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IMMIGRATION AND INTRA-INDUSTRY TRADE: THE RELEVANCE OF LANGUAGE, QUALIFICATION AND ECONOMIC INTEGRATION

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Abstract

This paper analyses the immigration into Portugal between 2000 and 2005, estimating the effect of the increasing stock of immigrants and some of its characteristics on Portugal's bilateral intra-industry trade with 37 countries. These comprise all the partner-states of the European Union (EU-27). Using panel data and the pseudo-likelihood logit estimator the results suggest that an increase of the immigrant stock will produce an increment in the intra-industry trade indexes. Our findings also suggest that immigrant qualifications and common language have a positive impact on intra-industry trade.

Key words: Immigration, intra-industry trade, language, qualification, entrepreneurship, Portugal, PALOPs, BRIC countries, European Union, logit pseudo-likelihood.

JEL classification: C33, F11, F12, F22.

Introduction

The aim of this paper is to estimate the effect of the increasing stock of immigrants and some of its characteristics on Portugal's bilateral intra-industry trade with 37 countries. These comprise all the partner-states of the European Union (EU-27), including Belgium and Luxembourg as a single entity, the five African countries with Portuguese as their official language (PALOPs) i.e. Angola, Cape Verde, Guinea-Bissau, Mozambique and São Tomé and Príncipe, together with Brazil, Russia, India and China, the USA, Moldova and Ukraine. In 2006, these countries accounted for 89% of the immigrants in Portugal and 83% of the country's trade in goods. The inclusion in the sample of PALOPs countries allows the paper to address the empirical question of whether culture, proxied by common language, can explain the evolution of intra-industry trade.

The empirical studies that test the hypothesis of a positive correlation between immigration and trade have increased in the last decade, using ad hoc processes as a gravitational approach, extended to include explanatory variables arising from the traditional and the new trade theories. These studies provide empirical evidence of the links between inter- and intra-industry trade and immigration, proposing new hypotheses for the trade theory (see, for example, Gould, 1994; Karemera et al., 2000; Girma and Yu, 2002; Gross, 2002; Blanes, 2006; White, 2007; Murat and Pistoresi,2009; Prettner and Kunst ,2009; Genc et al., 2010; Tadesse and White, 2011; Gross and Schmitt, 2011).

In Portugal the econometric studies relating the effects of immigration on trade are also very recent (see, e.g. Faustino and Leitão, 2008). Given the prior studies our motivation is threefold: first, to address the methodological question whether the use of a different estimator confirm or not the previous results; second, examine if the use of immigrant's characteristics - like the percentage of highly-qualified immigrants employed in manufacturing industry, the percentage of immigrant employers (entrepreneurs), common language with the host country- have a significant effect on intra-industry trade; three, address the empirical question of whether the degree of economic integration can help explain home countries' intra-industry trade.

Concerning estimation, since by definition the intra-industry trade indexes assume values between zero and one we follow the recent approach of Papke and Wooldridge (2008) to model fractional responses with panel data. While these authors use a Probit regression, we have chosen the Logit based on the results of a specification test. Linear regression would be easier to apply, but it may overlook important non-linearities in the conditional mean. On the other hand, it does not guarantee that the predicted values lie in the unit interval. To overcome the latter problem, traditionally the log-odds transformation is applied to the fractional response. However, this procedure requires that variables do not assume the corner values of zero and one, which is not verified in our data, given that we have observed zeros for the vertical intra-industry trade index. Moreover, partial effects of the explanatory variables are easy to estimate for the transformed variables in the linear model, but they are not relevant since our interested is focused rather on the partial effects for the expected value of the untransformed fractional responses, that is the trade indexes. These effects are difficult to obtain, since the expected value is impossible to recover from the transformed variables, unless strong independence assumptions are made.

