Abstract

This paper provides an ex-post assessment of the Regional Trade Agreements (RTAs) to see whether RTAs have been trade creating or trade diverting. We estimate the impact of RTAs on trade flows for country pair with dyed fixed effects and time dummies. These fixed effects capture the determinants of trade flows normally included in gravity model specifications and control for yearly shocks to countries’ trade. We use a gravity model inspired and adapted from Santos Silva and Tenreyo (2005) estimated with a Poisson Pseudo-Maximum Likelihood (PPML) method, which circumvents the heteroscedasticity bias encountered with the usual Ordinary Least Square (OLS) estimators. Annual data from 38 countries covering six RTAs in the Western Hemisphere for the years 1986–2005 is used. Our estimation showed that PPML method reduces the estimated trade impacts of regional agreements. The estimates reveal that the trade creation variables are significant and positive except NAFTA and LAIA, while the trade diversion effects of the mentioned RTAs are varied remarkably. The insignificance of the trade creation variable for NAFTA seems due to the lack of sufficient number of observations since there are only three member countries.

**JEL Classification:** F13, F15.

**Keywords:** Regional Trading Agreements, Gravity model, Poisson Pseudo-Maximum Likelihood, Trade Creation, Trade diversion
1. Introduction

The focal point of this paper is to find empirically the answer of the question, how the welfare effects of a regional trade agreement (RTA) depend on the trade creation and the trade diversion generated. Many economists have been interested in estimating these two effects and finding whether Regional Trade Agreements (RTAs) enhance welfare or not. In this paper we use a gravity model to analyze the effect of the regional trade agreements on the trade of both members and non-members of the RTAs in the Western Hemisphere that consists of the continents of North America and South America with their associated islands and regions.

Regional trade agreements (RTAs) at the closing of the twentieth century became almost a craze in the sedate world of economics, springing up here, there and everywhere. World Trade Organization\(^1\) notified 34 new RTAs between 1990 and 1994, it doubled and reached to 68 between 1995 and 2001, another 100 new RTAs formed from 2001 to 2005. Today, every country on earth belongs to at least one RTA and this impressive trend raises many questions of economic interest: to what extent are these RTAs carefully crafted projects that systematically advance the interests of their member states?

The empirical work estimating these effects is particularly important since the theoretical work suggests that regional agreements may be beneficial or harmful depending on the particular countries involved and the extent of the trade creation relative to the trade diversion (Panagariya, 2000). As Burfisher et al. (2001) put it, “whether or not a regional trade agreement benefits its members will depend on parameter values and initial economic structure — it is essentially an empirical issue that must be settled by data analysis.”

*Trade creation (TC)* occurs when the introduction of an RTA allows supply from a more efficient producer of the product. In contrast, *trade diversion (TD)* means that a RTA diverts trade, away from a more efficient supplier outside the RTA, towards a less efficient supplier within the RTA. As the introduction of an RTA will generally have both ‘trade creation’ and

\(^1\) GATT is restructured to WTO in 1994.
‘trade diversion’ effects, it is the net affect that needs to be assessed when deciding whether an RTA hinders or enhances welfare.

A Regional Trade Agreement has two types of effect on welfare called static effects and dynamic effects. Trade, by taking advantage of differences in factor endowments, larger markets and the availability of new technologies generates gains from pure arbitrage, economies of scale and more sophisticated product differentiation and extended innovations as explained in traditional trade models. Higher production efficiency brought about by enhanced competition, decreased average production costs due to economies of scale in larger markets, higher international investment, resulting from an increase in investment opportunities, enhanced technological change resulting from increased competition, all these dynamic effects change the welfare trajectory.

In line with most of the literature written on Regional Trade Agreements we also in this paper study the impact of Multilateral Regional Agreements in Western Hemisphere. The trade data of almost all the countries of Western Hampshire is empirically tested to measure the trade diversion and trade creation in the region collectively called Americas. The Americas cover 8.3% of the Earth's total surface area (28.4% of its land area) and contain about 14% of the human population (about 900 million people).

Probably the most successful empirical trade device of the last twenty-five years is the gravity equation and in this paper we also used this most common empirical tool to estimate the effects of RTAs. A gravity model involves a regression of trade on a series of explanatory variables, then using dummy variables to ascertain whether the trade is affected by the existence of RTAs.

