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Essays in International Economics

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Abstract

This dissertation consists of three chapters. These chapters use the power of the gravity model widely employed in the international economics literature. The first chapter investigates how economic integration agreements impact countries' local technology, wages, prices and market access, and how to aggregate these effects to compute the changes in countries' welfare. By examining 16 countries that have harmonized with the European Union since 1980, we show that almost all of the participating countries experience welfare gains as a result of signing integration agreements with the European Union.

The objective of the second chapter is to explain the determinants of foreign direct investment (FDI) flows; in particular, we focus on the effects of estimates of economic integration agreements on FDI flows while controlling for time-varying country specific unobserved variables as well as time constant country-pair unobserved variables. As compared to the previous literature, we find that the coefficient estimates of common market and custom union are overestimated and the free trade agreement coefficient becomes insignificant after accounting for above-mentioned unobserved variables.

Building on the work of Baier and Bergstrand (2009), the third chapter aims to obtain unbiased, consistent and efficient coefficient estimates of trade cost variables by accounting for unobserved country heterogeneity and approximation errors.

Dedication

To my handsome son, lovely wife, caring parents and precious siblings for their continued loves, supports and prays.

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Chapter 1

Do Economic Integration Agreements Increase Countries' International Trade, Welfare and Technology?

1.1 Introduction

Over the last two decades, the world has seen a tremendous increase in the number of economic integration agreements (EIAs). The World Trade Organization reports that the number of trade agreements in force increased from 14 as of 1980 to 379 as of June 2014[1]. These agreements cover different levels of economic integration. Following Baier et al. (2014), we classify these EIAs by depth of the agreements; in particular, the EIAs are classified as free trade agreements (FTAs), custom unions (CUs), common markets (CMs), and economic unions (EUs). A simple question this paper proposes to answer is "Why are countries willing to sign EIAs?" One common and obvious reason is that they increase bilateral (multilateral) trade flows through the reduction in trade costs as EIAs can remove trade barriers and allow free movement of goods and services across borders. It is not too surprising then that the rise in trade agreements over this period has been coupled with an extraordinary growth in international trade. According to the World Bank's "World Development Indicators" the world trade has increased by 845% while the world GDP has increased

[1]The data are available at www.wto.org.

by 550% since 1980[2]. Thus, the first objective of the current paper is to corroborate the findings of the literature by showing that each type of agreement has statistically and economically positive effect on bilateral trade flows.

The establishment of EIAs not only impacts bilateral trade flows between countries, they also bear other consequences as well. The ultimate objective of the trade agreements is to increase the living standards of the participating countries. A relevant and crucial question is "How and to what extent do increases in EIAs impact welfare[3]?" This is the primary objective of this study. To provide an answer in detail, we employ a structural gravity model where agents have Dixit-Stiglitz-Krugman (DSK) preferences with constant elasticity of substitution (CES); the marginal cost of production is constant, but firms have a fixed entry cost; we assume, as is standard in these models, the market structure is monopolistically competitive. The exercise is similar in spirit to Arkolakis et al. (2012), who decompose the welfare gains to simple sufficient statistics such that the welfare gains related to the share of expenditure on local products scaled by the elasticity of substitution. In this paper, we decompose these welfare gains into wage effect, technology effect and price effects.

In addition, we also build on the works of Fujita et al. (2001), and Redding and Venables (2004), who use a wage equation and empirically measure the effect of geography and technology on wages. In the framework of Redding and Venables, technology explains much less of variations in wages than in this study because our model explicitly accounts for technology for wages whereas their model links wages to geography, and technology assumed the same across countries is responsible for the rest. As in Redding and Venables, the wage equation is derived from the structural gravity equation, and this enables us to simultaneously track the effects of technology

[2]The data are available up to 2013 at http://data.worldbank.org

[3]Welfare is given by wages deflated by prices.

and market access on wages because the structural gravity equation can, in theory, identify changes in wages that are caused by EIAs' impact on market access as well as to identify correlations between entering into EIAs and productivity. For the empirical analysis, the identifications of market access and price index in this paper are similar to the outward multilateral resistance terms (OMRs) and inward multilateral resistance terms (IMRs) presented by Anderson and van Wincoop (2003).

As in most trade models with DSK preferences, welfare depends on the wage rate and price index, and the wage rate is a function of the OMR and "local" technology. In standard trade models, technology may be impacted by several reasons:

i) Free trade enables countries to specialize in the production of some goods through **comparative advantage technology**. In monopolistically competitive environments, trade allows for gains through economies of scale.

ii) An increase (decrease) in the production of traded goods stimulates (lessens) either the number of varieties or the volume of existing goods produced in a partner country. Either way, the increase (decrease) in the production supply generates a higher (lower) demand for workers available in the country. Under the condition of **increasing return to scale technology**, on the avereage, workers become more (less) productive and total productivity of that country will go up (down).

iii) As the level of openness increases **the competition among firms** in a market goes up, leading the least productive firms to exit the market. In this paper; on the contrary, the least productive firms do not exit since all firms within a country have identical technology. In addition, the CES structure implies the same mark-up so that no firm is squeezed out of the market.

iv) As the volume of bilateral trade increases between members, trade-related

technology diffusion between the members increases.

v) Increases in **capital accumulation** as a result of EIAs can contribute to technology of participating countries.

We then list two arguments on how prices can be affected: i) the reduction in trade costs due to free trade can decrease prices in a country, ii) a positive (negative) change in the country's technology diminishes (raise) price index as more (less) goods and varieties become available at lower (higher) production costs.

In this paper; however, we do not model these mechanism explicitly; instead, the wage equation in conjunction with the structural gravity model enable us to measure countries' technology. Technology in this model is similar to the Solow residual from the growth literature. Technology is the amount of average wages that cannot be explained once we take into account the other factors that influence bilateral trade. In order to decompose the wage equation into the contributions of technology and market access, we need to first estimate the coefficients on the trade cost variables. Then, the OMRs and the IMRs are calculated from the structural gravity equation using the coefficient estimates of the trade cost variables. The wage equation is applied to back out technology for each of the 182 countries for each year from 1970-2009 given the OMRs and per capita GDPs as proxy for wages. Finally, given IMR, OMR and technology, we can measure each country's welfare.

By utilizing the above-mentioned computation, the main objective of this paper is to investigate whether welfare and technology grow faster after a country becomes part of an EIA. In particular, this study focuses narrowly on the 5-year and 10-year average changes in welfare and technology (as well as wages, prices and market access) of 16 member countries before and after they joined the European Union

(EEU)[4]. We take the years of EEU entry as baselines for comparison analysis for 6 countries (Austria, Finland, Greece, Portugal, Spain and Sweden) as there was no prior agreement between the EEU and the six members[5]. Rather than the year of entry, we base on the years of signing of Association Agreements for 10 Central and Eastern European Countries (CEEC)[6] because Association Agreements aim to provide trade liberalization, prepare countries for future membership of the EEU, and establish close economic and political cooperation according to the EEU External Action Service[7]. In addition, Caporale et al. (2009) argue that the fundemental goal of the establisment of the EEU is not only to increase the market openness and welfare but also to present peace, stability and democracy to all joining countries for which the first step is to sign Association Agreements. Egger and Larch (2011) also consider Association Agreements to find an answer for how trade liberalization impacts trade, GDPs and welfare in both the EEU and the CEEC. These authors find Association Agreements to have positive effects on CEEC's trade, GDPs and welfare while using different methodology than this paper[8].

For impatient readers, we find that technology and welfare of fifteen in sixteen countries increase by more 10 years after the harmonisation as compared to 10 years before. In addition, all countries but Slovenia experience higher welfare and technology growth comparing 5 years before and after they integrated with the EEU. To

[4]The number of country used in this study is restricted by the data availability. Please see table 1.2.

[5]Note that the EEU signed trade agreements with Austria, Finland, Portugal and Sweden in 1973, but those FTAs did not allow for real harmonisation among the EEU and the countries, and thus were not much effective on the countries' economy.

[6]The EEU signed Association Agreements with Hungary and Poland in 1994, Bulgaria, Czech Republic, Romania and Slovakia in 1995, Estonia, Latvia and Lithunia in 1998, and Slovenia in 1999.

[7]For more information, please refer to http://eeas.europa.eu/association

[8]Egger and Larch (2011) neither employ a wage equation nor account for technology and its impact on welfare.

assess the robustness of the comparison results, we investigate how the participating countries perform relative to the rest of the world and relative to the incumbent EEU countries. Results are consistent and robust.

We organize the rest of this paper as follow. The next section summarizes a literature review, third section explains the derivations of the wage equation and structural gravity model, forth section describes the data, fifth section presents the estimation process of the gravity equation with fixed effect approach, sixth section shows how to measure welfare, technology, wages, prices and market access, seventh section reveals the coefficient estimates of trade cost variables and the comparison results of welfare, technology, wages, prices and market access. The last section is the conclusion.

1.2 Literature Review

The gravity equation is perhaps one of the most frequently used models in empirical international trade. This empirical approach has been widely used to explain the bilateral trade flows. Since the first study by Tinbergen (1962), the link between the empirical regularities of the gravity equation and theoritical models based on principles of microeconomics have provided more guidance in terms of empirical specifications and policy guidance.

A number of studies have attempted to evaluate the impacts of EIAs on bilateral trade flows. For example, Aitken (1973), Abrams (1980), and Brada and Mendez (1985) found that the European Economic Union (EEU) had a statistically significant effect on bilateral trades among members. Baier and Bergstrand (2007) find that the partial equilibrium impact of a trade agreement implies trade nearly doubles after 10 years. Baier et al. (2008) posed that the EEU had a large effect on bilateral trade flows over the period of 1960 through 2000, and recent EIAs have economically and statistically important impacts on members' trade employing the structural gravity equation. Vicard (2009) argued that establisment of regional trade agreements (RTAs) increased the bilateral trade flows of member countries. Roy (2010) found that CUs had larger effect than FTAs on bilateral trade. Baier et al. (2014) found deeper EIAs to have positively and significantly larger effect on the volume of bilateral trade among members. While most recent studies have found that these agreements increase trade, Bergstrand (1985) and Frankel et al. (1995) did not find a significant effect. These papers may suffer from the omitted variable bias discussed in Baier and Bergstrand (2007).

There are several studies that have provided insights linking the change in applied trade structure between countries to the change in their productivity. For instance, Choudhri and Hakura (2000) showed that the increase in trade openness promoted the level of productivity in the developing countries through competition among firms in the medium-growth manufacturing sector. Schiff and Wang (2004) found that technology diffusion from NAFTA and the EEU had a significant effect on technolgy growth in Mexico and Poland, respectively. Cardarelli and Kose (2004) found that the creations of NAFTA and CUSFTA decreased trade costs and increased not only the trade flows but also technology of the member countries. Bernard et al. (2006) showed that the reduction in trade costs increased productivity using a dataset that traced average tariff and transportation costs across U.S. manufacturing industries through 1977-2001. Miroudot et al. (2012) argued that the decrease in trade costs led higher productivity in service sectors and found that a 10% reduction in trade costs promoted productivity nearly 0.5%. A recent study of Alvarez et al. (2013) found that freer trade persistently and positively impacts productivity considering the effects of flow of ideas and diffusion.

An important implication of market access associated with our study is that it is we relate the changes in trade costs to wages. Overman et al. (2003) showed that the higher level of market access led to higher wages. In addition, Redding and Venables (2004) found that approximately 70% of the variation in wages was caused by the geographical effects; market access and supplier access. Boulhol et al. (2008) found that the lower market access relative to the OECD average caused a reduction in wages around by ten percent in Australia and New Zealand, whereas relatively higher market access positively contributed to wages around 7% in Belgium and the Netherlands. Waugh (2010) noted that there would be a reduction in wage differences among countries if poor countries had the same market access to wealthier markets.

There are a few studies that cover wages, productivity and trade policy. Melitz (2003) argues that a trade agreement may result in a shift in employment to more productive firms and increasing wage rates where he assumed one factor(labor), one industry and monopolostic competition. Behrens et al. (2012) show that productivity and wages respond to change in trade costs using Canada-US interregional data.

1.3 Theoritical Background and Gravity Equation

In this paper, the structural gravity equation is derived from a model where agents have Dixit-Stiglitz-Krugman preferences with constant elasticity of substitution (CES), the marginal cost of production is constant but firms have a fixed entry cost, and market structure is assumed to be monopolistically competitive.

