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Using the Gravity Equation to Explain the Portuguese Immigration-Trade Link

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ABSTRACT This paper tests the relation between immigration and Portuguese bilateral trade. Using a panel data analysis, the results show that the stock of immigrants has a positive effect on Portuguese exports, imports and bilateral intra-industry trade. The underlying assumption is that immigration contributes to decrease the costs of transactions, which in turn promotes trade flows. The results do not confirm the hypothesis of a negative effect of immigration on Portuguese exports. Our findings suggest that when immigrants to Portugal come from a Latin partner-country, the effects on trade are stronger than in the case of immigrants from non-Latin countries. The study is based on an extended gravitational model, in order to incorporate the qualitative factors as control variables.

KEY WORDS: intra-industry trade; immigration; gravity model; panel data.

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I. Introduction

With globalization, many nations have liberalized their trade policies and removed trade barriers. The transaction costs have decreased and immigration has contributed to increase international trade: inter-industry trade and intra-industry trade (IIT). According to the traditional trade theory (Ricardian and Heckscher-Ohlin models), the factor movements and trade are substitutes. According to the new trade theory, the link between migration and IIT can be established through the trade transaction costs (see, for example, Helpman and Krugman, 1985). However, the theoretical literature on the effects of immigration on trade is scarce. In his seminal paper, Rauch (1999) proposes a network view of trade in differentiated products where immigration can lead to a reduction in trade transaction costs. He uses a gravity model of international trade to test if proximity and common language/colonial ties are more important to differentiated products than for homogeneous products. There are some empirical studies on the relation between immigration and trade (see Girma and Yu, 2002; Blanes, 2005; White, 2007).

In this paper, which attempts to increase the scarce empirical evidence on this subject, we analyse the impact of immigration on Portuguese trade. The purpose of this paper is to test for the impact of immigration on Portuguese exports (X) and imports (M) and on Portuguese IIT by types (horizontal IIT, and vertical IIT), controlling the effects of other socio-economic factors, like factor endowments, distance and culture. As the purpose of this paper is not to estimate the determinants of inter-industry or intra-industry trade, it only requires applies trade theory in order to gain an understanding of the link between factor movements and trade flows and to justify the expected sign of the explanatory variables' coefficients.

To test our hypotheses, we use the gravity model, which has been applied to explain varying types of flows, such as bilateral trade flows and migration. The core explanatory variables to explain bilateral trade in the gravity model are measures of the economic size of trading partners (positive or gravitational effects) and the distance between them (a negative effect or counter-force). The gravity equation can be thought of as a kind of short-hand representation of supply (exports of a country to the world market) and

demand forces (imports of a country), with stimulating or restraining elements (tariff barriers, distance, culture, other socio-economic factors). Since Anderson (1979), it has been recognized that the predictions of the gravity model can be derived from different models (Ricardian and Heckscher-Ohlin models and new trade theory models, such as Helpman and Krugman 1985 models).

This paper uses a panel data analysis and considers the trade between Portugal and each European partner-country (EU-15) for the period 1995-2003. Estimation results confirm the hypothesis that the immigration stock has a positive effect on imports and intra-industry Portuguese trade.

.The remainder of the paper is organized as follows. The next section describes the theoretical background to the relationship between immigration and trade. Section 3 presents the gravity model. Section 4 presents the empirical model. Section five reveals the econometric results. The final section concludes.