We proceed as follows: First section introduces the topic and objectives of the paper. Second section gives literature review on the subject matter. Third section describes the nature and the history of RTAs in the Western Hemisphere, while section four elucidate the empirical framework and data including the model, the methodology and the results of the empirical analysis and finally the fifth section concludes the paper.
2. Literature Review

Jacob Viner (1950) is the starting point for the modern economic analysis of trading blocs. This seminal work described how the welfare effects of a regional trade agreement (RTA) depend on the trade creation and the trade diversion. Johnson (1960) developed a partial equilibrium diagram that explains the economic effects of ‘trade diversion’ and ‘trade creation’ impact of an RTA and sum up its several effects in markets where trade is diverted, countries may be better or worse off.

Tinbergen (1962) provides initial specifications for the gravity model and uses it to look at the determinants of the trade flows, while Aitken (1973) was one of the first applying this approach to analyze the RTAs. We can divide the existing studies estimating changes in trade patterns due to regionalism in two distinct ways. The one is ex-post studies which examine trade flows after the RTA has been implemented and compare the actual levels of trade with a prediction of trade in the absence of the RTA and the other is ex-ante studies using trade patterns and estimated elasticities or computable general equilibrium models prior to the agreement to calculate the predicted effect of eliminating trade barriers with a partner country. Ex-ante and ex-post, the both methods as currently implemented, however, are subject to criticism. Wonnacott and Lutz (1989) and Krugman (1991) have proposed a “natural trading partner” hypothesis according to which the countries will tend to form the regional agreements if they have already significant bilateral trade, and that such agreements are likely to be trade creating. An extreme case of the Krugman hypothesis even ignores the impact of RTAs and explains the entire tendency in trade volumes by the trade costs and the historical ties.

Bayoumi and Eichengreen (1997) and Frankel (1997), both of whom examined the effect of RTAs on non-members as well as members and try to separate the ‘trade creation’ and ‘trade diversion’ effects of RTAs. Low (2003) discusses some of the practical issues relating to RTAs and particular relevance to APEC and ASEAN.

Magee (2003) employs simultaneous equations model to demonstrate empirically that higher mutual trade flows do boost the probability that countries will form free trade agreements. Therefore, the coefficients on RTA dummy variables are capturing more than just the effects of
the agreement; they also include the possibility that high levels of intra-bloc trade may not be due
to the formation of preferential trading arrangements but rather to historical or political
relationships between bloc members. Bayoumi and Eichengreen (1995) made an effort to deal
with this criticism by running the gravity model in first differences so that unobserved country
pair characteristics that are constant over time will drop out. This methodology will not control
for time-varying omitted variables.

The estimates of gravity model calculating the RTA effects are also sensitive to the sample of
countries chosen for the analysis. Haveman and Hummels (1998) demonstrate that changing the
country sample results with a different prediction of trade in the absence of the RTA, and thus the
estimates of RTA effects vary considerably in their conclusions. Pomfret (1997) also mentions a
number of incredible results in studies using the gravity model to measure the trade effects of
RTAs and concludes the inadequacy in this approach. More recently, Ghosh and Yamarik
(2004) make a case that the gravity model results are very sensitive to the variables included in
the regressions and to the prior beliefs of the researchers. They find a remarkable drop in the
number of regional agreements that are trade creating when they incorporate the researcher's prior
beliefs into the estimation.

In the light of these researches we estimate the effect of regional agreements on trade flows after
controlling for country pair characteristics and time dummies. This estimation technique is
similar in principle to the ex-post studies described above in that the method is to compare
existing levels of trade under an RTA to a hypothesized counterfactual level of trade in the
absence of the RTA. The predicted counterfactual used in this paper, however, eliminates many
of the criticisms of gravity model studies. First, the estimation includes a dyad fixed effect that
controls for unobserved reasons why two countries may have historically had high levels of
bilateral trade. Thus, the method adopted in this paper solves the problem that countries forming
RTAs may have higher trade volumes even in the absence of the agreement. The use of dyad
fixed effects eliminates the need to choose which variables to include as controls of time
invariant characteristics in the regression, and thus it alleviates the criticism of Ghosh and
Yamarik (2004) that the researcher's prior beliefs are influencing the results presented. Finally,
year fixed effects are also included to capture the positive or negative shocks in world output by
adjusting the model for the inflation and the fluctuations in world dollar price to arrive at the real world growth. The models estimated in the paper also has a time dimension and captures the impact of RTAs in a long run while allowing regional agreements to have different impacts on trade flows over time.

