed so that the coefficients of explanatory variables satisfy some set of common factor restrictions. Thus only serrialy uncorrelated or moving average errors are allowed.
[15] The ε_{it} are assumed to be independently distributed across industries with zero mean, but arbitrary forms of heteroskedasticity across units and time are possible.

The model 3 can be rewritten in the following dynamic representation:

$$IIT_{it} = \rho IIT_{it-1} + \beta_1(HC_1)_{it} - \rho\beta_1(HC_1)_{it-1} + \beta_2(HC_2)_{it} - \rho\beta_2(HC_2)_{it-1} + \beta_3(MES_1)_{it} - \rho\beta_3(MES_1)_{it-1}$$
$$+ \beta_4(CONC_1)_{it} - \rho\beta_4(CONC_1)_{it-1} + \beta_5 PROD_{it} - \rho\beta_5(PROD)_{it-1} + \delta t + \eta_i + \varepsilon_{it}$$

The expected signs are:

ITT_{it-1} : The expected sign is positive;

PD1, (horizontal differentiation): Gray(1988), Greenaway and Milner(1986) considered a positive relation of this variable with IIT. Ethier (1982) considers the existence of a negative relation.;

HC1, HC2 (human capital*)*: This sign is ambiguous, because these variables have a positive influence on VIIT and a negative influence on HIIT and IIT enclose both;

HCS/L (stock intensity of human capital): The sign could be positive or negative depending on a predominance of VIIT or HIIT;

MES1, MES2 (minimum efficient scale): Ethier(1982) and Harrigan (1995) questioned the positive relation .The sign could be positive or negative depending on the market structure. The dominant paradigm considers a large number of firms and a negative sign. If we consider the hypothesis of a small number of firms the expected sign is positive;

CONC1, CONC2 (industrial concentration): The sign could be positive or negative depending on the market structure. With the hypothesis of a large number of firms the expected sign is negative, otherwise the expected sign is positive (hypothesis of a small number of firms);

PROD (Productivity*)*: if we assume that productivity is associated with differentiation of products, the sign should be positive.

5.2. Horizontal Intra-industry Trade Model

Model $\begin{bmatrix} 4 \end{bmatrix}$

$$HIIT_{it} = \beta_0 + \beta_1(PD_2)_{it} + \beta_2(HCS/L)_{it} + \beta_3(MES_2)_{it} + \beta_4(CONC_2)_{it} + \beta_5 PROD_{it} + \beta_6 L*_{it}$$
$$+ \beta_7(K/L)_{it} + \delta t + \eta_i + \varepsilon_{it}$$

The model 4 can be rewritten in the following dynamic representation:

$$HIIT_{it} = \rho HIIT_{it-1} + \beta_1(PD_2)_{it} - \rho\beta_1(PD)_{it-1} + \beta_2(HCS/L)_{it} - \rho\beta_2(HCS/L)_{it-1} + \beta_3(MES_2)_{it}$$
$$- \rho\beta_3(MES_2)_{it-1} + \beta_4(CONC_2)_{it} - \rho\beta_4(CONC_2)_{it-1} + \beta_5 PROD_{it} - \rho\beta_5(PROD)_{it-1} + \beta_6 L_{it}* - \rho\beta_6 L_{it-1}$$
$$+ \beta_7(K/L)_{it} - \rho\beta_7(K/L)_{it-1} + \delta t + \eta_i + \varepsilon_{it}$$

The expected signs are:

$HITT_{it-1}$: the expected sign is positive;

PD2 (horizontal differentiation) : the expected sign is positive;

HCS/L (stock intensity of human capital):this variable is associated with the neo-factorial theory (neo-factor proportions theory). So, the expected sign is negative or the coefficient is not significantly different from zero (there is no statistical association between HCS/L and HIIT);

MES2 (minimum efficient scale)*: the sign could be positive or negative. The dominant paradigm considers the hypothesis of a large number of firms, and, so, the expected sign will be negative. Otherwise the expected sign is positive (hypothesis of a small number of firms);

CONC2 (industrial concentration): the sign could be positive or negative depending on the market structure. With the hypothesis of a large number of firms, the expected sign is negative, otherwise the expected sign is positive (hypothesis of a small number of firms);

PROD (productivity*): if we consider that the productivity is associated with the differentiation of products, so the expected sign is positive.

L*(non- qualified labor), K/L (intensity of physical capital): these are variables of the HO factor proportions theory used in the empirical studies of comparative advantages. So, the expected signs are negative or the coefficients are not significantly different from zero at any conventional statistical level (non statistical association between these variables and HIIT)

5.3. Vertical Intra-industry Trade Model

Model $[5]$

$$VIIT_{it} = \beta_0 + \beta_1 VPD_{it} + \beta_2 (HCS/L)_{it} + \beta_3 (CONC_2)_{it} + \beta_4 (HC_2)_{it} + \beta_5 L^*_{it} + \beta_6 (K/L)_{it} + \eta_i + \varepsilon_{it}$$

The model 5 can be rewritten in the following dynamic representation:

$$VIIT_{it} = \rho VIIT_{it-2} + \beta_1 (VPD)_{it} - \rho\beta_1 (VPD)_{it-1} + \beta_2 (HCS/L)_{it} - \rho\beta_2 (HCS/L)_{it-1} + \beta_3 (CONC_2)_{it}$$
$$- \rho\beta_3 (CONC_2)_{it-1} + \beta_4 (HC2)_{it} - \rho\beta_5 (HC2)_{it-1} + \beta_5 L_{it}^* - \rho\beta_5 L^*_{it-1} + \beta_6 (K/L)_{it} - \rho\beta_6 (K/L)_{it-1} + \delta + \eta_i + \varepsilon_{it}$$

