LISBON
SCHOOL OF
ECONOMICS &
MANAGEMENT
UNIVERSIDADE DE LISBOA

Mestrado em Econometria Aplicada e Previsão

Trabalho final de mestrado

Dissertação

What drives Foreign Direct Investment to the tradable sector?

Márcio Filipe Mendes Mateus

Setembro de 2015

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Abstract

Researchers usually investigate the determinants of aggregated Foreign Direct Investment (FDI), although there is evidence that the sectoral distribution of FDI matters and that too much FDI in the non-tradable sector can exacerbate external imbalances. This thesis differs from most of existing studies on FDI determinants by focusing on tradable sector FDI. I show that countries with a large market size, a higher degree of economic openness, a higher productivity level and good institutions are more likely to receive FDI in the tradable sector. I also show that physical distance does not represent an obstacle so hard to transpose for tradable sector FDI as it seems to represent to aggregated FDI. In contrast with results of empirical studies on aggregated FDI, share a common border does not seem to have an impact on the attraction of FDI to the tradable sector. This paper uses a modified gravity model to compare different methods, specifications and variables in order to obtain robust results.

JEL Classification: C21, C23, F21, O52

Keywords: Gravity models, Econometrics, Foreign Direct Investment, European Union

Resumo

Geralmente os investigadores centram a sua análise nos determinantes do Investimento Direto Estrangeiro (IDE) agregado. Não obstante, existe evidência que o setor de atividade ao qual o IDE se destina é um aspecto relevante e que o IDE direcionado ao setor dos bens não transacionáveis tende a agravar os desequilíbrios externos dos países recetores. Esta tese difere da generalidade dos estudos realizados focando-se apenas no IDE direcionado ao setor dos bens transacionáveis. Os resultados sugerem que países com um grande mercado interno, uma maior abertura económica ao exterior, um elevado nível de produtividade e boas instituições são mais propensos a receber IDE no setor dos bens transacionáveis. Os resultados sugerem também que a distância física não representa um obstáculo tão difícil de transpor para o IDE direcionado ao setor dos bens transacionáveis como parece representar para o IDE agregado. A partilha de uma fronteira comum entre dois países, nomeadamente, não parece ter qualquer impacto na atração de IDE para o sector dos bens transacionáveis, ainda que parece ter na atração do IDE agregado. Este trabalho utiliza um modelo de gravidade modificado para comparar diferentes métodos, especificações e variáveis, a fim de obter resultados robustos.

Códigos JEL: C21, C23, F21, O52

Palavras-chave: Modelo de gravidade, Econometria, Investimento Direto Estrangeiro, União Europeia

Acknowledgments

I would like to start by express my great appreciation to my supervisors, Isabel Proença and Paulo Júlio. Their academic support, knowledge, experience and suggestions were crucial throughout this study. Secondly, I would also like to thank to my parents and to my sister Ana for their support and example of dedication and hard-working. Last but definitely not least, a very special thanks to Andreia for the encouragement, understanding and love during the hardest times.

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1 Introduction

One important feature of the globalization has been the significant increase in the flows of people, goods, services and investment between countries. According to United Nations Conference on Trade and Development (UNCTAD), from 1990 to 2013, Foreign Direct Investment (FDI) stocks have grown by a factor of more than 12. In the same period of time, by comparison, the world GDP has only grown by a factor of approximately 3.3 and global exports of goods and services have grown by a factor of nearly 5.6. In 2007, prior to the financial crisis, developed countries hosted nearly 71 percent of the world's FDI positions, 42 percent targeted to the European Union. Since then, the share of developed countries in the world inward FDI has decreased to 63 percent due to the decline of the FDI hosted by European Union countries (-8 percent to 34 percent). This evolution, explained by the economic and financial turmoil in Europe, urges the European Union to design successful policies to attract FDI investors.

Over the last decades, as multinational firms increasingly seek to spread their production all over the world in order to exploit countries' comparative advantages, the attraction of FDI has acquired a significant importance for both developing and developed economies. The attraction of FDI has become a key issue because this type of investment, as compared with other types, has generally a more significant impact in the long-run growth and development (Barrell and Pain, 1996; Borensztein et al.,1998). In fact, a direct investment relationship involves control or a significant degree of influence on the management from the investor to the investee, which means that it tends to involve a lasting relationship between companies and countries.

Literature shows that both investor and host countries benefit from FDI. For host countries, FDI means investment, job creation, technological transfer, improvement of managerial and marketing skills, increase in productivity and improvement of the host country institutions (Larraín and Tavares, 2004). FDI can also contribute to correct external imbalances since multinational firms have a greater propensity to export than domestic firms usually have. For investor countries and companies this kind of investment can also be positive. Investor companies can spread their production all over the world in order to take advantage of countries' specific comparative advantages (natural resources, less expensive or more qualified labor, legal framework, etc...). They can also reduce their risk by diversifying their holdings outside of a specific country. For the investor

country, FDI could also improve the access to foreign markets and to increase exports.

The vast majority of researchers investigate the determinants of aggregate FDI, an approach which could lead to spurious conclusions about what a country can do to attract FDI because aggregated FDI can be inflated by the presence of Special Purpose Entities (SPE's). These kind of entities choose their geographical location for tax reasons, have significant positions in direct investment (inward and outward) and a very small number of workers. More importantly, they do not hold a substantial real economic activity in the countries where they are located. Additionally, under the umbrella of FDI are investments in different economic activities (agriculture, mining, manufacturing, real estate, education, wholesale and retail trade, etc...) and buying a stake in a monopolist company operating in a protected economic sector is FDI as much as an investment in a company operating in a sector open to external competition. These two types of investment could have a very different impact in the host country's economy. This study differs from existing studies on FDI determinants by focusing on tradable sector FDI, instead of aggregate FDI.

Kinoshita (2011) studies the sectoral composition of FDI in Eastern Europe and finds that FDI in the non-tradable sector can exacerbate external imbalances of countries while FDI in the tradable sectors leads to an improvement of the external balance. FDI in the tradable sector is expected to increase exports over time[1], while FDI in the nontradable sector may fuel domestic demand and boost imports. Thus, according to Kinoshita (2011), countries where FDI is mainly targeted to the nontradable sector are expected to present a higher trade deficit than countries where FDI is mainly targeted to the tradable sector. In this sense the question policy makers should focuses in is not how to attract FDI, but instead how to attract tradable sector FDI. This is especially important for those european countries with significant external imbalances.[2] Data seems to support the idea that FDI in the tradable sector is associated with higher exports (see Figure B.1 in the Appendix) and current and capital account surpluses (see Figure B.2 and B.3 in the Appendix). This paper will therefore focus on the tradable sector FDI, since it is more open to international competition, with more potential to export and to create jobs and to transfer know-how. More importantly, it can be a important tool to solve external imbalances of countries.

[1] FDI in the tradable sector can also imply a reduction of imports once imported goods are replaced by domestically produced goods.

[2] The Eurozone debt crisis was a typical balance of payments crisis (Higgins and Klitgaard, 2014) and some of the most affected countries (Greece, Spain and Portugal) also presented the highest external imbalances (see Figure B.2 in the Appendix.

As a proxy for the tradable sector I use the manufacturing sector.[3] This sector does not usually contain SPE's, allowing me to avoid their effect.

In this thesis I first examine the role of economic, geographic, and institutional variables in attracting tradable sector FDI to European Union countries. I demonstrate that a large market size, a higher degree of economic openness, a higher productivity level and good institutions are key driving forces of tradable sector FDI. I then compare my results for tradable sector FDI with those obtained in the literature for aggregated FDI. I show that physical distance does not represent an obstacle so hard to overcome for tradable sector FDI as it seems to represent for aggregated FDI. Finally, I also demonstrate that the degree of economic openness is much more important as tradable sector FDI determinant than as aggregated FDI determinant.

Throughout this thesis I compare the performance of different methods, specifications and variables in the estimation of a gravity model, find out the best way to deal with zero-FDI values, heteroscedasticity, and heterogeneity across countries. I will apply a modified gravity model, using both a cross-section and a panel data specification.

The remainder of this paper is organized in the following way. Section 2 reviews the economic and econometric literature. The following section presents the data used in the empirical analysis. Section 4 presents the econometric methodology and Section 5 presents the results obtained. Section 6 concludes.

2 Literature Review

2.1 Economic and econometric literature

The FDI literature initially focused on economic and geographical determinants, including host-country market size, economic growth, economic openness, labor costs, tax rates and geographical distance between countries. The market size, measured as the GDP level or population, is the economic determinant that received most attention in the literature. Billington (1999), Scaperlanda and Balough (1983) and Alves et al. (2013) find a statistically significant impact of the

[3]Some other authors use a broader definition of the tradable sector. Kinoshita (2011) defines tradable sector as manufacturing, agriculture, mining, retail, hotels and restaurants.

market size and growth on FDI. Barrel and Pain (1996) find also a link between market size and FDI. Culem (1988) and Kinoshita (2011) conclude that a greater degree of openness affects aggregate FDI and the tradable sector FDI in a positive way, respectively. Barrel and Pain (1996) and Culem (1988) found a negative impact of labor costs on FDI, while Tsai (1994), Wheeler and Mody (1992), Kravis and Lipsey (1982) found a not statistically significant or positive effect. Hartman (1984, 1985) and Cassou (1997) find a negative relationship between taxation and FDI. Altomonte and Guagliano (2003) find that education has a negative effect on the investment of multinational companies in Central and Eastern Europe countries, while for investment in the Mediterranean countries they find a positive effect of education on investment targeted to the services sector and a negative effect on investment targeted to traditional industries. Kinoshita (2011), also for a panel of Eastern Europe countries, find that a highly educated labor force affects positively the share of FDI in the tradable sector. The distance between countries (Alves et al., 2013) or the distance to a central city (Altomonte and Guagliano, 2003 and Kinoshita, 2011) is used in literature as proxy of the physical and cultural barriers and also as a proxy of transaction costs.[4] Sometimes it is also used as proxy for the ease of access to a major consumer market. In any case, authors find a negative effect of distance on FDI.