3. Regional Trade Agreements in Americas

In the Western Hemisphere, the new wave of regionalism spread most visibly and, because of the involvement of the USA and Canada, it gained much reputation. Indeed this new wave of regionalism not only altered the regional economic relations on this continent, but the relative importance of regionalism on the overall world scenario as well. The competitive environment of this new regionalism and the current worldwide regional integration process has also changed the set out concepts of regional integration qualitatively. Usually, regional integration agreements had mostly been restricted to the formation of Free Trade Agreements (FTAs) and Custom Unions (CUs), in this manner it is basically an economic ventures. However, the modern integration concepts of the 1990s are most often targeted to become areas of deeper integration. This wave of regionalism has an objective to enforce the industries to be more competitive in international spectrum by having better integrated markets, so they involve a much higher political content than former agreements. Moreover, we can say that the new Regionalism is both political and economic. This is also particularly true for the American Regionalism, be it in the North (NAFTA) the South (MERCOSUR, The Andean Community, The Central America Common Market (CACM), CARICOM).

Brief about Regional Trade Agreements in Americas:

The Andean Community dates back to 1969, when five South American countries (Bolivia, Chile, Colombia, Ecuador and Peru) signed the Cartagena Agreement. The objective is to jointly improve their peoples’ standard of living through integration, economic and social cooperation. Chile withdrew from it in 1976 while Venezuela entered into this agreement in 1973 and quitted it in 2006. The policy or the model that dominated in the 70s was the “import substitution” or “closed model” that protected national industry by imposing high duties on products brought into the country. It was decided at a meeting held in (Ecuador) in 1989, to replace the model of closed
development with one of open development. Trade and the market became the driving forces and this was revealed in the adoption of a strategic design and a working plan in which trade occupied the central position. In 1993 the Andean countries eliminated tariffs on trade with member states, formed a free trade area. Trade of services was also liberalized, particularly the different modes of transportation.

**Caribbean Community and Common Market (CARICOM)** was the result of a 15 years effort to accomplish the regional integration which was initiated with the establishment of the British West Indies Federation in 1958. In 1962 the West Indies Federation came to an end with the beginning of what is now the Caribbean Community. In 1965, CARIFTA was established which worked as transition from the West Indies Federation to CARICOM and finally the Caribbean Community and Common Market (CARICOM) was established by the Treaty of Chaguaramas, which was signed by Barbados, Jamaica, Guyana and Trinidad & Tobago and came into effect on August 1, 1973. Later on, the other eight Caribbean territories joint CARICOM. The Bahamas became the 13th Member State of the Community on July 4, 1983, but not a member of the Common Market.

**Central American Common Market (CACM)** is an association established in 1960 by five Central American countries to facilitate regional economic development through free trade and economic integration. Guatemala, Honduras, El Salvador and Nicaragua are the founder members and latter on Costa Rica also joined in 1962. The CACM was formed to cater the need of member countries for attracting industrial capital and diversify their economies. Trade barriers between its member states were reduced, and between 1961 and 1968 trade among members increased to a figure seven times of its previous level. Regardless of growing discontent, the other members agreed to continue the CACM until Guatemala imposed many restrictions on regional trade in 1983 and ultimately because of internal political instability and violence in some member countries and mounting debt and protectionist pressures, the CACM suspended its activities in the mid-1980s and latter on the same organization was reorganized with the name of SICA in 1991.

**Latin American Integration Association (LAIA)** is a Latin American regional trade integration association. LAIA is a reorganization of the Latin American Free Trade Association (LAFTA)
which came into effect on January 2, 1962. LAIA has eleven member countries including Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, Venezuela and Uruguay. The main objective of LAIA is the establishment of a common market, in pursuit of the economic and the social development of the region. Montevideo Treaty signed in 1980, is an international legal framework that establishes and governs the Latin American Integration Association. LAIA brought many new and positive transformations to Latin America. With LAIA in place existing productive capacity could be used more fully to supply regional needs, industries could reduce costs as a result of potential economies through expanded output and regional specialization, and attraction to new investment occurred as a result of the regional market area.

MERCOSUR was founded in 1991 by the treaty of Asuncion among Argentina, Brazil, Paraguay and Uruguay, which was later on amended by the Treaty of Ouro Preto in 1994. Its main objective is to promote the free trade and the fluid movement of goods, people and currency. Bolivia, Chile, Colombia, Ecuador and Peru currently have associate member status. Venezuela became its member in 2006, but before becoming a full member its entry has to be ratified by the Paraguayan and the Brazilian parliaments. South Americans see MERCOSUR as tool to balance the activities of other global power such as NAFTA and European Union. The collapse of the Argentina economy in 2001 had an inverse effect on the effective development of MERCOSUR and also due to internal conflicts over trade policy, between Brazil and Argentina, Argentina and Uruguay, Paraguay and Brazil.