Therefore, the logit functional form for the conditional mean response is more appropriate to use, given that it allows us to obtain bounded predictions for the intra-industry trade indexes and to provide simple

estimates of the partial effects averaged across the population, known as the "average partial effects". Recently, the logit model with random coefficients, also known as mixed logit, has become a flexible and general approach to deal with unobserved heterogeneity depending on the explanatories when binary choice data is concerned (see, for example, Barros and Proença, 2005; Barros et al., 2007; Frick et al., 2010). However, that approach is not in the scope of this paper given that, on one hand, mixed logit models were never used in the context of pseudo-likelihoods, and on another, there are no known theoretical reasons to justify the existence of random coefficients in explaining trade among countries. Nonetheless, we believe that these issues deserve some attention on future research.

Our findings provide evidence that the stock of immigrants has a positive impact on intra-industry trade and also suggest that immigrant skills and common language are positively related to the intra-industry trade.

The paper is organized as follows. Section 2 presents the relationship between immigration and trade and the gravity equation. Section 3 describes the empirical model and the prior expectations of the sign of the coefficients of the explanatory variables. Section 4 reports and discuss the econometric results. Section 5 concludes.

Immigration and Trade: The Gravity Equation

There are two mechanisms by which immigrants can exert influence on bilateral trade flows: first, their preference for products from their countries of origin and second, the role of cultural ties and social networks in creating opportunities between the host country and their home countries. The preference for determined products connected with the immigrant's ethnicity, which are not initially available in the host country's market, can lead to an increase of imports to the host country from the respective country of origin. Similarly, cultural and linguistic ties, being associated to the information in the possession of immigrants about markets in their countries of origin, as well as the social networks into which they are integrated, can prove advantageous to the reduction of transaction costs. Rauch (2001) emphasises the role of social networks in removing certain barriers to trade, asserting that access to information on business and trading opportunities, through the social networks and the flexibility of relationships between economic agents, based more on the building of mutual trust than on formal contracts, have positive implications in terms of economic efficiency.

In addition, the process of immigrants' adaptation to the host society, in particular their integration into the labour market, is a variable of vital importance, to the extent that it can influence the development of an entrepreneurial-commercial class among immigrants. Several authors have sought to explain the causes and effects of entrepreneurship among immigrants, attempting to understand why some groups are more enterprising than others and how entrepreneurial strategies can be a vehicle for upward social mobility. Within the scope of the present paper, another issue is to verify whether the impact of immigrant entrepreneurs on bilateral trade is greater or less than the impact made by non-entrepreneurs. Light et al. (2002) tested this hypothesis in relation to Chinese immigrants in the USA. They concluded that the immigrant entrepreneurs had a positive effect on US exports, whereas no influence was found on imports.

From a different perspective, as Borjas (1989) and Blanes (2005) highlight, both the theory of international trade and empirical research have, until recently, ignored the effects of the labour migration factor on trade flows. The Heckscher-Ohlin model and theorem consider that labour is mobile at the national level, but immobile internationally. When countries open up to trade and as long as the hypothesis of incomplete specialisation is verified (countries will continue to produce, for the purpose of trading, the goods that they previously produced only for their own consumption), the equalisation of absolute and relative price factors will tend to occur. Thus, trade will function as a perfect substitute for international factor mobility. The Heckscher-Ohlin model explains inter-industry trade, considering that the markets function in perfect competition and that information circulates without costs and is symmetrical for all economic agents.

When intra-industry trade is examined (i.e. exports and imports belonging statistically to the same industry), we find a different situation and it is accepted that a relationship of complementarity may exist between trade and international factor mobility. The imperfection of markets, in particular the asymmetry of information and its effect on the preferences of consumers, may justify the relationship of complementarity between immigration and the increase of trade in differentiated products. According to the model of imperfect competition, when immigrants have fully legalised status, more information on their preferences is obtainable. If the costs of acquiring information become similar to the transaction costs, it is possible to state that the relationship between immigration and trade is positive, since transaction costs are decreasing.

Gould (1994) argued that the effects of immigration are stronger on the trade of differentiated products (intra-industry trade). This is explained by the fact that the additional information brought by immigrants is of greater relevance for consumers than for producers, so that trade in such products is strongly demand-side driven (i.e. consumer preferences for the products' variety or characteristics). The increased trade in differentiated products satisfies the specific preferences of the consumers. Rauch (1999) stressed the role of the immigrants' networks in reducing the transaction costs of trade in differentiated products. He also called attention to the preference and network effects on intra-industry trade. White (2008) finds that the final effect on intra-industry trade is ambiguous.