1.3.1 Consumer Behaviour

It is assumed that there exists a fixed number of consumers in each country j and the consumers can purchase up to N_i categories of goods from country i. Then, CES preferences for the representative individual in j are given by:

$$U_j = \left(\sum_{i=1}^{C} \int_0^{Ni} c_{ij}(z)^{\frac{\sigma-1}{\sigma}} dz \right)^{\frac{\sigma}{\sigma-1}}$$

where C denotes the set of countries and c_{ij}(z) is the consumption of good z produced in i and shipped to j. In order to make the model tractable, we make the simplifying assumptions that all firms within a country have access to the same technology; however, technology may vary across countries. This assumption implies that all goods exported by firms in country i sell for the same price in country j. In other words, $p_{ij}(z) = p_{ij}$ for all goods produced in i and shipped to j. Under this scenario, each consumer in country j consumes the same amount of each variety produced in country i with N_i varieties of goods. In this model, σ is the elasticity of substitution between goods also represents the elasticity of demand when the variety of products is large. The utility function of the representative consumer in country j takes the simplified form:

$$U_j = \left(\sum_{i=1}^{C} N_i c_{ij}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{1}$$

where C is the set of countries that j imports from, and c_{ij} represents the consumption of any good exported from country i to country j. N_i is also the number of firms as each firm produces a single variety of goods due to monopolistic competition. The representetive individual in country j maximizes the utility function in equation 1 subject to the following budget constraint:

$$W_j = \sum_{i=1}^{C} N_i p_{ij} c_{ij}$$

where income and total expenditure of the agent in country j are denoted by the term W_j (assuming trade is balanced), and p_{ij} stands for the price of any variety in country j shipped from country i and includes any additional cost. The price of a good, therefore, is measured on a c.i.f (cost, insurance, freight) basis whereas, p_i denotes the price of any variety in a domestic market and is on a f.o.b. (free on board) basis. We assume that goods shipped from i to j are subject to "iceberg" transportation cost (T_{ij}) as in Samuelson (1952). This implies that T_{ij} amount of goods have to be sent in order for one unit to arrive to the final destination where $T_{ij} \geq 1$.

The first-order conditions from the household's problem imply the demand for a variety of good as $c_{ij} = (p_{ij}/P_j)^{-\sigma}(Y_j/P_j)$, where P_j denotes the ideal price index of country j:

$$P_j = \left(\sum_{i=1}^{C} N_i (p_{ij})^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$$

1.3.2 Goods Market

We assume that total shipments from i, inclusive of iceberg trade costs, to all other market is equal to total production; that is: $q_i = \sum_{j=1}^{C} c_{ij} T_{ij}$. The total value of the products shipped from origin i to destination j is:

$$X_{ij} = N_i c_{ij} p_{ij} \tag{2}$$

By using the equation of the demand for a good from the consumer behaviour section, the equation 2 yields:

$$X_{ij} = N_i Y_j \left(\frac{p_{ij}}{P_j} \right)^{1-\sigma} \tag{3}$$

1.3.3 Firm's Behaviour

The market structure is assumed to be monopolistically competitive. This implies that each firm in country i produces and exports a single variety of goods under the condition of increasing return to scale technology. It is also assumed that labor is the only factor in the production process. Within a country all firms have access to the same technology, so that the production technology of a good z in country i is given by: $q_i(z) = A_i l_i(z) - f_i$, where $q_i(z)$ is the quantity of a variety z produced and $l_i(z)$ is the number of workers employed by the representative firm in country i. A_i and f_i denote the marginal productivity of a labor and the fixed cost in the production process, common to all firms in i. Total profits of the representetive firm are:

$$Profit(z)_i = \pi_i = \sum_{j=1}^{C} p_{ij} c_{ij}(z) - \frac{W_i}{A_i} * q_i(z) - W_i f_i$$

After the distribution condition from the goods market section is inserted into the profit function, it yields that $\pi_i = \left(\sum_{j=1}^{C} p_{ij} c_{ij} - W_i \frac{c_{ij} T_{ij}}{A_i} \right) - (W_i f_i)$. The demand of good z by individuals in j is substituted into the latter profit function, the first-order conditions for the profit maximization imply that price is a markup over the firm's marginal cost as $p_{ij} = \left(\frac{\sigma}{\sigma - 1} \frac{W_i}{A_i} \right) T_{ij}$ or $p_{ii} = \left(\frac{\sigma}{\sigma - 1} \frac{W_i}{A_i} \right)$. In this framework, the price that the firm charges is decreasing in σ. The markup is independent of its production and the production of other firms. Monopolistic competition implies that firms will make zero economic profit because there is free entry and exit in the long run. This condition determine the amount of goods produced by a firm as $q_i(z) = A_i f_i(\sigma - 1)$.

1.3.4 Labor Market

In this model, the labor market also clears in the equilibrium. By substituting the production technology equation from the firm's behaviour section, it reveals that:

$$L_i = \sum_{i=1}^{N_i} l_i = \sum_{i=1}^{N_i} \left(\frac{q_i - f_i}{A_i} \right) = N_i f_i \sigma$$

Clearing conditions are used to pin down the number of firms in country i as

$N_i = \frac{L_i}{\sigma f_i}$. The number of firms located and the varieties of goods produced in country i increase as the amount of labor force increases, and the elasticity of substitution and the fixed cost decrease.

1.3.5 Multilateral Resistance Terms and Wage Equation

The ideal price index of country j from the consumer's behaviour section can be written as $P_j = \left[\sum_{i=1}^{C} N_i (p_i T_{ij})^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$. After the number of firms and the mill price equations are inserted into the ideal price index:

$$P_j^{1-\sigma} = \sum_{i=1}^{C} \gamma(\sigma)^{\sigma} (\frac{\mathring{A}_i}{W_i})^{\sigma} W_i L_i (T_{ij})^{1-\sigma} \tag{4}$$

where $\mathring{A} = \frac{A_i}{(f_i)^{1/\sigma}}$, $\gamma(\sigma) = \sigma^{-1}(\sigma - 1)^{\frac{\sigma-1}{\sigma}}$ and $Y_i = W_i Li$. Equation 2 from goods market implies:

$$Y_i = N_i p_i^{1-\sigma} \left[\sum_{j=1}^{C} (\frac{T_{ij}}{P_j})^{1-\sigma} * Y_j \right] \tag{5}$$

where $Y_i = \sum_{j=1}^{C} X_{ij}$. Rearranging the above equation 5 yields:

$$W_i L_i = N_i (p_i)^{1-\sigma} \left(\sum_{j=1}^{C} \left[\frac{T_{ij}}{P_j} \right]^{1-\sigma} W_j L_j \right)$$

The expression in parentheses is a GDP-weighted measure of trade cost resistance imposed by firms in country i when they export their products to country j and is quite similar to the GDP share weighted OMRs used by Anderson and van Wincoop (2003). The OMRs can be defined by:

$$\mathit{\Pi}_i^{1-\sigma} = \left(\sum_{j=1}^{C} \left[\frac{T_{ij}}{P_j} \right]^{1-\sigma} W_j L_j \right)$$

Using the OMRs, the number of firms from the labor market section and equation 4, the wage equation can be stated as a function of market access, technology and constant scalar:

$$W_i = \gamma(\sigma)\mathring{A}_i \Pi_i^{\frac{1-\sigma}{\sigma}} \tag{6}$$

Equation 6 implies that wage in country i is affected by the change in technology of other countries and the change in market access that follows from any variation in trade costs between origin i and destination j. By substituting $\mathit{\Pi}_i^{\frac{1}{1-\sigma}} = \gamma(\sigma)^{\sigma}(\frac{\mathring{A}_i}{W_i})^{\sigma}$ into equation 4, the inward multilateral resistance terms (IMRs) is derived by:

$$P_j^{1-\sigma} = \left(\sum_{j=1}^{C} \left[\frac{T_{ij}}{\mathit{\Pi}_i}\right]^{1-\sigma} W_i L_i \right)$$

1.3.6 Identification of the Structural Gravity Equation

Inserting the OMRs into equation 5 reveals:

$$Y_i = N_i p_i^{1-\sigma} \Pi_i^{1-\sigma} \tag{7}$$

The structural gravity equation can be obtained by substituting equation 7 into equation 3:

$$X_{ij} = \left[Y_i Y_j\right] \left[\frac{T_{ij}}{\Pi_i P_j}\right]^{1-\sigma}, \tag{8}$$

The parameter T_{ij} is a proxy for iceberg trade costs when country i faced exporting the products. It is comprised of distance and the dummy variables common language, common border, common colonizer, FTA, CU, CM and EU . All of the variables are further explored in the subsequent section.

1.4 Data Description

The data on GDP and population for 182 countries over the period of 1970-2009 are drawn from the World Bank's "World Development Indicators"[9]. The data

[9] A complete list of countries is shown in table 1.1.

on bilateral trade flows for each pair come from "United Nations Commodity Trade Statistics Database" (UNCTAD)[10]. The data on the trade cost variables are shown as:

$$T_{ij} = d_{ij}^{\alpha_1} * e^{\alpha_2 lang_{ij} + \alpha_3 bord_{ij} + \alpha_4 col_{ij} + \alpha_5 FTA_{ij} + \alpha_6 CU_{ij} + \alpha_7 CM_{ij} + \alpha_8 EU_{ij} + e_{ij}}$$

The variables distance and common colonizer are drawn from "Centre d'Etudes Prospectives et d'Informations Internationales" (CEPII) [11]. We use the distance measure associated with distance in kilometers between the most populous city in countries. A number of articles have indicated that the amount of trade flows are negatively correlated with distance and the coefficient on distance is close to negative one (Tinbergen, 1962; Feenstra et al., 2001; Eaton and Kortum. 2002; Anderson and van Wincoop, 2003; Henderson and Millimet, 2008; Bergstrand et al., 2013). The trade cost among countries increases with d_{ij} because transportation costs and searching costs go up as well.

The variable colonial relationship, col_{ij}, is equal to one if two countries have ever shared a common colonizer and zero otherwise. One example of this case is Caribbean, Cameroon, Vietnam, and Tunisia were colonized by France. A colonial relationship refer to a historical tie between countries that can increase the amount of trade between them. Emprical studies of Rose and van Wincoop (2001), Estevadeordal et. al (2003), and Felbermayr and Kohler (2006) found a statistically significant positive impact of colonial relationship on bilateral trade.

The variables common language and common border are obtained from Head et al. (2010). The common language parameter,$lang_{ij}$, is equal to unity when countries have the same official language and 0 otherwise. This variable is used to understand

[10]The data are available at www.unctad.org

[11]French research center that produces studies, databases, and analyses on the world economy.

the influence that language has on direct comminication and translation between trading partners. Wei (1996), and Eaton and Kortum (2002) empirically showed that common language had statistically significant and positive effect on bilateral trade flow. The reduction in the amount of trade due to the usage of different language is likely caused by increases in trade cost such as the need to employ a translater. In addition to this example, Helliwell (1997) noted "A common language provides evidence of common cultural roots, shared literature and lore, and even shared codes of law. Where there is a common language there is also likely to be greater sharing of literature, radio and television communications, and even educational exchanges, and with all of these come greater knowledge of institutions, networks and individuals of a sort likely to forge tighter economic ties".

A pair of countries which share a common border (adjacency) are expected to have cultural and economic similarities that encourage trade between them. The variable for the adjacency effect, $bord_{ij}$, is equal to 1 when countries are adjacent and 0 otherwise, and captures the effect of geography on trade costs that is not caught by the distance parameter. Being contiguous provides more choices when sending goods across national borders. Redding and Venables (2004), and Bussiere and Schnatz (2009) showed that sharing the same national border promoted the bilateral trade flows between countries. Since crossing borders mostly entails additional fees and transactions costs, exporters will be subject to higher trade costs if countries are not adjacent because they have to across over more than one border.

A free trade area is a trade bloc for which countries sign a free trade agreement that removes tariffs and quatos between all involved countries. The variable free trade agreement, FTA_{ij}, is equal to 1 when countries have a signed free trade aggrement and 0 otherwise. A custom Union (CU) goes further than FTA because a CU requires its partners to impose a set of common tariffs against non-member countries. An example of CU is the extablished custom union between the EEU and Turkey in 1996. CU_{ij} is equal to 1 when countries have a custom union, and zero otherwise. A common market (CM) is comprised of a free trade area that includes regulations such as removing the impediments to the free movement of capital, labor, and other services. The binary variable CM_{ij} is equal to one if countries have a common market and 0 otherwise. The deepest integration is an economic union (EU) which basically consists of a common market and a custom union. Members agree upon regulations regarding the free movement of factors of production and services, and the rule of common external trade. Participants mostly accept using the same currency. EU_{ij} is equal to unity for countries have entered into an economic union and zero otherwise. The EEU is a good example of transition from a basic integration to a higher level of integration. The EEU was first founded as a custum union in 1952, converted to a common market in 1994, and was finally coverted into an economic union in 1999.

The data for free trade agreements, custom unions, common markets, and economic unions from 1970-2005 are obtained from Jeffrey Bergstrand's website[12] and from 2006-2009 are drawn from the WTO database. The effects of EIAs are widely covered in the literature section.

1.5 Estimation of the Structural Gravity Equation

Estimating the structural gravity specifacition is straightforward. A more convenient way to write the empirical equation 8 is in log-form:

$$log(X_{ij}) = \beta_1 log(Y_i) + \beta_2 log(Y_j) - (1-\sigma) log(\Pi_i) - (1-\sigma) log(P_j) + (1-\sigma) log(T_{ij}) \quad (9)$$

[12] The data are available at www.nd.edu/jbergstr/ and constructed under National Science Foundation grants SES-0351018 and SES-0351154, and used by many studies including Baier and Bergstrand (2007), Baier et al. (2008) and Baier et al. (2014).

where T_{ij} can be rewritten as:

$$log(T_{ij}) = \alpha_1 log(d_{ij}) + \alpha_2 lang_{ij} + \alpha_3 bord_{ij} + \alpha_4 col_{ij} + \alpha_5 FTA_{ij} + \alpha_6 CU_{ij}$$

$$+\alpha_7 CM_{ij} + \alpha_8 EU_{ij} + e_{ij}$$

The bilateral trade costs (T_{ij}) for each pair for each year can be estimated using the data on the trade variables[13]. Then, OMRs and IMRs for each country for each year can be computed using equation 9 given the coefficient estimates of bilateral trade costs, value of σ, GDPs and bilateral trade flows.