Over the last years, a second wave of research articles have pointed out that institutional and political factors play also a role in explaining inward FDI. As transaction costs were reduced with the proliferation of intra-regional integration agreements, competition between countries in attracting FDI started to be based on business facilitation measures that provide investing firms a better business environment. According to Stein and Daude (2007) the impact of institutions on investment can be reflected through two different channels, *"First, "bad" institutions might act as a tax by increasing the cost of doing business. Second, imperfect enforcement of contracts might also increase uncertainty regarding future returns and thus have a negative impact on the level of investment."* The classical example of bad institutions is corruption as it represents an increase of the cost of doing business and uncertainty.

Schneider and Frey (1985) were among the pioneers in assessing the importance of institutional factors, and show a negative relationship between political instability and inward investment.

[4] The impact of transaction costs in FDI is not so obvious as it is in trade, but they still exist because distance implies higher travel and communication costs.

Biswas (2002) concluded that institutions are important determinants of FDI inflows. Wei (2000) and Wei and Shleifer (2000) show that corruption has a negative impact on inward FDI. Lee and Mansfield (1996) and Knack and Keefer (1995) conclude that FDI inflows are positively correlated with the protection of property rights and intellectual property. Several other studies reported also that FDI is positively associated with the efficiency of the legal system (Buch et al., 2005), with the regulation of labor markets (Botero et al., 2004) and investors' protection (Djankov et al., 2008).

While a substantial amount of research has been devoted to study aggregated FDI, very few authors have devoted their time to analyze the sectoral FDI, in part due to the unavailability of this kind of data.[5] Altomonte and Guagliano (2003) constructed a panel of European multinationals that have invested in Central and Eastern Europe and in the Mediterranean (in 48 NACE 3 industries) and find that education matters for FDI targeted to the services sector but not to FDI targeted to traditional industries. Zhang (2005), using disaggregated industry level data, finds that FDI hosted by China has a stronger effect on exports from labor-intensive sectors than from capital-intensive industries. Kinoshita (2011) studies the sectoral composition of FDI in Eastern Europe and finds that tradable sector FDI leads to an improvement of the external balance while investment in the non-tradable sector has the opposite effect.

A significant amount of the trade and FDI literature has been developed based on gravity models over the last decades. Gravity models were first introduced by Tinbergen (1962) in the context of international trade. They are based on the idea that a gravity relationship, analogous to the Newton's law of universal gravitation, can explain trade flows between countries.[6] In its simplest formulation, the gravity model for international trade states that bilateral trade between country i to country j is proportional to the product of the two countries GDP's and inversely proportional to their physical distance. Since the first successful application to trade, gravity models were also used to model tourism, migration and bilateral FDI.

Most authors estimate the multiplicative gravity equation, after the model is log-linearly trans-

[5] Industry-specific information on bilateral FDI position is not available in official statistics even for some European countries, therefore researchers sometimes use firm-level data on multinational enterprises available on commercial databases.

[6] Newton's law of universal gravitation states that any two bodies in the universe attract each other with a gravity force that is directly proportional to the product of their masses and and inversely proportional to the square of the distance between them.

formed, applying the traditional OLS technique. Santos Silva & Tenreyro (2006), using cross-sectional data, showed that, in the presence of heteroscedasticity in the multiplicative error, the consistent estimation of the gravity equation by OLS after the logarithmic transformation entails very strong assumptions that do not hold in general. Moreover, due to the Jensen's inequality, which states that the expected value of the logarithm of a random variable is not equal to the logarithm of its expected value, logarithmic transformed models could be significantly misleading in estimating elasticities and semi-elasticities. The consistent estimation of the log-linearized model relies critically on the assumption that the error term, and also the log of the error term, are statistically independent of the regressors. However, the expected value of the logarithm of a random variable depends, in general, both on the mean and on higher-order moments of the distribution. For example, if the variance of the an error term φ_{ij} depends on regressors, the expected value of $ln(\varphi_{ij})$ will also depend on regressors, and therefore OLS estimates will be inconsistent. Santos Silva & Tenreyro (2006) illustrate this problem, considering the case in which φ_{ij} follows a log normal distribution, with $E(\varphi_{ij}|\ \mathbf{x_{ij}}) = 1$ and variance $\sigma_{ij}^2 = f(\mathbf{x_{ij}})$, where $\mathbf{x_{ij}}$ is the vector containing the regressors. In the log-linearized specification the error term will follow a normal distribution, with $E(ln(\varphi_{ij})|\ \mathbf{x_{ij}}) = -\frac{1}{2}ln(1+\sigma_{ij}^2)$, that is also a function of the covariates $\mathbf{x_{ij}}$. This way, Santos Silva & Tenreyro (2006) argued that in the presence of heteroscedasticity, the log-linearized errors will depend on the regressors, which leads to inconsistent estimates of OLS. The authors found strong evidence of the presence of heteroscedasticity in the empirical applications of the gravity model to international trade analysed in their work. Another problem concerning the log-linear transformation of the gravity equation is the existence of zeros (because the logarithm of zero is not defined). The usual approach followed in empirical studies to deal with this problem is simply to drop the pairs with zero values. Other approach followed by some authors consists in adding 1 to the dependent variable observations. Santos Silva & Tenreyro (2006) conclude that is not advisable to follow these procedures and estimate the gravity equation in the log-linear form with OLS. They suggest estimating the gravity equation, and constant-elasticity models, in the multiplicative form, through a Poisson pseudo-maximum-likelihood (PPML) estimator. To assess the performance of this estimator the authors performed a simulation study using different estimators (e.g. OLS, Tobit, NLS and PPML) and different patterns of heteroscedasticity. Results confirm that the PPML estimator is more robust than the alternatives.

The majority of the studies using the gravity equation have been based on cross-sectional data. However, this approach does not deal properly with heterogeneity among countries which can lead to biased results (Cheng and Wall (2005); Cheng and Tsai (2008). Panel data is an alternative that can mitigate this problem, allowing different types of heterogeneity to be taken into consideration.

The usual approach to estimate the gravity model using panel data is to estimate the log-linearized version of the gravity equation by fixed effect least squares. Following Santos Silva & Tenreyro (2006) work with cross-sectional data, Westerlund & Wilhelmsson (2009) pointed out that the log-linearized model still causes problems in the use of panel data estimation methods. Zeros and the presence of heteroscedasticity are also problems affecting panel data usual estimators. The log-linearized gravity equations can only be estimated consistently by least squares estimator if the conditional expected value of logarithm of the error term of the model equals to zero. Following the arguments of Santos Silva & Tenreyro (2006) they stress that this assumption is violated on panel data as well and, as a result, the fixed effects OLS estimator will be inconsistent.

Westerlund & Wilhelmsson (2009) also recommend to estimate gravity equations in their multiplicative form and propose a fixed effect Poisson pseudo-maximum-likelihood (FE-PPML) estimator. The authors compare the performance of OLS fixed effects estimator and PPML fixed effects on a simulation study, and conclude that OLS performed poorly when compared with PPML fixed effects. PPML estimation presented very small bias and good accuracy. Finally, Westerlund & Wilhelmsson (2009) argue that the PPML random effects estimator should not be used because it assumes non-correlation of the individual specific effect with the other regressors, which is hard to verify in practice for many applications.

Proença et al. (2014) propose a semiparametric gravity model for panel data to overcome the above-mentioned problems. These authors introduce a nonparametric component in the gravity panel equation in order to capture the dependency between the explanatories and the unobserved individual heterogeneity term. The method proposed seeks to captures country unobserved heterogeneity dependent on the explanatories without compromising the estimate of time invariant variables and untransformed nonlinear gravity equations.

2.2 Empirical results

This study aims to analyse the determinants of tradable sector FDI. I argue that tradable sector FDI is the kind of FDI that policy makers of countries with high external imbalances should be concerned to attract. An empirical survey on aggregated FDI determinants is important to realize on what extent my results, for tradable sector FDI determinants, are going to be different from the results obtained by authors for aggregated FDI. My overview of empirical studies on aggregated FDI determinants is limited to gravity models using bilateral FDI as dependent variable and empirical models somehow similar to the one I am going to use. An empirical survey on tradable sector FDI determinants would also be relevant but two problems emerged. On the one hand, there is very little literature produced on tradable sector FDI determinants. On the other hand, empirical models used by most authors are quite different from the one I am going to use, which makes it difficult and unwise to perform any comparison of results.

From the survey I have performed, five important conclusions emerged. First, the host country GDP elasticity varies between 0.83 (Bénassy-Quéré et al., 2007) and 1.18 (Alves et al., 2013), which means that estimates are usually around the unit. Second, estimated elasticities I found for distance between countries oscillate between -1.9 (Stein and Daude, 2007a) and -0.49 (Bénassy-Quéré et al., 2007). Nevertheless, the elasticity obtained by Stein and Daude (2007a) is clearly an outlier. Results usually obtained by authors vary between -0.9 and -0.49. Third, the contiguity dummy estimated coefficient varies between 0.55 (Alves et al., 2013) and 2.5 (Stein and Daude, 2007b). As a general rule, contiguity dummy comes out with a positive and statistically significant sign. Notwithstanding, there are studies showing a non-significant (Tong, 2005) or even a negative impact (Stein and Daude, 2007a) of sharing a common border. Fourth, the estimated coefficients I found in the literature for the degree of openness are relatively close but are not always statistically significant. Alves et al. (2013) estimates varies between 0.003 and 0.021, while Ali (2010) coefficients oscillate between 0.006 and 0.010. Fifth, the other variables do not appear so frequently as the previous ones and the results are not entirely conclusive on what concerns the statistical significance and, sometimes, even on the signal of the estimated coefficient.