The relationship between immigration and trade can be established on the basis of the transaction costs. The underlying hypothesis assumes that immigration contributes to the reduction of transaction costs, thus leading to increases of all trade flows.

There is a heterogeneous set of variables that determines the influence of immigrants on international trade, not only in respect of the country of origin, but also the host country, or even the immigrant community itself, particularly its social networks. These social networks are reinforced when immigrants share a common language. As this common characteristic can promote trade flows, the specified model should introduce a dummy variable to capture this effect (see, e.g. Lewer, 2006; Lewer and Van den Berg, 2008). The degree of integration is also a key aspect in the immigration analysis (Meseguer-Santamaria et al., 2010)

Since Anderson (1979), it has been acknowledged that the gravitational model explains adequately the flows of bilateral trade and that the gravitational equation can be based on the various models of trade: those of Ricardo and Hechscher-Ohlin and the models of intra-industry trade. 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.

Theoretically supported by the works of Anderson (1979), Bergstrand (1985, 1989, 1990), Helpman and Krugman (1985), Baier and Bergstrand (2001) and Feenstra et al. (2001), the gravitational model can include other explanatory hypotheses of trade, as well as GDP and distance. Feenstra et al. (2001) demonstrate that a large series of theories is consistent with the gravitational equation. In other words, different alternative theories of international trade can use the gravitational equation. Nevertheless, according to Helpman (1999), the gravitational equation yields better results when the countries are similar, with high levels of intra-industry trade, than when they differ widely in terms of the relative endowment factors and they are countries in which inter-industry trade is predominant.

Empirical Model

The main explanatory variables are those related to immigrant characteristics: immigrant stock (distinguishing those who speak the same language as the host country from the others), the percentage of highly-qualified immigrants employed in manufacturing industry (also making here the same distinction as before) and the percentage of immigrant employers (entrepreneurs) operating in manufacturing industry. However, in order to capture the effect of the transport costs, we will include the geographic distance as explanatory variable. To avoid problems of misspecification, we also include a set of control variables that, according to the international trade theory, have significant effects on intra-industry trade. Thus, the empirical model has the general form:

$$I_{it} = F(\text{immigrant´s characteristics; immigrant´s home country vars.;host country vars.}) \quad (1)$$

where I_{it} is the trade index between Portugal and country *i* at time *t*, assuming three different forms: intra-industry trade index (IIT), horizontal intra-industry trade index (HIIT) and vertical intra-industry trade index (VIIT).

Since I_{it} is an index verifying $0 \leq I_{it} \leq 1$, we assume that its conditional expected value has the following Logit specification:

$$E(I_{it}|\boldsymbol{x}_{it}) = \Lambda(\boldsymbol{x}_{it}\boldsymbol{\beta} + \delta_t) \quad i = 1, \dots, N\,; t = 1, \dots, T \quad (2)$$

where $\boldsymbol{x}_{it}$ is a $1 \times k$ vector of explanatory variables including the immigration-related and country-specific variables, $\boldsymbol{\beta}$ is $k \times 1$ vector of unknown coefficients, δ_t is a parameter to be estimated allowing for a different intercept each year which captures all factors (not included in the other variables) specific to year *t* affecting all countries equally, $\Lambda(\cdot)$ is the Logit function verifying $\Lambda(z) = \exp(z)/[1 + \exp(z)]$ and ensuring that $0 < E(I_{it}|\boldsymbol{x}_{it}) < 1$. Observe that though I_{it} may be equal to zero in estimation of the Logit model the fitted values cannot be 0 or 1. Papke and Wooldridge (2008) use alternatively the Probit specification which have the same limitations. There are no theoretical reasons to choose between Probit or Logit in this specific case, therefore our choice was made based on the results of a specification test. We use the pooled Bernoulli quasi-maximum likelihood estimator (QMLE), which is obtained by maximising the pooled Logit log-likelihood with robust estimation of variances to prevent

from misspecification, due to the fact that we are dealing with fractional data instead of Bernoulli. Additionally, it accommodates arbitrary heteroskedasticity and serial dependence across *t*.