1.5.1 Endogeneity Problem and Fixed Effect Approach

Lawrence (1998) commented that "The issue of exogeneity may also be an important problem when dummy variables are used (in the gravity specification) to estimate the effects of free trade areas. Free trade areas may well be an endogenous variable-that is, a response to, rather than a source of, large trade flows." In addition, Trefler (1993), and Lee and Swagel (1997) demonstrated that existence or absence of EIAs was not exogenous and estimation effects were underestimated due to endogeneity bias. A recent study by Baier and Bergstrand (2007) showed that estimation results of EIAs suffered from endogeneity bias, perhaps because of self selection of country pairs' governments into trade agreements and related to the amount of bilateral trade flows. Baier and Bergstrand (2007) also mentioned that the decisions of countries on joining EIAs were slow-moving; however, trade flows were not slow-moving. The presence of slow-moving problem implies that observed variables in trade costs are likely to be highly correlated with unobservable variables concealed in the error term e_{ij}.

Given the consensus over the potential of endogeneity of EIAs, Baier and Bergstrand

[13]Please see section 5.1. for more information on how to estimate the model.

(2007) suggested that applying panel data techniques employing country-pair fixed effect, importer-year and exporter-year fixed effects should get over endogeneity bias of EIAs[14]. Anderson and Yotov (2012) supported the results of Baier and Bergstrand (2007) using panel techniques, too. In addition, Anderson and van Wincoop (2003) suggested to account for fixed effects in the gravity equation to obtain unbiased multilateral resistance terms.

Following Baier and Bergstrand (2007), the below fixed effect model is used to obtain unbiased estimates of EIAs:

$$lnX_{ijt} = \beta_0 + \beta_1 FTA_{ijt} + \beta_2 CU_{ijt} + \beta_3 CM_{ijt} + \beta_4 EU_{ijt} + \kappa_{ij} + \xi_{it} + \zeta_{it} + \epsilon_{ijt} \quad (10)$$

where κ_{ij} is a country-pair fixed effect to capture possible time-invariant unobservable variables impacting bilateral trade flows. The parameters ξ_{it} and ζ_{it} represent exporter-year and importer-year fixed effects to capture time-varying GDP as well as possible unobservable time-variant country specific variables for each pair of country i and j impacting the amount of bilateral trade. The parameters ξ_{it} and ζ_{it} also contain the exporters and importers multilateral resistance terms referring to Anderson and van Wincoop (2003).

Note that we only estimate the coefficients on the"time-varying" variables FTA, CU, CM, EU using equation 10 to avoid unnecessary complexity. Because the bilateral fixed effects subsume all "time-invariant" variables (distance, language, adjacency and colonial relationship), they are chosen among coefficient estimates in the existing literature. Besides, more explanation about the value of coefficients on these variables are given in later sections. Notice that there will be some change (reduction) in

[14]Baier and Bergstrand (2007) also indicated that employing only country pair fixed effect did not provide an unbiased estimation if governments select into EIAs.

bilateral trade costs only if the time-variant variables take different values such as when a country partakes in any of the following actions: i) Sign a free trade agreement, ii) Join a custom union, iii) Join in a common market, iv) Enter into an economic union.

1.6 Measuring Technology

Along with the estimated OMRs, we need to back out country specific technology. We do so in three steps. The first step is to write the productivity of country i relative to the productivity of the United States (US) at time t using the wage equation:

$$a_{i,us,t} = \frac{\mathring{A}_{i,t}}{\mathring{A}_{us,t}} = \frac{W_{i,t}}{W_{us,t}} \left[\frac{\Pi_{i,t}^{1-\sigma}}{{\Pi_{us,t}}^{1-\sigma}} \right]^{\frac{-1}{\sigma}}$$

note that $\gamma(\sigma)$ is cancelled out because it is constant across countries for each year. After presenting a convenient normalization for the relationship between the world income and the effective world endowment of labor income, $\sum_{i=1}^{C} W_{i,t}L_{i,t} = \sum_{i=1}^{C} \mathring{A}_{i,t}L_{i,t}$, the second step can be expressed as:

$$\mathring{A}_{us,t} = \frac{\sum_{i=1}^{C} W_{i,t}L_i}{\sum_{i}^{C} a_{i,us,t}L_{i,t}} \tag{11}$$

where $\mathring{A}_{us,t}$ can be taken out of the summation since it is independent of i. Given wages, labor endowment, σ and estimated OMRs, we can first compute each country's relative technology and then measure technology of the US using equation 11. Last, once $\mathring{A}_{us,t}$ is known, technology of country i at time t is equal to the product of $\mathring{A}_{us,t}$ and $a_{i,us,t}$.

Note that when a country's technology is unusually high or low at any year, a comparison result might give a misleading answer. This type of issue arises for welfare, price index, wage and market access as well. To address this issue, we use

5-year and 10-year average growth rates for the variables of interest for comparison analyses.

1.6.1 Measuring the Average Growth Rates

Two distinguished measures are applied to make the comparison results robust. They are absolute measure and difference in difference measure. Each is further explored in the next sections.

1.6.1.1 Absolute Measure

In this section, we formulate absolute measures of average welfare gain, average technology growth, average wage growth and average changes in prices and market access. Considering the first variable of interest, a country's t-year average technology growth rate is:

$$g_{i,t} = \frac{log(\mathring{A}_{i,t}) - log(\mathring{A}_{i,0})}{t}$$

where $log(\mathring{A}_{i,t})$ and $log(\mathring{A}_{i,0})$ are the natural logarithmic values of country i's technology at time t and zero, respectively.

For example, country i's 5-year average technology growth rate before and after it integrates with the EEU in 1995:

$$g_{i,5b} = \frac{log(\mathring{A}_{i,1995}) - (\mathring{A}_{i,1990})}{5} \ , \ g_{i,5a} = \frac{log(\mathring{A}_{i,2000}) - (\mathring{A}_{i,1995})}{5}$$

where 5b and 5a denote 5-year before and 5-year after periods.

In this paper, welfare of an agent at time t is computed as wage divided by price index at time t, $welfare_{i,t} = W_{i,t}/P_{i,t}$. A change in welfare can be pinned down as the change in real incomes between two periods, or equivalently, the difference between t-year average wage growth rate ($\omega_{i,t}$) and t-year average change in prices ($\Phi_{i,t}$) is equal to t-year average welfare gain ($\varpi_{i,t}$):

$$\frac{log(welfare_{i,t})-log(welfare_{i,0})}{t} = \frac{log(W_{i,t})-log(W_{i,0})}{t} - \frac{log(P_{i,t})-log(P_{i,0})}{t}$$

Regarding the same country i, the average welfare gain for ten-year after is:

$$\varpi_{i,10a} = \omega_{i,10a} - \Phi_{i,10a}$$

where country i's 10-year after average wage growth rate is $\omega_{i,10a} = \frac{log(W_{i,2005})-log(W_{i,1995})}{10}$ and its 10-year after average change in price index is $\Phi_{i,10a} = \frac{log(P_{i,2005})-log(P_{i,1995})}{10}$.

Using the wage equation, market access of country i at time t is defined as wage divided by technology at time t:

$$\Pi_{i,t}^{\frac{1-\sigma}{\sigma}} = W_{i,t}/\mathring{A}_{i,t}$$

In connection with the above equation, t-year average change in market access of country i ($\pi_{i,t}$) is equal to the difference between t-year average wage growth rate ($\omega_{i,t}$) and t-year average technology growth rate:

$$\frac{log(W_{i,t})-log(W_{i,0})}{t} = \frac{log(\mathring{A}_{i,t})-log(\mathring{A}_{i,0})}{t} + \frac{log(\Pi_{i,t}^{\frac{1-\sigma}{\sigma}})-log(\Pi_{i,0}^{\frac{1-\sigma}{\sigma}})}{t}$$

As an example, country i's average market access rate for 5-year before is computed by subtracting 5-year average technology growth rate from 5-year average wage growth rate:

$$\pi_{i,5b} = \omega_{i,5b} - g_{i,5b}$$

1.6.1.2 Difference in Difference Measure

The second method is the difference in difference measure to compare a country's five-year and ten-year average rates before and after it joins the EEU. Two different approaches are applied under this method. One is to investigate 16 countries' performances relative to the world. In detail, we initially calculate population weights of each country[15], excluding the incumbent EEU members as of time t, $we_{j,t} = \frac{L_{j,t}}{\sum_{j=1} L_{j,t}}$, and then we measure the world's average technology growth, $g_{world,t} = \sum_{j=1}(we_{j,t}) * (g_{j,t})$; the world's average welfare gain, $\varpi_{world,t} = \sum_{j=1}(we_{j,t}) * (\varpi_{j,t})$; the world's average change in prices, $\Phi_{world,t} = \sum_{j=1}(we_{j,t}) * (\Phi_{j,t})$; the world's average wage growth, $\omega_{world,t} = \sum_{j=1}(we_{j,t}) * (\omega_{j,t})$; the world's average market access growth, $\pi_{world,t} = \sum_{j=1}(we_{j,t}) * (\pi_{j,t})$. Given the calculation of absolute measures, we compute how a country performs against the world over t years as $(g_{i,t} - g_{world,t})$, $(\varpi_{i,t} - \varpi_{world,t})$, $(\mathit{\Phi}_{i,t} - \mathit{\Phi}_{world,t})$, $(\omega_{i,t} - \omega_{world,t})$ and $(\pi_{i,t} - \pi_{world,t})$.

The following example is provided to enlighten the analysis. Considering the same country i once again, population weights of each country[16] is given by $we_{j,1995} = \frac{L_{j,1995}}{\sum_{j=1} L_{j,1995}}$. Thereafter, 5-year before average technology growth of the world is equal to $g_{world,5b} = \sum_{j=1}(we_{j,1995}) * (g_{j,5b})$. Given $g_{i,5b}$, country i's performance relative to the world is presented by $g_{i,5b} - g_{world,5b}$. In addition, using the same population weights, 5-year after average technology growth of the world is expressed as $g_{world,5a} = \sum_{j=1}(we_{j,1995}) * (g_{j,5a})$. Given i's average technology growth rate for five-year after, difference in difference of country i against the world is $g_{i,5a} - g_{world,5a}$. After comparing $(g_{i,5a} - g_{world,5a})$ to $(g_{i,5b} - g_{world,5b})$, i's technology increases by more than the world after joining the EEU if the former is greater than the latter.

The second approach of the difference in difference mesaure is to comparing 16 countries' performances against the incumbent members. Regarding the case of country i, population weights of each existing member is given by $we_{i,1995} = \frac{L_{i,1995}}{\sum_{i=1} L_{i,1995}}$. Furthermore, 10-year before average welfare gain is represented by $\varpi_{eeu,10b} = \sum_{i=1}(we_{i,1995}) * (\varpi_{i,10b})$. In a similar way, 10-year after average welfare gain is expressed as $\varpi_{eeu,10a} =$

[15]We also report the results based on GDP weights of each country in the Appendix.

[16]Considering the year 1995, the existing EEU countries Belgium, France, Italy, Luxembourg, the Netherlands, Germany, the UK, Ireland, Greece, Portugal and Spain are not included.

$\sum_{i=1}(we_{i,1995}) * (\varpi_{i,10a})$. Utilizing the results from the absolute measure, i's difference in difference measure of average welfare gain for 10-year after and 10-year before can be written by $(\varpi_{i,10a} - \varpi_{eeu,10a})$ and $(\varpi_{i,10b} - \varpi_{eeu,10b})$, respectively. Note that if the former is greater than the latter, country i's welfare gain is larger than the existing members following the harmonisation.

1.7 Empirical Results

In this section, we first present the results related to the structural gravity model, and then indicate the results related to welfare, technology, prices, market access and prices.

1.7.1 Trade Costs and Elasticity of Substitution

Related to the trade cost variables, we first report the results for the time-variant variables. We use constrained OLS to estimate the coefficients on EIAs in the fixed effect model (equation 10) with bilateral trade flows as an endogenous variable for the period 1969-2006. The output from the regression is located in table 1.3, where only variables of interest (FTA, CU, CM, and EU) are reported and the estimates of the importer-year, exporter-year, and country-pair fixed effects are not provided for brevity. The coefficients for free trade agreement, custom union, common market, and economic union in bilateral trade are positive and statistically significant, which corroborates the findings of the literature. These coefficients are 0.263, 0.416, 0.860, and 0.716 for FTA, CU, CM and EU, respectively.

As stated in the estimation of the structural gravity equation section, we do not estimate the effects of the time-invariant variables on bilateral trade flows because the coefficients on the these variables have already been estimated by many empirical papers in the literature. For the distance, we choose the elasticity of -1.00 among the most common values ($\alpha_1 = -0.50, -1.00, -1.50$). For the effect of common language, we select a value of $\alpha_2 = 0.29$. The choice of a value for common land border is $\alpha_3 = 0.80$, and the elasticity of common colonial relationship is chosen as $\alpha_4 = 0.12$.