The expected signs are:

$VIIT_{it-1}$: the expected sign is positive;

VPD (vertical differentiation) : the expected sign is positive;

HCS/L (intensity of human capital): as neo-factorial theory can explain the VIIT, the expected sign is positive;

HC2 (human capital): the expected sign is positive;

CONC2 (industrial concentration): the sign could be positive or negative. According to the dominant paradigm of a large number of firms the expected sign is negative, otherwise the sign will be positive (hypothesis of a small number of firms);

L* (non- qualified labor , K/L (intensity of physical capital):the expected signs are positive. Additionally if we make the distinction between superior quality and lower quality products, we can expect that Portugal exports lower quality varieties (products) if L*>0 and K/L<0 and exports higher quality varieties (products) if L*<0 and K/L>0 .

5. 4 Analysis of the results

We estimated three models of IIT and one model of HIIT and VIIT.

In dynamics models results are reported for two-step GMM estimator , because only the Sargan test based on the two-step GMM estimator is heteroskedasticity-consistent (Arellano and Bond, 1991). However, for each dynamic equation estimated coefficients, the null hypothesis that each coefficient is equal to zero is tested using one-step robust standard errors, because inference based on the one-step estimator has been found to be more reliable than the one based on the asymptotically more efficient two-step estimator (Arellano and Bond, 1991).

Table 1: Model I- Determinants of the IIT

Variables	European Union	Spain	France	Germany	Ireland	Greece	Netherlands
IIT_{t-1}	0.870 (16.6)**b**	0.968 (10.9)**b**	0.515 (3.93)**b**	0.813 (12.5)**b**	0.523 (3.67)**b**	-0.081 (-0.717)	0.683 (4.50)**b**
PD1	0.010 (0.486)	-0.016 (-0.533)	0.004 (0.114)	0.017 (0.454)	-0.0006 (-0.021)	-0.137 (-1.20)	0.006 (0.095)
$PD1_{t-1}$	0.034 (1.24)	0.030 (1.12)	-0.044 (-1.12)	0.003 (0.086)	0.007 (1.73)**a**	-0.145 (-1.38)	-0.028 (-0.384)
MES2	-0.0002 (-0.563)	-0.0003 (-0.27)**b**	0.0004 (1.14)	0.0006 (2.61)**b**	-0.0004 (-1.71)**a**	0.0009 (2.14)**b**	0.0004 (2.27)**b**
$MES2_{t-1}$	0.0008 (1.27)	0.0003 (3.05)**b**	0.0004 (1.47)	-0.0002 (-1.40)**b**	0.0005 (1.79)**a**	-0.0006 (-2.29)**b**	-0.0001 (-0.582)
CONC1	0.127 (0.481)	0.282 (0.412)	-0.0004 (-1.22)	-0.335 (-1.10)	-0.519 (-0.496)	0.160 (0.128)	-0.401 (-1.89)**b**
$CONC1_{t-1}$	-0.171 (-0.620)	-0.211 (-0.635)	-0.362 (-0.698)	0.251 (0.727)	0.338 (0.296)	-1.191 (-0.786)	0.306 (1.14)
PROD	0.004 (1.24)	0.002 (0.641)	-0.013 (-1.53)	0.008 (2.14)**b**	0.011 (1.72)**a**	-0.007 (-0.618)	0.0006 (0.030)
$PROD_{t-1}$	-0.002 (-1.45)	0.0009 (0.159)	0.013 (1.53)	-0.018 (-3.51)**b**	-0.015 (-1.78)**b**	0.013 (0.946)	-0.0009 (-2.47)**b**
C	-0.137 (-0.562)	-0.036 (0.390)	0.288 (4.14)	0.193 (2.46)	0.181 (1.56)	0.328 (2.05)	0.275 (2.67)
M1	0.5417 [0.588]	-1.078 [0.281]	5.661 [0.985]	-1.840 [0.066]	-0.2702 [0.787]	-0.8554 [0.392]	-0.9534 [0.340]
M2	-1.041 [0.298]	-0.9183 [0.358]	0.6561 [0.512]	1.193 [0.233]	0.1948 [0.846]	-0.8153 [0.415]	-0.2459 [0.806]
W_{JS}	2997 [0.000] df=9	490.5 [0.000] df=9	123.7 [0.000] df=9	522.1 [0.000] Df=9	208.8 [0.000] df=9	21.53 [0.010] df=9	430.1 [0.000] df=9
Sargan	6.397 [0.603]	5.590 [0.998] df=18	5.661 [0.985] df=15	11.58 [0.965] df=22	4.082 [1.000] df=21	11.41 [0.935] Df=20	6.400 [0.997] df=19
observations	84	80	80	80	60	68	80
parameters	13	13	15	13	13	13	13
Number of individuals derived from year	21	20	20	21	15	17	20

The null hypothesis that each coefficient is equal to zero is tested using one-step robust standard error. In round brackets are t-statistics (heteroskedasticity corrected).

a/b/c- statiscally significant, respectively at the 10%,5% and 1% level..

P-values are in square bracketes.

Year dummies are included in all specification(it is equivalent to transforming the variables into deviations from time means, i..e the mean across the n industries for each period).