Dependent variables

In order to measure intra-industry trade by types, three alternative measures are considered: the total intra-industry trade index (IIT), the vertical intra-industry trade index (VIIT) and the horizontal intra-industry trade index (HIIT). These will be the three variables to be explained. For the industry, *l*, and for the partner country, *i*, we have:

$$IIT_{li} = HIIT_{li} + VIIT_{li} \quad (3)$$

The Grubel and Lloyd IIT index

The Grubel and Lloyd index (1975) is used as the measure of the intra-industry trade between Portugal and the trading partner, country *i*. In order to avoid the problems of statistical aggregation, the index is calculated with the maximum of statistical disaggregation allowed by INE- Portuguese National Institute of Statistics (five digits):

$$IIT_{it} = \frac{\sum_{j=1}^{J}(X_{ijt}+M_{ijt}) - \sum_{j=1}^{J}|X_{ijt}-M_{ijt}|}{\sum_{j=1}^{J}(X_{ijt}+M_{ijt})} \quad (4)$$

where X_{ijt} and M_{ijt} are bilateral exports and imports respectively of Portugal with partner *i*, concerning the 5-digit product level *j* (of the CAE-Economic Activities Classification[1]) at time *t*. It can be clearly observed that $0 \leq IIT_{it} \leq 1$. An alternative measure is proposed by Fontagné and Freudenberg (1977). Blanes (2005) also considers the marginal intra-industry index (MIIT), proposed by Brulhart (1994), as an alternative dependent variable.

The HIIT and VIIT indexes

HIIT and VIIT are defined as simultaneous imports and exports of quality-differentiated products (5-digit product level). HIIT are trade flows that are not significantly different in quality, whereas VIIT are trade flows that are not similar in quality. The empirical studies require a methodology to separate HIIT from VIIT.

In this paper, the methodology of Abd-el-Rahaman (1991) and Greenaway et al. (1994) is used to separate the horizontal from the vertical intra-industry trade. The unit values of exports (UV^X) related to the unit values of imports (UV^M), defined as the value of trade by tonne, are used to distinguish between VIIT and HIIT. We use, as is common practice, a dispersion value of 15%. Fontagné and Freudenberg (1997) also proposed a different method to disentangle HIIT from VIIT. Despite the

[1] The Portuguese CAE classification is similar to the NACE classification.

difference between definitions of IIT, both methodologies consider that there is a high correlation between prices (unit values of exports and imports) and quality of traded products. This assumption is realistic if the statistical aggregation is minimised. So, The HIIT and VIIT are calculated with disaggregation of 5 digits. The calculations are made at the 5-digit product categories and the results are then aggregated to make up each 3-digit industry category.

HIIT satisfies the condition for all *t*:

$$1 - \alpha \leq \frac{UV_{jli}^{X}}{UV_{jli}^{M}} \leq 1 + \alpha \qquad (5)$$

while VIIT satisfies the condition for all t:

$$\frac{UV_{jli}^{X}}{UV_{jli}^{M}} < 1 - \alpha \quad \text{or} \quad \frac{UV_{jli}^{X}}{UV_{jli}^{M}} > 1 + \alpha \qquad (6)$$

where *j* denotes a 5-digit product, *l* denotes an industry and *i* is a trading partner of Portugal. The constant α can take any value between 0 and 1, but in this study, as in the majority of studies, we consider only $\alpha = 0.15$.