North American Free Trade (NAFTA) The implementation of North American Free Trade Agreement (NAFTA) started in 1994. NAFTA removed most barriers to trade and investment among the member countries United States, Canada and Mexico. In this respect all non-tariff barriers to agricultural trade between the United States and Mexico were eliminated and in addition, many tariffs were eliminated immediately, with others being phased out over periods of 5 to 15 years. U.S.-Canada Free Trade Agreement in 1989 was also incorporated into the NAFTA but limited to agricultural provisions. According to these provisions, all tariffs affecting agricultural trade between the United States and Canada, with a few exceptions for items covered by tariff-rate quotas, were removed in 1998. Mexico and Canada also reached a separate bilateral NAFTA agreement on market access for agricultural products. The Mexican-Canadian agreement eliminated most tariffs either immediately or over 5, 10 or 15 years, however the tariffs between the two countries affecting trade in dairy, poultry, eggs and sugar are maintained.
Trade Intensity for Regional Trade Agreements in Western Hemisphere:

Figure 1 shows the average of the intra-zone exportation volume over the total exportation volume of the zone for each five year interval. The indicator used is an adaptation of the trade intensity in order to measure the effect of the RTA for a group of country. The adjustment of the member countries’ internal trade with their world trade avoids possible mistakes in the interpretation due to the increase of the trade volume by a high growth rate of the region’s GDP (Frankel, 1997). The highest values of indicator, compared to the other five RTAs, are registered by NAFTA which is signed in 1994. On average, NAFTA countries made 40% of their total trade with each other in 2001-2005. Moreover, since it is implemented the trade intensity is increasing between its members. ANDEAN, CARICOM and CACM also show an upright trend during the period. LAIA seems volatile, while MERCOSUR countries experience a decrease for 2001-2005 after its formation in 1991. As mentioned by Siroën (2004), we observe the negative impact of the financial crisis in Argentine and Brazil on the integration process of MERCOSUR.

![Average Share of Intrazone Exportation in Total Exportation of the Zone](image)

Source: Direction of Trade Statistics of IMF.

However, there are several limits to this methodology. First, this indicator measures the impact of the RTA on the whole region. Yet, the importance of the RTA can change from member to member (Farouton, 1998). Second, it is very difficult to distinguish the effect of a general...
liberalization policy than a RTA, since both boost the trade with nearer countries (Siroën, 2004). Last, an increase in the world trade of the region can follow the increase of the intra-zone trade; as the sectors in the region become more productive with a competition oriented liberalization policy. Thus, in order to isolate the trade impact of these six RTAs we will use a gravity model in section 4.

4. Empirical framework and Data

Gravity Equation

Gravity equation is simply the assumption that the trade between two countries depends on their GDPs and geographic proximity of the two units. Regional economists and urban socialists used the name “gravity” as far back as 1946 (Zipf, 1946). However, the earliest application in international economics seems to be introduced with Tinbergen (1962). Evidently, the gravity model approach worked empirically well to explain the trade pattern in many cases and since, hopefully, lots of economists are working on the theoretical implications. The best known theoretical rationale of the gravity model is the approach made by Helpman and Krugman (1985) by introducing monopolistic competition in international trade models, which is since very popular in Economic Geography. While the ignorance of the localization in trade models is attributed to the insufficiency of Heckscher-Ohlin theory of comparative advantage, Deardorff (1995) succored by discovering how to derive the gravity model from HO model. Theoretical implications to the model made by Anderson and Van Wincoop (2003) showed that the trade between two regions depends on relative trade barriers, namely the bilateral trade barriers relative to the average trade barriers that both region face with all other partners. Baldwin and Taglioni (2006) enriched the theoretical model of Anderson and Van Wincoop (2003) by introducing the time variation of the multilateral resistance term in the model.

The basic model in multiplicative form can be written as follows:

\[ T_{ij} = \alpha_0 Y_i^{\alpha_1} Y_j^{\alpha_2} D_{ij}^{\alpha_3} \]

where \( T_{ij} \) is the trade flow from country \( i \) to country \( j \) and \( D_{ij} \) is the distance between the country pair \( ij \), or as considered in the theory all costs associated with doing a business at a distance. The
multiplicative form of the model indicates that a 1% increase of \( Y_i \) (GDP of country i) results in an increase of \( \alpha_1 \% \) in the exports of supplying country. This basic equation can be broadened to infer the effects of custom unions, exchange-rate mechanisms, international borders etc… by including dummies\(^2\) appropriate to the phenomena wanted to be explained in the model.

