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A Quantitative Approach Using the Gravity Equation

Ximena Clark and José Tavares

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A Quantitative Approach Using the Gravity Equation

Ximena Clark and José Tavares

Abstract

The gravity approach to the study of bilateral trade flows has been remarkably successful empirically, postulating that bilateral trade flows are positively related to importer and exporter countries' economic sizes and negatively related to geographical distance. We investigate whether Central America is different as far as the standard gravity framework goes and evidence that its exports are more sensitive to importer countries' GDP per capita. Moreover, Central America trades less with countries which share the same language. We find robust evidence that the Central American Common Market has very strong trade creation effects and the region trades more with the European Union, EFTA and NAFTA and less with MERCOSUR and East Asia than otherwise predicted by the gravity framework. When Central America becomes more competitive relative to Mexico, it exports more to the United States, this effect being statistically and economically significant for Food Products and for Manufactures. As for exchange rate volatility, it has a negative and significant effect on the volume of Total, Food and Manufactures exports. U.S. import duties also affect negatively the region's exports to the U.S.

Keywords: Central America, gravity approach, trade creation, trade diversion

JEL Codes: F10, F14, F15, O54

Ximena Clark is a Researcher for the Harvard Institute for International Development and the Department of Economics at Harvard University.

Jose Tavares, Ph.D. is a Development Associate at the Harvard Institute for International Development (HIID).

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I. INTRODUCTION

In this paper we apply the gravity approach to the study of international trade to the analysis of Central America's exports. The gravity approach uses a series of standard variables referring to the importer and exporter characteristics, such as GNP, per capita GNP and geographical distance, to predict bilateral trade flows. The objective of this paper is to use the very robust empirical results available in the literature as a benchmark with which to compare results for Central America.

There are four main issues addressed in this paper. First, is there evidence of a distinct behavior for Central America in what regards the typical gravity variables? The answer is yes and the distance and importer's per capita GNP variables are those for which Central America is distinct.

Second, what is the magnitude of trade creation for the different trade areas (including the Central American Common Market) and what is the magnitude of trade diversion, particularly with respect to Central America? We find that the Central American common market has particularly strong trade creation effects, the strongest for the sample of trade areas. We also find evidence that Central America trade with the European Union (EU) and the European Free Trade Association (EFTA) is higher than predicted by the gravity model. On the other hand, Central America trades with East Asia, South America and Mexico less than otherwise predicted by the model.

Third, what are the effects of the level and volatility of the exchange rate on the volume of Central American exports, namely in the important Food and Manufactures sectors? In particular, we analyze the impact of the changing competitiveness of Central America with respect to Mexico before and after the North American Free Trade Agreement. We find that the level of the exchange rate has the predicted effect that an increase in Mexico's competitiveness leads to lower Central American exports. This effect is present for the two sectors and is strongest for manufactures. We also find evidence that, after NAFTA ratification, both Central American exports to the U.S. became more sensitive to losses in competitiveness. Volatility has the expected negative effect on Central American export volume, present for total exports but stronger for food and manufactures exports, and its effect has become more pronounced since NAFTA

ratification. Finally, we check whether import charges applied by the U.S. to Central American exports (relative to U.S. charges on Mexican exports) affect the level of exports. The answer is positive for total exports and for food exports.

The paper is organized as follows. Section II presents an overview of the theoretical background and empirical applications of the gravity equation literature. Section III applies the empirical framework to characterize the determinants of Central American exports to the various trade areas and compare them with results for other countries. Section IV addresses the impact of exchange rate level and variability on Central American exports and Section V concludes.

II. THE GRAVITY APPROACH

The gravity approach to the study of bilateral trade postulates that bilateral trade flows are positively related to the importer and exporter countries economic size as measured by Gross Domestic Product¹ and negatively related to resistance factors such as geographical distance and divergent cultural characteristics. The name gravity derives from an analogy to the law of gravity in physics where two bodies are more attracted the larger their masses and the smaller the distance between them. In economics, the idea is similar to that the higher the volume of transactions in an economy, as measured by its product, the more likely it is that some are transactions across borders. Other factors, such as the existence of a more diversified production base, can also lead to more cross-border transactions. The fact that larger bilateral distance is associated with less trade is intuitive, however several different mechanisms may be at its root. Countries that are further apart may trade less because transport costs are higher or because distance is related to other trade resistance factors. In gravity studies, it has become standard to introduce dummies for common language and common land border in order to account for these additional trade enhancing factors. In such a way the distance variable will capture more precisely the effect of transport costs on trade volume.

¹ Or Gross National Product.

A. An Overview of the Theory

In this section, we will review the literature on the theory behind the gravity equation. It will become evident that the problem is not lack of theoretical foundations but rather the contrary: most current models of international trade deliver empirical predictions that can be summarized by the gravity relationship.