Independent Variables

The fundamental *independent variables* are those related to immigration. However, since there are other determinants for trade, both at the inter-industry trade (exports and imports) and the intra-industry trade levels (IIT, HIIT, VIIT), these variables must be included in the model in order to control the effects, improve the quality of the adjustment and avoid biased estimation due to omitted variables. As control variables, we chose: the per-capita GDP of Portugal and the GDP of the respective trading partner to measure the economic dimension of both countries, which is a commonly used variable in the empirical studies on intra-industry trade and in the gravity model; the price index of the trading partner of Portugal (another option was the ratio of the price indexes between Portugal and each of its trading partners, but this did not prove to be statistically robust); and the variable, geographic distance, measured in kilometers (we also used the distance measured in nautical miles, but the results did not improve with respect to the theoretically expected sign), as proxy for transportation costs. In addition to these quantitative variables, we also introduced qualitative dummy variables to reflect the impact of countries belonging to the European Union prior to the enlargement of 2004 (EU-15); of the emerging economies Russia, China and India (RICS) and of the five African Countries having Portuguese as the official language, together with Brazil (SLHC). It should be noted that further control variables that are commonly used in empirical studies were added, namely: the absolute difference between the per-capita incomes of the trading partners, the difference in electrical energy consumption between the trading partners (as proxy of the differences in physical capital endowments; the degree of openness and the weight of the trade balance in the GDP for each trading partner. However, these independent variables did not prove to be statistically significant and did not improve the quality of fit. Empirical linear correlations were calculated among the independent variables in order to avoid including those that

were strongly correlated. In any case, the different specifications always produced very similar results regarding the immigrant STOCK variable, mainly with regard to the positive sign of its coefficient.

The selected independent variables in the final model were the following:

- LYPCPT: i.e. the logarithm of the per-capita GDP of Portugal. This is a control variable related to dimension used in the intra-industry trade models, the expected sign for the coefficient of this variable being positive in the three equations related to intra-industry trade (IIT, HIIT and VIIT). It represents the hypothesis that the larger the economic dimension the larger the intra-industry trade (see, Hummels and Levinshon, 1995);

- LYPCK: i.e. the logarithm of the per-capita GDP of the trading partner. This is the other control variable related to dimension used in the intra-industry trade models; the sign for the coefficient of this variable is expected to be positive, consequently, the larger in economic terms is the trading partner, the larger the intra-industry trade should be (see, Hummels and Levinshon,1995);

- IPK: i.e. the price index for Portugal's trading partner. It is expected that the increase of this prices index in the trading partner-country will favour the competitiveness of the Portuguese exports and produce a negative effect on Portugal's imports from that country. Regarding the effect on the intra-industry trade indexes, we cannot assume *a priori* what the expected effect will be. The horizontal intra-industry trade is determined more by other characteristics than the price itself and the vertical intra-industry trade, although determined by price (considered equivalent to quality), is not homogeneous (there are low-quality products on which the impact of price modification can be relevant and high-quality products on which the impact of price modification can be less relevant). Consequently, we assume that the sign of the estimated coefficient in these equations is more a matter of empirical evidence. It must also be noted that since the ITT includes both the VIIT and the HIIT, the sign of the IPK coefficient for the IIT equation is always an ambiguous one;

- LDIST: i.e. the logarithm of geographic distance, measured in kilometers, between the capital cities of the trading partners. This is used as a proxy variable for transportation costs. Hence, a negative sign is expected for the coefficient of this variable. The same notion of the negative effect is reinforced when the empirical studies use the gravitational equation to explain bilateral trade;

- LSTOCK: i.e. the logarithm of immigrant stock in Portugal. Until 2000, the stock is equivalent to the stock of residence permits (AR). From 2000 to 2004, the stock is equivalent to the sum of AR and permits to stay (AP). From 2004 to 2005, the stock is equivalent to the sum of AR, renewed AP and renewed long-term visas (VL). A positive sign for the coefficient of this variable in all equations is expected, according to the hypothesis that migrant networks decrease transaction costs, facilitate the spread of information and, as a result, promote the increase in all types of trade;

- **MIHQW**: i.e. the percentage of highly-qualified immigrants employed in manufacturing industry (MI). A positive sign is expected for the coefficient of this variable, on the basis of the hypothesis that an increase in the level of qualification of immigrant workers will increase the products' quality and differentiation, and hence, will boost all types of intra-sector trade;