Table A.8 of Appendix provides the results obtained by Alves et al. (2013) to the aggregated FDI with cross-sectional data. Results demonstrate the huge importance of geographical deter-

minants to the aggregated FDI. According to these authors results the investment of a country in its neighbour is between 73 and 88 percent higher than the investment in a similar country that does not share a common border. Physical distance is also a key determinant, as an increase of 1 percent in the number of kilometers between countries is expected to reduce aggregated FDI between 0.54 and 0.63 percent. Table A.8 results also suggest that the market size, the economic growth and the quality of the host country's institutions play an important role in the attraction of the aggregated FDI. I report this table as the model and the variables used by these authors to the aggregated FDI are quite similar to the ones I am going to use to tradable sector FDI. The main differences between my and Alves et al. (2013) work is obviously the depend variable used. I use is the tradable sector FDI, while in Alves et al. (2013) is used the aggregated FDI. Additionally, the institutional variables used, the time span analysed and the sample of source and host countries are not quite the same. Finally, Alves et al. (2013) only use cross-section specification while I use both, cross-section and panel data.

In this sense, from now on, whenever I compare my results with the literature I am going to rely mostly on Alves et al. (2013) results as a reference. Even so, any comparison with Alves et al. (2013) or other authors' results should be looked at with caution, because of different time periods or/and different sample of countries used.

3 Data and variables

My main goal is to study the determinants of tradable sector FDI targeted to European Union countries. As a proxy of the tradable sector I use the manufacturing sector defined according to the new European classification of economic activity NACE Rev. 2. The dataset covers FDI from 47 source countries to 22 European host countries.[7] Source and host countries were selected based on data availability. Source countries included worth 86 percent of European Union inward FDI in the tradable sector and 92 percent of the 22 host countries considered. Selection bias should therefore not be a problem. The economic literature recommends the use of stocks relative to flows, because they are less volatile and are the relevant decision variable in the long term. The period considered is 2008-2011. This period was chosen based on the availability of data

[7] See Table A.1 of Appendix for a description of the variables and Table A.2 for a list of countries covered.

on the new European classification of economic activity NACE Rev. 2. For the cross-section analysis, I used a 4-year average for FDI stocks, an approach followed by other authors (Wei and Shleifer, 2000; Stein and Daude, 2007a; Alves et al., 2013) to avoid the influence of changes in FDI's valuation due to price changes or exchange rate variations. For panel data, due to the short time span available, I used the annual inward FDI stocks. The FDI data was collected from the Eurostat website.

Data on bilateral FDI positions exhibit a considerable number of zero and negative values as can be seen in Table A.3 of Appendix. We will see later in this work different ways to deal with the zeros. On what concerns negative bilateral FDI positions the approach pursued has been to drop these observations. The existence of negative bilateral FDI positions is explained by the methodology used to compile these statistics.[8]

Inward FDI in the tradable sector is explained in the framework of an augmented gravity model, using geographical, economic, and institutional regressors. In the cross-section specification the regressors are dated 2007[9] while in panel data annual FDI stocks are explained using regressors concerning the previous year, as a way to avoid simultaneity problems. Geographical variables include the physical distance (in kilometers) between investor and investee countries' capitals - a proxy for transaction costs and cultural and language barriers - and a border dummy variable, which takes the value 1 if the countries involved share a common border and 0 otherwise. A large distance between source and host countries should have a negative impact on FDI, while sharing a common border is expected to have a positive impact.

The economic variables considered are host countries' GDP (a proxy for market size), GDP growth rate (a market dynamism proxy), and labor costs. I considered also the degree of openness, measured as the share of imports plus exports over GDP, as an indicator of the degree of openness of the host country's economy. Finally, I include also education, defined as the average years of schooling in each country, and the Effective Average Tax Rate (EATR)[10]- a proxy of tax burden.

[8]The reason why there are negative values in the sample is because FDI data is presented according to the direction of the direct investment relationship based on the so-called directional principle. According to this principle, if company A (of country A) holds company B (of country B) and this position is worth 10, but company B grants a loan to company A in the amount of 11, the bilateral FDI position of country A in country B, in accordance with this principle, it will be -1.

[9]Mean years of schooling is available only for 2010 and was the only regressors not dated 2007.

[10]The EATR is a measure, proposed by Devereux and Griffith (2003), to assess the effective tax level that companies have to support. Unlike the statutory tax rate, EATR reflect all income and non-income taxes and also reflects the incentives such as investment tax credits, deductions and depreciation.

GDP, GDP growth and openness are expected to have a positive impact on tradable sector FDI. EATR is expect to have a negative impact. The effect of labor costs is unclear, as they can reflect labor productivity. Some studies argue that education could also have an ambiguous effect on FDI, because a higher level of education implies not only higher labor productivity, but also higher wage costs. As I have controlled the cost effect in my model, education is expected to have a positive effect on tradable sector FDI.

GDP, GDP growth rate, and openness were collected from Eurostat, and labor costs from AMECO. Mean years of schooling were obtained from the database in Barro and Lee (2010). This database has a five years range and for the time span considered in this work only 2010 data is available. Finally, effective average tax rate was collected from the 2012 final report[11] on effective tax levels produced by the Centre for European Economic Research in the scope of a project for the European Commission. All effective tax levels reports are publicly available on the European Comission website (http://ec.europa.eu). Those variables presented above were collected for the period 2007-2011.

The institutional variables used were obtained from three different databases: the Heritage Foundation Index of Economic Freedom database, the World Bank's Worldwide Governance Indicators database, and the Doing Business database. The Index of Economic Freedom comprises ten different components: property rights, freedom from corruption, fiscal freedom, government spending, business freedom, labor freedom, monetary freedom, trade freedom, investment freedom and financial freedom. It is expected that countries with better performances in this index attract more FDI into the tradable sector, once investors expect to deal with fewer problems on what concerns corruption, protection of property rights, tax burden and bureaucratic laws.

The Worldwide Governance Indicators database is based on a set of institutional variables developed by Kaufmann et al. (1999). The indicators measure six broad dimensions of governance: Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. The six aggregate indicators are based on 31 underlying data sources reporting the perceptions of governance of a large number of survey respondents and expert assessments worldwide. Voice and Accountability,

[11] http://ec.europa.eu/taxation_customs/resources/documents/common/publications/studies/effective_levels_company_taxation_final_en.pdf.

Political Stability and Absence of Violence/Terrorism gather those aspects related to the way societies select and replace their authorities, like the political process, civil rights and the risk of removal from power of the government in a violent and illegal way. Government Effectiveness and Regulatory Quality are associated with the ability of the government to formulate and implement policies efficiently and without excessive regulation. Rule of Law and Control of Corruption, consider aspects related to the respect by court decisions that govern interactions between citizens and government. Societies presenting better governance indicators are expected to attract more FDI because the existence of political instability, violence, terrorism and corruption make investment riskier.

Finally, the Doing Business database evaluates the cost of starting, running, and closing a company in each country. This database covers 33 different variables in nine areas: Starting a Business, Dealing with Construction Permits, Registering Property, Getting Credit, Protecting Investors, Paying Taxes, Trading Across Borders, Enforcing Contracts and Resolving Insolvency. This last database complements the information of the others with more generic information about the obstacles to doing business along the life cycle of a company.

Following the approach in Alves et al. (2013), I converted each of the 33 variables of Doing Business into indexes, according to the min-max standardization method.[12] This conversion was made such that higher values reflect a better institutional performance. The resulting indexes were summarized into the nine areas mentioned above. Once again, one should expect that countries with better performances in these indexes attract more FDI. The period considered in the collection of all institutional data was 2007-2011.

The Index of Economic Freedom indicators range from 0 to 100. For the Worldwide Governance Indicators the range is from -2.5 to 2.5. To ease comparisons across institutional indicators, these indexes were rescaled to the 0-10 range, with higher scores indicating better performances. Doing Business indicators were also ranged to the 0-10 interval when the min-max standardization was performed.

[12] The min-max standardization method rescaled to the 0-10 range implies to convert each original variable to an index according to the formula $Score_k = 10\frac{factor_k - factor_{min}}{factor_{max} - factor_{min}}$ if higher factor values imply better performances or $Score_k = 10 - 10\frac{factor_k - factor_{min}}{factor_{max} - factor_{min}}$ if higher factor values imply poorer performances.

The Appendix presents a set of summary statistics for cross-section (see Table A.4) and panel data (see Table A.6).

4 Methodology

Empirical studies concerning FDI are usually based on some variation of the gravity model employed in empirical models of bilateral trade. Although in the trade literature the gravity model has good theoretical support, in the case of FDI the use of this model still needs development of solid theoretical foundations. When applied to bilateral FDI, this model states that the greater the economic mass of the countries involved and the smaller the distance between them, the greater is the expected bilateral FDI. The usual procedure in trade literature is to add variables to the simplest gravity specification. In my paper I also use an augmented version of the gravity equation that includes economic, geographical and institutional variables affecting inward FDI.

Institutional variables considered in my model present a high degree of correlation between components, which leads to multi-collinearity problems in case of simultaneous inclusion of all variables that compose the three indicators previously introduced. Following Alves et al. (2013) I solved this problem running, for each year and for each one of the three institutional indicators used, a Principal Component Analysis (PCA), followed by a varimax rotation, in order to summarize data into a smaller set of indicators.

Using the standard eigenvalue-based criterion, with a cut-off of 1, I identify two different components in the Index of Economic Freedom, explaining 69 percent of total variance. The rotated factor loadings matrix associates the first component score with indicators like property rights, freedom from corruption, business freedom, investment freedom and financial freedom. The second component score is associated with indicators like fiscal freedom and government spending. Results are in line with Alves et al. (2013), and for that reason I also decided to call the first component "firm freedom", since it is associated with elements that influence the activity and profitability of companies, and the second component "public sector freedom", as it measures the public sector effect on economic freedom. Applying the PCA to the six governance variables from Worldwide Governance Indicators, I identify a component explaining 83 percent

of total variance. The component score - hereinafter Worldwide Governance - is interpreted as a broad measure of the quality of governance. Finally, the PCA identifies two components on the nine areas of Doing Business database, based on the standard eigenvalue-based criterion. Since factor loadings are difficult to associate to specific components and with a particular institutional feature, my option was to extract only one factor loading - hereinafter termed Doing Business - interpreted as a broad indicator of the ease of doing business. This component represents 45 percent of total variance, and is positively correlated with all nine areas of the Doing Business database.