The gravity equation appeared first as an empirical endeavor in Tinbergen (1962) and the justification for the chosen specification was based on intuition only. More important theoretical efforts were undertaken by Anderson (1979) and Bergstrand (1985), who used product differentiation models where differentiation took place by country of origin². Given this early work which derived the gravity equation from monopolistic competition models, Helpman (1987) used gravity variables to test for the validity of monopolistic competition in a cross-section of industrialized countries. Helpman interpreted the significance of the gravity variables as supportive of the trade theories that relied on monopolistic competition models and against models that did not have such features, such as the Heckscher-Ohlin factor proportions model³. Hummels and Levinshon (1995) then applied the same test to a sample of developing countries where monopolistic competition is unlikely to describe the market setting and found that gravity variables were again relevant, raising the possibility that gravity features were not particular to a unique set of models.

The object of study in the Heckscher-Ohlin trade model is the direction of trade flows, not their volume. Heckscher-Ohlin is examined for its implications on net trade, say, the exchange of factors of production obtained through trade in goods. As Deardorff (1995) points out, gross trade flows can be much larger than net trade flows if producers and consumers are indifferent between different markets. In this case, when consumers are indifferent between buying from national or foreign sources, i.e. the goods are homogeneous, the volume of trade is indeterminate. If consumers are not indifferent and there is a “home bias” that makes them prefer to buy from national sources, then further questions arise what is of the root at this bias -be it transport costs, cultural affinity or

² This is the so-called Armington assumption

³ Deardorff (1984), in an article in the *Handbook of International Economics* concluded for the incompatibility between the empirical output of gravity studies and the Heckscher-Ohlin model.

other- should also determine what other countries consumers buy from. Moreover, it is total trade and not bilateral trade that is determined in the Heckscher-Ohlin model.

Deardorff (1995) derives bilateral trade equations from two Heckscher-Ohlin type of models where country factor proportions determine trade flows. If countries produce homogeneous goods and there are no impediments to trade of any kind, then producers and consumers will be indifferent among trading partners. Hence, the volume of trade -as mentioned above- will be indeterminate. However, a way to have a sense of the "average" outcome is to assume that this indifference on "who to buy from" is resolved randomly. In this case, the bilateral volume of trade can be described by a simple gravity equation where trade is related only to importer and exporter countries incomes⁴. The author then turns to the case of impeded trade, where there are transport costs for every good, and where he assumes that each country produces (and thus exports) a particular good⁵. In this case bilateral trade can be shown to depend on each partner's GDP. In addition, he shows that if preferences are CES then bilateral trade flows decrease with transport costs.

Helpman and Krugman (1985) have shown that, in models with increasing returns to scale, one can derive a gravity equation under very general conditions. Their model has two countries and two goods, which come in many different but symmetric varieties. With identical increasing returns production functions, each country will produce a particular variety and bilateral trade flows will be proportional to the product of the countries Gross Domestic Product. This gravity relationship is present whenever there is perfect product specialization, consumers in all countries have identical homothetic preferences and face the same prices for internationally traded goods.

Evennet and Keller (1997) reaffirm Deardorff (1995) and Helpman and Krugman (1985) results for perfect specialization and also derive gravity-type equations for the cases of imperfect product specialization. They show that when some goods are produced under increasing returns to scale and others under constant returns to scale, as

⁴ Deardorff works out the cases where preferences are identical and homothetic and diverse preferences where each country can spend a different share of its income in a specific good. In the latter case, bilateral trade volume is explained by the gravity relationship above plus a correction that has to do with the shares of total consumption and total production that the importer and exporter countries are responsible for.

the share of the latter decreases the level of bilateral trade increases. More interestingly, even when both goods are produced under constant returns to scale, bilateral trade can be given by a gravity equation where the volume of trade is larger the further apart the two countries factor endowments are⁶.

In conclusion, the literature has found justification for a gravity type of equation in a variety of models. As a result, this empirical framework may not be the most appropriate for deciding on the validity of different theories of trade. However, given its considerable predictive power, what the gravity equation can be used for is the study of additional determinants of trade. We turn now to a review of the issues that have been studied in the context of the gravity framework.

B. A Review of the Empirical Literature

The gravity approach has been used in different ways as a mean of understanding the determinants of international trade. In this section we illustrate the applications of the gravity framework by reviewing some of the empirical studies that have addressed relevant issues .

The Effects of Trade Agreements

One of the questions that is better suited for study through the gravity approach is the extent to which trade agreements affect trade flows. Using indicators of the status of each country in relation to a specific trade agreement, we can obtain estimates of trade creation (when both countries are part of the agreement) and trade diversion (when one

⁵ So his results are also valid for Heckscher-Ohlin model with complete specialization, a Ricardian model with specialization or a monopolistic competition model, which departs from the assumption of specialization

⁶ In sum, the objective of their paper is to find out which element is responsible for the empirical success of the gravity estimates. To the extent that production is specialized, they find it to be due to increasing returns, which they find evidence for among developed economies. To the extent that production is not perfectly specialized, both increasing returns and factor abundance play a role in explaining the success of the simple gravity equation.

country is and the other is not part of the trade agreement)⁷. Empirical studies using this technique tend to find a substantial effect of trade agreements on a member's volume of bilateral trade⁸.