- **MIENT**: i.e. the percentage of immigrant employers (entrepreneurs) operating in manufacturing industry. A positive sign is expected for the coefficient of this variable, based on the hypothesis that increases in the number of immigrant employers will reinforce the ethnic and commercial networks, thereby contributing to the reduction of transaction costs;

- **EU15**: i.e. a dummy variable that assumes the value 1 if the trading partner is a member of the EU15 and zero otherwise. We expect a positive sign for the coefficient of this variable, because the integration process reinforces the intra-industry trade;

- **RICS**: i.e. a dummy variable that assumes the value 1 if the country is Russia, India or China and zero otherwise. The sign for the coefficient of this variable is a question of empirical evidence. It is to be noted that since the language of Brazil is Portuguese, it was decided to include this country with the PALOPs (see the next variable). For this reason, instead of a BRIC dummy variable, this study uses the RIC dummy variable, which is a bloc of the three above-named countries.

- **SLHC**: i.e. a dummy variable that assumes the value 1 if the trading partner is one of the five African countries considered in this study with Portuguese as its official language or Brazil, and zero otherwise. We expect a positive sign for the coefficient of this variable;

- **Interaction terms**: we have interacted LSTOCK and MIHQW with SLHC in order to evaluate if the channels through which the stock of immigrants and the percentage of highly-qualified immigrants employed in the manufacturing industry effect in trade indexes work more intensively when immigrants share a linguistic identity with the host country.

Empirical Results

The data and descriptive statistics

Variables	Mean	Std. Dev.	Min	Max	N
IIT	0.1785	0.1617	0.0008	0.6134	183
HIIT	0.0365	0.0527	0.0000	0.2434	184
VIIT	0.1419	0.1262	0.0008	0.4938	183
STOCK	9459.41	16036.40	3	67457	185
MIHQW	5.21	7.87	0.00	50.00	171
MIENT	5.75	11.56	0.00	100.00	171
DIST	3433.75	2026.01	503	9986	185
YPCPT	20030.00	784.01	18782.00	21125.00	185
YPCK	17346.37	12159.63	785.00	48395.00	184
IPK	17.8091	87.8730	0.7995	878.5100	184
SLHC	0.1622	0.3696	0	1	185
RICS	0.0811	0.2737	0	1	185
EU15	0.3514	0.4787	0	1	185

Table1. Descriptive statistics: full sample

The data set used in the estimation it is an unbalanced panel of 38 countries (Angola, Austria, Belgium and Luxembourg (data is combined for these two countries), Brazil, Bulgaria, Cape Verde, China, Cyprus, Csech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Guiné Bissau, Hungary, India, Ireland, Italy, Latvia, Lithuania, Malta, Moldova, Mozambique, Netherlands, Poland, Portugal, Romania, Russia, São Tomé and Principe, Slovakia, Slovenia, Spain, Sweden, UK, Ukraine and USA) observed for the years 2000 and 2002 to 2005. Descriptive statistics for the data are given in Table 1. As can be observed in the results for the mean, the IIT index is mainly of the VIIT type (IIT= 0.1785; HIIT= 0.0365; VIIT= 0.1419).

Estimation results

Variables	IIT	VIIT	HIIT	Expected sign
LSTOCK	0.143***	0.105 ***	0.195 ***	+
	(0.031)	(0.031)	(0.052)	
LSTOCKxSLHC	0.493*	0.601 **	0.096	+
	(0.256)	(0.244)	(0.461)	
MIHQW	0.028***	0.026 ***	0.023 **	+
	(0.006)	(0.007)	(0.010)	
MIHQWxSLHC	0.371***	0.364 ***	0.149	+
	(0.086)	(0.082)	(0.195)	
MIENT	0.003	0.002	0.004	+
	(0.005)	(0.005)	(0.008)	
LDIST	-0.711***	-0.523 ***	-0.771 ***	-
	(0.095)	(0.100)	(0.129)	
LYPCPT	-2.096	-2.546 *	0.458	+
	(1.323)	(1.347)	(2.230)	
LYPCK	0.750***	0.652 ***	0.957 ***	+
	(0.159)	(0.156)	(0.243)	
IPK	-0.005***	-0.006 ***	-0.003	+/-
	(0.001)	(0.002)	(0.002)	
SLHC	-6.296**	-7.366 ***	-1.881	+
	(2.968)	(2.831)	(5.353)	
RICS	0.451	0.426	0.032	+/-
	(0.410)	(0.385)	(0.470)	
EU15	-0.324	-0.248	-0.439	+
	(0.202)	(0.209)	(0.363)	
D2002	0.008	0.038	-0.077	
	(0.134)	(0.145)	(0.202)	
D2003	-0.091	-0.111	0.032	
	(0.146)	(0.152)	(0.218)	
D2004	-0.023	-0.035	0.015	
	(0.152)	(0.157)	(0.195)	
C	16.588	20.504	-12.502	
	(13.103)	(13.379)	(21.710)	
R^2	0.698	0.584	0.596	
RESET(p-value)	0.076	0.706	0.083	
N	167	167	167	