The variable that is not calculated by any equation, but must be known to pin down the values of multilateral resistance terms in the gravity equation is the elasticity of substitution(σ) across variety of products. For this parameter, our selection is $\sigma = 6$ amongst the values most commonly used in the literature ($\sigma = 3, 6, 10$). When $\sigma = 6$ the impact of geography on wages is on the average relative to the cases where $\sigma = 3$ (strong love of variety) and $\sigma = 10$ (weak love of variety). This selection is consistent with that used by Anderson and van Wincoop (2003), Redding and Venables (2004) and Egger and Larch (2011).

1.7.2 Results for Absolute Measure

We first report the results for 5 years after the harmonisation as compared to 5 years before. Columns (1), (3) and (4) in table 1.4 show that fifteen out of sixteen countries experience welfare gains ($\varpi_{i,5} = \varpi_{i,5a} - \varpi_{i,5b}$), positive wage growth ($\omega_{i,5} = \omega_{i,5a} - \omega_{i,5b}$) and positive technology growth ($g_{i,5} = g_{i,5a} - g_{i,5b}$) comparing 5-year after to before. Take Romania for example; average annual welfare gain ($\varpi_{rom,5}$) is 1.10%, average annual technology growth is 0.93% and average wages ($\omega_{rom,5}$) grow by 1.02% annually.

We then investigate 10-year absolute measures of average welfare change ($\varpi_{i,10} = \varpi_{i,10a} - \varpi_{i,10b}$), average wage growth ($\omega_{i,10} = \omega_{i,10a} - \omega_{i,10b}$) and average technology growth ($g_{i,10} = g_{i,10a} - g_{i,10b}$). Colomns (1), (3) and (4) in table 1.5 show that welfare, wages and technology of all countries, excluding Greece, increase by more 10 years after joining the EEU as compared to 10 years before. For the case of Estonia, average annual welfare gain is 3.04%, average annual wage growth is 2.70% and average annual technology growth is 2.31%.

Although market access and prices for 5-year and 10-year periods do not respond to the harmonisation in the way we anticipate, most of the countries' price index decreases and market access increases comparing post-entry periods to pre-entry periods. It should be noted that technology is dominant factor in wages and technology is much more responsible of the variation in wages than market access. The change in wages determines whether a member gains or losses. To analyze the accuracy of this argument, we perform difference in difference measures of average welfare gain, average technology growth, average wage growth and average changes in prices and market access.

1.7.3 Robustness

In this section, we check the robustness of the comparison results found in the absolute measure section by addressing how 16 participating countries perform relative to the rest of the world and relative to the incumbent EEU members.

1.7.3.1 Relative to The World

Table 1.6 reports the results on how 16 countries perform relative to the world (not including the existing EEU countries) by 5 years after the integration with the EEU against 5 years before. Columns (1) represents that only Slovenia experinces average annual welfare loss ($\varpi_{i,5} - \varpi_{world,5}$) by -1.57%. Referring to columns (3) and (4) in table 1.6, all countries but Slovenia show increases in average annual wage growth against the world ($\omega_{i,t} - \omega_{world,t}$) and average annual technology growth against the world ($g_{i,t} - g_{world,t}$) comparing 5-year after to before. For the case of Hungary, $(\varpi_{hun,5} - \varpi_{world,5})$, $(\omega_{hun,5} - \omega_{world,5})$ and $(g_{hun,5} - g_{world,5})$ are 2.41%, 2.45% and 2.44%, respectively.

Comparing 10 years after the harmonisation to 10 years before , columns (1) and (3) in table 1.7 present that all countries except Austria and Greece experience average annual welfare gains $(\varpi_{i,t} - \varpi_{world,t})$ and average annual wage growth $(\omega_{i,10} - \omega_{world,10})$ relative to the world. In addition, column (4) indicates that only Austria's technology against the world $(g_{i,10} - g_{world,10})$ decreases by more 10 years after the signing of the agreement as compared to 10 years before. Take Hungary for example; $(\varpi_{hun,10} - \varpi_{world,10})$, $(\omega_{hun,10} - \omega_{world,10})$ and $(g_{hun,10} - g_{world,10})$ are 1.36%, 1.29% and 1.21%, relatively. Notice that average annual welfare gains for Latvia and Lithunia are 4.78% and 3.96%, implying they are among the participating countries taking the advantage of the EEU at most.

As in the absolute measure section, most countries' market access (prices) increases (decreases) 10 years after the signing of the agreements as compared to 10 years before; however, $(\Phi_{i,5} - \Phi_{world,5})$ does not fall and $(\pi_{i,5} - \pi_{world,5})$ does not increase for several countries referring to columns (2) and (5) in table 1.6. Since there are also many other economic integration agreements take places between countries in the world, these results are somewhat expected.

We close this section by noting that the comparison results in this section are virtually identical to those in the absolute measure section. They are thus robust and consistent.

1.7.3.2 Relative to the Incumbent EEU Members

Table 1.8 reports the results on how 16 countries perform relative to the existing EEU countries by 5 years after the signing of the agreements as compared to

5 years before. Column (1) indicates that the same 15 countries as in the absolute measure section experience average annual welfare gains relative to the incumbent EEU countries, whereas two countries (Bulgaria and Slovenia) show decreases in average annual wage growth and average annual technology of four countries (Austria, Bulgaria, Romania and Slovenia) decreases as distinct from the absulate measure section.

We reports the results for the measures of difference in difference against the incumbent EEU 10 years after joining the EEU as compared to 10 years before in table 1.9. Columns (1), (3) and (4) show that $(\varpi_{i,10} - \varpi_{eeu,10})$, $(\omega_{i,10} - \omega_{eeu,10})$ and $(g_{i,10} - g_{eeu,10})$ are greater than zero for all countries except Greece. These results basically imply that these 15 countries benefit from harmonisation in terms of welfare, wages and technology. Also, the results are consistent with the EEU's purpose of increasing the living standards of potential candidate countries and help them gradually reaching real convergence.

1.8 Conclusion

The minor purpose of this paper is to find whether different levels of economic integration agreements (EIAs), namely free trade agreements (FTAs), custom unions (CU), common markets (CMs) and economic unions (EUs) increases bilateral trade flows. We find that each of them positively and significantly impacts international trade among countries using fixed effect approach. The primary objective of the paper is to address how and to what extent these EIAs affect countries' welfare. By noting that welfare is computed by wage is deflated by price index, we use a wage equation to decompose the contributions of technology and market access into wages. The outward multilateral resistance terms serve as a proxy for market access. The inward multilateral resistance terms proxy for price index. These are estimated from the structural gravity model.

To understand the effects of EIAs on welfare and technology (as well as wage, price index and market access), we focus norrowly on 5-year and 10-year average changes in welfare and technology (as well as wages, prices and market access) of 16 countries before and after they integrate with the European Union. The comparison results show that the signing of agreements mostly have positive impacts on welfare and technology of these participating countries. To assess the robustness of comparison results, several measures are used in the empirical analysis. These findings are also robust and consistent.

Even though we are not able to identify the reasons behind the changes in welfare, technology, wage, price index and market access as it will be beyond the scope of this paper, further studies may be interested in investigating these effects separately. This study can easily be reproduced when the new dataset on bilateral trade flows and the trade cost variables become available.

Tables

Table 1.1: Country List

Afghanistan	Dominica	Latvia	So Tom and Principe
Albania	Dominican Rep	Lebanon	Saint Kitts and Nevis
Algeria	Ecuador	Lesotho	Saint Lucia
Angola	Egypt	Liberia	Saint Vincent and the Grenadines
Antigua And Barbuda	El Salvador	Libya	Samoa
Argentina	Equatorial Guinea	Lithuania	Saudi Arabia
Armenia	Eritrea	Luxembourg	Senegal
Australia	Estonia	Macao, China	Seychelles
Austria	Ethiopia	Macedonia, Fyr	Singapore
Azerbaijan	Fiji	Madagascar	Slovak Republic
Bahamas	Finland	Malawi	Slovenia
Bahrain	France	Malaysia	Solomon Islands
Bangladesh	Gabon	Maldives	South Africa
Barbados	Gambia	Mali	Spain
Belarus	Georgia	Malta	Sri Lanka
Belgium	Germany	Marshall Islands, Rep	Sudan
Belize	Ghana	Mauritania	Suriname
Benin	Greece	Mauritius	Swaziland
Bermuda	Grenada	Mexico	Sweden
Bhutan	Guatemala	Micronesia, Fed.Sts.	Switzerland
Bolivia	Guinea	Moldova	Syria
Bosnia and Herzegovina	Guinea-Bissau	Mongolia	Taiwan
Botswana	Guyana	Morocco	Tajikistan
Brazil	Haiti	Mozambique	Tanzania
Brunei Darussalam	Honduras	Myanmar	Thailand
Bulgaria	Hong Kong	Namibia	Togo
Burkina Faso	Hungary	Nepal	Tonga
Burundi	Iceland	Netherland	Trinidad (Trinidad And Tobago)
Cambodia	India	New Caledonia	Tunisia
Cameroon	Indonesia	New Zealand	Turkey
Canada	Iran	Nicaragua	Turkmenistan
Cape Verde	Iraq	Niger	Uganda
Central African Republic	Ireland	Nigeria	UK
Chad	Israel	Norway	Ukraine
Chile	Italy	Oman	United Arab Emirates
China	Ivory Coast	Pakistan	Uruguay
Colombia	Jamaica	Panama	USA
Comoros	Japan	Papua New Guinea	Uzbekistan
Congo, DR	Jordan	Paraguay	Vanuatu
Costa Rica	Kazakhstan	Peru	Venezuela
Croatia	Kenya	Philippine	Vietnam
Cuba	Kiribati	Poland	Yemen
Cyprus	Korea	Portugal	Zambia
Czech Republic	Kuwait	Romania	Zimbabwe
Denmark	Kyrgyzstan	Russia	
Djibouti	Laos	Rwanda	

Table 1.2: Countries and Years

Country	**Year**
Austria	1995
Bulgaria	1995
Czech Rep.	1995
Estonia	1998
Finland	1995
Greece	1981
Hungary	1994
Latvia	1998
Lithunia	1998
Poland	1994
Portugal	1986
Romania	1995
Slovakia	1995
Slovenia	1999
Spain	1986
Sweden	1995

Table 1.3: The Estimates of the Fixed Effect Model

Independent Variables	
FTA	0.263***
	(-0.03)
Custom Union	0.416***
	(-0.07)
Common Market	0.860***
	(-0.05)
Economic Union	0.716***
	(-0.10)
Constant	-0.858
	(-53.93)
Importer-Year	Yes
Exporter-Year	Yes
Country-Pair	Yes
Observations	111376
R^2	0.387

Note: * p <0.05, ** p <0.01, *** p <0.001.
Numbers in parenthesis are standard errors.

Table 1.4: Results for Absolute Measures of 5-year Period

Country	Welfare	Price	Wage	Technology	Market
Austria	1.25	-0.34	0.92	0.62	0.30
Bulgaria	0.76	-0.06	0.70	0.63	0.07
Czech Republic	1.26	0.10	1.36	1.42	-0.06
Estonia	0.51	0.10	0.61	0.57	0.04
Finland	1.38	0.31	1.69	1.93	-0.24
Greece	0.07	0.08	0.15	0.30	-0.15
Hungary	2.47	-0.06	2.41	2.31	0.10
Latvia	0.31	0.09	0.40	0.36	0.04
Lithuania	1.20	0.16	1.36	1.39	-0.03
Poland	3.68	-0.40	3.28	3.24	0.04
Portugal	1.27	0.08	1.35	1.49	-0.14
Romania	1.10	-0.08	1.02	0.93	0.09
Slovakia	2.37	0.07	2.43	2.47	-0.04
Slovenia	-0.95	0.32	-0.63	-0.37	-0.26
Spain	0.88	0.24	1.12	1.40	-0.28
Sweden	0.87	0.38	1.25	1.55	-0.30

Table 1.5: Results for Absolute Measures of 10-year Period

Country	Welfare	Price	Wage	Technology	Market
Austria	0.18	-0.11	0.07	0.09	-0.02
Bulgaria	1.28	-0.04	1.24	1.16	0.08
Czech Republic	1.67	-0.30	1.37	1.08	0.29
Estonia	3.04	-0.34	2.70	2.31	0.39
Finland	0.68	0.20	0.88	0.99	-0.11
Greece	-0.74	0.15	-0.59	-0.49	-0.10
Hungary	1.65	-0.03	1.62	1.51	0.11
Latvia	5.60	-0.35	5.25	4.85	0.40
Lithuania	4.78	-0.32	4.46	4.09	0.37
Poland	2.20	-0.26	1.94	1.88	0.06
Portugal	0.49	-0.14	0.35	0.31	0.04
Romania	2.10	-0.03	2.07	2.00	0.07
Slovakia	2.49	-0.29	2.20	1.92	0.28
Slovenia	0.68	-0.15	0.53	0.31	0.22
Spain	0.72	-0.02	0.69	0.75	-0.06
Sweden	0.54	0.24	0.78	0.90	-0.12