Bayoumi and Eichengreen (1995) find that the EEC and EFTA free trade areas are responsible for an increase in trade volume that cannot be attributed to the member countries economic characteristics. Since they use a difference version of the gravity equation, they are able to exclude the influence of unchanged unobservables (such as a history of intimate trade relations) as the explanation of their results.

Frankel et al (1993) find evidence in favor of the existence of three trading blocs (Americas, Europe and Eastern Asia) since intra regional trade exceeds what can be explained by the usual gravity variables. Using a model of monopolistic competition with tariffs and transportation costs, they show that if barriers to trade are low -say between 10 and 20% of value- continental free trade agreements can reduce welfare⁹. Wei and Frankel (1995) depart from the acknowledgement that trade arrangements are being formed in different parts of the world and attempt to evaluate whether these trade blocs are trade-reducing by hurting trade with countries outside the bloc¹⁰. The authors use 1970-1992 bilateral trade data to examine the existence of trade diversion in several areas of the world. They find that both East Asia and Western Europe were quite open at the beginning of the sample but while East Asia trade with countries outside the region increased over time, the opposite happened in the case of Western Europe.

In one of the few papers using the gravity framework where the Central American Common Market is explicitly studied, Brada and Mendez (1985) attempt to quantify the

⁷ Specifically, trade creation and diversion can be estimated respectively by using dummy variables that take the value 1 when both countries belong to the trade agreement (and zero otherwise) and dummy variables that are 1 when one country does and the other does not belong to the trade agreement.

⁸ Eichengreen and Irwin (1996) argue that the measurement of the effects of trade agreements in such a way suffers from omitted variable bias. The idea is that there are country characteristics having to do with history that explain both the high propensity to trade of such countries and the emergence of the trade agreement. In other words, the authors argue that past trade flows lead to trade arrangements today and find evidence consistent with this assumption in the period 1949-1964.

⁹ These agreements are thus dubbed "super natural".

¹⁰ The guide to this exercise is the elusive concept of open regionalism. Kemp and Wan (1976) have showed that regional blocs can be formed in a way that always represents a Pareto improvement and MacMillan (1993) indicated that GATT adopted as a rule that new trade arrangements do not decrease the volume of trade with non-members. Both of these can be seen as manifestations of the idea of open regionalism.

increase in volume of trade due to various trade agreements¹¹ in the years 1970, 1973 and 1976. They separate trade creation effects into an “environment effect”, measuring how average distance and average per capita GDP contribute to trade creation, and a “policy effect”, measuring the relative effectiveness of the trade agreement in creating trade. Interestingly, the Central American Common Market (CACM) stands out, for two different reasons. First, the trade creation effects due to environment effects are of the same order of magnitude as those of the EEC and EFTA and larger than those of the Andean Pact and the Latin American Free Trade Association. This is due to the short average distance between Central American economies, the shortest in the sample of trade pacts. This short distance compensates for the fact that Central American countries have relatively low per capita GDP, which does not favor trade. Secondly, trade creation due to policy factors is higher for the CACM than for any other trade area. This may be interpreted as evidence that policies that favor free trade among countries are likely to have large effect in Central America.

Home Bias

The question of whether goods produced in a particular country enjoy a special preference by consumers of that country is very prevalent in discussions of international trade. Several reasons have been advanced as possible causes of home bias, such as transports costs, habit formation and the existence of national networks that facilitate transaction¹². However, until recently, very few papers had tested for the existence and estimated the magnitude of the phenomenon. The wealth of information involved in bilateral trade flows allowed researchers to make new progress. McCallum (1995) used province-level data for Canada and state-level data for the United States to show that Canadian provinces are twenty times as likely to trade between themselves than with U.S.states, after controlling for distance and economic size. Wei (1996) studies home

¹¹ The other trade agreements studied are the EEC, EFTA and the Andean Pact.

¹² Helliwell (1996) finds that international migration rather than inter-provincial migration, is likely to have a positive effect on the volume of trade. This can be seen as evidence that networks are indeed national in nature.

bias in the goods market using a sample of OECD countries. He finds a significant home bias in that OECD countries trade ten times as much with themselves than with other countries, after distance and size have been taken into account, which is half the estimate of home bias in McCallum (1995). Wei also finds that the extent of home bias is decreasing over time.

Exchange Rates

A possible and appealing determinant of bilateral trade flows is exchange rate uncertainty. The higher the variability of the exchange rate between two countries, the higher the risk involved in transactions across borders and thus, for given expected gains from trade, the lower the volume of trade. In fact, this is the most commonly cited rationale in favor of European Monetary Union and the adoption of a single currency by European countries. In sharp contrast to the view held by most policy-makers, the academic view is that there is no strong evidence that trade flows are affected by exchange rate uncertainty. Papers as Thursby and Thursby (1987) have addressed this issue in the context of the gravity equation and found mixed results: exchange rate variability affects negatively the volume of bilateral trade for 10 of 17 industrial countries, for the period between 1974 and 1982. On the other hand, in his attempt at explaining the home-bias, Wei (1996) enters the direct exchange rate volatility between the two trading countries to find that it does not significantly affect trade flows¹³.