The score vectors resulting from the procedure described above are orthogonal to each other, diminishing the correlation among components of institutional indicators used. This procedure was accompanied by a Kaiser-Meyer-Olkin (KMO) test, which measures the sampling adequacy and confirmed the PCA as appropriate. The newly created institutional variables are then included in equations as regressors to capture the effect of institutions on FDI. New institutional variables were combined so that different dimensions of institutions were covered without causing near multi-collinearity problems.

I use both a cross-section and a panel data specification.

4.1 Cross-section

In the cross-section specification I explain average inward FDI for the 2008-2011 period using regressors dated 2007, with the exception of the mean years of schooling, which were collected for the year of 2010 due to data restrictions. The approach is intended to minimize potential endogeneity problems.

Denoting the source country by j and the host country by i, I initially estimate the following log-linear augmented gravity-type equation:

$$ln(FDI_{ij}) = c_j + DISTANCE_{ij}\beta_1 + ECON_i\beta_2 + INST_i\beta_3 + \varepsilon_{ij} \tag{4.1}$$

where FDI_{ij} is the FDI stock from country j to country i, $DISTANCE_{ij}$ is a vector composed of the distance between the capitals of countries i and j and the border dummy variable, $ECON_i$

is the vector containing economic variables of the host country (GDP, GDP growth, the degree of openness, education, labor costs and EATR), and $INST_i$ is a vector containing the institutional variables of the host country. The vectors β_1, β_2 and β_3 contain unknown coefficients to be estimated; and c_j is a fixed effect that captures all idiosyncratic characteristics of the source country affecting its volume of outward FDI, like GDP or institutional framework.[13] Finally, ε_{ij} is an i.i.d. error term assumed to be normally distributed. The variables FDI_{ij}, GDP, distance between countries' capitals and labor costs enter in (4.1) in logarithmic form.

The log specification is usually preferred in literature because typically shows the best fit to the data, as suggested by Stein and Daude (2007a). However, this approach poses a problem when using the log of FDI as dependent variable, as the logarithm of zero is not defined. This problem has been dealt with in different ways. Some authors (Rose, 2000) simply drop all zero observations. This approach could lead to biased estimates as those observations may contain important information. An alternative approach followed by other authors is to use a simple transformation and work with ln(1+ FDI)[14] instead of ln(FDI), although Flowerdew and Aitkin (1982) demonstrate that adding small positive values makes estimates highly sensitive to the choice of the specific value added. Another way to deal with zero observations is to use a Tobit model (Stein and Daude, 2007a) considering that we have a censored-sample problem. This approach is based on the assumptions that stocks below a certain threshold are incorrectly recorded as zeros because of rounding in FDI statistics or that zeros are a consequence of fixed cost of investing abroad for investments below a certain threshold, despite the desired level of investment being positive.

I will perform a OLS estimation of (4.1) using as depend variable ln(FDI), excluding zeros, and using ln(1+ FDI) as alternative. Furthermore, I also estimate (4.1) using a Tobit model assuming a threshold of ln(1/4).[15]

The consistent estimation of the log-linearized model relies critically on the assumption that the ε_{ij} is not correlated with the regressors. Since this assumption may not hold, as Santos Silva & Tenreyro (2006) present strong evidence, the estimation of (4.1) by OLS or Tobit may lead to inconsistent estimates. Santos Silva & Tenreyro (2006) thus recommend estimating such models

[13] This fixed effect enters in the equation as a vector of source country dummy variables.
[14] Some authors use ln(α+FDI) were α is a parameter to be estimated.
[15] Minimum value possible of the average of inward stocks for 2008-2011 period: 1/4 million of euros

in the multiplicative form and propose a Poisson pseudo-maximum-likelihood estimator. The authors stressed that, besides solving the inconsistency problem, PPML estimator rightly deals with zero-FDI values.

The specification of the equation to be estimated is:

$$FDI_{ij} = exp\left[c_j + DISTANCE_{ij}\beta_1 + ECON_i\beta_2 + INST_i\beta_3\right]\varphi_{ij} \tag{4.2}$$

where $\varphi_{ij} = exp(\varepsilon_{ij})$.

Sometimes it happens that institutional indicators were highly correlated with some of the economic variables. Whenever this problem arose I opted to not include the correlated variables together in the same regression. This resulted in alternative model specifications.

To check the adequacy of the estimated models I performed the RESET test (Ramsey, 1969) and a Pregibon (1980) link test, both in their heteroskedasticity-robust versions. These tests try to identify if there are omitted variables or misspecification of the functional form of the model. Despite some similarities, these two tests differ in the regressors used to test the misspecification. RESET is performed by fitting the original model augmented by the powers of the fitted values of the dependent variable ($\widehat{y}$), while the link test is performed by fitting the original model augmented by the fitted values of the independent variables ($X\hat{\beta}$). The aim is to detect if the new added variables help to explain the dependent variable. If so, there is evidence of misspecification. These two tests generally produce similar results for linear models, although, for non-linear models they can yield different outcomes. For that reason I decided to perform both tests.

4.2 Panel data

In the panel data specification I explain annual inward FDI stock using regressors collected for the previous year as a way to avoid simultaneity problems. Ideally, the dependent variable should be the tradable sector FDI average stock. However, due to the short time span of data available (four years), I opted to use annual stocks instead of average stocks. Hence, FDI positions are not purged from the influence of price changes that can affect FDI's valuation, which means that cross-sectional and panel data results may not be fully comparable. All regressors used in the

cross-section specification are also included in the panel regression. Additionally, I included also a fixed time-effect (μ_t).[16] The time effect component is intended to capture all forms of time-varying heterogeneity that affect all country-pairs similarly. The panel data version of the gravity log-linearized equation becomes:

$$ln(FDI_{ijt}) = c_j + \mu_t + DISTANCE_{ij}\beta_1 + ECON_{it-1}\beta_2 + INST_{it-1}\beta_3 + \varepsilon_{ijt} \tag{4.3}$$

Westerlund & Wilhelmsson (2009) argue that the conventional approach of applying OLS to the log-linearized model with panel data is likely to cause bias and misleading inference even when the proportion of zeros is very small. They also point out that the PPML estimator adequately handles the zero-FDI observations and solve the heteroskedasticity problem (as referred in section 2) while dealing with the bias caused by country specific heterogeneity. In this sense, I will also estimate the following equation using a PPML estimator:

$$FDI_{ijt} = exp\left[c_j + \mu_t + DISTANCE_{ij}\beta_1 + ECON_{it-1}\beta_2 + INST_{it-1}\beta_3\right]\varphi_{ijt} \tag{4.4}$$

Gravity models usually contain many time-invariant or nearly time-invariant regressors. In my model, variables such as distance, education and border dummies are time-invariant. Using the traditional fixed effects estimator all these variables would be omitted from the regression, however, these variables are key to my analysis. Additionally, to use the same set of variables in the panel and in cross-section specifications allow us to compare the results obtained. In this sense, I decided not to use the traditional fixed effect estimation method. Given that I control for source country fixed effects, it remains only the host country unobserved heterogeneity (and possibly some country-pair which, given the others, should be irrelevant). But, as there are many observed controls in the model specific to the host country it is likely that host country unobserved heterogeneity will be not so important. Despite it, I am aware that both cross-section and panel estimations risk to be biased if these uncontrolled host heterogeneity is correlated with the regressors. However, I have no sound conjecture that make me suspect of the relevance of such problem in this application, nor is mentioned in the literature.

[16] The addition of a fixed time-effect can minimize the FDI's valuation problem but does not eliminate it because price changes can be idiosyncratic.

To perform the econometric estimation of equation (4.3) and (4.4) I used the pooled OLS and the pooled PPML. The random effects estimators are not used because are based on stronger assumptions, namely that observations are time independent, which is hard to verify in practice. I assume that relevant unobserved heterogeneity is captured by the fixed time-effect (μ_t) and by the source country fixed effect (c_j).[17] The estimated standard errors are heteroskedasticity robust and allow for intragroup correlation and group heteroskedasticity, sweetening the requirement that the observations are independent, which means that observations are independent across groups (clusters) but are not necessarily independent within groups.

To check the adequacy of the models, I performed a RESET test and a Pregibon link test, both heteroskedasticity-robust.

5 Results

Table 1 reports the results of the two specification tests performed. The results of these tests and all other results presented in this section were obtained with Stata (StataCorp., 2011). Table 1 presents only the least favorable p-values obtained with each method[18] (the highest when the null hypothesis is rejected and the lowest otherwise). In the OLS regressions, both tests rejects the null hypothesis that the coefficient of the test regressor is 0. This means that the models estimated using the logarithmic form are misspecified. A similar result is found for the Tobit in the RESET test. In contrast, all the models estimated using the PPML regressions pass RESET and Pregibon link test, that is, both tests provide no evidence of misspecification.

In what follows I will focus on the analysis of the PPML results, as this method is able to deal with zero-FDI values in a suitable way, relies on weaker assumptions than the other methods and, most of all, is the only one that shows no evidence of misspecification simultaneously in both tests, as we can see in Table 1. Nevertheless, whenever it is deemed appropriate, I will compare PPML results with those obtained by OLS and Tobit. The OLS and Tobit outcomes, corresponding to

[17] I have also estimated the equations presented above including a host country fixed effect, however, the estimated coefficients were not statistically significant. This result can simply mean that the host country effect is not relevant but, on the other hand, it can also be a consequence of the lack of information of the panel used. A longer and richer panel data set would be required to clarify this issue.

