Country-Specific Determinants of Horizontal and Vertical Intra-Industry Trade in Portugal

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ABSTRACT

This study examines the features and determinants of Portuguese intra-industry trade (IIT) during the period 1995-2003. We separate horizontal IIT from vertical III using data at the five-digit level. Based on Falvey and Kierzkowski (1987) and Flam and Helpman (1987) theoretical models and on Greenaway, Hine and Milner(1994), Hummels and Levinshon (1995) empirical studies, we use a static and dynamic panel data approach to test the country-specific characteristics. We include income variables together with supply-side variables in order to test the demand similarity and factor endowments difference hypotheses .The results suggest that the Linder hypothesis is confirmed and that differences in income levels has a positive (negative) effect on vertical IIT (IIT and horizontal IIT). To estimate the dynamic models, we apply the methodology of Blundell and Bond [1998, 2000] using the GMM system estimator.

Key words: intra-industry trade, horizontal intra-industry trade, vertical intra-industry trade, GMM (SYS) estimator.

JEL Classification: F12, C2, C3, L1.

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1. Introduction

In this paper we analyze the country-specific determinants of intra-industry trade (IIT) , horizontal intra-industry trade (HIIT), and vertical intra-industry trade (VIIT) between Portugal and European Union (EU-15), using an unbalanced panel data for the period 1995-2003. Furthermore we want to test some hypotheses suggested by the theory of monopolistic competition and the Neo-Heckscher-Ohlin theory and to compare our results with those obtained by Greenaway et al. (1994) and Hummels and Levinsohn (1995).

It is a matter of fact that the most empirical studies of IIT found more empirical support for country –specific determinants (i.e., income levels, endowments, economic dimension, foreign direct investment) than for industry-specific determinants (market structure, scale economies, product differentiation). Geenaway et al. (1994, 1995) concluded that it was worthwhile separating out HIIT and VIIT because the theory suggests that they have different determinants. So, in this study, we apply the methodology of Abel-el-Rahaman (1991) and Greenaway et al. (1994) in order to separate HIIT from VIIT. The empirical results presented in this paper supports the idea that the distinction of the two types of IIT is important. Our results also show that in Portugal and for the sub-period 1999-2003 over 60 per cent of all IIT is VIIT. In 2000, VIIT accounts for 85% of total IIT between Portugal and EU-15.

In this paper we revisit Helpman´s (1987) empirical tests as well as Greenaway et al. (1994) and Hummels and Levinsohn´s (1995) empirical studies. Helpman (1987) and Greenaway et al. (1994) use differences in per capita income as a proxy for differences in factor endowments. As Hummels and Levinsohn (1995, p.812) note there are two problems associated with that. First, the proxy is adequate if there are only two factors of production and all goods are traded. In this case, as Helpman (1987) suggests a higher per capita income is related to a higher capital-labor ratio. Second, the differences in per capita income reflects more the demand side phenomenon than the supply side. Following Hummels and Levinshon (1995) we decided to include supply-side variables to distinguish income effects from factor endowments effects. We concluded for a negative relationship between differences in per capita income and IIT, which confirms the Linder (1961) hypothesis. We also tested the factor endowments hypotheses (differences in physical and human capital) and found statistical significant results.

Following Hummels and Levinshon (1995) we apply a logistic transformation to IIT, HIIT and VIIT and different econometric methods to know if the data still support the theory's country-specific hypotheses. In order to compare the results we estimated the models using a static and a dynamic panel data. Although the theoretical models of IIT do not suggest a dynamic specification, we decided to introduce a dynamic variant of the static model because in this model there are serial correlation, heteroskedasticity and endogeneity of some explanatory variables.[1] These econometric problems were resolved by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bound (1988, 2000) that developed the first-differenced GMM and the GMM system estimators. The GMM system estimator, used in this paper, 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 . We conclude that it may be preferable to use the GMM system estimator than fixed effects estimator. At least, the results obtained from their use should be verified.

The remainder of paper is organized as follows. Section 2 presents the theoretical background and the revisited empirical work on IIT. Section 3 presents Portugal's IIT by types over the period 1995-2003. Section 4 presents the empirical model. Section 5 analyzes the estimation results. The final section concludes.