Most of the precedent applications of the model used the OLS estimator by log-linearization of the multiplicative form. Pooled or in cross-section, under the classical assumptions, OLS is an unbiased, consistent and efficient estimator. Nevertheless, as discussed in Santos Silva and Tenreyro (2006) the gravity model is violating the OLS estimator in some senses but most severely by the heteroscedasticity of the error term. Thus, the OLS estimations of parameters are not only inefficient, but also inconsistent.

In particular, the constant elasticity model in stochastic form can be written as follows\(^3\);

\[
Y_i = \exp(x_i \beta) + \varepsilon_i
\]  

where \( Y_i > 0 \) for a given value of \( x_i \) and \( E(\varepsilon_i | x) = 0 \) and \( x_i \) are the variables in logarithm. First problem, the trade data includes lots of zero values rendering the log-linearization impossible. Second and the worst is by log-linearization, the error terms turn to be correlated with explanatory variables. These both raise the inconsistency in the estimation.

The above equation can be found in the literature by the following form;

\[
Y_i = \exp (x_i \beta) \gamma_i
\]  

which is similar to the equation (1) with \( \gamma_i = 1 + \varepsilon_i / \exp (x_i \beta) \) and \( E(\gamma_i | x) = 1 \). This is the evidence for the heteroscedasticity of the error term; however the conditional expectation is

\(^2\) In the multiplicative form equation these dummies will be in exponential form. Thus, the equation is as follows:

\[
T_{ij} = \alpha_0 \gamma_1^{a_2} \gamma_2^{a_3} D_{ij}^{a_4} e^{a_5}
\]

\(^3\) These explanations are subject to the Santos Silva and Tenreyro (2006).
constant once considered $E(\varepsilon_i|x)=0$. But the gravity model estimated by OLS in log form is one step further;

$$\ln(y_i) = x_i\beta + \ln(y_i)$$

(3)

where $E(\ln(y_i)|x)$ depends on $x_i$ unless very specific conditions on the error term are held, since the expected value of the logarithm of a random variable depends both on its mean and on higher-order moments of its distribution. Brief, the log-linearization process drives inconsistent estimates due to the correlation between error term and explanatory variables. Santos Silva and Tenreyo (2006) give, as a solution, the usage of the pseudo-maximum likelihood estimator which is a consistent estimator basing on the multiplicative form of the model rather than the linearized one. Moreover, the information for the country pairs with no trade can be used in the estimation of the parameters by PPML\(^4\).

Aiming to examine the impact of trade agreements on bilateral trade volumes, our empirical analyses will be structured on this basic gravity model estimated by, both, OLS and PPML in order to compare the differences in results. However, in the light of the problems faced in the literature our model differs from this basic one in some senses. Next section will discuss the variables in model and how to render them more efficient by restructuring the gravity model.

**Data and Empirical Methods**

The trade flow data from *Direction of Trade Statistics* of the International Monetary Fund is used for this paper. It covers 38 countries in Western Hemisphere including Canada and USA (see *Appendix 1* for the list of the countries) for 20 years (1986-2005) counting for 28,120 data points. However, approximately 10% of the observations in bilateral trade volume is missing (25,197 zero or positive values left over). GDP of exporter and GDP of importer are taken from World Development Indicators (WDI) database in current dollars and in nominal terms. Bilateral distance is computed using the great circle algorithm of Andrew Gray (2001) calculating the

\(^4\) The usage of PPML estimator in gravity model is a common practice in the literature since Santos Silva & Tenreyo (2006). See Magee (2008), Duc & Lavallée & Siröen (2008), Siliverstovs & Schumacher (2008) for several applications.
shortest distance between two latitude-altitude combinations on the world sphere. In order to calculate the distance between two countries, we have generally used their capitals. Meanwhile, we substituted the major city to the capital when it seems to be the country’s economic center (see Appendix 1). The information for trade agreements are taken from WTO internet site for the year of the agreement and its member countries.

Working with a cross-section data raises some problems in evaluating the impact of the RTAs even it is very common in the literature. First of all, as mentioned by Frankel (1997) the time before and after that the agreement goes into effect has an impact over the extent of trade creation and trade diversion in the year considered by cross-section estimate. According to Magee (2008), the agreement has no cumulative impact after the 11th year of the implementation. Secondly, some trade agreements have a very few members and the cross-section data on one year gives a very little idea about its impact. Time dimension furnishes a big number of observations and so the information. Thirdly, which year to choose as the reference for the estimation is another question; especially in case of Americas the economic conjuncture is very volatile across the time.