II. The Relationship between the Immigration and Trade

There is currently a debate as to whether the migration of labour and international trade are substitutes or complement. The link between immigration and trade can be explained by the Heckscher-Ohlin (HO) model. Under the assumption that specialization is incomplete, the factor price equalization theorem, also known as the Heckscher-Ohlin-Samuelson (HOS) theorem, provides strong evidence that trade in final goods essentially substitutes for movements of factors between countries, leading to an increase in the price of the abundant factor and a fall in the price of the scarce factor among the trading partners until relative (and absolute) factor prices are equal. Thus, under the HO assumptions, trade and labour mobility are substitutes. In other words, the trading of goods substitutes for the trading of people. When a country imports labour-intensive goods, it is equal to "importing" labour from these countries and this "mechanism" leads to the equalization of wage rates across countries even if labour is internationally immobile. Immigration and imports of labour-intensive goods are substitutes. In the same way, exporting labour-intensive goods corresponds to "exporting" labour. The question is, what happens if the migration flows are introduced into the HO model? As the HO

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model treats goods flows and migration flows symmetrically, this does not alter the HO theorem (each country specializes and exports the goods that are intensive in the country's relatively abundant factors) and the HOS theorem (free trade will equalize the factor prices). Furthermore, what happens to the trade flows? Unfortunately, as is mentioned by Borjas (1989) and Blanes (2005), international trade theory and empirical studies have almost ignored the effects of labour migration on trade flows.

According to Rauch (1999), Girma and Yu (2002), and Blanes (2005), immigrants can influence bilateral trade flows in two ways. The first is associated with the notion that the immigrants bring with them a preference for home-country products (preference channel). The second expresses the idea that immigration can reduce transaction costs between the home and host countries, through ethnic networks or information mechanisms (transaction cost reduction channel).

Following these authors, and considering that there is an immigrant preference for home-country products, we will expect a positive effect of immigration on imports and a negative effect on exports.

 However, the HO trade model is an inter-industry trade type model. When we consider IIT, the reality can be rather different and we can find a complementary, rather than a substitute relationship between trade and international factor movements. In this case, trade and immigration can complement each other. We can think about market imperfections, namely, information asymmetries and their effect on consumption preferences and intra-industry trade. In the perfect competition model, the workers have the same preferences and the information on this market is symmetric. In the imperfect competition model, if the immigrants have legal registered status, there is more information on their preferences and the transaction costs decrease. In the medium or long run, when the immigrants take the citizenship of the host country, the transaction costs also decrease. So, if transaction costs are proxied by the costs of acquiring market information, immigration will have a positive effect on bilateral IIT. The mechanism is the relation between immigration, market information and trade transaction costs. As IIT occurs mainly in differentiated products (Helpman and Krugman, 1985), there is an

underlying assumption: the elasticity of substitution between varieties of the same product is higher than the same elasticity between homogeneous products.

Gould (1994), Dunlevy and Hutchinson (1999) and Girma and Yu (2002) found a positive relationship between immigration and bilateral trade between host and home countries. Gould (1994) considered that trade in differentiated products involves stronger immigrant effects. The reason is that the additional information brought by immigrants is more relevant to consumer goods than to producer goods and the increasing imports will satisfy immigrants' specific preferences. Blanes (2005) argues and concludes that the immigrants have a positive effect on trade in differentiated products, measured by the IIT index.

III. The Gravity Equation

The gravity model is analogous to Newton's Law of Gravity, which states that the gravity between two objects is directly related to their masses and inversely related to the distance between them. According to the gravity approach, the trade between two countries is directly related to their incomes (or per-capita incomes) and inversely related to the distance between them.

$$F_{ij} = G \frac{Y_i^\alpha Y_j^\beta}{D_{ij}^\delta} \tag{1}$$

Where F_{ij} denotes the flow from country i to country j. Y_i and Y_j are the economic sizes of the two countries, usually measured as the gross domestic product (GDP), or per-capita GDP. D_{ij} is the distance between countries. G is a gravitational constant.

In order to facilitate the econometric estimations, we apply logs the gravity equation (1) and hence, we obtain a linear relationship as follows:

$$\text{Ln } F_{ij} = \ln G + \alpha \ln Y_i + \beta \ln Y_j - \delta \ln D_{ij} \tag{2}$$

Where lnG corresponds to the intercept, while α, β and δ are elasticities.