2. Theoretical Background and Empirical Work

Linder (1961) considered that tastes of consumers are conditioned by their income levels. These tastes yield demands for products and this demand structure generates a production response. So, countries with similar per capita income will have similar demand structures and will export similar goods. So, the Linder theory of overlapping demands suggests that goods must first be produced for home markets and after exported to similar countries. According to Linder (1961) hypothesis it is expected a negative relationship between income differences and IIT. Linder (1961) theory can also explain VIIT. The less developed countries with low per capita incomes specialize and

[1] The idea of a dynamic variant without a theoretical support was previously introduced by Baier and Bergstand (2001) and Badinger and Breuss (2004). The dynamic approach has been frequently used in studies of firms' growth, growth of trade and productivity spillovers from foreign direct investment

export low-quality products (varieties) whereas the developed countries with high per capita incomes specialize and export high-quality products (varieties of the same product). So, the Linder's theory suggests that the higher the difference in per capita income, the greater the VIIT.

The Linder theory is consistent with some aspects of the product cycle theory developed by Vernon (1966). The Vernon's theory divides the life cycle of the new product into three stages: new product stage, maturing product stage and standardized product stage. The country source of exports shifts throughout the life cycle of the product and the foreign direct investment (FDI) has a decisive role in this dynamic process. In the last product stage the technology becomes available to the less developed countries through the FDI . This allows that less developed countries export low-quality differentiated products to the developed countries, importing at the same time the high-quality product varieties from these countries. So, the Vernon's theory suggests a positive relationship between VIIT and per capita income differences and between VIIT and FDI.

In the theoretical models the distinction between the two types of IIT is very important. As was stressed by Greenaway et al. (1994,1995) there are theoretical reasons – different determinants – and empirical evidence that justify to separate HIIT from VIIT. The first theoretical models about IIT were made by Krugman (1979, 1980, 1981), Lancaster (1980) and Helpman (1981). This work was synthesized in Helpman and Krugman (1985) Chamberlin-Heckscher-Ohlin model. This is a model that combines monopolistic competition and Heckscher-Ohlin (HO) theory, incorporating factor endowments differences, horizontal product differentiation and increasing returns to scale. The model generates both intra- and inter-industry trade and formulates the following country-specific hypothesis: the more different are the factor endowments, the smaller is IIT. As horizontal product differentiation considers that different varieties are of the same quality, but of different characteristics, they may be produced with similar factor intensity. So, Helpman and Krugman (1985) model also suggests the following country-specific hypothesis: the larger the difference in factor endowments, the smaller (larger) the extent of HIIT (VIIT).

Making the distinction between types of IIT, Linder theory can also be used to explain HIIT and VIIT. As the similarity of the demands determines the similarity of the goods traded, Linder (1961) suggests us the following country-specific hypothesis: the more different the factor endowments, the smaller (greater) the extent of HIIT (VIIT).

The main reference in VIIT models are Falvey (1981), Shaked and Sutton (1984), Falvey and Kierzkowski (1987) and Flam and Helpman (1987). The essential of these models can be summarized as follows. Vertical product differentiation means that different varieties are of different qualities and, on the demand side, it is assumed that consumers rank alternative varieties according to product quality. On the supply side it is assumed that high- (low-) quality varieties are relatively capital- (labor-) intensive. In the HO theory, as in the Neo-HO theory, there is a linkage between factor endowments of the countries and factor proportions. The relatively labor-abundant countries have comparative advantages in labor-intensive products lower-quality varieties) and relatively capital-abundant countries have comparative advantage in capital-intensive products (higher-quality varieties).

For example, Falvey and Kierzkowski [1987, p.144], following the Linder hypothesis, consider that "a significant element in explaining vertical product differentiation will be unequal incomes". Inequalities in income distribution ensure that both countries will demand all the available qualities. So, a large difference in income levels increases the share of VIIT because income differences generate dissimilarity in demand. This is on the demand side. On the supply side, the model considers technology differences and product quality linked to capital intensity of production. Thus it is expected that technologically advanced countries (with higher productivity and higher wages) will have comparative advantages in capital-intensive products (higher-quality set of varieties), which they will then export. These countries are capital-abundant, since capital is relatively cheaper. Symmetrically, the labor-abundant country (low-wage country) will have comparative advantages in low-quality varieties that are labor-intensive. The framework of the Flam and Helpman [1987] model is similar, but it is the differences in technology (labor productivity) that explain VIIT. The conclusion is similar: the most productive country, where wages are higher, exports the highest-quality varieties.

To sum up, the Neo-HO theory shows that VIIT takes place between countries with different factor endowments (supply-side) and with differences in per capita income (demand-side).

HO theory has been generalized in two versions: the Jones (1956) commodity content version and the Vanek (1968) factor content version. After the Leontief paradox, the commodity version included a new factor, human capital as a non-homogeneous factor and become known as neo-factor proportions theory (see Baldwin, 1971, Hirsch, 1974, Stern and Maskus, 1981). So, we decided to include as an explanatory variable the difference in human capital endowments jointly with the differences in physical capital.