Table 1.6: Results for Relative to the World of 5-year Period

Country	Welfare	Price	Wage	Technology	Market
Austria	1.37	-0.29	1.08	0.84	0.24
Bulgaria	0.88	-0.01	0.87	0.85	0.01
Czech Republic	1.38	0.15	1.53	1.64	-0.12
Estonia	0.30	0.04	0.33	0.36	-0.02
Finland	1.50	0.36	1.86	2.15	-0.29
Greece	0.47	0.04	0.51	0.65	-0.14
Hungary	2.41	0.03	2.45	2.44	0.01
Latvia	0.10	0.03	0.12	0.15	-0.02
Lithuania	0.99	0.10	1.08	1.18	-0.09
Poland	3.62	-0.31	3.32	3.37	-0.05
Portugal	1.23	0.14	1.37	1.48	-0.11
Romania	1.22	-0.03	1.19	1.15	0.03
Slovakia	2.49	0.12	2.60	2.69	-0.10
Slovenia	-1.57	0.36	-1.21	-0.91	-0.30
Spain	0.83	0.30	1.13	1.39	-0.26
Sweden	0.99	0.43	1.42	1.77	-0.35

Table 1.7: Results for Relative to the World of 10-year Period

Country	Welfare	Price	Wage	Technology	Market
Austria	-0.20	-0.10	-0.30	-0.22	-0.08
Bulgaria	0.90	-0.03	0.87	0.85	0.03
Czech Republic	1.29	-0.29	1.00	0.77	0.24
Estonia	2.22	-0.33	1.89	1.61	0.28
Finland	0.30	0.21	0.51	0.68	-0.17
Greece	-0.13	0.10	-0.03	0.06	-0.09
Hungary	1.36	-0.07	1.29	1.21	0.08
Latvia	4.78	-0.34	4.44	4.15	0.29
Lithuania	3.96	-0.31	3.65	3.39	0.26
Poland	1.91	-0.30	1.61	1.58	0.03
Romania	1.72	-0.02	1.70	1.69	0.02
Portugal	0.45	-0.09	0.36	0.29	0.07
Slovakia	2.11	-0.28	1.83	1.61	0.23
Slovenia	0.42	-0.16	0.26	0.14	0.12
Spain	0.67	0.03	0.70	0.73	-0.03
Sweden	0.16	0.25	0.41	0.59	-0.18

Table 1.8: Results for Relative to the EEU of 5-year Period

Country	Welfare	Price	Wage	Technology	Market
Austria	0.76	-0.60	0.16	-0.33	0.49
Bulgaria	0.27	-0.32	-0.05	-0.32	0.26
Czech Republic	0.77	-0.16	0.61	0.47	0.13
Estonia	0.85	-0.09	0.75	0.66	0.09
Finland	0.89	0.05	0.94	0.98	0.04
Greece	0.05	0.20	0.25	0.41	-0.16
Hungary	0.24	1.76	2.00	1.70	0.30
Latvia	0.65	-0.10	0.54	0.45	0.09
Lithuania	1.54	-0.03	1.50	1.48	0.02
Poland	1.45	1.42	2.87	2.63	0.24
Portugal	0.65	0.16	0.81	0.93	-0.12
Romania	0.61	-0.34	0.27	-0.02	0.28
Slovakia	1.88	-0.20	1.68	1.52	0.15
Slovenia	-0.77	0.36	-0.40	-0.10	-0.30
Spain	0.25	0.32	0.57	0.84	-0.27
Sweden	0.38	0.12	0.50	0.60	-0.10

Table 1.9: Results for Relative to the EEU of 10-year Period

Country	Welfare	Price	Wage	Technology	Market
Austria	0.45	-0.29	0.16	0.08	0.08
Bulgaria	1.55	-0.22	1.33	1.15	0.18
Czech Republic	1.94	-0.48	1.46	1.07	0.39
Estonia	3.46	-0.57	2.89	2.41	0.48
Finland	0.95	0.02	0.97	0.98	-0.01
Greece	-0.73	0.07	-0.66	-0.58	-0.08
Hungary	0.45	1.23	1.68	1.47	0.21
Latvia	6.02	-0.58	5.44	4.95	0.49
Lithuania	5.20	-0.55	4.65	4.19	0.46
Poland	1.00	1.00	2.00	1.84	0.16
Portugal	0.01	0.08	0.09	0.16	-0.07
Romania	2.37	-0.21	2.16	1.99	0.17
Slovakia	2.76	-0.47	2.29	1.91	0.38
Slovenia	1.23	-0.33	0.90	0.62	0.28
Spain	0.23	0.20	0.43	0.60	-0.17
Sweden	0.81	0.06	0.87	0.89	-0.02

Appendix. Results Based on GDP Weights

Results for Relative to the World of 5-year Period

Country	Welfare	Price	Wage	Technology	Market
Austria	0.94	-0.28	0.67	0.44	0.24
Bulgaria	0.45	0.00	0.45	0.45	0.01
Czech Rep.	0.95	0.16	1.11	1.24	-0.12
Estonia	0.85	-0.03	0.83	0.80	0.03
Finland	1.07	0.37	1.44	1.75	-0.30
Greece	0.43	0.06	0.49	0.67	-0.18
Hungary	2.17	0.08	2.25	2.24	0.02
Latvia	0.65	-0.04	0.62	0.59	0.03
Lithunia	1.54	0.03	1.58	1.62	-0.04
Poland	3.38	-0.26	3.12	3.17	-0.04
Portugal	1.42	0.15	1.57	1.70	-0.12
Romania	0.79	-0.02	0.77	0.75	0.03
Slovekia	2.06	0.13	2.18	2.29	-0.10
Slovenia	-1.11	0.32	-0.79	-0.52	-0.27
Spain	1.03	0.31	1.34	1.61	-0.26
Sweden	0.56	0.44	1.00	1.37	-0.36

Results for Relative to the World of 10-year Period

Country	Welfare	Price	Wage	Technology	Market
Austria	0.16	-0.14	0.03	0.09	-0.06
Bulgaria	1.26	-0.07	1.20	1.16	0.04
Czech Republic	1.65	-0.33	1.33	1.08	0.25
Estonia	3.00	-0.40	2.61	2.26	0.34
Finland	0.66	0.17	0.84	0.99	-0.15
Greece	-0.15	0.05	-0.10	0.07	-0.17
Hungary	1.38	0.27	1.65	1.60	0.05
Latvia	5.56	-0.41	5.16	4.80	0.35
Lithuania	4.74	-0.38	4.37	4.04	0.32
Poland	1.93	0.04	1.97	1.97	0.00
Portugal	0.71	-0.07	0.63	0.56	0.07
Romania	2.08	-0.06	2.03	2.00	0.03
Slovakia	2.47	-0.32	2.16	1.92	0.24
Slovenia	-0.77	0.25	-0.52	-0.22	-0.30
Spain	0.94	0.03	0.97	1.00	-0.03
Sweden	0.52	0.21	0.74	0.90	-0.16

Results for Relative to the EEU of 5-year Period

Country	Welfare	Price	Wage	Technology	Market
Austria	0.78	-0.60	0.19	-0.30	0.49
Bulgaria	0.29	-0.32	-0.03	-0.29	0.26
Czech Republic	0.79	-0.16	0.63	0.50	0.13
Estonia	0.88	-0.10	0.78	0.69	0.09
Finland	0.91	0.05	0.96	1.01	-0.05
Greece	0.03	0.30	0.33	0.50	-0.17
Hungary	0.26	1.78	2.04	1.74	0.20
Latvia	0.68	-0.11	0.57	0.48	0.09
Lithuania	1.57	-0.04	1.53	1.51	0.02
Poland	1.47	1.44	2.91	2.67	0.14
Portugal	0.60	0.15	0.75	1.22	-0.47
Romania	0.63	-0.34	0.29	0.01	0.28
Slovakia	1.90	-0.19	1.70	1.55	0.15
Slovenia	-0.78	0.36	-0.42	-0.12	-0.30
Spain	0.21	0.31	0.52	1.13	-0.61
Sweden	0.40	0.12	0.52	0.63	-0.11

Results for Relative to the EEU of 10-year Period

Country	Welfare	Price	Wage	Technology	Market
Austria	0.45	-0.31	0.13	0.05	0.08
Bulgaria	1.55	-0.24	1.30	1.12	0.18
Czech Republic	1.94	-0.50	1.43	1.04	0.39
Estonia	3.47	-0.57	2.89	2.41	0.48
Finland	0.95	0.00	0.94	0.95	-0.01
Greece	-0.58	0.14	-0.43	-0.32	-0.12
Hungary	0.47	1.22	1.69	1.49	0.21
Latvia	6.03	-0.58	5.44	4.95	0.49
Lithuania	5.21	-0.55	4.65	4.19	0.46
Poland	1.02	0.99	2.01	1.86	0.16
Portugal	0.07	0.05	0.13	0.31	-0.19
Romania	2.37	-0.23	2.13	1.96	0.17
Slovakia	2.76	-0.49	2.26	1.88	0.38
Slovenia	1.24	-0.34	0.90	0.62	0.28
Spain	0.30	0.17	0.47	0.75	-0.29
Sweden	0.81	0.04	0.84	0.86	-0.02

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Chapter 2

Are Economic Integration Agreements Important in Determining FDI Flows?

2.1 Introduction

Accompanying the growth of trade, globalization has also witnessed to a large increases in the amount of foreign direct invesment (FDI) flows and in the number of economic integration agreements (EIAs) since 1990s[17]. Over this time period, the global FDI flows increased by about 816%, EIAs went up by nearly 950% and the world GDP rose by 220%[18]. Along with the statistical indicators, several previous studies using gravity model show that bilateral FDI is positively linked to the presence of EIAs (Yeyati et al., 2003; MacDermott, 2007; Adam, 2013) as well as GDPs of pair countries (Bevan and Estrin, 2004; Benassy-Quere et al., 2007; Berden et al., 2012; Estrin and Uvalic, 2014).

The gravity equation is perhaps one of most widely used specifications to explain the determinant factors of bilateral FDI flows among countries (Blonigen, 2005). Typically, the dependent variable FDI from home country to host country is regressed

[17] EIAs typically refer to free trade agreements (FTAs), custom unions (CUs), common markets (CMs), and economic unions (EUs); however, in the present paper, FTA and CU are combined due to few observations.

[18] The data on FDI and GDP are obtained from the World Bank's "World Development Indicators", http://data.worldbank.org, and the data on EIAs are taken from the World Trade Organization database, http://www.wto.org/.

on the GDPs of home and host countries, bilateral distance and a variety of variables that proxy for investment costs or the absence of investment costs. These variables typically include factors such as common language, common border and integration agreements. Yet, an econometric issue in the estimaton process of typical gravity model arises as a result of endogeneity bias problem since the presence of EIAs (in a gravity equation) is not exogenous (Trefler, 1993; Baier and Bergstrand, 2007; 2009) because countries likely select into EIAs due to reasons correlated with the amount of bilateral FDI, but not easily captured by the econometrician.

A seminal work in international trade by Baier and Bergstrand (2007) not only persuasively argued that neither a traditional nor a theoritically motivated gravity specification would produce unbiased estimates of right-hand side variables in a cross-section framework but also suggested that one could remove the EIAs endogeneity problem and obtain unbiased coefficients on EIAs applying panel data into the gravity equation using country-year and country-pair fixed effects. Anderson and Yotov (2012) supported the use of the fixed effects with the panel data to obtain unbiased estimates.

Although endogeneity bias of EIAs are extensively addressed in the international trade literature, to the best of our knowledge, no study has ever used the gravity equation with cross-section or panel data to address this econometric issue and aim to individually estimate the effects of each type of EIAs (FTA, CM and EU) on bilateral FDI flows employing home-year and host-year, and country-pair fixed effects following Baier and Bergstrand (2007). Morever, the estimation results from the previous literature are mixed at best (Yeyati et al., 2003; Di Giovanni, 2005; Jang, 2011; Paniagua, 2011; Adam, 2013)[19]. Thus, the objective of the current study is to

[19] These papers estimate the variables of interest using a gravity equation with only country-specific fixed effect and/or time-dummies.

fill the gap in the FDI literature.

Furthermore, the papers analyzing the determinants of bilateral FDI based on the gravity model mostly have a relatively small sample or use one form of EIAs. The present study contributes to the existing literature in two ways in addition to addressing and attempting to resolve endogeneity bias caused by omitted variables (and selection). We study with bilateral FDI data of 189 countries for ten years (1999-2008) and estimate coefficients on EIAs for bilateral FDI flows as well as bilateral distance and the dummy variables common language, adjacency and colonial relationship on bilateral FDI flows accounting for the time-varying country specific and country-pair specific fixed effects.

2.2 Estimation of the Gravity Model with Cross-Sectional Data

The gravity equation has been recently applied to FDI context even though it has been widely used in international trade literature. Although theoritical models based on principles of microeconomics have been implemented into the international trade literature, the gravity equation on FDI has limited formal theoritical foundaditions. Nevertheless, the recent empirical and theoritical applications of the gravity approach to international trade, i.e. Anderson and van Wincoop (2003), can be adopted into FDI literature because the same issue arises in this context and the employed gravity approach for bilateral FDI is still a gravity-like model.

We first write the traditional gravity model to explain the bilateral FDI flows employing cross-section data:

$$ln(FDI_{ij}) = \alpha_0 + \alpha_1 ln(GDP_i) + \alpha_2 ln(GDP_j) + \alpha_3 ln(d_{ij}) + \alpha_4 lang_{ij} + \alpha_5 bord_{ij}$$

$$+\alpha_6 col_{ij} + \alpha_7 FTA_{ij} + \alpha_8 CM_{ij} + \alpha_9 EU_{ij} + \epsilon_{ij} \tag{12}$$

where FDI_{ij} is the total value of nominal foreign direct investment flows from investor country i to host country j, GDP_i and GDP_j are the countries' current values of gross domestic products used as proxies for national incomes, the variable d_{ij} denotes the bilateral distance between origin i to destionation j, the dummy variable $lang_{ij}$ is equal to one when countries officially speak the same language and 0 otherwise, the binary variable for the border effect, $bord_{ij}$, is equal to unity when countries are adjacent and 0 otherwise, col_{ij} is a dummy variable assuming the value 1 when two countries have ever shared a common colonizer and zero otherwise.