For these purposes, we prefer to work with cross-section-time series data and believe on its advantages even it is sometimes difficult to manage with a huge data. However, one should be careful while working with time dimensions. Without allowing each year to have a separate constant term in the regression, the fluctuation in world dollar price can distort the estimates. Sure, one can always choose to use GDP in PPP as Boisso and Ferrantino (1993, 1996), but then suffers from the measurement errors of PPP as pointed out by Srinivasan (1995). Furthermore, the theoretical implications of the gravity model oblige to normalize the growth of countries by the real world growth. Thus, our first model is

\[
\ln(m_{ijt}) = \alpha_t + \beta_1 \ln(Y_{it}) + \beta_2 \ln(Y_{jt}) + \beta_3 \ln(D_{ij}) + \beta_4 GRTA_{ijt} + \epsilon_{ijt},
\]

(1)

5 For example, NAFTA has only three members which counts for 6 \((\binom{3}{2} \times 2)\) observations different than 0 in each year (1406 observations) after 1994.

where \( m_{ijt} \) is the exportation from country \( i \) to country \( j \) in year \( t \), \( D_{ij} \) is the bilateral distance, \( Y_{it} \) is the GDP level of the exporter country and \( Y_{jt} \) is the GDP level of the importer country. \( GRTA_{ijt} \) is a dummy variable which takes the value 1, if country \( i \) and country \( j \) are both the members of one of the RTAs discussed above, namely ANDEAN community, CARICOM, CACM, LAIA, MERCOSUR and NAFTA. These six basic RTAs cover the 30 countries of the region. However, as \( GRTA_{ijt} \) variable consists of country pairs in year \( t \) rather than the individual countries, only 24% of the observations are different than 0. A positive \( \beta_4 \) indicates that the bilateral trade volumes of member countries are higher than those of the countries outside the considered RTAs. \( \alpha_t \) is the time dummy aiming to adjust exporter and importer GDPs for exchange rate volatility and global shocks.

The very simple structure of the gravity equation with its limited number of explanatory variables obliges the one to question what could the model have left behind for the error term and the possible violations of the model due to the correlation problem. Thus, the distance variable or indeed the cost of trade at a distance deserves more attention. Linnemann (1966) defined three categories of costs associated with doing business at a distance: physical shipping cost, time-related costs and cultural unfamiliarity. To capture these different costs, the international economists proposed lots of solutions or in fact lots of dummies. Distance, to be landlocked or not, adjacency…etc. are some in the purpose of measuring physical costs or time-related costs while how to measure the unfamiliarity costs stay less evident. For instance, common language, colonial ties…etc. are a few of dummies introduced in the literature in order to capture the unfamiliarity.

However, it seems each time some characteristics included in the model some others left. As discussed in the literature review, predictions are very sensitive to the explanatory variables included in the model and to the country samples. According to Magee (2008), these characteristics are correlated with the RTA dummies. As mentioned in Haveman and Hummels (1998), “high levels of intra-bloc trade may be due not to the formation of preferential trading arrangements but rather to historical or political relationships between bloc members”. In order to solve the bias caused by possible omitted variables, our second model is as follows.
where $\alpha_t$ is always the time dummy and $\alpha_{ij}$ is dyad fixed effects. Dyad fixed effect dummy variable captures the dyad country pair characteristics which have an impact on bilateral trade flows and which are constant across the time. Since in this manner the trade volume is controlled for the historical and colonial ties along with other time invariant pair characteristics; the decision of joining a RTA is independent of the historically high bilateral trade values.

Two models mentioned above give us a better structured basis compared the very basic version of the gravity model. Nevertheless, they explain the impact of these six RTAs in the region in a limited way, indeed only on general terms and without considering their impact on the non-members. Thus, in the next model we will introduce a separate RTA dummy for each regional agreement. Yet, the impact of RTAs on the trade with non-member countries rest ambiguous. While increasing the bilateral trade between two members, RTAs can decrease the trade of a member with non-members which is called either as trade diversion (Magee, 2008) or as openness (Frankel, 1997) in literature. We prefer to use the trade diversion term, since it accents more the discrimination of non-members from trade flows.