[18] I estimated four different equations with each estimator. These equations differ by including different combinations of institutional variables and intended to achieve a good characterization of the institutional framework without causing any multicollinearity problems.

Table 1: Results of the specification tests (p-values)

	OLS ln(FDIij)	OLS ln(FDIij+1)	TOBIT ln(FDIij+1/4)	PPML FDIij
		Cross-section		
RESET test	0.009	0.000	0.008	0.203
Link test	0.000	0.000	0.117	0.534
		Panel		
RESET test	0.000	0.000	-	0.286
Link test	0.000	0.000	-	0.166

Least favorable p-values for each method - the highest when the null hypothesis is rejected and the lowest otherwise.

the estimation of equations 4.1 and 4.3, can be seen in Table A.9 to A.13 of Appendix.[19] Finally, I will also compare my cross-section PPML results with Alves et al. (2013) results (see Table A.8 of Appendix) obtained for aggregated FDI with a very similar model. This last comparison should be analyzed and interpreted with caution as, despite the models being quite similar, the time period and the samples used are different and results can not be fully comparable.

Table 2 below reports the outcomes from the cross-section PPML estimation (equation 4.2) and Table 3 presents the results of the panel data PPML estimation (equation 4.4). The first column of each table reports the results of the baseline regression, in which no institutional variable is included. We should interpret this column results with caution, as the regression may suffer from omitted variable bias. Columns (2) to (4) present different combinations of independent institutional variables. The combination of variables was made in order to achieve a good characterization of the institutional framework and, simultaneously, avoiding problems caused by near multi-collinearity of some institutional variables.[20] This approach is also a way to assess the robustness of the results obtained. Collinearity diagnostics tests were performed, after the estimation of the models, and none of the four specifications (combinations of variables)

[19] The OLS results presented in Table A.9 and A.12 were obtained using log of bilateral FDI as depend variable, which means that all zero values are dropped. On what concerns to Table A.10 and Table A.13 results, the dependent variable considered is log of bilateral FDI+1, as a way to avoid the loss of zero observations. Although adding small values to the dependent variable is not the best solution to deal with zeros problem, as mentioned in section 4, it is important to measure and understand the impact on the estimates of the two different approaches.

[20] Collinearity problems are mostly caused by high correlation between institutional variables as can be seen from Tables A.5 and A.7 of Appendix.

present a significant collinearity problem according to the VIF (variance inflation factor) measure.

5.1 Cross-section results

Table 2 reports the cross-section PPML estimates. These regressions leave out 128 pairs of countries with negative bilateral FDI (884 country pairs, out of 1012, or 87% of the sample, exhibit a non-negative average FDI position as can be seen in Table A.3 of Appendix). As a comparison, the OLS estimation technique, using the logarithm of FDI as dependent variable, leaves out 378 pairs of countries, which means that only 63% of the sample is used because of the zeros and negative bilateral FDI positions.

The PPML-estimated coefficients differ significantly from those obtained using OLS and Tobit (see Table A.9 to A.11 of Appendix). On the other hand, they are very similar to the PPML coefficients estimated using only the positive-FDI subsample (see Table A.14 of Appendix). These results suggest that heteroskedasticity in the multiplicative error is the main cause for the difference between PPML results and those of OLS.

PPML estimates reveal that the role of geographical distance is much smaller than the one obtained using other methods: the estimated PPML elasticities oscillate between -0.33 and -0.43. These results mean that an increase of 1 percent in the number of kilometers between source and host countries is expected to reduce, on average, tradable sector FDI between 0.33 and 0.43 percent. OLS and Tobit estimates for these coefficients vary between -1.47 and -1.64. Alves et al. (2013) using as depend variable aggregated FDI, estimated PPML elasticities that oscillate between -0.54 and -0.63[21] (see Table A.8 of Appendix), which may lead to conclude that distance seems to be an obstacle harder to overcome for aggregated FDI than for the tradable sector FDI.

Results concerning contiguity are similar for different estimation methods and combination of variables and reveal that sharing a common border does not affect inward FDI into the tradable sector. This outcome differs significantly from the results obtained by Alves et al. (2013) and from the results that have usually been obtained in literature for aggregated FDI. Alves et al. (2013) found that the FDI of a country in its neighbour is approximately between 73 and 88

[21] Estimated elasticities in literature oscillate between -1.9 (Stein and Daude, 2007a) and -0.49 (Bénassy-Quéré et al., 2007).

percent (see Table A.8 of Appendix) higher than the FDI in a similar country that does not share a common border. Border and distance results show that physical distance does not represent a major obstacle to the attraction of FDI into the tradable sector.

The level of GDP is always statistically significant, which supports the economic mass hypothesis. PPML estimated GDP elasticities are around 1 (the null hypothesis of an unit elasticity is never rejected at the usual significance levels in any of the estimated equations). These results are in line with the GDP elasticities I obtained with other estimators and with the empirical results obtained in literature for aggregated FDI.

The effect of economic growth and education does not seem to be significant when we use the PPML estimator. However, for all other estimation methods used, economic growth is statistically significant and plays a negative role on FDI. One possible explanation for economic growth statistical insignificance is that local market growth is not crucial to FDI because, usually, tradable sector production is not targeted only to the national market but also to the world market. Some authors argue that the statistical insignificance of education may result from two opposite effects that cancel each other out. On the one hand, more education implies higher productivity, but, on the other, it is also associated with higher wage costs. Since I have controlled the labor costs effect, the result suggests that the productivity effect captured by the education variable does not seem to be relevant to the attraction of tradable sector FDI. Alves et al. (2013) PPML estimates (see Table A.8 of Appendix) presented some statistical evidence of a negative effect of education and of a positive effect of economic growth on FDI.

An increase in the degree of openness by one percentage point is expected to rise, on average, tradable sector FDI between 1.7 and 2 percent. Alves et al. (2013) PPML estimates for aggregated FDI reported a positive but not always statistically significant effect of openness on FDI. The estimated coefficients for aggregated FDI are always smaller (see Table A.8 of Appendix) when compared with my tradable sector PPML estimates. This result is not surprising since tradable activities are more prone to international trade than other activities.

The EATR coefficient is always statistically significant, with the expected negative sign: an increase in the effective average tax rate by 1 percentage point is expected to reduce, on average, tradable sector FDI between 5.3 and 12.1 percent. Alves et al. (2013) PPML estimates for EATR are always not statistically significant. This means that tax competitiveness should be taken into

account for countries seeking to attract FDI into tradable sectors. Effective average tax rate reflects the tax incentives, such as investment tax credits granted to companies when investments are made, and validates this kind of economic policies as a way to attract foreign direct investment into the tradable sector.[22]

The labor costs is statistically significant only in the PPML estimation and impacts FDI positively. The results in Alves et al. (2013) for this variable (see Table A.8 of Appendix) suggest a negative effect for aggregated FDI. This opposite result hint that productivity gains for tradable sector FDI, which are positively associated with labor costs, overcome the negative effect of higher wages, while for aggregated FDI the opposite holds.

Institutional variables Firm freedom, Worldwide Governance and Doing Business are highly correlated and were not included simultaneously in the regressions. Results in Table 2 suggest that Firm freedom and Public sector freedom were the only institutional variables to play a role in tradable sector FDI. These two variables seem to impact FDI, positively and negatively, respectively. Worldwide Governance and Doing Business are non-significant. Alves et al. (2013) PPML estimates for Firm freedom, Public sector freedom and Doing Business were consistent with my estimates in terms of signal. The main difference is that they find a non-significant effect of Public sector freedom on aggregated FDI and their estimates for Firm freedom coefficient (varying between 0.53 and 0.76) are substantially larger than my estimate (0.13).

Firm freedom is associated with indicators like protection of property rights, freedom from corruption, investment and business freedom, in this sense, societies that guarantee these set of rights and freedoms to foreign investors will surely attract more FDI.

Public sector freedom is associated with indicators like fiscal freedom and government spending. Theoretically, it is not clear if higher public expenditures, should attract or repeal FDI. On the one hand, a strong state presence in the economy takes space from private enterprises. On the other hand, higher public expenditures may be associated with good infrastructures, stable socioeconomic conditions and strong public incentives for FDI.

My results support the idea that state intervention in the economy could have a positive effect for the attraction of FDI into the tradable sector, although the evidence is weak (coefficient is

[22] My results are in line with Cassou (1997) that found that host country corporate tax rates have a negative impact on investment flows and Hines (1996) that found that state tax rates influenced the pattern of FDI in United States.

Table 2: Cross-Section PPML estimates

	(1)	(2)	(3)	(4)
Log distance	-0.329**	-0.350**	-0.428***	-0.422***
	(0.155)	(0.154)	(0.146)	(0.140)
Contiguity dummy	0.059	0.092	0.032	0.028
	(0.202)	(0.213)	(0.213)	(0.211)
Log GDP	0.847***	1.011***	1.215***	1.131***
	(0.153)	(0.214)	(0.201)	(0.225)
GDP growth	0.031	0.036	0.052	0.039
	(0.039)	(0.047)	(0.046)	(0.047)
Education	0.022	-0.018	0.005	-0.001
	(0.088)	(0.086)	(0.094)	(0.089)
Openness	0.017***	0.017***	0.018***	0.018***
	(0.006)	(0.006)	(0.006)	(0.006)
EATR	-0.053**	-0.082*	-0.121***	-0.107**
	(0.027)	(0.046)	(0.043)	(0.046)
Firm freedom		0.133**		
		(0.066)		
Public sector freedom		-0.144	-0.252*	-0.211*
		(0.131)	(0.137)	(0.124)
Log labor costs	0.027***			
	(0.007)			
Worldwide Governance			-0.026	
			(0.078)	
Doing Business				0.045
				(0.066)
Observations	884	884	884	884
Pseudo R-squared	0.821	0.820	0.817	0.818
RESET test p-value	0.232	0.323	0.203	0.208
Linktest p-value	0.957	0.655	0.542	0.534

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source country dummies were included, but not reported.

only statistically significant at the 10 percent level).