The binary variable free trade agreement, FTA_{ij}, is equal to 1 when countries sign a free trade aggrement and 0 otherwise, CM_{ij} is a binary variable assuming the value one if countries are in a common market and 0 otherwise, the dummy variable EU_{ij} is equal to unity for countries which join to an economic union and zero otherwise.

The traditional gravity equation for each single year from 1999 to 2008 is estimated based on the ordinary least squares (OLS) approach. The cross-section estimation results of eq. 12 are reported in table 2.2. GDPs of origin and destination countries are found to have significant and positive effects on bilateral FDI. In addition, GDP of the origin has greater impact on FDI flows, which is in line with that found by Bergstrand and Egger (2007) and Berden et al. (2012). The effect of bilateral distance is negative and significant across years. As consistent with the international trade and FDI literatures, the dummy variables common language, common border and colonial relationship are found to increase bilateral FDI.

Table 2.2 shows that the coefficients on EIAs, even for the same type of agreement, are prominently differrent in terms of their signs and magnitudes over years[20]. In detail, the coefficients on FTA are very unstable, ranging from -0.41 to 0.37, and statistically insignificant in some years. The estimates for the binary variables CM and EU are more stable in the sense they are consistently positive but they show a fair degree of variation.

2.2.1. Introducing Fixed Effects

As elaborated by Anderson and van Wincoop (2003) and supported by Baier and Bergstrand (2007) in international trade context, and Berden et al. (2012) in FDI context, there is an econometric issue in estimating eq. 12 because of the omitted-variable bias problem which arises due to omission of one or more important factors makes the estimates biased and inconsistent (Wooldridge, 2009). Following Anderson and van Wincoop (2003) and Feenstra (2004), eq.12 can be re-written including country-specific fixed effects to obtain unbiased estimation results. Hence, eq. 13 can be defined as:

$$ln(FDI_{ij}/GDP_i * GDP_j) = \alpha_0 + \alpha_k T_{ij} + v_i + u_j + \epsilon_{ij}, k = 3, 4..., 9 \qquad (13)$$

where T_{ij} stands for time-constant (distance, common border, common language and colonial relationship) and time-varying (FTA, CM and EU) investment costs. The home-and-host-specific fixed effects are denoted by v_i and u_j, in order.

We apply constrained OLS techniques to estimate the model in eq. 13 using country-specific fixed effects to control for unobserved variables due to Anderson and van Wincoop (2003) and Feenstra (2004). The cross-section outputs for each year from

[20]Pease note that although FTA can mostly remove the tariffs and quatos between member countries, CM and EU not only removes the trade barriers but also allows the free movement of capitals (FDI), labors and services among members.

1999-2008 of eq. 13 are represented in table 2.3. Relying on the suggestions of these authors, the coefficients on EIAs should be more stable. However, the estimation results for them are still unstable across time and in some years are interestingly different in terms of signs. Thus, the estimates are said to biased as Baier and Bergstrand (2007) argued that the use of country-specific fixed effects in a cross-sectional framework would not completely solve the endogeneity bias if countries selected into EIAs[21].

A few studies have employed instrumental variables (IV) or control-function as alternative methodologies to eliminate the possible endogeneity problem of EIAs in a gravity equation with cross-sectional data[22]. These studies; however, failed to take care of the EIA endogeneity bias caused by omitted variables while using a set of economic and political IV or Heckman's control-function methodology because it is very hard to find an instrumental variable representing EIAs, but not correlated with the error term and as Baier and Bergstrand (2007) explained that " ... the vast number of variables that are correlated cross-sectionally with the probability of having an FTA (EIAs) are also correlated cross-sectionally with trade (FDI) flows, preventing elimination of the endogeneity bias using cross-section techniques". Although previous papers and discussions imply that we are not able to solve endogeneity problem of EIA dummy variables in a cross-sectional framework, we argue in section 3 that one can deal with the problem applying a panel data to the gravity specification.

2.2.2 Endogeneity Bias

One of the well known issues in a cross-sectional framework is the possible endogeneity of dependent variables. When an independent variable in either eq. 12 or

[21]Further information about the endogeneity bias is given in the later section.

[22]Please see Baier and Bergstrand (2002), Magee (2003), and Baier and Bergstrand (2007).

eq. 13 is correlated with the error term, ϵ_{ij}, fails to produce unbiased and consistent estimates of α_k (k=1,2,...9). Wooldridge (2009) categorized the possible sources of endogeneity bias as "omitted variables", "simultaneity" and "measurement error". Baier and Bergstrand (2007) claimed that "omitted variables" (and selection problem) among them was the most important factor in creating endogeneity bias[23].

Focusing narrowly on the endogeneity problem of EIA binary variables, Lawrence (1998) pointed that "The issue of exogeneity may also be an important problem when dummy variables are used (in the gravity model) to estimate the effects of free trade areas (EIAs). Free trade areas may well be an endogenous variable-that is, a response to, rather than a source of, large trade flows." In addition, Trefler (1993), and Lee and Swagel (1997) demonstrated that existence or absence of EIAs was not exogenous and estimation effects were underestimated due to endogeneity bias. A recent study by Baier and Bergstrand (2007) showed that estimation results of EIAs suffered from endogeneity bias, perhaps because of self selection of country pairs' governments into trade agreements and related to the amount of bilateral trade flows. They also mentioned that the decisions of countries on joining EIAs were slow-moving; however, trade (FDI) flows were not slow-moving. The presence of slow-moving problem implies that observed variables in investment costs, T_{ij}, are likely to be highly correlated with unobservable variables concealed in the error term ϵ_{ij}.

2.3 Estimation of the Gravity Model with Panel Data

Given potential endogeneity of EIAs when estimating time-varying investment cost variables in the gravity equation with cross-sectional data, we apply the panel data into the gravity model with fixed effects to address and resolve the problem. Fixed effects versus random effects are preferred because we believe that there are

[23] Please see their paper for further information and discussion on the sources of endogeneity bias.

unobservable time-constant country-pair variables $-\kappa_{ij}-$ impacting the existence of EIAs as well as the volume of bilateral FDI flows. Relying on the presence of correlation between κ_{ij} and EIAs, fixed effects versus random effets are chosen since the former enables random correlation between κ_{ij} and EIAs; on the contrary, the latter assumes no correlation between those variables.

2.3.1 Data

The data on bilateral foreign direct investment flows for 189 countries over the period of 1999-2008 are kindly provided by Baier and Bergstrand[24]. The data for GDP for each pair come from the World Bank's "World Development Indicators". The data on investment cost variables are obtained from diffrent sources.

The variables distance and common colonizer are drawn from "Centre d'Etudes Prospectives et d'Informations Internationales" (CEPII). We use the distance measure associated with distance in kilometers between the most populous city in countries. Papers mentioned in the introduction section indicated that the volume of bilateral FDI are negatively correlated with bilateral distance. Intuitively, marginal costs (i.e. transportation costs) and fixed costs (i.e. searching cost) rise as d_{ij} increases. A colonial relationship refer to a historical tie between countries that can increase FDI among them.

The variables common language and common border are obtained from Head et al. (2010). Expected sign of speaking the same offical language is positive as Helliwell (1997) noted "A common language provides evidence of common cultural roots, shared literature and lore, and even shared codes of law." In addition, a pair of adjacent countries are expected to have cultural and economic similarities that encourage FDI among them.

[24]A complete list of countries is provided in table 2.1.

The data for EIAs from 1999-2005 are taken from Jeffrey Bergstrand's website[25] and from 2006-2008 are drawn from the WTO database. Because both CM and EU provide free movement of capital, labor and other services, members likely have more FDI flows. In constrast, FTA and CU may or may not have statistically significant effects on FDI as they can only eliminate trade barriers among members.

2.3.2 Fixed Effects Estimation of the Gravity Model

In a panel framework, the traditional gravity equation can be written by:

$$ln(FDI_{ijt}) = \alpha_0 + \alpha_1 ln(GDP_{it}) + \alpha_2 ln(GDP_{jt}) + \alpha_3 ln(d_{ijt}) + \alpha_4 lang_{ijt}$$

$$+\alpha_5 bord_{ijt} + \alpha_6 col_{ijt} + \alpha_7 FTA_{ijt} + \alpha_8 CM_{ijt} + \alpha_9 EU_{ijt} + \epsilon_{ijt} \quad (14)$$

We perform OLS techniques to estimate the model in eq. 14 using several methods with and without country-pair fixed effects and year fixed effects. Column (1) in table 2.4 shows the estimation results for ten years of eq. 14 without using any fixed-effect. GDPs of home-and-host country have economically significant and positive effects on bilateral FDI. The effect of bilateral distance on FDI_{ij} is significant and negative. The dummy variables common language, common border and colonial relationship have expected signs. As discussed in the data section, FTA is not statistically significant in determining bilateral FDI. The coefficient estimates of CM and EU are 0.66 and 1.08, implying that country i invest more in country j when they sign an economic agreement allowing free movement of capital across countries.

The first modification is performed by including time (year) effects into eq. 14 to

[25] The data are available at www.nd.edu/jbergstr/ and constructed under National Science Foundation grants SES-0351018 and SES-0351154, and used by many studies including Baier and Bergstrand (2007), Baier et al. (2008) and Baier et al. (2014).

control for unobserved independent variables that vary over years but stay unchanged across countries. Ignoring year-fixed effects may result in an omitted variable bias problem because some variations in FDI cannot be completely captured by the dependent variables. Column (2) in table 2.4 provides the estimates of gravity equation using year fixed effects. Even though the coefficient on FTA is still not statistically significant, the average treatment effects of CM and EU on bilateral FDI sligtly go up to 123% and 207%, respectively[26].

The next modification is applied by including only country-pair (bilateral) fixed effects to consider unobserved time-constant variables. Egger and Pfaffermayr (2003) noted that country-pair fixed effects account for a considerable part of variations in the dependent variable. Hence, inclusion of bilateral fixed effects presumably eliminates some portion of the EIAs endogeneity. The estimation results of the gravity equation with country-pair fixed effects are reported in column (3). Prominent changes are that the coefficient estimate for FTA become significant, and the impacts of CM and EU are less than the previous case.

Last, time dummies and bilateral fixed effects are simultaneously included into eq. 14 to control for the above-mentioned time-invariant and time-varying unobserved omitted variables together. Column (4) represents that the presence of FTA, CM and CU result in 15%, 93% and 170% increases in bilateral FDI, respectively[27]. It is obvious that bilateral fixed effects and time dummies account for a large number of explanatory unobserved variables; nevertheless, they cannot capture very important country-specific unobserved variables varying over time, namely the multilateral resistance terms. Baier and Bergstrand (2007) also indicated that employing only country pair fixed effect did not provide an unbiased estimation if governments select

[26] $e^{0.80}$=2.23, $e^{1.12}$=3.07

[27] $e^{0.14}$=1.15, $e^{0.66}$=1.93, $e^{0.99}$=2.70.

into EIAs. We should thus consider the time-varying country specific effects because neglecting such terms can potentially yield an endogeneity due to omitted variables (and selection).

Baier and Bergstrand (2007) suggested that one should remove endogeneity bias of EIAs by applying panel data techniques into the gravity equation and employing country-pair fixed effect, home-year and host-year fixed effects[28]. Following their approach, we can express eq. 15 by scaling the dependent variable by the product of GDPs as suggested by Anderson and van Wincoop (2003) and including country-pair fixed effect, and home-year and host-year fixed effects to attain unbiased estimates of EIAs:

$$ln(FDI_{ijt}/GDP_{it} * GDP_{jt}) = \alpha_0 + \alpha_7 FTA_{ijt} + \alpha_8 CM_{ijt} + \alpha_9 EU_{ijt} + \kappa_{ij} + \xi_{it} + \zeta_{it} + \epsilon_{ijt} \quad (15)$$

where κ_{ij} is a country-pair fixed effect to capture possible time-invariant unobservable variables impacting bilateral FDI. The parameters ξ_{it} and ζ_{it} represent home-year and host-year fixed effects to account for time-variant GDPs of pair countries as well as possible unobservable time-variant country specific variables for each pair of country i and j impacting the amount of bilateral FDI.

We use constrained OLS to estimate the coeffcients on EIAs in eq. 15. The output from the regression is reported in column (5) of table 2.4[29]. As shown, the coefficient for FTA becomes statistically insignificant; in addition, the CM and EU coefficient estimates of 0.51 and 0.74 imply that they stimulates FDI by about 67%

[28]Yotov and Anderson (2012) among others supported the results of Baier and Bergstrand (2007) using panel techniques.