Based on Anderson (1979) and Rauch (1999), the empirical model may include other variables based on trade theory, such as immigration. Despite the discussions about the theoretical foundations of the variables that appear in the gravity equations, the results are very robust because the gravity model allows more factors to be taken into account to explain bilateral trade flows.

IV. The Econometric Model and Data Source

The sources of the data on the explanatory variables are the World Bank, World Development Indicators (2005) and Serviços de Fronteiras, Ministério da Administração Interna (Border Services Administration, Portugal). The source used for dependent variables was INE – the Portuguese National Institute of Statistics (Trade Statistics)

IV.1. Dependent Variables

The Grubel and Lloyd IIT index

The Grubel and Lloyd (1975) index is employed as a measure for IIT between Portugal, country i, and European partner j. X and M are bilateral exports and imports. To avoid problems of statistical aggregation, the data is at the 5-digit level of the SITC classification .

$$IITi = \frac{\sum_{j=1}^{n} \left(X_{ij} + M_{ij}\right) - \sum_{j=1}^{n} \left|X_{ij} - M_{ij}\right|}{\sum_{j=1}^{n} \left(X_{ij} + M_{ij}\right)}$$

(3)

The HIIT and VIIT indexes

To separate horizontal from vertical intra-industry trade, the Grubel and Lloyd index and the methodology of Abd-el-Rahaman (1991), and Greenaway et al. (1994) are used. Relative unit values of exports and imports are 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. Moreover, we must consider:

$$HIIi = \frac{RH_i}{\sum_{j=1}^{n} \left(X_{ij} + M_{ij} \right)} \tag{4}$$

$$VIIT_i = \frac{RV_i}{\sum_{j=1}^{n} \left(X_{ij} + M_{ij} \right)} \tag{5}$$

The HIIT and VIIT indexes are also calculated with the desegregation of 5-digit Portuguese Economic Activity Classification from INE - Trade Statistics.

IV.2. Explanatory Variables

The paper uses the following explanatory variables in logs:

 -LogDGDP is the logarithm of the absolute difference in per capita GDP (PPP, in current international dollars) between Portugal and the European trading partner. Loertscher and Wolter (1980) and Greenaway et al. (1994) provide empirical support for a negative relation between difference in per-capita income and IIT. Falvey and Kierzkowski (1987) suggest a positive sign for VIIT model and Loertscher and Wolter (1980) and Greenaway et al. (1994) provide empirical support for a negative relation between differences in per-

capita income and HIIT. The expected effect of this variable on exports and imports is positive;

- LogEP is a proxy for differences in physical capital endowments. It is the logarithm of absolute difference in electric power consumption (Kwh per capita) between Portugal and the European partners. Helpman and Krugman (1985), Helpman (1987) and Hummels and Levinsohn (1995) considered a negative relation between IIT and differences in factor endowments. Based on Helpman and Krugman (1985) and Bergstrand (1983), we expect a positive sign for the VIIT model and a negative sign for the HIIT model. The expected effect of this variable on exports and imports is positive;

- LogEC is the second proxy for difference in physical capital endowments. It is the logarithm of absolute difference in energy use (1 kg of oil equivalent per capita) between Portugal and the European partners. A negative effect is expected on IIT and HIIT and a positive effect on VIIT, exports and imports;

- 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), a positive sign is expected;

- LogMaxGDP is the logarithm of the higher value of GDP per capita (PPP, in current international dollars) between Portugal and the European partners. This variable is also included to control for relative size effects. A negative sign is expected (Helpman, 1987; Hummels and Levinshon, 1995);

- Log IMI is the logarithm of the stock of immigrants in Portugal by partner-country. This variable is included to capture any effects of immigration on trade flows. A positive effect of immigration is expected on imports, but not on exports. The expected effect on IIT, HIIT and VIT is positive. Blanes (2005) found a positive sign for the IIT model;

- LogDIST is the logarithm of geographical distance between the Portugal and partner country. Distance serves to proxy for transport costs. According to the gravitational model, a negative sign is expected for all models;

- BORDER is a dummy variable that equals 1 if the partner-country shares a border with Portugal (i.e., Spain) and 0, otherwise. The expected sign is positive for all models;

- LATIN is a dummy variable that equals 1 if the partner-country is a Latin country (i.e., Spain, Greece, France and Italy) and 0, otherwise. The expected sign is positive for all models.