5.2 Panel data results

In this sub-section, I extend my analysis to assess the tradable sector FDI determinants over time. Besides representing an additional robustness check to cross-section results, the panel data model allows us to have more observations and to control for the time-varying heterogeneity by means of a fixed time effect.

Table 3 shows the panel pooled PPML estimates with clusters-robust standard errors. These regressions leave out 415 observations with negative bilateral FDI (3633 country pair observations, out of 4048, or 90% of the sample, exhibit a non-negative FDI position as can be seen in Table A.3 of Appendix). Once again, estimating the model in logarithmic form through OLS leaves out 1707 pairs of countries, or equivalently 42 percent of the sample, due to non-positive FDI positions. As the pairs of countries do not leave the panel randomly, the loss of observations is more severe in small countries or countries where the manufacturing sector has a smaller relative size. Hence, the panel become highly unbalanced. This means that the impact of zero observations in my sample is more severe in panel data and to simply drop this data will likely lead to serious estimation bias.

Pooled PPML coefficients differ significantly from those obtained using pooled OLS the same way that cross-section PPML estimates diverge from cross-section OLS. Additionally, PPML-estimated coefficients are very similar using the whole sample and using the positive-FDI sub-sample (see Table A.15 of Appendix). These results suggest that heteroskedasticity in the multiplicative error is the main explanation for the difference between PPML and OLS results, as it was already observed for the cross-section data.

The role of geographical distance as FDI deterrent is slightly higher under pooled PPML than under cross-section PPML: now an increase of 1 percent in the number of kilometers between source and host countries is expected to reduce tradable sector FDI between 0.40 and 0.56 percent. The contiguity dummy estimated coefficients stress that to share a common border does not matter for inward FDI. These results corroborate the hypothesis that distance is not a difficult obstacle to transpose for tradable sector FDI.

Results obtained for GDP level are somewhat different from those of pooled OLS and of cross-section models. In particular, estimated elasticities now oscillate between 0.62 and 0.69, while pooled OLS estimates vary between 0.89 and 0.95 and cross-section estimated GDP elasticities are close to 1. These results still support the economic mass hypothesis but rules out the hypothesis of a unit elasticity of level GDP (The null hypothesis of an unit elasticity is unequivocally rejected at any usual significance level).

Openness plays a positive role on FDI with an estimated coefficient varying between 0.015 and 0.017, in line with cross-section results, and is always statistically significant at the 5 percent

level. These results strengthen the hypothesis that the degree of openness is important to attract FDI into the tradable sector.

Economic growth is statistically significant and, as expected, has a positive effect on FDI, while in cross-section framework it is non-significant.

Education and EATR do not seem to affect FDI based on Table 3 results. EATR statistical insignificance contradicts the cross-section PPML results and puts into question the idea of attracting FDI into tradable sector through policies promoting countries tax competitiveness. The effect of labor costs on FDI is statistically significant and in line with cross-section results in terms of economic significance which consolidates the idea that in tradable sector FDI, productivity gains, which are positively associated with labor costs, overcome the negative effect of higher wages.

Table 3 results stress also that the institutional variable Firm freedom, as in cross-section framework, plays an important role on the attraction of tradable sector FDI. The estimated coefficient is 0.28 in pooled PPML, while in cross-section is only 0.13, both statistically significant at the 5 percent level. Public sector freedom is not statistically significant. This result contradicts cross-section outcomes for this variable in the sense that it does not support the idea that state intervention in the economy has a positive effect on FDI.

Worldwide Governance and Doing Business seems to impact FDI positively in pooled PPML regressions, while in cross-section they are not statistically significant. Thus, according to these results, countries presenting a better governance, more efficiency and less bureaucracy are expected to attract more FDI.

Panel data results do not always coincide with those of cross-section. On the one hand, the difference between panel and cross-section results can be explained by the different nature of the dependent variable. In the cross-section specification the dependent variable is a 4-years FDI average stock while in the panel specification is the annual inward FDI stock. Thus, panel data FDI positions are not purged from the influence of price changes that can affect FDI's valuation. On the other hand, panel data allow us to use more observations, taking advantage of the increased sample variability, and also allow us to control for the unobserved heterogeneity by means of a fixed time effect.

Table 3: Panel Data Pooled PPML estimates

	(1)	(2)	(3)	(4)
Log distance	-0.458***	-0.395**	-0.544***	-0.555***
	(0.151)	(0.160)	(0.154)	(0.149)
Contiguity dummy	-0.112	0.010	-0.146	-0.173
	(0.194)	(0.210)	(0.215)	(0.213)
Log GDP	0.651***	0.617***	0.693***	0.661***
	(0.106)	(0.116)	(0.110)	(0.124)
GDP growth	0.038**	0.042**	0.030*	0.035**
	(0.016)	(0.017)	(0.016)	(0.015))
Education	-0.037	-0.052	-0.078	0.020
	(0.095)	(0.088)	(0.100)	(0.089)
Openness	0.015**	0.017***	0.016**	0.016**
	(0.006)	(0.006)	(0.007)	(0.006)
EATR	-0.025	0.006	-0.022	-0.012
	(0.024)	(0.033)	(0.033)	(0.034)
Firm freedom		0.279***		
		(0.066)		
Public sector freedom		0.030	-0.049	-0.072
		(0.107)	(0.114)	(0.102)
Log labor costs	0.026***			
	(0.006)			
Worldwide Governance			0.161**	
			(0.079)	
Doing Business				0.180***
				(0.069)
Observations	3.633	3.633	3.633	3.633
Pseudo R-squared	0.797	0.800	0.790	0.791
RESET test p-value	0.300	0.379	0.286	0.361
Linktest p-value	0.510	0.511	0.180	0.166

Standard errors adjusted for 979 clusters. *** p<0.01, ** p<0.05, * p<0.1
Source country and time dummies were included, but not reported.

6 Conclusion

In this work I have looked at the determinants of tradable sector FDI. I have shown that, such as in the aggregated FDI, countries with a large market size, a higher degree of economic openness and good institutions are expected to receive more FDI in the tradable sector. On the other hand, this work has depicted some relevant differences relative to the aggregated FDI literature. It has found that distance does not represent an obstacle so hard to transpose for tradable sector FDI as seems to represent to aggregated FDI. In fact, even to share a border did not seem to have an impact on the attraction of FDI to the tradable sector. Results have also stressed that the degree of openness is much more relevant as tradable sector FDI determinant than as an aggregated FDI determinant. Finally, this work have also presented evidence that the productivity gains, which are positively associated with labor costs, overcome the negative effect of higher wages for tradable sector FDI, while for aggregated FDI the opposite usually holds. These results were robust to the use of different methods, specifications and variables.

In sum, this thesis demonstrates that policies promoting economic growth, an increase of productivity levels and the economic openness of a country to international trade are expected to have a positive effect on the attraction of FDI to the tradable sector. This work has also stressed the importance of the quality of the institutions to FDI on establishing a predictable framework for investment, in this sense, policies based on the protection of property rights, guaranteeing freedom from corruption and freedom to investment are expected to attract FDI.

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Appendix

A Tables

Table A.1: List of variables

Dependent variable
FDI stock: Bilateral inward FDI stock (in millions of euros).
Geographical variables
Log distance: Logarithm of the distance (in kilometers) between source and host countries' capitals.
Contiguity dummy: Dummy variable that takes the value of 1 if source and host countries share a border.
Economic variables
Log GDP: Logarithm of the Gross Domestic Product at current market prices (in millions of euros).
GDP growth: Anual real GDP growth rate (percentage).
Education: Average Years of Schooling.
Openness: Degree of openness, measured as the share of imports plus exports over GDP.
EATR: Effective average tax rate in the host country.
Log labor cost: Logarithm of the annual nominal compensation per employee (in thousands of euros).
Institutional variables
Firm freedom: Broad measure of a company' freedom (investment freedom, freedom from corruption).
Public sector freedom: Broad measure of the public sector effect on economic freedom.
Worldwide Governance: Broad measure of the quality of host countries' governance.
Doing Business: Broad measure of the ease of doing business in the host country.

Table A.2: List of countries

Host Countries	Source Countries	
Belgium	Australia	Lithuania
Bulgaria	Austria	Luxembourg
Czech Republic	Brazi	Malaysia
Denmark	Bulgaria	Malta
Estonia	Canada	Mexico
Finland	China	Netherlands
France	Croatia	New Zealand
Germany	Cyprus	Norway
Greece	Czech Republic	Poland
Hungary	Denmark	Portugal
Ireland	Estonia	Romania
Italy	Finland	Russia
Latvia	France	Singapore
Lithuania	Germany	Slovakia
Netherlands	Greece	Slovenia
Portugal	Hong Kong	South Korea
Romania	Hungary	Spain
Slovakia	India	Sweden
Slovenia	Ireland	Switzerland
Spain	Israel	Thailand
Sweden	Italy	Turkey
United Kingdom	Japan	United Kingdom
	Latvia	United States

Table A.3: Summary statistics on negative and zero FDI positions

	Cross-section	Panel
Number of zeros	250	1292
(Percentage of total)	*(25%)*	*(32%)*
Number of negatives	128	415
(Percentage of total)	*(13%)*	*(10%)*
Observations	1012	4048

Table A.4: Cross-Section summary statistics

Variable	Mean	Std. Dev.	Min	Max
FDIij	948.038	3629.45	-2455.5	45047.75
Log FDIij	4.666	2.675	-1.386	10.715
Log distance	7.741	1.082	4.127	9.895
Contiguity dummy	.067	.25	0	1
Log GDP	12.187	1.505	9.685	14.703
GDP growth	4.795	2.785	.1	10.5
Education	10.715	.9165	8.03	12.11
Openness	42.345	17.374	17.1	77.7
EATR	22.491	7.135	8.8	35.5
Firm freedom	2.45	1.488	-.312	5.241
Public sector freedom	-1.217	1.376	-3.895	.846
Log labor costs	27.024	14.971	3.806	47.47
Worldwide Governance	2.653	1.262	.221	4.811
Doing Business	2.053	1.189	-.273	4.380