Gravity and Politics

Very little has been done on the effect of political variables on bilateral trade. One example of such work is Summary (1989) who studies U.S. bilateral exports and imports in 1978 and 1982 through a gravity model. The author finds that, in addition to the usual

¹³ The author also controls for the average exchange volatility of importer and exporter and finds them to be statistically insignificant.

gravity variables, proxies for political closeness to the United States and information flows between the U.S. and each country are significant in explaining trade flows¹⁴. In turn, an index of political rights, indicating how democratic a country is, does not have a significant effect on that country's trade (exports or imports) with the United States.

III. EMPIRICS

In this section we will implement a gravity study of bilateral trade with the specific purpose of isolating the major determinants of Central American exports. Thus, the dependent variable used will be bilateral exports. The independent variable set includes the product of importer and exporter population and the product of their per capita GNP, which can be directly interpreted as a size and an income per capita effect respectively¹⁵. We also include the distance between countries, approximated as the distance between their capitals since these tend to be the economic center of the countries¹⁶. The distance variable represents the effect of transportation costs on trade, where the notion of transportation costs must be understood in a wide sense; that is, not only including physical transport cost but also costs of communications. Two additional independent variables, Border and Language, take the value of 1 if the countries share a common land border or an official language respectively¹⁷. In addition, when addressing issues related to regionalism, we also include dummy variables for trade blocs.

¹⁴ The arms sales by NATO members to the country are seen as indicating the country is a political ally of the United States. The amount of information flows between a particular country and the United States is proxied by variables such as the number of civilian employees in the local U.S. embassy.

¹⁵ An alternative specification includes the products of GNPs, which represent the size effect instead of population, and per capita GNPs.

¹⁶ In the case of the United States, the distance to Chicago is used instead of the distance to Washington DC. Chicago is the geographical middle of the most economically powerful regions of the United States: the Northeast, California and the Midwest itself.

¹⁷ It might be remarked that distance, border and language are highly correlated leading the specification to suffer from multicollinearity. The simple coefficients of correlation between the logarithm of distance and border and language are -0.42 and -0.15 , respectively, while the one between border and language is 0.18 . The signs are as expected but the size of the coefficient of correlation is relatively small. For this reason, and in order to have a better approximation of the effect of distance on trade, we include all three variables on the estimations.

Thus, a basic form for the gravity equation is:

$$X_{ij} = \alpha(\text{POP}_i \text{POP}_j)^\beta (\text{PGNP}_i \text{PGNP}_j)^\delta (\text{DIST})^\gamma \exp(\eta \text{BORD} + \lambda \text{LANG} + \mu \text{BLOCS} + \varepsilon)$$

The dependent variable X_{ij} denotes bilateral exports from country i to country j , PGNP denotes per capita GNP, DIST refers to the distance between countries i and j , BORD takes the value of one if countries are adjacent and zero otherwise, LANG takes the value of one if countries share the same language and zero otherwise. BLOCS is a vector including dummies for regional blocs, each of these taking the value of one if countries belong to the corresponding regional bloc and zero otherwise.

Given that the dependent variable is bounded below by zero - and many observations achieve this bound- we estimate this gravity equation using Tobit procedure instead of OLS. Following Eaton and Tamura (1994), we assume that for the dependent variable, the logarithm of $(\square + X_{ij})$ is linear homogeneous on the logarithms of the explanatory variables (the right-hand side of the above equation), where \square is a parameter to be estimated. Thus, a positive parameter \square means that the right-hand side of the above equation must achieve a minimum threshold value before strictly positive values of X_{ij} occur. Hence, from now on we call \square the threshold value. The actual equation to be estimated is:

$$X_{ij} = \max\{-\square + \alpha(\text{POP}_i \text{POP}_j)^\beta (\text{PGNP}_i \text{PGNP}_j)^\delta (\text{DIST})^\gamma \exp(\eta \text{BORD} + \lambda \text{LANG} + \mu \text{BLOCS} + \varepsilon), 0\}$$

Rearranging and taking natural logarithms, this equation becomes as follows:

$$\ln(X_{ij} + \square) = \max\{\ln\alpha + \beta \ln(\text{POP}_i \text{POP}_j) + \delta \ln(\text{PGNP}_i \text{PGNP}_j) + \gamma \ln(\text{DIST}) + \eta \text{BORD} + \lambda \text{LANG} + \mu \text{BLOCS} + \varepsilon, \ln \square\}$$

This final equation has to be estimated by maximum likelihood, where the likelihood function is constructed using the Tobit procedure¹⁸. This method of estimation, different from what is usually employed, has the advantage that avoids bias in the estimates by taking into account the large sub-sample of observations that are zero due to the fact that many pairs of countries do not trade among themselves.

We use a sample of 68 countries that are responsible for an overwhelming fraction of world trade flows¹⁹. The years for which trade flows are measured are 1970, 1980, 1990 and 1995²⁰. The sources for bilateral exports are Wei (1995) and Directions of Trade Statistics (FMI), while for the others variables the source is International Monetary Fund (FMI)²¹.