IV.3. Empirical Specification

The econometric panel data model

$$F_{ijt} = \beta_0 + \beta_1 X_{ijt} + \delta_t + \varepsilon_{ijt} \tag{6}$$

Where F_{ijt} stands for either Portuguese exports, imports and IIT indexes; X is a set of country-specific explanatory variables. It includes dummy variables and a variable that measures the stock of immigrants from country j residing in Portugal (country i) during year t; δt captures a common deterministic trend; ε_{ijt} is a random disturbance assumed to be normal, independent and identically distributed (IID) with E (ε_{ijt}) =0 and Var (ε_{ijt}) = $\sigma^2 > 0$.

Because IIT is an index varying between zero and one, we apply a logistic transformation to IIT indexes (see Hummels and Levinsohn, 1995). All explanatory variables, except dummy variables, enter the equation in natural logarithms. We do not include the unobserved time-invariant country-specific effects, since this would remove some relevant variables that do not vary along time and that are important to the robustness of the results. We do control for time effects by including a time dummy variable (year).

V. Estimation Results

The results in Table 1 are consistent with the hypothesis of a positive correlation between

immigration and trade. The explanatory variable, LogIMI (stock of immigrants in logs) is highly statistically significant (1% level) in the five equations. The results are very robust to different measures of the dependent variable. The only result that is unexpected is the positive sign of LogIMI in the export equation. Therefore, we must hypothesize that the Portuguese manufactured goods had already incorporated specific tastes originating in the immigrants' home countries. So, the additional information provided by immigrants was relevant to consumer and producer goods and this led to an increase in exports and imports between immigrants' host and home countries.

When we consider intra-industry trade (IIT) as a dependent variable, the results are in accordance with expectations. The effect of the stock of immigrants on IIT is positive and remains positive when we consider IIT by types (HIIT and VIIT). These results confirm the hypothesis that the immigrants' information mechanism reduces the trade transaction costs in differentiated products and has a positive effect on all types of intra-industry trade.

Considering that the variable, LogDIST (distance in logs) can be used as a proxy for trade transaction costs and capture part of these costs, the introduction of this variable in all regressions controls for this effect. The results demonstrate that this variable has the correct sign in all equations and is statistically significant in three of them: exports, imports and VIIT equations.

When we control for per-capita income differences (LogDGDP) and factor-endowment differences, better results for the immigration variable are obtained.

On the other hand, if we did not incorporate these country specific characteristics the results were inferior, because the immigration variable captured these effects.

The dummy variable, LATIN has the expected positive sign, providing evidence that the effect of immigration on Portuguese trade is greater for the trade between Portugal and partner countries that are Latin than for the trade with other countries which do not share the same cultural background.