M1,amd, M2 are tests for first-order and second –order correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null hypothesis of no serial correlation(based on the efficient two-step GMM system estimator)

W_{JS} is the Wald statistic of joint significance of independent variables (for first-steps, excluding time dummies and the constant term)

Sargan is a test of the over-identifying restrictions, asymptotically distributed as χ^2 under the null of instruments validity (with two-step estimator)

To European Union and for the equations in first differences the instruments in levels used are MES2(3,3),CONC1(3,3),IIT(3,3). To Spain, and France the instruments used are MES2(2,2), CONC1(2,2), IIT(2,3). To Germany and Ireland the instruments in levels are MES2(2,3),CONC1(2,3),IIT(2,3) . To Greece, and Netherlands the instruments in levels are MES2(2,2),CONC1(2,2),IIT(2,3). For levels equations the instruments used are first differences of all variables lagged t-1.

The model presents consistent estimates with no serial correlation (m1,m2 statistics). The specification Sargan test shows that we do not have problems with the validity of instrument used, with exception of Ireland.

This model presents one   significant variable for European Union (IIT_{t-1}), three for Spain (IIT_{t-1}, MES2, $MES2_{t-1}$),   one   for   France, (IIT_{t-1}) ,five for Germany (IIT_{t-1}, MES2, $MES2_{t-1}$,PROD,$PROD_{t-1}$), six for Ireland(IIT_{t-1}, PD_{t-1}, MES2, $MES2_{t-1}$,PROD,$PROD_{t-1}$), two for Greece (MES2, $MES2_{t-1}$), and four for Netherlands (IIT_{t-1}, MES2, $MES2_{t-1}$, PROD, $PROD_{t-1}$).

Other results relating to statistically significant variables:

- lagged intra-industry trade (IIT_{t-1}): We expected a positive sign, and results confirm this;

- lagged horizontal differentiation ($PD1_{t-1}$): The expected sign is positive or ambiguous, and the single coefficient significant is positive(Ireland);

- economies of scales(MES2): The dominant paradigm with large number of firms expects a negative sign, and we have two coefficients statistically significant with a negative sign (Spain and Ireland). The coefficients are positive for Germany, Greece and Netherlands;

- lagged economies of scales($MES2_{t-1}$): We expects a negative sign, and the results are negative (Germany, Greece), and positive (Spain);

- industrial concentration(CONC1): The expected sign is negative, and the coefficient statistically significant is negative (Netherlands);

- productivity (PROD): we expected a positive sign, and the coefficients statistically significant are positive (Germany and Ireland) ;

 - lagged productivity ($PROD_{t-1}$): we expected a positive sign and all significant coefficients are negative Germany, Ireland and Netherlands).

Table 2. : Model II- Determinants of the IIT

Variables	European Union	Spain	France	Germany	Ireland	Greece	Netherlands
IIT_{t-1}	0.859 (8.04)**b**	1.140 (6.98)**b**	0.603 (4.51)**b**	0.640 (4.41)**b**	0.277 (1.47)	-0.241 (-1.80)**a**	0.863 (4.31)**b**
PD1	-0.072 (-0.936)	0.011 (0.279)	0.049 (1.53)	0.039 (1.38)	0.019 (1.16)	-0.145 (-1.72)**a**	0.040 (0.420)
$PD1_{t-1}$	0.063 (1.17)	-0.014 (-0.426)	-0.056 (-1.30)	0.034 (0.714)	0.014 (3.24)**b**	-0.075 (-0.925)	-0.008 (-0.089)
MES1	-0.004 (-1.50)	-0.028 (-0.822)	0.048 (0.774)	-0.064 (-1.61)	0.039 (0.715)	-0.008 (-0.090)	0.147 (2.18)**b**
$MES1_{t-1}$	0.052 (1.36)	0.019 (0.466)	0.048 (0.774)	0.011 (0.277)	-0.095 (-1.46)	-0.005 (-0.054)	-0.174 (-2.49)**b**
CONC2	0.522 (1.82)**a**	0.478 (0.965)	-0.032 (-0.420)	1.262 (1.82)**a**	1.680 (1.20)	-2.010 (-0.554)	-1.620 (-3.08)**b**
$CONC2_{t-1}$	-0.041 (-0.124)	-0.181 (-0.383)	-0.384 (-0.420)	-1.196 (-3.11)**b**	-1.908 (-1.29)	-2.010 (-0.554)	1.764 (2.78)**a**
PROD	-0.0003 (-3.85)**b**	-0.004 (-0.934)	-0.001 (-0.291)	-0.005 (-0.756)	-0.0002 (-0.741)	-0.011 (-1.04)	0.013 (2.81)**a**
$PROD_{t-1}$	-0.0004 (-3.96)**b**	0.005 (0.799)	0.0011 (0.127)	0.005 (0.901)	0.0003 (1.29)	0.021 (1.61)	-0.022 (-2.84)**a**
C	-0.0011 (-0.017)	-0.080 (-0.799)	0.156 (1.50)	0.185 (1.27)	0.313 (1.63)	0.315 (1.99)	0.187 (1.15)
M1	-0.888 [0.374]	-0.950 [0.342]	-1.807 [0.071]	-1.623 [0.105]	-0.285 [0.775]	-1.190 [0.234]	-0.911 [0.362]
M2	0.468 [0.639]	-0.530 [0.596]	0.777 [0.437]	0.775 [0.438]	-0.256 [0.798]	-0.467 [0.640]	0.713 [0.476]
W_{JS}	2692 [0.000] df=9	144.7 [0.000] df=9	67.56 [0.000] df=9	74.88 [0.000] df=9	246.9 [0.000] df=9	8.797 [0.456] df=9	161.6 [0.000] df=9
Sargan	5.236 [0.990] df=15	11.82 [0.693] df=15	6.129 [0.977] df=15	8.207 [0.904] df=19	2.060 [1.000] df=19	6.721 [0.965] df=15	5.878 [0.982] df=15
observations	84	80		79	60	68	80
parameters	13	13		13	13	13	13
Number of individuals derived from year	21	20		20	15	17	20