About the empirical studies we revisited here, they may be synthesized as follows. Helpman (1987) tested three predictions based on Helpman and Krugman (1985) model using data from fourteen OECD countries and his results suggest the confirmation of the theory. Hummels and Levinsohn (1995), using a panel data analysis, did the same Helpman's tests and conclude that the theory is confirmed. However, when country-specific fixed effects (country-pair dummies) were used they conclude that most of the variation in the share of IIT for all country pairs of OECD countries was explained by factors that were specific to the countries. This result contradicts the results of the Helpman's(1987). Hummels and Levinsohn (1995) conclude that their results are inconsistent with Helpman and Krugman (1985) model and questioned the empirical success of the monopolistic competition models. May be the solution would be not to refine the theory, as Hummels and Levinsohn suggested, but, following Greenaway et al. (1994), to consider that IIT encompass both VIIT and HIIT and we need to separate them because they have different determinants. Other possible solution to the empirical success of these theoretical models would be the use of different econometric techniques and specifications.[2] Greenaway et al. (1994) separate HIIT from VIIT, but do not use the panel data framework and, furthermore, use the income variable as a proxy for differences in relative factor endowments. The given assumption is that per-capita income reflects both demand- and supply-side factors. This has potential problems, as Hummels and Levinsohn (1995) suggests.

Our main objective is to avoid these problems and to compare the results, examining if dynamic panel data estimations brings us something new.

3. Portugal's IIT over Time

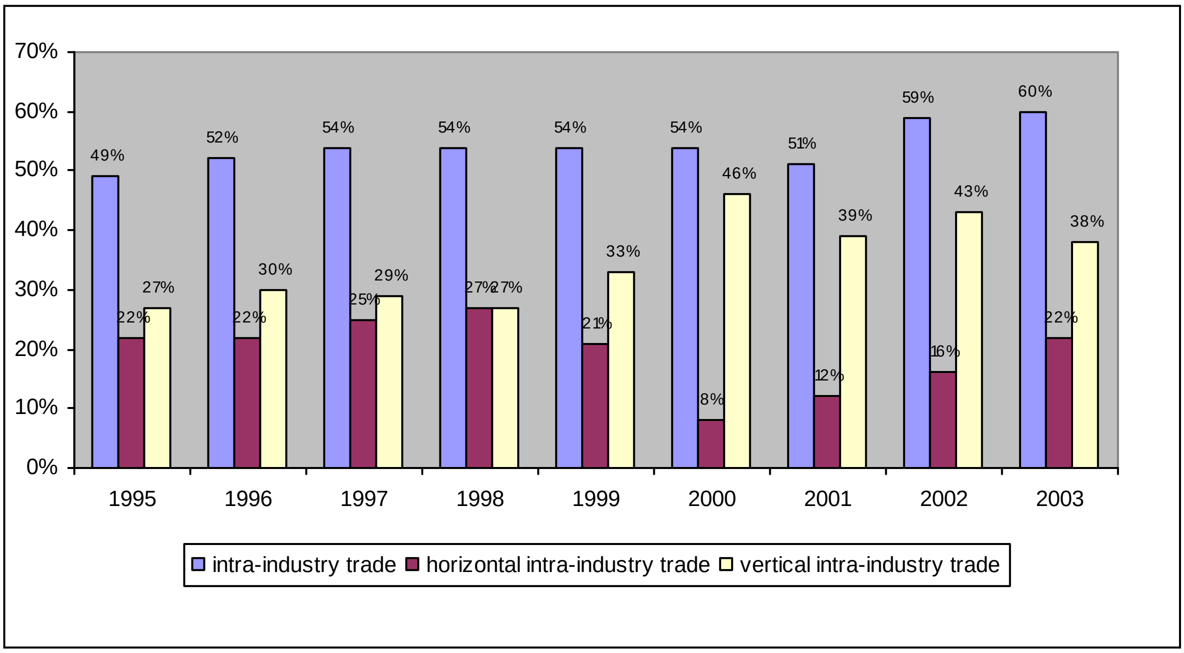
Figure 1 shows Portugal's IIT, HIIT and VIIT indexes over the period 1995-2003.
Three points should be highlighted. Firstly, the IIT index in trade between Portugal and EU-15 increased over the period from 49% in 1995 to 60% in 2003. Secondly, the

[2] In static panel data models, three kinds of estimators are used: pooled OLS, fixed effects and random effects estimators. The results of the empirical studies that use a static panel data approach are questionable due to the difficulty in finding exogenous variables than can be regarded a priori as being uncorrelated with the individual effects.

predominance of VIIT in total IIT, although its relative importance had decreased from 85% in 2000 to 63,3% in 2003 . Thirdly, These values are in accordance with those expected for a developed country as Portugal . Other country studies that distinguish VIIT from HIIT observed the same predominance (e.g. Greenaway et al.,1994; Aturupane et al.,1999; Zhang et al. 2005).