A. The General Gravity Equation

Determinants of Trade

Table I presents the results for the general gravity equation, where the rows display coefficient estimates and the corresponding standard errors. Equation 1 in the first column shows all coefficients to be highly significant and of the expected sign. The larger the size of the exporter and importer countries and the higher their per capita GNP, the more they trade. It must be noted that given the existence of the threshold value, which is positive and significant at 1% level, the coefficients of population and per capita GNP converge only asymptotically to the size and per capita income elasticity respectively. For this reason, we prefer to call these coefficients as size and income effects²². The value of the coefficients tells us that the size effect is 0.856. An increase of one percent of the product of per capita GNP, on the other hand, leads to an increase in

¹⁸ For more details about the procedure as applied to the gravity framework, see Eaton and Tamura (1994).

¹⁹ There are 63 countries in Wei (1995), to which we add the five Central American countries of interest in this study: Costa Rica, El Salvador, Guatemala, Nicaragua and Honduras.

²⁰ Wei (1995) had used trade data for 1992 instead of 1995 as here.

²¹ Except for the distance variable, which correspond to the Great Circle Distance and is taken from Wei (1995) and from an on-line service.

²² The estimated elasticity, evaluated at the mean value, can be found by multiplying the coefficient estimates by $(X+\Phi)/X$, where X denotes the dependent variable mean and Φ the threshold value.

bilateral exports that is slightly above one percent. In the same column, we can see the distance effect to be minus one²³, while border and language have positive and significant coefficients of similar size (around 0.6). Since the latter are dummy variables, their coefficient are interpreted as indicative that countries which share either border or language export other things being equal 1.85 and 1.78 times [equal to $\exp(0.619)$ and $\exp(0.587)$ respectively] what otherwise similar countries do. The impact of these variables on trade is close to but larger than those obtained in Wei (1995). The difference seems to stem from the different estimation methods, in particular the fact that the Tobit method corrects for coefficient bias by taking into account the high number of bilateral exports that are 0. An additional difference with respect to Wei (1995) is that we use exports instead of exports plus imports. This will allow us to differentiate between the size and income effects of the exporter and importer countries.²⁴

Equations 2 and 3 add time dummies and trade area dummies respectively to the basic specification (equation 1). In the whole 1970-1995 period, the trade areas considered are the Central American Common Market (CACM), the European Economic Community (EC)²⁵, the European Free Trade Association (EFTA), East Asia (EA)²⁶, the North American Free Trade Agreement (NAFTA), the Andean Pact (AP) and MERCOSUR. The last three only came into effect in 1995. The introduction of time and trade area dummies does not substantially affect the overall results: the coefficients keep their sign and remain highly significant. However, the distance effect decreases slightly in size while the other effects increase slightly. Though not presented, we obtain negative time dummies that increase in absolute size as they refer to more recent periods. These cannot be interpreted as meaning that countries trade less over time since the introduction of time dummies leads to an increase in the size of all the coefficients with

²³ The same interpretation than for population and per capita GNP applies to the coefficient estimate of distance.

²⁴ We thus have twice as many observations and, in specifications where we don't use exporter and importer variables separately, identical explanatory variables for each pair of observations. We have run the specifications with exports plus imports to check the robustness of our results. We find, as expected given the high coefficient of correlation between exports only and exports plus imports, that the size and sign of coefficients do not change. Moreover the coefficients, with few exceptions, keep their significance level.

²⁵ In 1995 European Union.

²⁶ Even when East Asia is not a trade bloc in the formal sense, it is treated as such given the common characteristics and geographical proximity of these economies. It includes Continental China, Hong Kong, Indonesia, Japan, Malaysia, the Philippines, Singapore, South Korea, Taiwan and Thailand.

the exception of distance. Given that the values of Population and per capita GNP increase over time while distance, border and language stay the same, this means that predicted trade volume does not necessarily decrease over time²⁷. As for trade agreements, countries in the same trade area tend to be relatively close to each other and share cultural characteristics. It is not a surprise, then, that the introduction of trade area dummies decreases the size of some of the coefficients relative to column 2²⁸.

The last four columns of Table I present the same specification as the first column, but for each of the four sub-periods in the sample. As can be verified, the coefficients on size, per capita GNP and distance are relatively constant. The coefficients on Border and Language, on the other hand, experience large changes. The introduction of trade area dummies for each of these year specifications, not shown, does not change these coefficients significantly.

The basic gravity specification estimated in Table I ignores the most frequently cited reason for trade between countries: differences in factor endowments. Endowment differences lead to trade in goods since countries benefit by producing goods that use locally abundant factors and then exchange them in the international market for goods produced with factors that are scarce at home. In an attempt to incorporate the effect of differences in endowments into our study, we introduce as an independent variable the logarithm of the absolute value of the difference in exporter and importer's per capita GNPs. Richer countries tend to be relatively abundant in capital and thus the difference in GNP per capita is likely to be a good proxy for the difference in endowments²⁹. What we are interested in is the absolute difference in endowments; the larger it is, the larger should the volume of trade be. In Table II we show that this variable affects bilateral trade positively and is statistically significant. However, the size of the coefficient is relatively small.