For equations in first differences the instruments in levels used are MES1(2,2),CONC2(2,2),IIT(2,2) to European Union, Spain, France, Greece ,and Netherlands ; MES2(2,3),CONC1(2,2),ITT(2,3) to Germany, and Ireland. For levels equations the instruments used are first differences of all variables lagged t-2.

This model presents consistent estimates with no autocorrelation (m1,m2 tests). The specification Sargan test shows that we do not have problems with the validity of the instrument used, with exception of Ireland .

The model presents four significant variables for European Union (IIT_{t-1}, CONC2, PROD, $PROD_{t-1}$), one for Spain (IIT_{t-1}),one for France (IIT_{t-1}),three for Germany (IIT_{t-1}, CONC2, $CONC2_{t-1}$),one for Ireland ($PD1_{t-1}$), two for Greece(IIT_{t-1} ,PD1),and seven for Netherlands (IIT_{t-1}, MES1, $MES1_{t-1}$, CONC2, $CONC2_{t-1}$, PROD, $PROD_{t-1}$).

Other results relating to statistically significant variables:

- lagged intra-industry trade(ITT $_{t-1}$): we expected a positive sign, and the results confirm this;

- horizontal differentiation(PD1): the expected sign is positive ,and the single statistically significant coefficient is negative(Greece);

- lagged horizontal differentiation (PD1 $_{t-1}$): we expected a positive sign, and Ireland present an expected sign;

economies of scale(MES1), and lagged economies of scale (MES1 $_{t-1}$) : the dominant paradigm of a large number of firms considers a negative sign. We have a positive sign for MES1(Netherlands) and a negative one for MES1 t-1 (Netherlands), which deserves further investigation;

- industrial concentration(CONC2): the expected sign is negative, and we have a positive sign for European Union and Germany and a negative one for Netherlands;

- lagged industrial concentration(CONC2 $_{t-1}$): we expected a negative sign, and we have a negative sign for Germany and a positive one for Netherlands;

- productivity (PROD): the expected sign is positive, and we have a positive coefficient(Netherlands)and other negative (European Union)

- lagged productivity (PROD $_{t-1}$: we expected a positive sign, and the results are negative (European Union and Netherlands).

Table 3. : Model III – Determinants of the IIT

Variables	European Union	Spain	France	Germany	Ireland	Greece	Netherlands
IIT $_{t-1}$	0.756 (13.9)**b**	0.999 (11.1)**b**	0.329 (0.178)	1.085 (2.39)**b**	0.526 (1.38)	0.242 (0.203)	0.830 (7.53)**b**
HC1	0.127 (0.785)	-0.110 (-0.593)	0.114 (0.069)	0.716 (0.582)	-0.178 (-0.451)	0.151 (0.146)	-0.367 (-1.50)
HC1 $_{t-1}$	-0.127 (0.785)	0.188 (1.02)	-1.225 (-0.622)	-0.692 (-0.688)	-0.254 (-0.735)	-3.312 (-1.66)	-0.328 (-0.868)
HC2	0.691 (2.29)**b**	-0.1000 (-0.139)	-3.142 (-1.06)	-0.897 (-0.360)	-1.052 (-0.876)	-0.334 (-0.080)	-0.803 (-1.47)
HC2 $_{t-1}$	-0.339 (-1.36)	0.152 (0.277)	1.333 (0.770)	3.105 (1.17)	0.197 (0.264)	-4.229 (-1.21)	-0.142 (-0.268)
MES1	0.015 (0.391)	-0.008 (-0.001)	0.044 (0.169)	0.169 (0.655)	0.120 (0.754)	0.164 (0.327)	-0.029 (-0.476)
MES1 $_{t-1}$	-0.022 (-1.08)	0.029 (0.602)	-0.160 (-0.491)	0.169 (0.655)	-0.202 (-1.45)	-0.340 (-1.03)	-0.007 (-0.173)
CONC1	0.182 (0.407)	-0.071 (-0.180)	0.814 (0.124)	-0.003 (-0.369)	-0.043 (-0.040)	-1.972 (-0.515)	-0.064 (-0.137)
CONC1 $_{t-1}$	-0.439 (-1.02)	0.182 (0.395)	-1.849 (-0.206)	-1.009 (-0.450)	-0.164 (-0.129)	2.021 (0.396)	-0.191 (-0.409)
PROD	0.007 (10.4)**b**	-0.005 (-0.180)	0.011 (0.490)	0.008 (3.82)**b**	-0.0003 (-0.188)	0.040 (1.15)	0.002 (1.23)
PROD $_{t-1}$	-0.006 (-1.62)	0.005 (0.115)	0.001 (0.530)	-0.001 (-0.652)	0.001 (0.450)	-0.049 (-1.14)	-0.001 (-0.927)
C	-0.408 (-1.62)	-0.103 (-0.389)	1.557 (0.378)	-2.143 (-1.63)	0.918 (0.901)	4.020 (1.24)	0.857 (1.50)