FIGURE 1

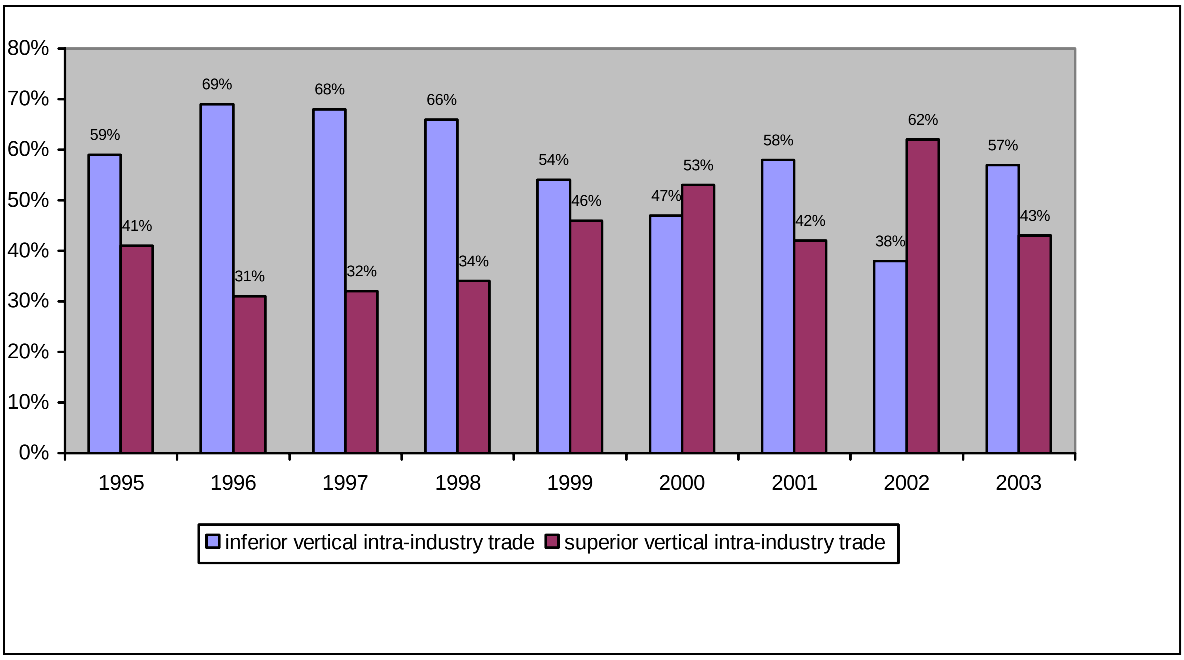
IIT by types between Portugal and European Union in the Period 1995-2003



Source: Own calculations from INE database.

Figure 2 reports the weight of high-quality (superior) VIIT and low-quality (inferior) VIIT in total VIIT. The proportion of inferior VIIT is predominant over 1995-2003 period, except in the years 2000 and 2002. However the predominance of low-quality VIIT is particularly high in the sub-period 1995-98. In conclusion, it would seem that Portugal IIT with EU-15 has been dominated by inferior VIIT, although this predominance has decreased in the last years.

FIGURE 2
Weight of inferior VIIT and superior VIIT in Total VIIT between Portugal and European Union



Source: Own calculations from INE database.

4. Empirical Model

The dependent variables used are the IIIT Grubel and Lloyd (1975) index and HIIT and VIIT indexes. The explanatory variables are country-specific characteristics that have been used in others empirical studies (e.g. Greenaway et al., 1994; Hummels and Levinshon, 1995; Zhang et al. 2005). The data for explanatory variables are sourced from World Bank, World Development Indicators (2005). The source used for dependent variables was INE- National Institute of Statistics (Trade Statistics).

4.1. Dependent and Explanatory Variables

The IIT index

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.

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

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

In the empirical analysis, we consider all the products at the five-digit level of the Combined Nomenclature (CN). In econometric analysis, the 5-digit product categories were aggregated to the 3-digit industry level, according to the Portuguese Classification of Economic Activities (CAE)[3]. The conversion between CN and CAE is provided by INE. Our sample comprises the fifteen member states of the European Union (EU15), prior to its enlargement in 2004 (trade data for Belgium and Luxembourg is aggregated).