The predicted value of trade is hardly affected by the introduction of differences in factor proportions: the correlation between the predicted value for the earlier and the

²⁷ The theoretical derivation of the gravity equation includes the value of world Gross Domestic Product, which is year-specific but identical across all countries in a given year. The omitted increase in the world GDP would induce the intercept to decline over time without decreasing trade.

²⁸ We refer more in detail to the effects of trade areas on the next sections.

²⁹ We reproduced these results using differences in physical capital per capita for 1992 kindly provided by Alberto Trejos and the results were very similar.

current estimates of trade flows is 0.99. For this reason in the specifications below we do not include the variable for the absolute of the difference in per capita GNP between exporter and importer. We have, nonetheless, run that specification and have verified that the results are basically unchanged relative to those reported.

Table I: Standard Gravity Equations, Whole Period (1970-1995) and per year

Variables	Estimations for the Period 1970-1995			Estimations per Year (Equation 1)			
	Equation 1	Equation 2	Equation 3	1970	1980	1990	1995
Constant	-9.596 * 0.241	-13.475 * 0.243	-14.701 * 0.249	-13.339 * 0.491	-17.830 * 0.639	-15.632 * 0.505	-15.222 * 0.430
Distance	-1.017 * 0.021	-0.890 * 0.020	-0.797 * 0.021	-0.857 * 0.039	-0.927 * 0.046	-0.840 * 0.040	-0.900 * 0.034
Population	0.856 * 0.008	0.967 * 0.008	0.973 * 0.008	0.851 * 0.017	0.985 * 0.019	0.988 * 0.016	1.031 * 0.014
Per Capita GNP	1.010 * 0.008	1.253 * 0.009	1.280 * 0.009	1.274 * 0.021	1.420 * 0.024	1.214 * 0.016	1.195 * 0.014
Border	0.619 * 0.101	0.751 * 0.094	0.632 * 0.094	0.628 * 0.177	0.716 * 0.213	1.194 * 0.187	0.509 * 0.165
Language	0.587 * 0.046	0.802 * 0.043	0.708 * 0.043	0.500 * 0.083	0.851 * 0.099	0.813 * 0.086	1.069 * 0.073
Threshold Value	2.094 * 0.014	1.948 * 0.013	1.916 * 0.012	1.844 * 0.026	2.254 * 0.030	1.980 * 0.025	1.631 * 0.020
# Observations	17828	17828	17828	4556	4556	4556	4556
Log Likelihood	-31837.93	-30779.99	-30543.57	-6703.76	-8266.17	-8242.81	-7298.62
Year Dummies	No	Yes	Yes	No	No	No	No
Trade Area Dummies	No	No	Yes	No	No	No	No

(*): significant at 1%. First row indicates the coefficient value and the second its standard error.

Table II: Effect of Factor Endowments on Trade, whole Period and per Year

Variables	Whole Period	Estimations per Year			
	1970-1995	1970	1980	1990	1995
Constant	-13.510 * 0.243	-13.131 * 0.492	-18.116 * 0.640	-15.679 * 0.506	-15.445 * 0.432
Distance	-0.906 * 0.020	-0.883 * 0.039	-0.945 * 0.046	-0.854 * 0.040	-0.908 * 0.034
Population	0.963 * 0.008	0.839 * 0.017	0.980 * 0.019	0.986 * 0.016	1.030 * 0.014
Per Capita GNP	1.207 * 0.010	1.214 * 0.025	1.351 * 0.026	1.176 * 0.019	1.163 * 0.015
Border	0.838 * 0.094	0.692 * 0.178	0.857 * 0.214	1.271 * 0.188	0.589 * 0.166
Language	0.828 * 0.043	0.514 * 0.083	0.884 * 0.099	0.841 * 0.086	1.096 * 0.073
Endowment Differences	0.120 * 0.013	0.130 * 0.028	0.193 * 0.030	0.092 * 0.024	0.094 * 0.021
Threshold Value	1.945 * 0.013	1.842 * 0.026	2.247 * 0.030	1.979 * 0.025	1.628 * 0.020
# Observations	17812	4542	4554	4556	4160
Log Likelihood	-30717.95	-6676.31	-8242.64	-8235.50	-7288.47
Year Dummies	Yes	No	No	No	No

(*): significant at 1%. First row indicates the coefficient value and the second its standard error.

Is Central America Different?