[29]we report only variables of interest (FTA, CM, and EU) and do not report the estimates of the home-year, host-year and country-pair fxed effects for brevity.

and 110%, respectively. Our findings also indicate that the effects of these variables larger the more integrated the economic relationship is. One can realize that the average treatment effects of CM and EU are now smaller after controlling for time-varying country-year fixed effects and country-pair fixed effects. The estimation results of eq. 15 suggest that the previous studies using no-fixed effects or only year-fixed effects or only country-pair fixed effects or year and bilateral fixed effects provided biased coefficient estimates of EIAs. More imporantly, the FTA coefficient was considered statistically significant althoguh it is not, and the CM and EU coefficients were overestimated.

2.4 Conclusion

The gravity model has been recently used to explain bilateral FDI flows. However, an econometric issue arises in the estimaton process of typical gravity model as a result of endogeneity bias problem since the presence of EIAs is not exogenous. Hence, the primary objective of this study is to use a tradiation gravity model with cross-sectional data and then apply a panel data into a gravity equation with fixed effects to address and eliminate potential endogeneity of FTAs, CMs and EUs. We assert that the panel data approach produces unbiased and consistent coefficient estimates of FTA, CM and EU while the cross-sectional approach does not. What is more to the point is that we find that the CM and EU coefficients are overestimated and the FTA coefficient become insignificant after accounting for the endogeneity problem.

Tables

Table 2.1: Country List

Afghanistan	Dominica	Laos	Qatar
Albania	Dominican Rep	Latvia	So Tom and Principe
Algeria	Ecuador	Lebanon	Saint Kitts and Nevis
Angola	Egypt	Lesotho	Saint Lucia
Antigua And Barbuda	El Salvador	Liberia	Saint Vincent and the Grenadines
Argentina	Equatorial Guinea	Libya	Samoa
Aruba	Eritrea	Lithuania	San Marino
Armenia	Estonia	Luxembourg	Saudi Arabia
Australia	Ethiopia	Macao, China	Senegal
Austria	Faeroe Islands	Macedonia, Fyr	Seychelles
Azerbaijan	Fiji	Madagascar	Singapore
Bahamas	Finland	Malawi	Slovak Republic
Bahrain	France	Malaysia	Slovenia
Bangladesh	Gabon	Maldives	Somalia
Barbados	Gambia	Mali	Solomon Islands
Belarus	Georgia	Malta	South Africa
Belgium	Germany	Marshall Islands, Rep	Spain
Belize	Ghana	Mauritania	Sri Lanka
Benin	Greece	Mauritius	Sudan
Bermuda	Grenada	Mexico	Suriname
Bhutan	Greenland	Micronesia, Fed.Sts.	Swaziland
Bolivia	Guatemala	Moldova	Sweden
Bosnia and Herzegovina	Guinea	Mongolia	Switzerland
Botswana	Guinea-Bissau	Morocco	Syria
Brazil	Guyana	Mozambique	Taiwan
Brunei Darussalam	Haiti	Myanmar	Tajikistan
Bulgaria	Honduras	Namibia	Tanzania
Burkina Faso	Hong Kong	Nepal	Thailand
Burundi	Hungary	Netherland	Togo
Cambodia	Iceland	New Caledonia	Tonga
Cameroon	India	New Zealand	Trinidad (Trinidad And Tobago)
Canada	Indonesia	Nicaragua	Tunisia
Cape Verde	Iran	Niger	Turkey
Cayman Islands	Iraq	Nigeria	Turkmenistan
Central African Republic	Ireland	Norway	Uganda
Chad	Israel	Oman	UK
Chile	Italy	Pakistan	Ukraine
China	Ivory Coast	Panama	United Arab Emirates
Colombia	Jamaica	Papua New Guinea	Uruguay
Comoros	Japan	Paraguay	USA
Congo, DR	Jordan	Peru	Uzbekistan
Costa Rica	Kazakhstan	Philippine	Vanuatu
Croatia	Kenya	Poland	Venezuela
Cuba	Kiribati	Portugal	Vietnam
Cyprus	Korea	Romania	Yemen
Czech Republic	Kuwait	Russia	Zambia
Denmark	Kyrgyzstan	Rwanda	Zimbabwe
Djibouti			

Table 2.2: Estimation Results of the Traditional Gravity Equation

Variables	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
lnGDPi	1.10**	1.10**	1.28**	1.06**	1.13**	1.08**	1.06**	1.06**	1.09**	1.11**
lnGDPj	0.74**	0.74**	0.56**	0.70**	0.80**	0.75**	0.80**	0.80**	0.79**	0.80**
lnDIST	-0.43**	-0.39**	-0.43**	-0.51**	-0.53**	-0.54**	-0.50**	-0.67**	-0.74**	-0.69**
ADJ	0.77*	0.92**	0.77**	0.65*	0.69*	0.70*	0.67*	0.67*	0.56*	0.49*
LANG	0.78**	0.89**	1.42**	1.14**	1.65**	1.43**	1.44**	1.54**	1.84**	1.70**
COL	0.96**	1.03**	0.63**	0.60*	0.65**	0.61**	.75**	0.62**	0.79**	0.84**
FTA	-0.26	-0.20	-0.41*	-0.23	0.02	0.08	0.34	0.37*	0.14	0.24
CM	1.11**	1.19**	1.17**	1.10**	1.46**	1.71**	0.33	0.33	0.47*	0.66**
EU	0.95**	1.15**	0.88**	0.94**	1.23**	1.31**	1.20**	1.13**	0.85**	1.17**
CONS	-40.43**	-40.57**	-40.52**	-37.45**	-42.23**	-39.44**	-40.77**	-39.13**	-39.55**	-40.69**
R^2	0.54	0.52	0.53	0.48	0.50	0.50	0.48	0.49	0.48	0.50

** (*) denotes the significant at 1 (5) % levels. The dependent variable is the natural log of nominal FDI_{ij}

Table 2.3: Estimation Results of the Gravity Equation with Country-Specific Fixed Effects

Variables	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
lnDIST	-0.57**	-0.54**	-0.65**	-0.68**	-0.61**	-0.64**	-0.60**	-0.75**	-0.81**	-0.72**
ADJ	0.35	0.5	0.21	0.23	0.43	0.37	0.37	0.41	0.34	0.27
LANG	1.17**	1.23**	1.80**	1.49**	1.94**	1.68**	1.67**	1.74**	2.04**	1.89**
COL	1.03**	1.12**	0.83**	0.77**	0.70**	0.67**	0.78**	0.67**	0.82**	0.91**
FTA	-0.61*	-0.52*	-0.82**	-0.60**	-0.35	-0.29	0.05	0.1	-0.12	0.12
CM	0.46	0.58*	0.20	0.32	0.82**	0.98**	-0.04	-0.04	0.13	0.40*
EU	0.31	0.56	-0.02	0.18	0.66*	0.59*	0.65*	0.61*	0.38	0.89**
CONS	-42.63**	-42.89**	-41.74**	-41.52**	-42.65**	-42.47**	-42.96**	-41.66**	-41.33**	-42.28**
$WithinR^2$	0.15	0.15	0.14	0.15	0.15	0.15	0.13	1.16	0.17	0.19

** (*) denotes the significant at 1 (5) % levels. The dependent variable is the natural logarithmic of the ratio of nominal FDI_{ij} to the product of nominal GDP_i and GDP_j.

Table 2.4: Estimation Results of the Gravity Equation with Panel Data

Variable	No fixed or time effects	Year effects	Bilateral fixed effects	Year and bilateral fixed effects	Bilateral fixed and country-year effects
lnGDPi	1.07**	1.10**	0.78**	1.09**	
lnGDPj	0.76**	0.77**	0.73**	0.82**	
lnDIST	0.56**	0.54**			
ADJ	0.66**	0.65**			
LANG	1.48**	1.46**			
COL	0.74**	.74**			
FTA	0.02	0.04	0.13*	0.14**	0.08
CM	0.66**	0.80**	0.64**	0.66**	0.51**
EU	1.08**	1.12**	1.00**	0.99**	0.74**
CONS	-39.50**	-40.92			
R^2	0.49	0.50			
R^2 within			0.26	0.27	0.30

** (*) denotes the significant at 1 (5) % levels. For column (1), (2), (3) and (4), the dependent variable is the natural log of nominal FDI_{ij}. For column (5), the dependent variable is the ratio of nominal FDI_{ij} to the product of nominal GDP_i and GDP_j.

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Chapter 3

Estimation of Gravity Equation with Approximation Errors

3.1 Introduction

The gravity equation is perhaps one of the most frequently used models to explain the determinants of bilateral trade flows. In a traditional gravity model, the dependent variable bilateral trade flows from origin to destination is regressed on the GDPs of exporter and importer countries, bilateral distance and a variety of binary variables that proxy for trade costs or the absence of trade costs. However, the traditional gravity equation does not account for the effects of third-country on international trade between pairs. It consequently produces biased and inconsistent estimates. The seminal work by Anderson and van Wincoop (2003) (Hereafter, A-vW) developed multilateral resistance terms (or prices) to control the interactions of pairs with the rest of the world (or third-country effects). Although the theoritical gravity equation with multilateral resistance terms provides unbiased estimates, it has not been widely adopted as it requires a non-linear estimation procedure.

Building also on the theoritical model of A-vW, Baier and Bergstrand (2009) (Hereafter, BB) use a log-linear Taylor-series expansion (TSE) to linearize the multilateral resistance terms so that the model can be estimated using ordinary least squares (OLS) method. These approximations not only allow for "Bonus Vetus" OLS, but also provide unbiased and consistent estimates since they are formally equal to multilateral resistance terms. Yet, the analysis of BB was mainly on a simple first-order TSE in which higher-order terms (approximation errors) were eliminated. However, elimination of these terms causes inefficient estimates of trade cost variables (Wooldridge, 2009). Furthermore, unobserved heterogeneity still remains in trade flows among countries as a result of not controlling for approximation errors (random effects). Thus, the primary objective of this study is to estimate the theory-based gravity equation using BB's motivation in mixed effects model while accounting for higher-order terms. In short, the coefficient estimates of models based on A-vW and BB are unbiased and consistent, but only those of mixed effects model are efficient due to the introduction of random effects and unobserved country heterogeneity.

3.2 Background

3.2.1 Theory

The empirical-based gravity model can be derived from several theoritical models (c.f. Anderson, 1979; Baier and Bergstrand, 2001; Eaton and Kortum, 2002; Helpman et al., 2008). Perhaps one of the most implemented models is the model of A-vW. In their model, individuals in country j have constant elasticity of substitution (CES) preferences and can purchase up to N varieties of goods from N exporter countries. Considering firms within a country, the marginal cost of production is constant but there is a fixed entry cost. In addition, production takes place under the conditions of monopolistic competition and increasing return to scale technology. Because all firms within country i have access to identical technology, prices of each differenciated goods exported from i to j are equal to $p_{ij}(z) = p_{ij} = p_i{*}T_{ij}$, where p_i denotes domestic prices of varieties, and T_{ij} represents trade costs (i.e. transportation, insurance, tariff) that firms in origin i face exporting the goods to destination j. In conjunction with these assumptions, market-clearing conditions and several algebraic calculations compose the gravity equation as:

$$X_{ij} = \left[\frac{Y_i Y_j}{Y_w}\right] \left[\frac{T_{ij}}{\Pi_i P_j}\right]^{1-\sigma} \tag{16}$$

where X_{ij} is the volume of bilateral trade flows from i to j, Y_i and Y_j are incomes of exporter and importer countries, and Y_w are world income that is constant across countries and thus buried into the constant parameter along the further analyses. The parameter σ is the elasticity of substitution between varieties of goods. The variables accounting for the importance of third-country prices are outward and inward multilateral resistance terms explicitly written by:

$$\mathit{\Pi}_i^{1-\sigma} = \left(\textstyle\sum_{j=1}^{C} \left[\frac{T_{ij}}{P_j}\right]^{1-\sigma} \theta_j \right)$$

$$P_j^{1-\sigma} = \left(\textstyle\sum_{j=1}^{C} \left[\frac{T_{ij}}{\mathit{\Pi}_i}\right]^{1-\sigma} \theta_i \right)$$

where $\theta_i(\theta_j)$ stands for country i's (country j's) share of world income. Note that because true values of trade costs between countries are unobservable, as is common to the international trade literature we approximate them by:

$$T_{ij} = DIST_{ij}^{\alpha_1} exp(\alpha_2 LANG_{ij} + \alpha_3 ADJ_{ij} + \alpha_4 COL_{ij})$$

where the variable $dist_{ij}$ denotes the bilateral distance between origin i to destination j, the dummy variable $lang_{ij}$ is equal to one when countries share the offical language and 0 otherwise, the binary variable adj_{ij} is equal to unity when countries are adjacent and 0 otherwise, col_{ij} is a dummy variable assuming the value 1 when two countries have ever shared a common colonizer and zero otherwise. In the framework of A-vW, the dependent variable based on a theory is formulated as bilateral trade flows divided by the product of exporter and importer incomes. Thus, we also impose unitary income elasticities to be consistent with their econometric model. Then, the gravity model in equation 16 can be written in log-level form for the sake of empirical analysis:

$$ln(X_{ij}/Y_i * Y_j) = ln(Z_{ij}) = \beta_0 + \beta_1 lnDIST_{ij} + \beta_2 LANG_{ij} + \beta_3 ADJ_{ij}$$
$$+\beta_4 COL_{ij} + (\sigma - 1)ln\Pi_i + (\sigma - 1)lnP_j + \epsilon_{ij} \quad (17)$$

where $\beta_i = \alpha_i(1 - \sigma)$, (i=1,...,4). A-vW estimated equation 17 using customized nonlinear least squares (CNLS), minimazing the sum of squared errors. In the subsequent sections, we discuss several distinguished approaches. They are by definition analogous to equation 17 in terms of unbiasedness and consistency.