The HIIT and VIIT indexes

To separate horizontal from vertical intra-industry trade it is used the Grubel and Lloyd index and the methodology of Abel-el-Rahaman (1991), and Greenaway et al. (1994). Relative unit values of exports and imports (TT_{ij}) is used to disentangle total IIT into total HIIT (RH) vis-à-vis total VIIT (RV). We use a unit value dispersion of 15 per cent

If $TT_{ij} \in [0{,}85;1{,}15]$, we have RH; otherwise we have RV.

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

HIIT- Horizontal intra-industry trade índex.

Xi, Mi are the exports and imports of the industry i.

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

VIIT- Vertical intra- industry index

If TTij < 0,85 ou TTij >1,15 we have VIIT. TTij < 0,85, we have inferior VIIT (lower quality varieties). TTij> 1.15, we have superior VIIT (higher quality varieties).

[3] At this level of disaggregation, CAE is similar to NACE.

The HIIT and VIIT are calculated with desegregation of 5 digits CAE from INE-Trade Statistics.

4.2. Explanatory variables and expected sign

In order to analyse the country-specific determinants of the IIT, HIIT and VIIT, we used the following explanatory variables:[4]

- LogDGDP is the logarithm of the absolute difference in GDP per capita (PPP, in current international dollars) between Portugal and the European trade partner. Falvey and Kierzkowski (1987) suggest a positive for VIIT model and Loertscher and Wolter (1980) and Greenaway et al. (1994) provide empirical support for a negative relation between difference in per capita income and HIIT. Linder (1961) considers that countries with similar demands will trade similar products. So, the Linder hypothesis suggests a negative sign for IIT (See, also, Falvey and Kierzkowski,1987, Helpman ,1987, and Hummels and Levinshon, 1995). The underlying hypothesis is that the similarity in incomes implies a greater similarity in the demands. So the more similar are the countries the larger will be IIT. Based on Helpman(1987), Greenaway et al. (1994) uses this variable to test the effects of factor endowments differences on HIIT and VIIT. This is problematic because per capita income reflects both demand and supply side. Hummels and Levinshon (1995) alternately employ per capita income and factor ratios. In this paper, we consider different variables for demand and supply sides and we will use two proxies for factor endowments differences;
- LogEP, it is a proxy for difference in physical capital endowments. It is the logarithm of absolute difference in electric power consumption (Kwh per capita) between Portugal and European partner . Based on Helpman and Krugman (1985) we formulated the following hypothesis: the larger the difference in factor endowments the larger (smaller) the VIIT (HIIT). Bergstrand (1983) found empirical support for a negative relationship between the differences in factor endowments and HIIT. Helpman and Krugman (1985), Helpman (1987) and Hummels and Levinsohn (1995) considered a negative relation between IIT and differences in factor endowments. In our opinion, as IIT encompass both HIIT and VIIT the expected sign for IIT is ambiguous. It is a matter of empirical evidence ;

[4] We also considered other explanatory variables as “Distance”, “Differences in school enrollment rate in tertiary education” and “Trade imbalance” (to control for bias in estimation), but the introduction of these variables do not improved the results.

- LogEC , it is the second proxy for difference in physical capital endowments. It is the logarithm of absolute difference in energy use (kg of oil equivalent per capita) between Portugal and European partner. It is expected a negative (positive) sign for HIIT (VIIT) and an ambiguous sign for IIT;
- LogSEC it is the proxy for the difference in human capital endowments. It is the logarithmic of the absolute difference in school enrollment rate in secondary education between Portugal and the European trade partner. According to the literature, as higher the difference in factor endowments between Portugal and its trade partners higher (less) will be VIIT (HIIT). So, we expected a positive sign for VIIT, a negative sign for HIIT and an ambiguous sign for IIT.

- LogDIM is the logarithm of the average of GDP (PPP, in current international dollars) between Portugal and European trade partner. This is a proxy for economic dimension and it is expected a positive sign (Loertscher and Wolter ,1980, Greenaway et al., 1994);
- LogFDI, it is the logarithm of the foreign direct investment, net inflows , that originate from a trade partner (%GDP). Markusen (1984), Helpman (1984, 1985) provide an explanation for a positive relation between FDI and IIT, both vertical and horizontal. Greenaway et al. (1995) consider a positive sign for IIT. The product life cycle theory of Vernon (1966) also justifies that FDI is positively associated with VIIT;
- LogMinGDP is the logarithm of the lower value of GDP per capita (PPP , in current international dollars) between Portugal and European partner . This variable is included to control for relative size effects. According to Helpman (1987) and Hummels and Levinshon (1995) it is expected a positive sign for IIT, HIIT and VIIT;
- LogMaxGDP is the logarithm of the higher value of GDP per capita (PPP, in current international dollars) between Portugal and the European partner. This variable is also included to control for relative size effects. It is expected a negative sign (Helpman,1987 ; Hummels and Levinshon, 1995).