The first important question that one should ask about Central American exports is whether they show some specificity in the context of the gravity determinants of bilateral trade flows. This can be approached by selecting the sub-sample of observations in which a Central American country is the exporter, whatever the importer. The underlying assumption is that, because they share similar characteristics as far as the gravity model is concerned, the five Central American countries can be considered together. This is a fair assumption given that these five countries are similar in size, income per capita and location³⁰. For comparison we look also at the sub-samples of East Asian (EA9), Non-industrial (NIND) and Industrial (IND) exporters³¹. Central America may share characteristics with the set of developing countries that it does not share with developed countries and East Asia is a particularly interesting set of countries given its successful export performance³². On the importer side, in addition to the sample of 68 countries, we divide the world into industrial (IND) and non-industrial (NIND) countries to check for differences in the behavior of exports to these two groups. The threshold value reported at the bottom of each table has an interesting interpretation. In Tobit specifications, it is an estimate of the minimum amount of *predicted* trade that results in positive *actual* trade. Thus a value of, say, 2.000 can be directly read as saying that on average countries need at least that amount of predicted trade to actually start trading. The fact that countries need these minimum amounts to start an exchange relation makes sense since there are fixed costs, in terms of transport and other communication costs that may not make it worthwhile to trade if total volume is below a certain amount.

The estimation results are presented in Table III. The first noticeable fact is that the coefficient on distance for Central America is more negative than for any other sub-sample of countries. This result captures the fact that Central American countries trade much more between themselves and with the United States, or with countries that are

³⁰ Later in the paper we will also study these countries individually to check whether their joint behavior is representative of each country's behavior.

³¹ The latter two correspond to the non OECD and OECD member countries in the sample with Mexico considered as non-OECD.

³² In this particular analysis, EA9 includes all the countries mentioned above as East Asia with the exception of Japan, which is included in IND.

geographically close. The coefficients for the sub samples of NIND, EA and IND exporters are progressively smaller, suggesting that the higher the level of development the smaller the importance of distance in determining bilateral export volume. For most of the sub-groups of exporters, the distance coefficient is higher when the importer country is non-industrial rather than industrial. This again suggests a negative relationship between level of development and the size of the distance coefficient. Notice that level of development may capture a host of country characteristics, including good transport infrastructure.

The coefficient for the *Border* dummy variable is also larger for CA, maybe capturing also the large amount of intra-regional trade. Common language, on the other hand, does not seem to be important as a determinant of bilateral exports for Central America. Its negative sign indicates that, if anything, Central America trades less with Spanish speaking countries than with other countries. This result probably derives from the low volume of exports from Central America to other countries in Latin America; it is confirmed for both NIND and IND importers and is absent for any of the other groups of exporters. With respect to the size and income effect, we separate these variables into exporter and importer effects to see if there exist asymmetries between the different groupings of countries.

With respect to the size and income effects, we separate these variables into exporter/importer size and income effect, in order to see whether there exist asymmetries depending on the industrialization level of the exporter/importer country. The overall results do make sense: when the importer is a NIND country an increase in its size does not affect exports as much as an increase in the exporter's size and the reverse is true when the importer country is industrialized. As for the effect of income per capita on exports, it is the exporter's characteristics that tend to affect exports the most, irrespective of whether the importer is an industrial or non-industrial country. Interestingly, the only exception is Central America, whose exports to industrial countries depend mostly on the latter's income per capita³³.

³³ The same occurs for East Asia.

Table III: Comparison of Effects by Group of Countries: All, CA, IND, NIND and EA9, for the Whole Period (1970-1995) (a)

Variables	General	All Countries as Importers				Non-Industrial Countries as Importers				Industrial Countries as Importers			
		CA	NIND	IND	EA9	CA	NIND	IND	EA9	CA	NIND	IND	EA9
Constant	-13.476 *	-7.040 *	-13.291 *	-13.884 *	-10.218 *	-5.725 *	-11.488 *	-16.163 *	-6.472 *	-6.708 *	-10.322 *	-7.689 *	-11.699 *
	0.242	1.434	0.380	0.372	1.131	2.137	0.592	0.547	1.654	2.428	0.581	0.474	2.066
Distance	-0.889 *	-1.935 *	-1.071 *	-0.753 *	-1.168 *	-1.799 *	-1.285 *	-0.703 *	-1.515 *	-1.524 *	-0.655 *	-0.728 *	-0.486 *
	0.020	0.118	0.032	0.020	0.076	0.176	0.049	0.035	0.099	0.201	0.038	0.017	0.158
Size Effect (Popul.) Exporter	1.013 *	0.776 *	0.990 *	1.010 *	0.790 *	1.271 *	1.159 *	1.134 *	0.892 *	0.251	0.832 *	0.801 *	0.645 *
	0.012	0.178	0.019	0.012	0.071	0.287	0.029	0.017	0.103	0.165	0.020	0.012	0.075
Importer	0.919 *	0.769 *	1.036 *	0.782 *	0.946 *	0.217 **	0.877 *	0.777 *	0.737 *	0.926 *	1.121 *	0.778 *	1.023 *
	0.011	0.054	0.017	0.013	0.035	0.103	0.028	0.019	0.058	0.049	0.018	0.012	0.034
Income Effect (PGNP) Exporter	1.308 *	1.386 *	1.240 *	1.463 *	1.252 *	1.876 *	1.466 *	1.666 *	1.518 *	0.853 *	1.021 *	1.070 *	0.861 *
	0.012	0.139	0.024	0.038	0.097	0.233	0.037	0.053	0.141	0.126	0.026	0.040	0.102
Importer	1.198 *	1.668 *	1.377 *	1.014 *	1.273 *	0.762 *	1.015 *	0.984 *	0.861 *	1.673 *	0.834 *	0.678 *	1.064 *
	0.012	0.069	0.018	0.014	0.035	0.132	0.036	0.024	0.070	0.155	0.056	0.040	0.108
Border	0.752 *	2.177 *	1.153 *	0.262 *	1.460 *	1.939 *	1.213 *	0.769 *	1.335 *	--	0.495	0.372 *	--
	0.094	0.407	0.135	0.109	0.374	0.499	0.169	0.325	0.442	--	0.350	0.076	--
Language	0.802 *	-0.938 *	0.825 *	0.700 *	0.524 *	-0.808 **	0.920 *	0.746 *	0.183	-0.054	0.466 *	0.634 *	0.947 *
	0.043	0.254	0.062	0.054	0.132	0.378	0.092	0.073	0.192	0.318	0.079	0.060	0.141
Threshold Value	1.944 *	2.082 *	2.296 *	1.271 *	2.146 *	2.480 *	2.705 *	1.439 *	2.514 *	1.275 *	1.550 *	0.757 *	1.327 *
	0.013	0.066	0.020	0.013	0.038	0.127	0.032	0.018	0.059	0.050	0.019	0.013	0.035
# Observations	17828	1325	11998	5830	2385	885	8016	3982	1593	440	3982	1848	792
Log Likelihood	-30747.96	-1598.53	-20259.53	-9328.52	-4385.10	-793.10	-12360.84	-6648.09	-2835.52	-647.73	-6986.90	-2113.47	-1323.14
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(*): significant at 1%, (**): significant at 5%. First row indicates the coefficient value and the second its standard error.