Table A.5: Cross-Section: Correlation of institutional variables

	Log labor costs	Firm freedom	Public sector freedom	Worldwide Governance	Doing Business
Log labor costs	1.0000				
Firm freedom	0.7898	1.0000			
Public sector freedom	-0.7260	-0.4981	1.0000		
Worldwide Governance	0.8264	0.9184	-0.6695	1.0000	
Doing Business	0.6678	0.8321	-0.3073	0.7509	1.0000

Table A.6: Panel Data summary statistics

Variable	Mean	Std. Dev.	Min	Max
FDIij	948.038	3755.36	-3787	67012
Log FDIij	4.904	2.527	0	11.112
Log distance	7.741	1.082	4.127	9.895
Contiguity dummy	.0672	.250	0	1
Log GDP	12.190	1.493	9.545	14.730
GDP growth	.124	5.105	-17.7	10.5
Log labor costs	27.870	15.056	3.806	50.999
Openness	40.484	16.840	13.3	77.7
Education	10.715	.9162	8.03	12.11
EATR	21.710	6.682	8.8	35.5
Firm freedom	2.526	1.422	-.312	5.536
Public sector freedom	-1.144	1.264	-3.895	.846
Worldwide Governance	2.610	1.258	.221	4.811
Doing Business	1.992	1.140	-.326	4.380

Table A.7: Panel Data: Correlation of institutional variables

	Log labor costs	Firm freedom	Public sector freedom	Worldwide Governance	Doing Business
Log labor costs	1.0000				
Firm freedom	0.7901	1.0000			
Public sector freedom	-0.7476	-0.5700	1.0000		
Worldwide Governance	0.8036	0.9212	-0.6799	1.0000	
Doing Business	0.6483	0.8091	-0.3728	0.7501	1.0000

Table A.8: Alves et al. (2013) estimates for aggregated FDI (cross-sectional data)

	(1) OLS	(2) PPML	(3) OLS	(4) PPML	(5) OLS	(6) PPML
Log distance	-1.370***	-0.587***	-1.332***	-0.536***	-1.424***	-0.628***
Contiguity dummy	0.742***	0.596***	0.707***	0.630***	0.691***	0.548***
Log GDP	1.076***	0.905***	1.097***	1.092***	1.183***	1.030***
GDP growth	0.259***	0.110	0.306***	0.148*	0.397***	0.282***
Education	-0.111*	-0.035	-0.202***	-0.110	-0.315***	-0.166**
Openness	0.007**	0.003	0.009***	0.005**	0.021***	0.013***
EATR	0.019	0.017	0.012	-0.007	0.028*	0.014
Firm freedom	0.759***	0.527***				
Public sector freedom	-0.397***	-0.075	-0.120	-0.020	-0.387***	-0.021
Log labor costs	-0.611***	-0.466**	-0.205	-0.541***	-0.088	0.251
Doing Business					0.549***	0.066
Political risk			0.751***	0.831***		
Political tensions	0.060	-0.031	0.074	0.025	0.057	0.066
Government stability	0.038	0.385**	-0.340***	0.147	-0.347***	-0.039
Observations	1.220	1.832	1.220	1.832	1.211	1.768
Pseudo R-squared	0.730	0.910	0.724	0.913	0.732	0.910

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source country dummies were included, but not reported.

Table A.9: Cross-Section OLS estimates (dependent variable ln(FDIij)

	(1)	(2)	(3)	(4)
Log distance	-1.488***	-1.470***	-1.487***	-1.487***
	(0.151)	(0.153)	(0.151)	(0.151)
Contiguity dummy	0.154	0.190	0.159	0.159
	(0.271)	(0.274)	(0.272)	(0.272)
Log GDP	1.014***	0.932***	0.989***	0.984***
	(0.116)	(0.118)	(0.118)	(0.117)
GDP growth	-0.079***	-0.095***	-0.086**	-0.088**
	(0.030)	(0.037)	(0.038)	(0.038)
Education	0.054	0.021	0.048	0.057
	(0.092)	(0.095)	(0.097)	(0.093)
Openness	0.017***	0.017***	0.018***	0.018***
	(0.005)	(0.005)	(0.005)	(0.005)
EATR	-0.061***	-0.047*	-0.056**	-0.055**
	(0.020)	(0.025)	(0.025)	(0.025)
Firm freedom		0.093*		
		(0.052)		
Public sector freedom		0.098	0.034	0.036
		(0.095)	(0.113)	(0.094)
Log labor costs	-0.002			
	(0.006)			
Worldwide Governance			0.013	
			(0.075)	
Doing Business				0.023
				(0.064)
Observations	634	634	634	634
R-squared	0.702	0.703	0.702	0.702
White test p-value	0.007	0.011	0.008	0.008
RESET test p-value	0.007	0.009	0.008	0.009
Linktest p-value	0.000	0.000	0.000	0.000

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source country dummies were included, but not reported.

Table A.10: Cross-Section OLS estimates (dependent variable ln(FDIij+1))

	(1)	(2)	(3)	(4)
Log distance	-1.631***	-1.636***	-1.616***	-1.622***
	(0.143)	(0.144)	(0.143)	(0.144)
Contiguity dummy	0.181	0.183	0.180	0.186
	(0.269)	(0.270)	(0.268)	(0.269)
Log GDP	1.102***	1.065***	1.130***	1.104***
	(0.093)	(0.098)	(0.098)	(0.098)
GDP growth	-0.065**	-0.072*	-0.054	-0.059
	(0.030)	(0.037)	(0.038)	(0.038)
Education	0.232***	0.222***	0.267***	0.222***
	(0.078)	(0.078)	(0.079)	(0.075)
Openness	0.020***	0.020***	0.020***	0.020***
	(0.005)	(0.005)	(0.005)	(0.005)
EATR	-0.088***	-0.083***	-0.093***	-0.089***
	(0.017)	(0.021)	(0.021)	(0.021)
Firm freedom		0.008		
		(0.046)		
Public sector freedom		0.034	-0.068	-0.001
		(0.084)	(0.098)	(0.083)
Log labor costs	-0.003			
	(0.006)			
Worldwide Governance			-0.120*	
			(0.066)	
Doing Business				-0.060
				(0.054)
Observations	904	904	904	904
R-squared	0.718	0.718	0.719	0.718
RESET test p-value	0.000	0.000	0.000	0.000
Linktest p-value	0.000	0.000	0.000	0.000

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source country dummies were included, but not reported.

Table A.11: Cross-Section TOBIT estimates

	(1)	(2)	(3)	(4)
Log distance	-1.493***	-1.474***	-1.492***	-1.491***
	(0.160)	(0.160)	(0.160)	(0.160)
Contiguity dummy	0.157	0.195	0.162	0.162
	(0.263)	(0.263)	(0.263)	(0.263)
Log GDP	1.023***	0.939***	0.995***	0.990***
	(0.116)	(0.117)	(0.119)	(0.116)
GDP growth	-0.079**	-0.096**	-0.088**	-0.091**
	(0.031)	(0.038)	(0.040)	(0.040)
Education	0.053	0.019	0.045	0.059
	(0.098)	(0.100)	(0.106)	(0.099)
Openness	0.018***	0.017***	0.018***	0.018***
	(0.005)	(0.005)	(0.005)	(0.005)
EATR	-0.062***	-0.047**	-0.057**	-0.056**
	(0.019)	(0.023)	(0.023)	(0.023)
Firm freedom		0.099*		
		(0.052)		
Public sector freedom		0.104	0.042	0.042
		(0.092)	(0.106)	(0.089)
Log labor costs	-0.001			
	(0.006)			
Worldwide Governance			0.021	
			(0.076)	
Doing Business				0.031
				(0.060)
Observations	634	634	634	634
RESET test p-value	0.006	0.008	0.007	0.008
Linktest p-value	0.258	0.117	0.221	0.203

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source country dummies were included, but not reported.

Table A.12: Panel Data Pooled OLS estimates (dependent variable ln(FDIij))

	(1)	(2)	(3)	(4)
Log distance	-1.293***	-1.267***	-1.294***	-1.290***
	(0.128)	(0.129)	(0.127)	(0.128)
Contiguity dummy	0.274	0.320	0.268	0.272
	(0.232)	(0.233)	(0.232)	(0.231)
Log GDP	0.936***	0.909***	0.948***	0.943***
	(0.084)	(0.080)	(0.080)	(0.080)
GDP growth	0.024**	0.030***	0.025**	0.026**
	(0.010)	(0.010)	(0.010)	(0.010)
Education	0.125*	0.069	0.113	0.125*
	(0.075)	(0.076)	(0.079)	(0.074)
Openness	0.011**	0.010**	0.011**	0.010**
	(0.004)	(0.004)	(0.004)	(0.004)
EATR	-0.039**	-0.036*	-0.044**	-0.042**
	(0.016)	(0.019)	(0.018)	(0.018)
Firm freedom		0.121**		
		(0.047)		
Public sector freedom		0.038	-0.050	-0.040
		(0.078)	(0.082)	(0.072)
Log labor costs	0.003			
	(0.005)			
Worldwide Governance			0.010	
			(0.061)	
Doing Business				0.034
				(0.054)
Observations	2.341	2.341	2.341	2.341
R-squared	0.686	0.689	0.686	0.686
RESET test p-value	0.000	0.000	0.000	0.000
Linktest p-value	0.000	0.000	0.000	0.000

Standard errors adjusted for 692 clusters. *** p<0.01, ** p<0.05, * p<0.1
Source country and time dummies were included, but not reported.