4.3. Model Specification

$$IIT_{it} = \beta_0 + \beta_1 X_{it} + \delta t + \eta_i + \varepsilon_{it}$$

Where IIT_{it} stands for either IIT, HIIT,or VIIT, that means Total, Vertical or Horizontal Portuguese IIT index ,X is a set of country- specific explanatory variables in logs ; ηi is the unobserved time-invariant country-specific effects; δt captures a common deterministic trend; ε_{it} is a random disturbance assumed to be normal, independent and identical distributed (IID) with E (εit) =0 and Var (εit) = σ^2 >0 .

The model can be rewritten in the following dynamic representation:

$$IIT_{it} = \rho IIT_{it-1} + \beta_1 X_{it} - \rho\beta_1 X_{it-1} + \delta t + \eta_i + \varepsilon_{it}$$

Because IIT is an index varying between zero and one we apply a logistic transformation to IIT, HIIT and VIIT (see Hummels and Levinsohn ,1995).

$IIT = \ln[IIT/(1-IIT)]$. The same is made for HIIT and VIIT.

5. Estimation Results

5. 1. Results for the Static Models

We only present the fixed effects estimates, although the random-effects regression results are similar to the fixed-effects results. The fixed-effects estimator was selected, because it avoids the inconsistency due to correlation between the explanatory variables and the country-specific effects (Arellano and Bover,1995).

The main results of the estimated regressions for IIT, HIIT and VIIT, present in table1, can be summarized as follows: (i) the variable LogDGDP (difference in per capita income) is not statistically significant in all models. The estimated coefficient has a predicted (non predicted) negative sign for the IIT and HIIT (VIIT) model. So, these static results do not confirm the Linder's hypothesis.

(ii) both variables proxy for differences in factor endowments are statistically significant in IIT model. The variable LogEP (difference in electric power consumption) has a negative effect on IIT and the variable LogEC (difference in energy use) has a positive sign.

(iii) The variable LogSEC (difference in school enrollment rate in secondary education) used as proxy for difference in human capital endowments is not statistically significant in all models.

(iv) The variable LogDIM (average of GDP), used also by Greenaway et al. (1994), has a significant and predicted positive effect on IIT, but it is insignificant in both HIIT and VIIT models.

(v) The variable LogFDI (foreign direct investment) enters significantly in IIT model and has a predicted positive sign, but it is insignificant in both HIIT and VIIT models.

(vi) The variables LogMinGDP and LogMaxGDP, included as size effect controls, are statistically significant in IIT and VIIT models, although LogMinGDP has a wrong sign.

(vii) The results for HIIT and VIIT regressions are very poor. In HIIT equation only LogEC is significant, whereas in VIIT regression only the variables that control for bias are significant. May be there are a possible misspecification and/or the potential endogeneity of the explanatory variables. These results suggested us a dynamic specification.

(viii) The explanatory power of the IIT regression is very high (R^2 = 0.967). So, we can conclude that in Hummels and Levinsohn (1995) paper the fixed effects are picking up the effects of the missing explanatory variables. The R^2 of their fixed effects regression jumps from 0.524 (without country-pair dummies) to 0.96 when country dummies are included in regression. Instead of country-pair dummies we use country-specific variables.

Table 1– Estimated Regressions for IIT, HIIT, and VIIT

	Fixed effects			Expected sign		
Variable	IIT	HIIT	VIIT	IIT	HIIT	VIIT
LogDGDP	-0.089	-0.038	-0.256	(-)	(-)	(+)
	(-0.367)	(-0.054)	(-1.131)			
LogEP	-0.814	-1.474	-1.078	(+/-)	(-)	(+)
	(-2.359)**	(-0.752)	(-1.379)			
LogEC	0.125	0.478	0.043	(+/-)	(-)	(+)
	(1.678)*	(2.057)**	(0.444)			
LogSEC	0.052	-0.405	0.014	(+/-)	(-)	(+)
	(0.523)	(-0.594)	(0.077)			
LogDIM	1.542	-4.615	2.062	(+)	(+)	(+)
	(1.707)*	(-1.287)	(1.574)			
LogFDI	0.085	-0.016	0.059	(+)	(+)	(+)
	(2.013)**	(-0.54)	(0.673)			
LogMINGDP	-1.900	4.108	-2-234	(+)	(+)	(+)
	(-2.443)**	(1.227)	(-1.654)*			
LogMAxGDP	-0.686	1.484	-0.771	(-)	(-)	(+)
	(-2.542)**	(1.304)	(-1.769)*			
Adj.R^2	0.967	0.639	0.794			
N	88	88	88			

Note: t-statistics (heteroskedasticity corrected) are in parentheses. ***, **, * indicates significance at the 1% , 5% and 10% level respectively.