Note: This table includes the results of the Logit regression applied to each of the intra-trade indexes. Robust standard errors are in round brackets. ***, **, * denote significance at the 1%, 5% and 10% levels respectively.

Table 2. Logit regression explaining intra-industry trade indexes

The results of the estimation of model (2) are presented in Table 2. The pooled fractional llogit was used with standard errors robust to general heteroskedasticity and serial correlation. All regressions show a very reasonable *R*-squared (particularly for the IIT fit) and no evidence of misspecification at the 5% level, given the values obtained for the RESET test statistic. The results are in accordance with the theory. The stock of immigrants (LSTOCK) has a positive and statistically significant effect (at 1%) in all trade indexes. Moreover, we see that the common language with the host country enhances this effect for IIT and VIIT at, respectively, the 10% and 5% significance levels, given that the estimated coefficient of the interaction between LSTOCK and SLHC is positive.

The percentage of highly-qualified immigrants employed in manufacturing industry (MIHQW) has a positive impact as well in all indexes and is statistically significant at 1% for IIT and VIIT and at 5% for HIIT. This effect is also amplified when immigrants speak the same language as that of the host country in relation to IIT and VIIT. The percentage of immigrant employers (MIENT) has no effect in the intra-industry trade indexes considered. The other control variables have the expected signs, except for the per-capita GDP of Portugal (LYPCPT), which proved to be not statistically significant at 5%. Equally, the RICS and EU15 dummies are also not statistically significant. Therefore, we can only depict a distinct behaviour of immigrants on intra- industry trade for those whose language is the same as that of the host country, which shows the importance of linguistic and cultural ties in promoting trade. Note that the coefficient of the dummy SLHC cannot be interpreted alone, due to the interactions terms.

	IIT			VIIT			HIIT		
	APE	St. Err.	p-val.	APE	St. Err.	p-val.	APE	St. Err.	p-val
LSTOCK (AVERAGE)	0.0230	0.0041	0.00	0.0165	0.0036	0.00	0.0071	0.0018	0.00
LSTOCK (SLHC=0)	0.0195	0.0043	0.00	0.0125	0.0038	0.00	0.0071	0.0019	0.00
LSTOCK (SLHC=1)	0.0416	0.0120	0.00	0.0458	0.0107	0.00	0.0126	0.0168	0.46
MIHQW (AVERAGE)	0.0065	0.0009	0.00	0.0055	0.0009	0.00	0.0010	0.0004	0.02
MIHQW (SLHC=0)	0.0038	0.0008	0.00	0.0030	0.0008	0.00	0.0008	0.0004	0.03
MIHQW (SLHC=1)	0.0261	0.0016	0.00	0.0253	0.0024	0.00	0.0074	0.0088	0.40
MIENT	0.0004	0.0006	0.51	0.0002	0.0006	0.73	0.0001	0.0003	0.61
LDIST	-0.0962	0.0128	0.00	-0.0617	0.0117	0.00	-0.0277	0.0048	0.00
LYPCPT	-0.2836	0.1787	0.11	-0.3004	0.1587	0.06	0.0165	0.0802	0.84
LYPCK	0.1015	0.0219	0.00	0.0769	0.0188	0.00	0.0344	0.0093	0.00
IPK	-0.0007	0.0002	0.00	-0.0007	0.0002	0.00	-0.0001	0.0001	0.17
SLHC	0.0499	0.0370	0.18	0.0526	0.0347	0.13	0.0308	0.0700	0.66
RICS	0.0662	0.0650	0.31	0.0557	0.0554	0.32	0.0012	0.0173	0.95
EU15	-0.0432	0.0267	0.11	-0.0291	0.0247	0.24	-0.0172	0.0157	0.27