Trading blocs can arise from an import-substitution philosophy which aims to find local markets for the products of low productivity sectors or on the contrary to enforce the regional competition and meanwhile raise the competitiveness of the local sectors. While the first is trade diverting by substituting the member markets than the non-members, the former expands the trade also with non-members. In order to capture separately the trade diversion and the trade creation effects of RTAs, our last model expands as follows,

\[
\ln(m_{ijt}) = \alpha_{ij} + \alpha_t + \beta_2 \ln(Y_{it}) + \beta_3 \ln(Y_{jt}) + \beta_4 GRTA_{ijt} + \varepsilon_{ijt},
\]

where $\alpha_t$ is always the time dummy and $\alpha_{ij}$ is dyad fixed effects. Dyad fixed effect dummy variable captures the dyad country pair characteristics which have an impact on bilateral trade flows and which are constant across the time. Since in this manner the trade volume is controlled for the historical and colonial ties along with other time invariant pair characteristics; the decision of joining a RTA is independent of the historically high bilateral trade values.
signed by the country $i$ or the country $j$ has similar impacts on the trade flows from the country $i$ to the country $j$. This assumption is completely parallel to the conclusions of Soloaga and Winters (1999) according to which the increasing propensities to export are accompanied by increasing propensities to import.

**Results:**

Table 1 presents the estimates of the trade impact of regionalism. The coefficients are estimated in PPML and OLS which furnish to the lecturer an empirical comparison of the methodologies found in the literature. The inferences are based on an Eicker-White (Eicker, 1963; White, 1980) robust covariance matrix estimator since both of the estimators cannot fully account for the heteroscedasticity (Santos Silva & Tenreyro, 2006).

First model in Table 1 gives the results for the estimation of the basic gravity model controlling for the distance and the time variant fluctuations. The role of geographical distance is negative in both estimation methods as expected; however it is larger under OLS. The size of the exporter economy has a positive impact and statistically higher than 1. This fact contradicts with the general assumption of “the big countries look less open”. The PPML seems more reasonable in this aspect and strengthen our methodological choice for the PPML against the OLS. In both, the importer country’s size has a less impact on trade compared to the exporter’s size, since the country becomes more self-sufficient with the increase of GDP. Lastly, to be a member of a RTA in the region increases the trade by 6 times according to OLS and positive but less accentuated under PPML with a value of 67%. Brief, the estimation with PPML seems more promising than to OLS in general terms. Thus, from now on we’ll interpret the estimations under PPML for policy implications. Still, the lecturer can find the results of OLS regressions in Table 1.

Model 2, different than Model 1, includes also the country pair fixed effects which forces us to drop the distance term. One can question at this point the difference of effectuating the regression by including the country pair dummies than to regress a fixed effect model since both controls for the time invariant characteristics of the country pair, namely the distance, the historical ties, common border, common language, etc… Indeed, we assume that the trade impact of the dyad
**TABLE 1: Regression Results**

<table>
<thead>
<tr>
<th>Model</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
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<tr>
<td></td>
<td>OLS $\ln (m_{ij})$</td>
<td>PPML $m_{ij}$</td>
<td>OLS $\ln (m_{ij})$</td>
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<td>Estimator</td>
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<td>2.874*** (.042)</td>
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<td>2.381*** (.101)</td>
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<td>2.789*** (.070)</td>
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<td>-.041 (.066)</td>
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<tr>
<td>CARICOM-td</td>
<td>-.051 (.044)</td>
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<td>.049 (.043)</td>
</tr>
<tr>
<td>CACM-td</td>
<td>.141*** (.046)</td>
<td></td>
<td>.115*** (.039)</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>-1.287*** (.060)</td>
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<tr>
<td>MERCOSUR-td</td>
<td></td>
<td></td>
<td>-1.264*** (.058)</td>
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<tr>
<td>NAFTA-td</td>
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<td>.129*** (.057)</td>
</tr>
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<tr>
<td>Dyad-fixed effects</td>
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<td>18523</td>
</tr>
<tr>
<td>$R^2_{li}$</td>
<td>.6526</td>
<td>.8097</td>
<td>.5643</td>
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</table>

All inferences are based on an Eicker-White robust covariance matrix estimator.

In case of the models estimated by PPML, $R^2$ are pseudo $R^2$.

* The coefficient is significant at 10%.

** The coefficient is significant at 5%.

*** The coefficient is significant at 1%.
fixed effects is symmetric. Thus, instead of having a dummy for each panel observation, the model is regressed over the country pair dummies\(^7\).

Second column for Model 2 shows the results under PPML controlling for dyad fixed effects. The impact of the exporter and importer GDP is always smaller than 1 and statistically significant in 1%, however less accentuated. Being a member of a RTA in the region which is measured for the six basic RTAs of Western Hemisphere has a greater impact over trade once the country pair characteristics are included. This is a contradictory result to what is expected in the literature, since it is generally discussed that RTA dummies are capturing more than just the impact of the agreement but also the historical and political ties and seem more influential. These results are also contradictory to what is registered by Magee (2008) and needs further attention.