5. 2. Results for the Dynamic Models

We considered an individual effects autoregressive panel data model and that the explanatory variables are not strictly exogeneous with respect to error term.[5]

The dynamic panel data model is valid if the estimator is consistent and the instruments are valid. The Sargan test of over-identifying restrictions tests the validity of the instruments. The first- and second- order serial correlation in residuals is tested by M_1 and M_2 statistics. The GMM system estimator is consistent if there is no second-order serial correlation.

According to the specification of the dynamic model it is important the estimated sign for the difference between coefficients of the same variable and the lagged variable (e.g., ΔLogEP = Log EP- $LogEP_{t-1}$).This requires that both variables are statistically significant. However, we also consider the result to be relevant when only the variable or the lagged explanatory variable is significant, but in this case we do not consider the difference between coefficients.

The regression results presented in table 2 can be summarized as follows:

(i)Lagged IIT, HIIT and VIIT variables have an expected positive sign and are significant in IIT and HIIT models.

(ii) As Greenaway et al. (1994) cross-section study, we find evidence in support of the Linder's hypothesis in IIT, HIIT, VIIT panel data dynamic models. However, Greenaway et al. (1994) found unexpected positive sign for income per capita differences in IIT model. In our study, the variable LogDGDP (difference in per capita income) has a negative and significant sign in IIT, HIIT and VIIT equations. However, if we consider the joint effect of LogdGDP and $LogDGDP_{t-1}$ the sign in VIIT equation is positive (the difference between coefficients is positive, i.e., -0.983+2.405 >0).

(iii) The sign of the physical capital endowments difference proxies (LogEP and LogEC) are as expected in all three models, but LogEP(difference in electric power consumption) is significant only in HIIT model and LogEC (difference in energy use) is significant only in VIIT model.

[5] As reported by Arellano and Bover (1995) and Blundell and Bond (1998), we have an interesting case when 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.

(iv) The human capital endowments difference proxy (LogSEC) is significant in HIIT and VIIT equations. However, the negative sign in VIIT equation is contrary to expectations.

(v) The variables LogDIM (dimension) LogFDI and LogMinGDP are not statistically significant in all models.

(vi) The variable LogMaxGDP is significant in all models and has the expected negative sign.

(vii) The Sargan test and M_2 statistics show that the instruments used are valid and the parameter estimates are consistent.

Comparing the GMM estimates with the fixed effects estimates we note an improvement in the results for HIIT and VIIT models. However there are variables that are insignificant and/or with the wrong sign. As we used the same specification for all models, may be the solution of the problem is to use different equations for HIIT and VIIT models. As in our sample VIIT accounts on average for 64 per cent of the total IIT it is acceptable that in the future we use the same regression for IIT and VIIT and a different equation regression for HIIT. Another solution is to use capital stock and labor force from Penn World Tables (if available) and do not use the proxies for the capital-labour ratio.

Another remarkable difference is that the income per capita differences variable (LogDGDP) is now significant and with the predicted sign in IIT, HIIT and VIIT models.