Note: This table includes the average partial effect (APE) for each variable, the respective standard error (St. Err.) calculated with the Delta Method and the p-value (p-val.) to test the null that the average partial effect is zero. For LSTOCK and MIHQW, the APEs were included for the entire sample, the APE calculated at SLHC=0 and at SLHC=1.

Table 3. Average partial effects

The average partial effect of each variable is calculated in Table 3, also with the respective standard error and p-value to test the null that this effect is zero.

Because the model is non-linear, the coefficients do not directly give the partial effect of the variables. In general, the statistical significance of the average partial effects follows that obtained in the regression for the coefficient estimates, except for SLHC and the interaction with LSTOCK, which here is statistically significant at the 1% level for IIT and VIIT. If the stock of immigrants increases by 10%, then on average, the IIT index is estimated to increase by 0.0023, by 0.0020 if immigrants do not originate from countries with Portuguese as their official language and by 0.0042 if they are from a Portuguese-speaking country. Thus, the latter estimate amounts to the double of the former. This difference reflects the relevance of immigrants whose language is the same as that of the host country to expanding trade ties. This relevance is particularly important for the APE of highly-qualified immigrants, for whom the discrepancy between those who speak Portuguese and the remainder is almost 7 times greater. With regard to the VIIT index, the conclusions are basically the same, but the effects are, in general, a little less. Regarding HIIT, the effects are substantially less, which is not so surprising given that the IIT is mainly vertical in nature. Moreover, the language influence is not depicted in HIIT, since the APEs for the immigrant stock and highly-qualified immigrants who speak the same language as that of the host country are not statistically significant.

Conclusions

This paper uses the logit regression to model the intra-industry trade, in view of the fractional nature of the response variables. This is a new approach allowing the explicit quantification of the average partial effects of each explanatory variable, in particular those related to immigration. The results show that there is strong empirical evidence that the stock of immigrants has a positive impact in all intra-industry trade indexes. On the other hand, the increase of the percentage of highly-qualified immigrants employed in manufactory industry leads to higher values of all the indexes analysed, while the variation of the percentage of entrepreneurs has no effect in those indexes. The effects of the stock of immigrants and level of qualification are clearly potentiated if immigrants speak the same language as that of the host country. However, this effect was not detected for the horizontal intra-industry trade. As expected, the effect of the distance between trading-partner countries in all type intra-industry trade is negative, as it is in the empirical studies that use the gravitational equation.

The consequences for immigration policy and economic policy are clear. When viewed as a whole, immigration brings beneficial effects to the Portuguese economy in terms of international trade. These effects are reinforced when two characteristics of the immigrants come under consideration: skills in the context of manufacturing industry and cultural ties proxied by common language. What the data suggests is that immigration policies that facilitate the admission of immigrants and favour their skills-upgrading are beneficial for Portugal, in terms of the trade balance and the trade pattern.

It is also noteworthy that this study has not obtained robust results regarding the effects of other immigrant characteristics on bilateral trade. These included variables such as gender, educational level, occupation, skill levels (other than the percentage of highly-skilled immigrants in manufacturing industry) and type of employment contract. As statistical databases on immigration become more numerous and

reliable, a future study could estimate again these models in order to establish whether the results for these variables will be confirmed or not. There are also other aspects of immigration that should be taken into account in a future research, namely the problem of social cohesion (see, for example, Taylor and Jason, 2015) and the role of internet facilities to connect the immigrants and provide new trade opportunities (see, for example, Son, 2015).

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