Our first two regression models showed that an extreme Krugman hypothesis is not the only explanation of the trade volumes in the region. The membership to a RTA is significantly different than 0 at 1% level and positive. In particular, our set of RTAs including NAFTA, MERCOSUR, ANDEAN Community, CARICOM, CACM and LAIA increased the trade of the member countries between each other and are highly efficient as they trade approximately 2.5 times more than the non-members (Model 2 under PPML, \(e^{0.960} = 2.61\)). This result gives a general idea for the efficiency of the trade agreements in the region after controlling for the tight historical and the linguistic ties very specific to the Western Hemisphere. Nevertheless, the measurement of the trade creation and diversion obliges a more detailed analysis.

In Model 3, the individual impacts of the each RTA on the trade volume of member and non-member countries are calculated separately. All the coefficients on the trade creation variables are significant and positive except NAFTA and LAIA under PPML. For NAFTA, similar results can be found in the literature\(^8\). Since the number of member countries to NAFTA is very limited, the regression suffers from the lack of information and it seems difficult to conclude with. In case of LAIA, its internal trade passed through a marked rise in the 90s (Foroutan, 1998). However, lots of the member countries of LAIA belong also to the other sub-groupings (ANDEAN, CARICOM, MERCOSUR).

---

\(^7\) In a fixed effect model, country pair \(ij\) and \(ji\) are considered as two different panel observations and indexes two different characteristic sets. Nevertheless, in a gravity model the characteristics of \(ij\) are completely same as the characteristics of \(ji\).

MERCOSUR) whose formation and/or revival coincide with 90s. Our regression shows that the increase of the trade volume of LAIA in 90s is attributable to these sub-groups instead of a success of the LAIA and LAIA has no positive effect on member’s internal trade with each other. At the same time, ANDEAN has a positive impact of 171% on the trade volumes of the members and MERCOSUR increased the internal trade by 3.6 times. The trade impact of CARICOM and CACM is also highly significant.

On the other side, the trade diversion effects of the mentioned RTAs are various. The coefficient of NAFTA is significant and negative. LAIA has a negative impact on the trade with non-member countries, once considered that it does not create trade between the members, its overall trade impact is negative. MERCOSUR also seems to be trade diverting with a value of -48%. Contrarily, ANDEAN and CACM are not only increasing the trade between members but also with non-member countries. These two agreements and trade liberalization policy of member countries create more competitive industries at international level.

5. Conclusion

The endeavor of this article was to judge the influence of Regional Trade Agreements (RTAs) on trade flows. We used a pooled data analysis with Poisson Pseudo-Maximum Likelihood (PPML) estimator in order to correct the heteroscedasticity and deal with zero values which create the bias in OLS estimations of log-linear gravity models.

Regional Trade Agreements (RTAs) have complex consequences on trade flows and it is also difficult to frame an appropriate empirical methodology for measuring effectively the trade creation and trade diversion. The estimates in our paper progress as in preceding studies by using fixed effects to account for the historical ties and for aggregate shocks to countries’ trade. Dummies for dyad fixed effects controls for all of the variables normally used in gravity models and many others unnoticed variables and it eliminates the difficulties in choice of the hypothesized variables that should be included in the model. Another objective of using the fixed effects is to solve the over valorization of the RTA impact on trade due to the fact that country pairs trading more than normal pattern are more likely to sign regional trade deals. However, the
results presented in this paper contrarily to the literature show that adding the fixed effects increased the estimated impacts of regional agreements on trade and the time invariant country pair characteristics are decreasing the trade volumes in case of Western Hemisphere.

The regression estimates for the effects of the different RTAs varied remarkably. All RTAs were found to foster greater trade and so were welfare enhancing except LAIA and NAFTA. While LAIA, NAFTA and MERCOSUR show a significant trade diversion effect, ANDEAN and CACM have a positive significant trade diversion coefficient which gives us the indication that these RTAs are not only helping in boosting the trade within the region but also contributing the overall world trade. This enhancement of world trade through a better oriented RTA policy can be a forward step for the globalization.
References


APPENDIX 1: List of Countries

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<tr>
<th>Name of the Country</th>
<th>Capital</th>
<th>Commercial Center</th>
<th>Coordinates</th>
</tr>
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<td>Oranjestad</td>
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