Variables	European Union	Spain	France	Germany	Ireland	Greece	Netherlands
M1	-	-1.573 [0.116]	0.677 [0.498]	-0.888 [0.374]	-1.353 [0.176]	-1.042 [0.298]	-0.5759 [0.565]
M2	-0.496 [0.619]	-0.130 [0.897]	-0.007 [0.994]	1.043 [0.297]	0.995 [0.319]	0.2397 [0.811]	-1.431 [0.153]
W_{JS}	6556 [0.000] df=11	1419 [0.000] df=11	322.3 [0.000] df=11	616.5 [0.000] df=11	19.95 [0.046] df=11	17.42 [0.096] df=11	2049. [0.000] df=11
Sargan	1.524 [0.981] df=7	4.682 [0.699] df=7	4.933 [0.668] df=7	3.816 [0.801] df=7	5.431 [0.608] df=7	4.753 [0.690] df=7	4.875 [0.675] df=7
observations	84	80	84	84	79	80	84
parameters	15	15	14	15	15	15	15
Number of individuals derived from year	21	20	21	21	20	20	21

For the equations in first differences the instruments in levels used are HC2(3,3),MES1(3,3),IIT(3,3) to European Union, Spain, France, Germany, Ireland, Greece, and Netherlands. For levels equations the instruments used are first differences of all variables lagged t-2.

This model presents consistent estimates with no serial correlation (m1 and m2 statistics). The specification Sargan test shows that the model does not have problem with the validity of instruments[16].

This model presents three significant variables for European Union(IIT$_{t-1}$,HC2,PROD),one for Spain(IIT$_{t-1}$), two for Germany(IIT$_{t-1}$, PROD),and one for Netherlands(IIT$_{t-1}$).

Other results relating to statistically significant variables:

-lagged intra-industry trade(IIT$_{t-1}$): We expected a positive sign, and the results confirm this;

-human capital (HC2): the expected sign is ambiguous, and the results confirm this. The single coefficient statistically significant is positive (European Union);

-productivity (PROD): we expected a positive sign, and the positive sign predominate. The coefficients statistically significant are positive (European Union and Germany).

Table 4. : Model IV- Determinants of the HIIT

Variables	European Union	Spain	France	Germany	Ireland	Greece	Netherlands
HIIT$_{t-1}$	0.604 (3.36)**b**	0.059 (0.412)	0.368 (1.27)	-0.209 (-1.79)**a**	-0.231 (-2.76)**b**	-0.461 (-3.25)**b**	-0.231 (-2.76)**b**
PD2	-0.001 (-0.094)	0.001 (0.486)	0.157 (1.41)	0.047 (1.45)	0.004 (0.122)	-0.006 (-1.68)**a**	0.0004 (0.122)
PD$_{t-1}$	-0.001 (-0.094)	0.001 (0.486)	-0.174 (-1.49)	-0.028 (-0.891)	-0.003 (-0.674)	-0.006 (-1.68)**a**	-0.003 (-0.674)

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[16] We also estimated the model using intruments dated t-2 for the equations in first differences and instruments dated t-1 for the equations in levels. We do not present the results as the Sargan test strongly rejects the validity of these instruments.

Variables	European Union	Spain	France	Germany	Ireland	Greece	Netherlands
HCS/L	-0.006 (-1.10)	-0.046 (-0.700)	0.005 (0.034)	0.029 (0.224)	-0.014 (-0.618)	-0.145 (-1.59)	-0.014 (-0.618)
HCS/L $_{t-1}$	0.022 (3.43)**b**	0.216 (2.73)**b**	0.049 (1.39)	-0.101 (-0.729)	0.026 (0.841)	0.178 (1.64)	0.026 (0.841)
MES2	-0.0002 (-0.093)	-0.0003 (-0.651)	-0.0003 (-1.39)	-0.0002 (-0.079)	-0.0001 (-1.29)	-0.0004 (-0.945)	-0.0001 (-1.29)
MES2 $_{t-1}$	0.0002 (0.708)	0.0004 (0.797)	0.0004 (1.35)	0.0003 (0.860)	0.0001 (1.34)	0.0002 (0.977)	0.0001 (1.35)
CONC2	-0.251 (-1.81)**b**	-0.504 (-1.13)	-0.863 (-1.05)	-1.322 (-1.00)	-0.184 (-1.18)	0.289 (0.482)	-0.184 (-1.18)
CONC2 $_{t-1}$	-0.190 (-1.51)	0.927 (1.84)**b**	0.768 (1.12)	0.589 (0.548)	0.110 (0.609)	0.008 (0.015)	0.110 (0.609)
PROD	0.0004 (0.054)	0.006 (1.15)	0.010 (1.35)	0.0003 (0.003)	0.003 (1.42)	-0.0004 (-0.050)	0.003 (1.42)
PROD $_{t-1}$	-0.007 (-0.671)	-0.011 (-1.50)	-0.013 (-1.18)	-0.009 (-0.793)	-0.003 (-1.25)	0.002 (0.371)	-0.003 (-1.25)
L*	0.043 (1.01)	0.478 (0.586)	0.157 (0.113)	-0.212 (-0.152)	0.501 (1.28)	1.126 (1.43)	0.501 (1.28)
L* $_{t-1}$	0.111 (2.20)**b**	-0.065 (-0.123)	-0.058 (-0.035)	-2.585 (-2.06)**b**	-0.051 (-0.302)	0.904 (1.16)	-0.051 (-0.302)
K/L	0.0004 (0.379)	0.001 (0.830)	0.0009 (0.391)	0.001 (0.367)	-0.0002 (-0.808)	-0.0009 (-1.10)	-0.0002 (-0.808)
K/L $_{t-1}$	-0.0009 (-1.20)	-0.0005 (-0.512)	-0.0006 (-0.27)	-0.001 (-0.844)	-0.0004 (-0.783)	0.0009 (0.173)	-0.0004 (-0.783)
C	0.294 (3.23)	0.777 (2.49)	0.391 (0.434)	0.179 (0.558)	0.039 (0.506)	0.001 (0.004)	0.039 (0.506)
M1	-1.601 (0.109)	-1.626 (0.104)	-0.954 [0.340]	-1.663 (0.096)	-1.314 [0.189]	-1.037 [0.300]	-1.314 [0.189]
M2	0.668 (0.109)	1.605 (0.109)	-0.046 [0.936]	1.315 (0.139)	1.029 [0.304]	1.379 [0.168]	1.029 [0.304]
W $_{JS}$	6306 [0.000] df=15	145.5 [0.000] df=15	10.82 [0.765] df=15	2521 [0.000] df=15	28.27 [0.020] df=15	126.9 [0.000] df=15	28.27 [0.020] df=15
Sargan	12.90 (0.610) dl=15	8.642 (0.979) dl=19	17.10 [0.705] df=21	28.04 (0.139) dl=21	10.32 [0.945] df=19	6.889 [0.998] df=21	10.32 [0.945] df=19
observations	84	80	84	84	79	80	79
parameters	19	19	19	19	19	19	19
Number of individuals derived from year	21	20	21	21	20	20	20