Table A.13: Panel Data Pooled OLS estimates (dependent variable ln(FDIij+1))

	(1)	(2)	(3)	(4)
Log distance	-1.578***	-1.573***	-1.559***	-1.558***
	(0.132)	(0.132)	(0.131)	(0.132)
Contiguity dummy	0.282	0.276	0.261	0.270
	(0.255)	(0.255)	(0.253)	(0.254)
Log GDP	0.887***	0.919***	0.946***	0.956***
	(0.074)	(0.068)	(0.066)	(0.066)
GDP growth	0.008	0.007	0.005	0.002
	(0.008)	(0.009)	(0.008)	(0.008)
Education	0.164**	0.180**	0.230***	0.175**
	(0.072)	(0.072)	(0.073)	(0.068)
Openness	0.017***	0.017***	0.018***	0.017***
	(0.004)	(0.004)	(0.004)	(0.004)
EATR	-0.057***	-0.062***	-0.067***	-0.071***
	(0.014)	(0.017)	(0.016)	(0.016)
Firm freedom		0.004		
		(0.047)		
Public sector freedom		-0.055	-0.156**	-0.104
		(0.073)	(0.079)	(0.068)
Log labor costs	0.006			
	(0.005)			
Worldwide Governance			-0.137**	
			(0.059)	
Doing Business				-0.113**
				(0.050)
Observations	3.633	3.633	3.633	3.633
R-squared	0.686	0.685	0.687	0.687
RESET test p-value	0.000	0.000	0.000	0.000
Linktest p-value	0.000	0.000	0.000	0.000

Standard errors adjusted for 979 clusters. *** p<0.01, ** p<0.05, * p<0.1
Source country and time dummies were included, but not reported.

Table A.14: Cross-Section PPML estimates (FDIij>0)

	(1)	(2)	(3)	(4)
Log distance	-0.304**	-0.312**	-0.390***	-0.390***
	(0.153)	(0.151)	(0.143)	(0.137)
Contiguity dummy	0.081	0.123	0.060	0.052
	(0.200)	(0.210)	(0.211)	(0.208)
Log GDP	0.813***	0.983***	1.171***	1.096***
	(0.154)	(0.215)	(0.204)	(0.227)
GDP growth	0.031	0.042	0.055	0.044
	(0.039)	(0.047)	(0.047)	(0.048)
Education	-0.008	-0.063	-0.047	-0.044
	(0.090)	(0.090)	(0.099)	(0.093)
Openness	0.017***	0.017***	0.017***	0.017***
	(0.006)	(0.006)	(0.006)	(0.006)
EATR	-0.051*	-0.082*	-0.119***	-0.106**
	(0.026)	(0.046)	(0.043)	(0.046)
Firm freedom		0.141**		
		(0.064)		
Public sector freedom		-0.167	-0.264*	-0.233*
		(0.131)	(0.137)	(0.124)
Log labor costs	0.027***			
	(0.007)			
Worldwide Governance			-0.004	
			(0.077)	
Doing Business				0.058
				(0.066)
Observations	634	634	634	634
Pseudo R-squared	0.796	0.796	0.792	0.792
RESET test p-value	0.166	0.272	0.152	0.155
Linktest p-value	0.752	0.901	0.784	0.766

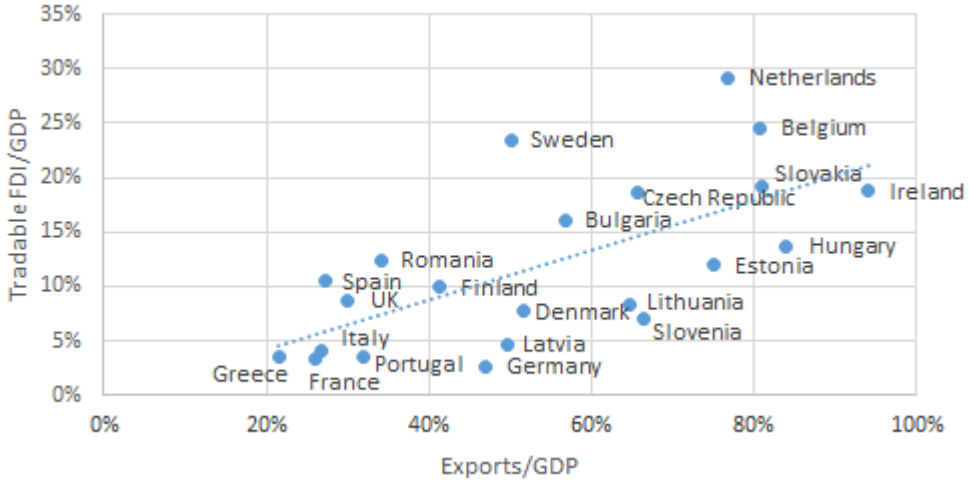
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source country and time dummies were included, but not reported.

Table A.15: Panel Data Pooled PPML estimates (FDIij>0)

	(1)	(2)	(3)	(4)
Log distance	-0.427***	-0.349**	-0.494***	-0.509***
	(0.148)	(0.157)	(0.150)	(0.145)
Contiguity dummy	-0.089	0.042	-0.111	-0.144
	(0.190)	(0.206)	(0.211)	(0.210)
Log GDP	0.629***	0.594***	0.661***	0.627***
	(0.107)	(0.117)	(0.112)	(0.126)
GDP growth	0.040**	0.045***	0.032*	0.038**
	(0.016)	(0.017)	(0.017)	(0.015)
Education	-0.053	-0.084	-0.121	-0.001
	(0.098)	(0.092)	(0.105)	(0.092)
Openness	0.014**	0.016**	0.015**	0.015**
	(0.006)	(0.006)	(0.006)	(0.006)
EATR	-0.026	0.004	-0.022	-0.011
	(0.024)	(0.033)	(0.033)	(0.033)
Firm freedom		0.287***		
		(0.064)		
Public sector freedom		0.018	-0.054	-0.079
		(0.107)	(0.113)	(0.101)
Log labor costs	0.027***			
	(0.006)			
Worldwide Governance			0.185**	
			(0.077)	
Doing Business				0.206***
				(0.069)
Observations	2.341	2.341	2.341	2.341
Pseudo R-squared	0.764	0.769	0.755	0.758
RESET test p-value	0.187	0.324	0.192	0.313
Linktest p-value	0.801	0.716	0.288	0.252

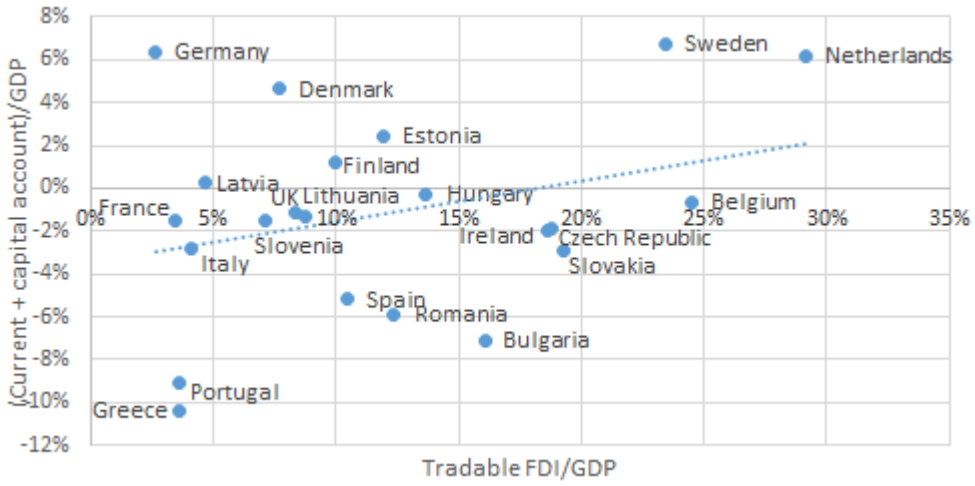
Standard errors adjusted for 692 clusters. *** p<0.01, ** p<0.05, * p<0.1
Source country and time dummies were included, but not reported.

B Figures



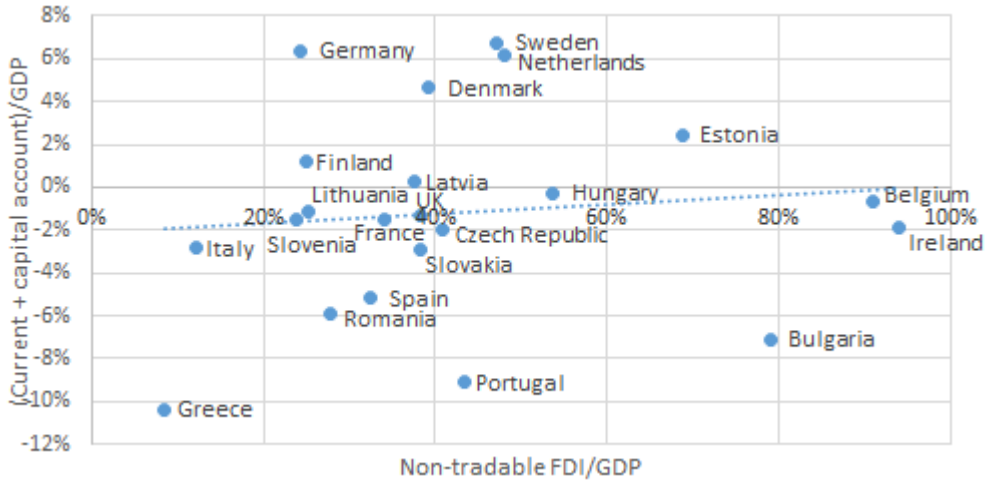
Source: Authors' calculations based on Eurostat data

Figure B.1: Tradable FDI vs. Export as % GDP (2008 - 2011 average values)



Source: Authors' calculations based on Eurostat data

Figure B.2: External imbalances vs. tradable FDI as % GDP (2008 - 2011 average values)



Source: Authors' calculations based on Eurostat data

Figure B.3: External imbalances vs. non-tradable FDI as % GDP (2008 - 2011 average values)