Table 1. The impact of immigration on trade

Variables	Exports X	Imports M	IIT	HIIT	VIIT	Expected Sign
LogDGDP	-0.183	-0.025	0.045	-1.163	0.599	X, M, VIIT(+)
	(-0.839)	(-0.147)	(0.150)	(-1.37)	(2.25)**	IIT,HIIT(-)
LogEC	-0.130	0.243	0.376	0.395	0.360	X, M, VIIT(+)
	(-1.08)	(5.62)***	(1.55)	(0.828)	(1.70)*	IIT,HIIT(-)
LogEP	0.292	-0.036	-0.354	-0.249	-0.589	X, M, VIIT(+)
	(3.83)***	(-0.290)	(-1.75)	(-0.466)	(-3.1)***	IIT,HIIT(-)
LogMinGDP	3.398	1.960	4.013	-0.596	4.342	(+)
	(2.89)***	(3.20)***	(2.52)**	(-0.079)	(2.67)***	
LogMaxGDP	2.865	2.055	3.735	6.045	2.663	(-)
	(3.33)***	(3.34)***	(3.50)***	(2.45)**	(2.81)***	
LogIMI	0.598	0.555	0.753	1.123	0.534	X(-), M(+)
	(8.36)***	(8.01)***	(5.82)***	(4.27)***	(5.24)***	IIT,HIITVIIT,(+)
LogDIST	-0.880	-1.188	-1.462	-1.003	-1.453	(-)
	(-1.70)*	(-3.1)***	(-1.57)	(-0.519)	(-2.08)**	
BORDER	-0.077	-0.042	-0.145	-0.263	-0.122	(+)
	(-0.257)	(-0.183)	(-0.262)	(-0.232)	(-0.298)	
LATIN	0.065	0.180	0.097	0.053	0.182	(+)
	(0.559)	(1.66)*	(0.573)	(0.136)	(1.26)	
C	-19.305	-9.412	-31.374	-22.920	-29.054	
	(-2.00)	(-1.60)	(-2.50)	(-0.598)	(-2.43)	
Adj.R^2	0.886	0.898	0.779	0.397	0.723	
Observations	112	112	112	112	112	

OLS estimations including time dummies variables.
T-statistics (heteroskedasticity corrected) are in round brackets. ***/**/*- statistically significant, respectively at the 1%, 5% and 10% levels.

VI. CONCLUSION

This paper tests the impact of immigration on Portuguese intra-industry trade. Immigrants express knowledge spillovers that can reduce information costs for economic agents. The empirical results indicate that this reduction in trade transaction costs is an important variable in the determinants of all trade. Our findings suggest that immigration leads to the reduction of trade transaction costs, and increases all types of intra-industry trade i, as

well as exports and imports. Comparing our results with those of Blanes (2005), we note that both found a positive relationship between immigration and IIT.

Although further research should be carried out into this subject, especially the relation between economic theory and international migration, considering the immigrants' different skills (see Borjas, 1999; Peixoto, 2001), this paper makes some new contributions. First, the paper examines the impact of immigration on all trade flows: exports, imports and intra-industry trade, by types. Second, the results permit us to conclude that immigration could be a vehicle that contributes to the decrease of trade transaction costs and could stimulate Portuguese trade. Third, the results suggest that the additional information brought by immigrants is equally relevant to consumer goods and producer goods. The positive effect on exports and imports confirm this hypothesis. Fourth, some of the control variables, such as relative factor endowments and distance, are found to be statistically significant and the results are more robust with the introduction of these country-specific characteristics variables. Fifth, the paper introduces cultural ties (common culture) and neighborhood as proxies for trade transaction costs. The introduction of these control variables also improved the specification model. The results suggest that when immigrants to Portugal come from a Latin partner-country, the effects on trade are greater than they are in relation to those from other countries. Finally, our findings suggest that Portuguese export industries need not be afraid of a liberal immigration policy: both host and source countries can gain. Free trade and freedom of labour migration are not a zero sum game. What is of most relevance for immigration policy is the immigrants' skills.

Although the theoretical models of IIT do not suggest a dynamic specification, we will introduce, in a further research, a dynamic variant of the static model, because in this model there are problems with serial correlation, heteroskedasticity and endogeneity of some explanatory variables. These econometric problems were resolved by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bound (1988, 2000), who

developed the first-differenced GMM and the GMM system estimators. Furthermore, we need to consider the all countries of European Union (EU27) and immigrants from other regions of the world, namely Brazil and African countries, as well as, the immigrants' skills.

Notes

1. In the same way, common language, culture or historical colonial ties, as well as geographical distance between countries, can be used as proxies for transaction costs.

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