For equations in first differences the instruments in levels used are MES2(2,2),CONC(2,2),HIIT(2,2) to European Union, and Netherlands; MES2(2,3),CONC(2,2),HIIT(2,3) to Spain, and Ireland; MES2(2,3),CONC(2,3),HIIT(2,3) to France, Germany, and Greece. For levels equations the instruments used are first differences of all variables lagged t-1.

This model presents consistent estimates with no autocorrelation (m1,m2 tests).In relation to specification Sargan test it shows that we do not have problems with the validity of the instrument used.

This model presents four significant variables for European Union (HIIT $_{t-1}$,HCS/L $_{T-1}$,CONC2, L* $_{t-1}$), two for Spain(HCS/L $_{T-1}$,CONC2 $_{t-1}$), two for Germany (HCS/L $_{T-1}$,CONC2 $_{t-1}$), one for Ireland (HIIT $_{t-1}$),three for Greece(HIIT $_{t-1}$,PD2,PD2 $_{t-1}$),and one for Netherlands(HIIT $_{t-1}$).

Other results relating to statistically significant variables:

- lagged horizontal intra-industry trade (HITT $_{t-1}$): The expected sign is positive and the results are contradictory (positive for EU and negative for Germany, Ireland, Greece, and Netherlands)

- horizontal differentiation (PD2) and lagged horizontal differentiation (PD2 $_{t-1}$) : The expected sign is positive and the results confirm this, but Greece present a negative coefficient ;

- lagged intensity of human capital (HCS/L $_{t-1}$): the expected sign is negative or the coefficient is not significantly different from zero. The coefficients are positive and significant for European Union, and for Spain;

- industrial concentration (CONC2) and lagged industrial concentration (CONC2 $_{t-1}$): the dominant paradigm with a large number of firms expects a negative sign and we have a negative one for CONC2 (European Union has a significant coefficient) and a positive sign for CONC2 $_{t-1}$ (only Spain has a significant and positive coefficient);

- non- qualified labor (L*) and intensity of physical capital(K/L):the expected sign is negative or there are non statistical association between these variables and HIIT. The coefficients are all not significantly different from zero at any conventional level, which confirm the theory;

- lagged non-qualified labor (L* $_{t-1}$): the expected sign is negative or the coefficient is not significantly different from zero. With European Union this coefficient present a positive sign , but with Germany the coefficient is negative..

- lagged intensity of physical capital (K/L $_{t-1}$): the expected sign is negative or the coefficient is not significantly different from zero, and the results confirm the theory.