Table 2 – Estimated Regressions for IIT, HIIT and VIIT

GMM-SYSTEM				EXPECTED SIGN		
Variable	IIT	HIIT	VIIT	IIT	HIIT	VIIT
Constant	26.295	160.03	112.76			
	(2. 03)	(1.58)	(2.62)			
(IIT; HIIT; VIIT)t-1	0.645	0.473	0.134	+	+	+
	(4.29)***	(4.62)***	(0.715)			
LogDGDP	-0.323	-1.262	-0.983	(-)	(-)	(+)
	(-1.77)*	(-1.96)**	(-2.33)**			
LogDGDPt-1	0.362	0.627	2.405			
	(0.898)	(0.831)	(2.12)**			
LogEP	0.270	-4.769	1.496	(+/-)	(-)	(+)
	(0.372)	(-1.89)*	(0.904)			
LogEPt-1	-0.119	5.397	-1.868			
	(-0.14)	(2.12)**	(-1.05)			
LogEC	0.306	-1.003	0.914	(+/-)	(-)	(+)
	(1.43)	(-1.49)	(1.99)**			
LogECt-1	-0.404	0.457	-1.150			
	(-1.94)*	(0.586)	(-2.48)**			
LogSEC	-0.196	-0.968	-0.934	(+/-)	(-)	(+)
	(-1.28)	(-1.81)*	(-1.84)**			
LogSECt-1	0.159	0.039	-0.192			
	(0.886)	(0.06)	(-0.444)			
LogDIM	-1.184	-2.77	-8.184	(+)	(+)	(+)
	(-0.255)	(-0.25)	(-0.986)			
LogDIMt-1	-3.033	-9.65	4.115	(+)		
	(-0.778)	(-0.76)	(0.531)			
LogFDI	-0.031	0.496	-0.226	(+)	(+)	(+)
	(-0.195)	(1.01)	(-0.891)			
LogFDIt-1	-0.148	-1.087	-0.025			
	(-1.18)	(-1.77)*	(-0.07)			
LogMINGDP	1.843	-19.95	-8.391	(+)	(+)	(+)
	(0.313)	(-1.18)	(-0.967)			
LogMINGDPt-1	1.535	29.81	12.12			
	(0.285)	(1.56)	(1.61)			
LogMAxGDP	-10.02	-50.75	-50.30	(-)	(-)	(-)
	(-2.14)**	(-2.04)**	(-3.15)***			
LogMAxGDPt-1	8.187	37.26	38.26			
	(2.19)**	(2.28)**	(3.13)***			
M1	-1.181	-1.113	-0.647			
	[0.238]	[0.266]	[0.517]			
M2	0.137	0.916	0.454			
	[0.891]	[0.360]	[0.650]			

Table 2 (cont) – Estimated Regressions for IIT, HIIT and VIIT

	GMM-SYSTEM			EXPECTED SIGN		
Variable	IIT	HIIT	VIIT	IIT	HIIT	VIIT
W_{JS}	4999 [0.000] df=17	5954 [0.000] df=17	6449 [0.000] df=17			
Sargan	-1.9e-15 [1.000] df=55	3.3e-015 [1.000] df=73	1.645e-15 [1.000] df=45			
N	74	74	74			

Note: ***, **, * indicates significance at the 1% , 5% and 10% level respectively.
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).P-values are in square bracketes.Year dummies are included in all specifications (it is equivalent to transforming the variables into deviations from time means, i..e the mean across the n industries for each period). M1 and M2 are tests for first-order and second–order serial 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 estimator).W_{JS} is the Wald statistic of joint significance of independent variables , excluding time dummies and the constant term (two-step estimation)Sargan is a test of the over-identifying restrictions, asymptotically distributed as χ^2 under the null of instruments validity (two-step estimation) . Instruments used: 1- IIT and HIIT models. The instruments used are LOGIIIT (3,4) or LOGIHIIT (3,4), LogMinGDP (3,4), LogMaxGDP (3,4) for the equations in first differences and first differences of all variables for the equations in levels; 2- VIIT model. The instruments used are LOGIVIIT (3,4), LogMinGDP (3,4), LogMaxGDP (3,4) for the equations in first differences and first differences of all variables except LogMinGDP and LogMaxGDP for the levels equation.

6- Conclusions

In this paper we tested some hypotheses generated from Linder's and Vernon's international trade theories, and from formal models as Helpman and Krugman's (1985), and Falvey and Kierzkowski's (1987) models. We also revisited Greenaway et al. (1994) and Hummels and Levinsohn (1995) empirical studies, that tested some of these hypotheses, although with different econometric specifications and estimators. Following Hummels and Levinsohn (1995), and according to Linder, we considered that demand structure is proxied by the difference in per capita income difference and that the supply side structure is proxied by the factor endowments difference. So, we do not consider that per capita income difference is an adequate proxy to measure differences in factor composition. Our findings reveals that the Linder's hypothesis (the demand similarity hypothesis) is confirmed when we include the supply-side variables. The results presents a negative (positive) relationship between income per capita difference and IIT, HIIT (VIIT) , when we use a dynamic panel data analysis. Our results also suggest that country-pair dummies used by Hummels and Levinsohn (1995) should be replaced by differences in relative factor endowments(physical and human capital) and other country-specific variables as economic dimension and foreign direct investment. Comparing our static panel data regression (without country-pair dummies) with Hummels and Levinsohn's panel data regression (with country-pair dummies) we conclude that explanatory power of both regressions is identical (R^2=0.96). Comparing our results with those of Greenaway et al.(1994) we note that both found a negative relationship between per capita income differences and both types of IIT. However our dynamic analysis allow us to conclude that the effect on VIIT is positive if we consider the marginal effect (ΔLogDGDP). So, 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 IIT studies rather than pooled OLS, fixed effects or random effects estimators. At least the results should be verified. In our opinion, 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 endogeneous right-hand-side variables.

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