3.2.2 Fixed-Effects Approach

Despite the fact that CNLS can produce unbiased and consistent estimates of equation 17, the non-linear approach has not been widely adapted. Nevertheless, A-vW and Feenstra (2004) proposed to replace multilateral resistance terms for country-specific fixed effects as an alternative specification that can be estimated by ordinary least squares (OLS) techniques. This method not ony takes relatively less time but also produce unbiased and consistent coefficient estimates of β_i as well. Fixed effects version of equation 17 is defined as:

$$ln(Z_{ij}) = \beta_0 + (1 - \sigma)lnT_{ij} + v_i + u_j + \epsilon_{ij} \quad (18)$$

where the parameters v_i and u_j represent exporter and importer fixed effects, respectively, and ϵ_{ij} is a normally distributed error term. Note that although both CNLS and fixed effects approaches reveal unbiased and consistent coefficient estimates as both account for prices, it does not necessarily mean that the coefficients on trade costs would be identical. This matter is further discussed in the estimation results section. Both of these empirical formulations only reveal the average treatment effect and the general equilibrium effects can not be easily obtained.

3.2.3 Bonus Vetus OLS

Building also on the theoritical model of A-vW, Baier and Bergstrand (2009) (Hereafter, BB) use a log-linear Taylor-series expansion (TSE) to linearize the multilateral resistance terms so that the model can be estimated using OLS. These approximations not only allow for "Bonus Vetus" OLS, but also provide unbiased and consistent estimates since they are formally equal to multilateral resistance terms. In addition, conditional general equilibrium effects can be obtained. To understand the implication of TSE on mixed effects model, following BB the multilateral resistance terms in equation 17 can be expressed as:

$$(\sigma - 1)ln\mathit{\Pi}_i = \beta_i(\bar{T}_i - \bar{\bar{T}}) + \delta_i$$

$$(\sigma - 1)lnP_j = \beta_j(\bar{T}_j - \bar{\bar{T}}) + \delta_j$$

where $\bar{T}_i = \frac{\sum_{k=1}^{N} T_{ik}}{N}$, $\bar{T}_j = \frac{\sum_{k=1}^{N} T_{kj}}{N}$, and $\bar{\bar{T}}_i = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N} T_{ij}}{N^2}$, and δ_k (k=i,j) are the approximation errors capturing higher-order terms (or random effects). As is consistent with random effects model in Wooldridge (2009), we assume that δ_k is not correlated with explanatory trade cost variables, cf. equations 23-24. In addition, under strict exogeneity on independent variables we also assume that random effects δ_k is partially correlated with the multilateral resistance terms that may be constant distortions or not captured by the linearization, but not correlated with error terms, cf. equations 19-22.

$$E\Big[(\sigma - 1)ln\Pi_i \mid T_{ij}\Big] = \phi + \phi_i\bar{T}_i \tag{19}$$

$$E\Big[(\sigma-1)lnP_j \mid T_{ij}\Big] = \phi + \phi_j \bar{T}_i \tag{20}$$

$$E\Big[(\sigma-1)ln\Pi_i \mid T_{ij}, \delta_i\Big] = \phi + \phi_i \bar{T}_i + \delta_i \tag{21}$$

$$E\Big[(\sigma-1)lnP_j \mid T_{ij}, \delta_j\Big] = \psi + \phi_j \bar{T}_j + \delta_j \tag{22}$$

$$E\Big[\delta_i \mid T_{ij}\Big] = 0 \tag{23}$$

$$E\Big[\delta_j \mid T_{ij}\Big] = 0 \tag{24}$$

A relevant question is "In what aspects does this study differ from BB?" The analysis of BB was mainly on a **simple first-order TSE** with the assumptions of 19-20 in which higher-order terms were not explicitly included and instead eliminated as BB noted "... a simple fixed-point iteration procedure that eliminates the approximation errors without using a higher-order Taylor expansion which, as for modern dynamic macroeconomic models, is very difficult and outside the paper's scope". However, elimination of δ_k causes inefficient estimates of trade cost variables, cf. Wooldridge (2009). Furthermore, unobserved heterogeneity, ϵ_{ij}, remains in trade flows among countries as a result of not controlling for approximation errors. Thus, the primary objective of this study is to estimate the theory-based gravity equation by mixed effects model while accounting for higher-order terms[30].

After identifying that equations 21-22 have the same form as the correlated random effects, we can thus substitute them into equation 17 to obtain:

$$ln(Z_{ij}) = \xi + \beta_1 lnDIST_{ij} + \beta_2 LANG_{ij} + \beta_3 ADJ_{ij} + \beta_4 COL_{ij} + \phi_i \bar{T}_i + \phi_j \bar{T}_j$$
$$+\delta_i + \delta_j + \eta_{ij} \tag{25}$$

[30]For this purpose, the STATA xtmixed code can be commanded in equation 25 assuming that the intercepts for the source and destination countries are random.

The above equation now resembles a two-way correlated random effects (or mixed effects) model. Because an intercept is explicitly shown in the above model, we assume that the random effects are normally distributed with a zero mean as in Wooldridge (2009). As mentioned earlier in this section, the econometric model in equation 25 is similar to that in BB except omitting the parameters δ_i and δ_j[31].

3.3 Data

A cross-sectional data of 189 countries for 2005 is employed within this study[32]. The data on GDPs as proxy for incomes are drawn from the World Bank's "World Development Indicators"[33]. The data on bilateral trade flows for each pair come from UNCTAD. The data on trade cost variables are taken from diffrent sources.

The variables distance and common colonizer are drawn from "Centre d'Etudes Prospectives et d'Informations Internationales" (CEPII). We use the distance measure associated with distance in kilometers between the most populous city in countries. A number of studies have shown that the amount of trade flows are negatively correlated with bilateral distance. Intuitively, marginal costs (i.e. transportation costs) and fixed costs (i.e. searching cost) rise as d_{ij} increases. A colonial relationship refer to a historical tie between countries that can increase international trade among them.

The variables common language and common border are obtained from Head et al. (2010). Expected sign of speaking the same offical language is positive as Helliwell (1997) noted "A common language provides evidence of common cultural roots, shared literature and lore, and even shared codes of law." In addition, a pair of adjacent countries are expected to have cultural and economic similarities that

[31]The other difference related to equation 25 is that we approximate trade costs by DIST, LANG, ADJ and COL whereas BB defined trade costs by only DIST and ADJ just as in A-vW.

[32]A complete list of countries is posted in table 3.1.

[33]The data are available at http://data.worldbank.org

encourage international trade between countries.

3.4 Estimation Results and Conclusion

Starting with the fixed effects specification, we apply constrained OLS approach to estimate the model in equation 18 using country-specific fixed effects to control for the multilateral resistance (prices) terms. The coefficients estimates and estimated average treatment effects (ATEs) for trade cost variables are reported in column (1) of table 3.2[34]. Considering BB's first-order Taylor expansion, we also employ OLS to estimate the econometric model in equation 25 excluding random effects δ_k. Estimates of the effects of trade cost variables are presented in column (2) of table 3.2. Then, we estimate equation 25 including approximation errors capturing higher-order terms by using mixed effects approach. The estimates of β_i and estimated ATEs for trade cost parameters are posted in column (3) of table 3.2.

In advance to reporting estimation results of the models in this paper, it is critical to elaborate the findings of previous studies related to this study. BB showed by taking a first-order Taylor expansion and using "true" trade flows in a Monte Carlo simulation that the coefficient estimates of distance and common border are nearly identical to fixed effects and CNLS estimates in A-vW and Feenstra (2004)[35]. However, it is noteworthy that by using "observable" trade flows of US-Canada for 1993 instead, BB indicated that the border effect was somewhat different than that estimated using CNLS and fixed effects methods. Based on the same US-Canada data, Feenstra (2004) also compared the border effect obtained using fixed effects to that found by A-vW applying CNLS. The author reported that the ATE for common border in fixed effects model was 4.7 and quite close to average effect of 5.2 explored

[34] Coefficient estimates of fixed effects are not reported for the sake of brevity.

[35] The authors generated true values of bilateral trade flows and multilateral resistance terms given GDPs, bilateral distances and binary variables.

by A-vW accounting for endogenous multilateral resistance terms. We close the review by noting that the estimates of distance and common border in fixed effects model, BB and A-vW are all consistent since they control for prices. As dinstict from these studies, mixed effects model produces not only consistent but also accounts for approximation errors. Assuming these errors are normally distributed lead to more efficient estimation of equation 10 because it simultaneously accounts for prices and unobservable country heterogeneity.

Returning back to analyses in this paper, column (1) reports that the coefficients on distance, common language, common border and common colonizer are -1.62, 0.82, 0.87 and 1.00, respectively, and statistically significant at 1% level. The ATEs for LANG, ADJ and COL are 2.27, 2.38 and 2.71, in order. Rather than those in fixed effects equation, column (2) based on BB posts that the ATEs for LANG, ADJ and COL are 2.01, 2.36 and 2.51. Note that the DIST coefficients of both models are identical and the ATEs for binary variables of both models are close to each other as expected. The estimates of β_i(i=1,...,4) of equation 25 are -1.64, 0.75, 0.79 and 0.95, respectively, referring to column (3). Although, the ATEs for trade cost variables are slightly different than those in fixed effects and BB, they are once again quite close to each other in the way we anticipated. We end this section by noting that the coefficient estimates in columns (1)-(3) are unbiased and consistent; however, only those in column (3) are efficient due to the introduction of random effects and unobserved heterogeneity between countries.

Tables

Table 3.1: Country List

Afghanistan	Dominica	Laos	Qatar
Albania	Dominican Rep	Latvia	So Tom and Principe
Algeria	Ecuador	Lebanon	Saint Kitts and Nevis
Angola	Egypt	Lesotho	Saint Lucia
Antigua And Barbuda	El Salvador	Liberia	Saint Vincent and the Grenadines
Argentina	Equatorial Guinea	Libya	Samoa
Aruba	Eritrea	Lithuania	San Marino
Armenia	Estonia	Luxembourg	Saudi Arabia
Australia	Ethiopia	Macao, China	Senegal
Austria	Faeroe Islands	Macedonia, Fyr	Seychelles
Azerbaijan	Fiji	Madagascar	Singapore
Bahamas	Finland	Malawi	Slovak Republic
Bahrain	France	Malaysia	Slovenia
Bangladesh	Gabon	Maldives	Somalia
Barbados	Gambia	Mali	Solomon Islands
Belarus	Georgia	Malta	South Africa
Belgium	Germany	Marshall Islands, Rep	Spain
Belize	Ghana	Mauritania	Sri Lanka
Benin	Greece	Mauritius	Sudan
Bermuda	Grenada	Mexico	Suriname
Bhutan	Greenland	Micronesia, Fed.Sts.	Swaziland
Bolivia	Guatemala	Moldova	Sweden
Bosnia and Herzegovina	Guinea	Mongolia	Switzerland
Botswana	Guinea-Bissau	Morocco	Syria
Brazil	Guyana	Mozambique	Taiwan
Brunei Darussalam	Haiti	Myanmar	Tajikistan
Bulgaria	Honduras	Namibia	Tanzania
Burkina Faso	Hong Kong	Nepal	Thailand
Burundi	Hungary	Netherland	Togo
Cambodia	Iceland	New Caledonia	Tonga
Cameroon	India	New Zealand	Trinidad (Trinidad And Tobago)
Canada	Indonesia	Nicaragua	Tunisia
Cape Verde	Iran	Niger	Turkey
Cayman Islands	Iraq	Nigeria	Turkmenistan
Central African Republic	Ireland	Norway	Uganda
Chad	Israel	Oman	UK
Chile	Italy	Pakistan	Ukraine
China	Ivory Coast	Panama	United Arab Emirates
Colombia	Jamaica	Papua New Guinea	Uruguay
Comoros	Japan	Paraguay	USA
Congo, DR	Jordan	Peru	Uzbekistan
Costa Rica	Kazakhstan	Philippine	Vanuatu
Croatia	Kenya	Poland	Venezuela
Cuba	Kiribati	Portugal	Vietnam
Cyprus	Korea	Romania	Yemen
Czech Republic	Kuwait	Russia	Zambia
Denmark	Kyrgyzstan	Rwanda	Zimbabwe
Djibouti			

Table 3.2: Estimation Results

	Fixed Effects (1)		Bonus Vetus (2)		Mixed Effects (3)	
Indp. Var.	Coeff.	ATE	Coeff.	ATE	Coeff.	ATE
lnDIST	-1.62		-1.62		-1.64	
	(0.02)		(0.02)		(0.02)	
LANG	0.82	2.27	0.72	2.01	0.75	2.12
	(0.05)		(0.06)		(0.05)	
ADJ	0.87	2.38	0.86	2.36	0.79	2.20
	(0.12)		(0.14)		(0.12)	
COL	1.00	2.71	0.92	2.51	0.95	2.59
	(0.07)		(0.08)		(0.07)	
CONS	-42.14		-16.63		-12.59	
	(1.08)		(0.72)		(1.03)	

Note: Numbers in parentheses are std. errors of estimates.

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