Table 5. :Determinants of the VIIT

Variables	European Union	Spain	France	Germany	Ireland	Greece	Netherlands
VIIT $_{t-1}$	0.085 (0.151)	-0.063 (-0.240)	1.391 (2.20)**b**	0.146 (0.413)	0.028 (0.058)	-0.077 (-0.167)	0.705 (4.92)**b**
VPD	-1.649 (-1.17)	0.015 (0.019)	0.966 (0.845)	0.278 (0.320)	-0.196 (-0.919)	0.608 (0.719)	-0.420 (-1.37)
VPD $_{t-1}$	0.979 (0.885)	0.607 (1.96)**b**	0.091 (0.040)	-0.918 (-0.886)	-0.590 (-0.461)	-1.574 (-1.49)	-0.045 (-0.076)
HCS/L	-0.032 (-0.196)	-0.091 (-0.327)	-0.242 (-1.20)	0.001 (0.007)	-0.040 (-0.398)	0.281 (1.23)	-0.012 (-0.127)
HCS/L $_{t-1}$	-0.012 (-0.054)	0.016 (0.055)	0.251 (1.00)	-0.084 (-0.359)	-0.065 (-0.558)	-0.338 (-1.43)	-0.005 (-0.049)
CONC2	0.1339 (0.054)	-0.785 (-0.257)	2.774 (0.990)	2.101 (1.60)	1.214 (1.08)	0.710 (0.448)	-1.073 (-0.858)
CONC2 $_{t-1}$	0.659 (0.242)	0.786 (0.237)	-1.764 (-0.760)	-2.074 (-1.72)**a**	-1.326 (-1.05)	-1.115 (-0.881)	1.043 (0.839)
HC2	5.153 (1.98)**a**	-0.373 (-0.093)	-3.213 (-1.83)**a**	-0.698 (-0.613)	-0.402 (-0.340)	0.180 (0.040)	-0.229 (-0.215)
HC2 $_{t-1}$	-7.716 (-4.99)**b**	1.520 (0.276)	4.114 (2.03)**b**	-0.158 (-0.141)	0.549 (0.491)	-0.149 (-0.030)	-0.371 (-0.437)
L*	6.125 (2.42)**b**	-0.817 (-0.363)	-0.709 (-0.221)	-5.452 (-1.77)**a**	-2.393 (-0.950)	-1.843 (-0.737)	0.972 (-0.669)
L* $_{t-1}$	-6.307 (-2.33)**b**	2.419 (0.679)	4.206 (1.21)	2.169 (0.815)	1.813 (1.05)	1.211 (0.329)	0.267 (0.264)

Variables	European Union	Spain	France	Germany	Ireland	Greece	Netherlands
K/L	-0.006 (-1.25)	-0.002 (-0.133)	-0.009 (-0.699)	-0.003 (-0.902)	0.009 (0.232)	0.0023 (0.720)	0.0003 (0.190)
K/L_{t-1}	-0.0006 (-0.672)	0.0002 (0.323)	0.0002 (0.337)	0.0003 (1.20)	0.0001 (0.301)	0.0004 (0.575)	-0.0002 (-1.05)
C	2.044 (0.626)	-1.080 (-0.515)	-0.882 (-0.350)	1.443 (0.972)	-0.301 (-0.366)	-0.030 (-0.012)	0.576 (0.850)
M1	-1.498 (0.134)	-1.208 (0.227)	-0.399 [0.689]	-1.123 (0.261)	-0.939 [0.347]	-1.321 [0.186]	-1.948 [0.051]
M2	0.038 (0.969)	0.617 (0.537)	0.309 [0.757]	1.175 (0.240)	0.683 [0.494]	0.217 [0.828]	-1.277 [0.202]
W_{JS}	649.5 [0.000] df=13	44.43 [0.000] df=13	32.69 [0.002] df=13	47.92 [0.000] df=13	27.01 [0.012] df=13	25.23 [0.021] df=13	282.3 [0.000] df=13
Sargan	3.306 (0.855) df=7	4.260 (0.749) df=7	2.093 [0.955] df=7	6.124 (0.525) df=7	3.135 [0.872] df=7	2.523 [0.925] df=7	3.399 [0.996] df=13
observations	84	80	84	84	79	80	84
parameters	17	17	17	17	17	17	17
Number of individuals derived from year	21	20	21	21	20	20	21

The instruments used are CONC2(3,3),HC2(3,3), KL(3,3),VIIT(3,3)for the equations in differences. For the equations in levels the instruments used are first differences of variables lagged *t-2* .

The model presents consistent estimates with no serial autocorrelation (m1,m2 tests). The specification Sargan test shows that wedo not have problems with the validity of the instrument used.

This model presents four significant variables for the European Union(HC2,HC2$_{t-1}$,L*, L*$_{t-1}$), one for Spain(VPD$_{t-1}$), three for France(VPD$_{t-1}$, HC2,HC2$_{t-1}$) two for Germany(CONC2$_{t-1}$,L*), and one to Netherlands (VPD$_{t-1}$);

Other results relating to statistically significant variables:

- lagged vertical intra-industry trade(VIIT$_{t-1}$): the expected sign is positive, and it is confirmed (France, and Netherlands);

- lagged vertical differentiation (VPD$_{t-1}$): the expected sign is positive, and the single coefficient statically significant is positive (Spain);

-lagged industrial concentration(CONC2$_{t-1}$): the expected sign may be negative (dominant paradigm-hypothesis of large number of firms) or positive (small number of firms). The single coefficient statically significant is negative (Germany);

- human capital (HC2) and lagged human capital (HC2$_{t-1}$): the expected sign is positive and we have contradictory results for European Union and France;

- non-qualified labor (L*): the expected sign is positive (negative) if Portugal exports products of low (high) quality. The sign is positive for European Union which confirms the idea that on a multilateral

basis (European Union) Portugal has comparative advantage in low quality differentiation products. This deserves further investigation;

-lagged non-qualified labor (L*$_{t-1}$): the expected sign is positive (negative) if Portugal exports low (high) quality products and the single coefficient statistically significant is negative for European Union, which is contradictory with the previous result.

Conclusions and further research

Our main conclusions are: **(i)** the IIT between Portugal and European Union (EU) and between Spain and Germany is over 50% of total trade. The IIT between Portugal and France is approximately 40% of trade and between Portugal and Netherlands is 30% of total trade. The IIT with Greece presents poor values (5 and 9 per cent).The VIIT is, generally, much higher than the HIIT. For the main's partners there is, however, a clear difference between Germany and Spain in the last three years (200-2002). For the all period (1995-2002) the IIT between Portugal and Spain is almost VIIT, but for Germany the weight of HIIT and VIIT is similar for the period 2000-2002; **(ii)** as was expected the results given on a multilateral basis (European Union) and on a bilateral basis (six partners) are different; **(iii)** lagged dependent variables and some lagged right-hand-side variables are often statistically significant; **(iv)** estimated coefficients are often insignificant or with the wrong sign. This may be the result of misspecification or inadequate proxies for the explanatory variables, or failure to distinguish inferior VIIT from superior VIIT; **(v)** in the dynamic models of IIT, HIIT and VIIT on a specific group of countries ,**Portugal-European Union**, we stress:

- a positive and significant statistical association between IITt-1, Human Capital, Productivity, on he one hand, and IIT on the other hand;
- a positive and significant association between HIITt-1, Intensity of Human Capital, Lagged Non-Qualified Labor, on the one hand and HIIT on the other hand;
- a negative and significant association between Industrial Concentration and HIIT;
- a positive and significant association between Human Capital, Non-Qualified Labor and VIIT;
- a negative and significant association between Lagged Human Capital, Lagged Non-Qualified Labor and VIIT;
- In the HIIT model the variables L*, K/L, K/L t-1 are not statistically significant which is predicted by the theory. Only L* t-1 has a wrong positive sign;
- In the VIIT model the variable L* has a significant positive coefficient and the variable K/L a negative one, which means that Portugal has comparative advantages in lower quality varieties(products). L*t-1 has a wrong (not predicted) negative sign.

(vi) in the dynamic models on a bilateral basis, **Portugal –Spain**, we stress:
- a positive and significant statistical association between IIT t-1, MES2 t-1 and IIT;
- a negative and significant association betewwenMES2 and IIT;
- a positive and significant association between MES2t-1 and IIT;
- a positive and significant association between HCS/L t-1, CONC2 t-1 and HIIT;

- a positive and significant association between VPD t-1 and VIIT;
- In the HIIT model the variables L*, L* t-1, K/L, K/L t-1 are not statistically significant as was expected by theory;
- In the VIIT model also the same variables are not significant. This need a further research making the distinction between superior VIIT and inferior VIIT.

(vii) in the dynamic models on bilateral basis, **Portugal-France**, we stress:
- a positive and significant association between IITt-1, and IIT;
- a positive and significant association between VIITt-1,HC2t-1 and VIIT;
- a negative and significant association between HC2 and VIIT;

(viii) in the dynamic models on a bilateral basis ,**Portugal –Germany**, we stress:
- a positive and significant association between IIT t-1, MES2, CONC2, PROD and IIT;
- a negative and significant association between MES2t-1, PROD t-1 and IIT;
- a negative and significant association between HIIT t-1, L* t-1 and HIIT;
- a negative and significant association between CON2 t-1, L* and VIIT;
- in the HIIT model the variables L*, K/L, K/L t-1 are not statistically significant, as it is predicted by theory, and L* t-1 has a negative sign, according to theory too;
- in the VIIT model , and relating to comparative advantages variables, only L* is statistically significant (negative coefficient) and it deserves further investigation.

(ix) in the dynamic models on a bilateral basis, **Portugal –Ireland** , we stress:
- a positive and significant association between IITt-1,PD1t-1,MES2t-1,PROD and IIT;
- a negative and significant association between MES2, PROD, and IIT;
- a negative and significant association between HIIt-1 and HIIT;

(x) in dynamic models on bilateral basis, **Portugal-Greece**, we stress:
- a negative and significant association between MES2t-1 and IIT;
- a positive and significant association between MES2,PROD and IIT;
- a negative and significant association between HIITt-1,PD2t-1 and HIIT.

(xi) in dynamic model on bilateral basis , **Portugal-Netherlands** ,we stress:
- a positive and significant association between IITt-1,MES1,MES2, CONC2t-1, PROD and IIT;
- a negative and significant association between MES2t-1, CONC1, PRODt-1 and IIT;
- a negative and significant association between HIITt-1 and HIIT;
- A positive and significant association between VIITt-1 and VIIT;

(xii) in general there is no statistical association between HIIT and comparative advantages variables or the signs are negative. This was expected by theory; **(xiii)** the results obtained on a multilateral basis (European Union) suggest that Portugal has comparative advantages in lower quality varieties(products). This result must be checked against an alternative model that makes the distinction between superior VIIT and inferior VIIT; **(xiv)** the results obtained on a specific group of countries (EU) are different from those obtained on a bilateral basis (Portugal-Spain and Portugal-Germany). However, we think that the bilateral empirical studies are very important to policy recommendations; **(xv)** when we analyzed the intensity of Human Capital and the Industrial Concentration for the main's partners we have a positive effect on the HIIT between Portugal and Spain, but these same variables have no significant effect on the

HIIT between Portugal and Germany. On the other hand the Non-Qualified Labor has a negative effect on VIIT between Portugal and Germany; **(xvi)** finally, although the use of more sophisticated econometric techniques should not be an end in itself, it may be preferable to use the GMM system estimator in empirical intra-industry trade rather than pooled OLS, fixed effects or random effects estimators. At least we should check their results. The system GMM estimator has the comparative advantage based on the potential for obtaining consistent parameter estimates even in the presence of measurement errors and endogenous right-hand-side variables.

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