(a): EA9 does not include Japan, which is included in the Industrial countries group.

The size and income effects also reveal Central American particularities. The size of the importer economy in the large sample (columns 2 through 5) is smaller for Central America than for any other sub-sample of exporters. However, the separation of the importer countries into industrial and non-industrial reveals more: while an increase in the size of non-industrial economies has a very small effect on Central America's exports (0.217 in column 6), the increase in size of the industrial clients has a very strong effect on Central America's exports (0.926 in column 10). The effect of an increase in Central America's size, on the other hand, has a strong effect on Central America's exports to Non-industrial countries (1.271 in column 6) and a small effect on the region's exports to Industrial countries (0.251 in column 10). It is true that for all sub-samples of exporters the exporter size effect is larger than the client size effect if the client is Non-industrial and the reverse if the client is Industrial. However, only for Central America the difference is so stark. This can be interpreted as saying that Central America's exports are particularly sensitive to growth in developed economies.

When we observe the coefficients on the income effect, Central America seems to be very sensitive to increases in income per capita, be it each country's own income per capita or the client's income per capita. Confirming the results on size above, columns 6 through 13 show that an increase in Central America's own income per capita has a large effect on exports to Non-industrial countries and a small effect on exports to Industrial countries. Note that for all exporter groups with the exception of Central America, each country's income effect is higher than the client's income effect when the importer country is industrialized. It is striking the difference in coefficients when we observe Central American exports to Industrial countries: an increase in the client's income per capita has an elasticity of 1.673 for Central America, while for the other exporter sub-groups it is, at most 1.064. The largest share of Central America's trade is with Industrial countries, suggesting that income per capita growth in Central America will diversify its export client base while growth in the client economies will accentuate its current dependence on Industrial clients.

The message seems to be twofold. First, growth in rich countries affects Central America's exports more than growth in poor countries, irrespective of whether this is growth in the economy's sheer size or in income per capita. Second, growth of the Central American economies increases exports to non-industrial countries more than to industrial countries,

again irrespectively of whether this is growth in the size of the economy or in income per capita.

When we add dummies indicative of the trade bloc of the importer country, the coefficient on distance for Central American exports decreases substantially for the ALL and NIND sample of importers. It remains large for the sample of IND importers. Moreover, the border effect becomes smaller and not-significant for Central America. Both these changes in the coefficient estimates derive from the fact that we now have a dummy indicating whether the importer is a Central American country and this corrects for the large intra regional trade within Central America. However, the size and income effects maintain the same qualitative behavior with rich and poor countries growth respectively more and less important for Central America than for the other groups of importers. An additional check, is to estimate individual country coefficients and verify if they mimic the characteristics above, when Central America is treated as a group. That is undertaken in the next section.

As mentioned above, the threshold reported at the bottom of the table is related to the fixed cost of exporting. This fixed cost may and should be different for different pairs of countries. It is comforting that in our estimates this threshold is lower for IND than for NIND countries, for all and each type of partner, so that it is lowest for IND countries exporting to IND countries. It is interesting that the estimated thresholds for East Asia exporting to IND countries are very similar to those of Central America. Figure I below presents these threshold values for the different subgroups of countries.

Country by Country Gravity Equations for Central America

We now present results for the specific gravity equations, or the equations for each of the Central American countries. The objective is to determine whether the results uncovered above hold for each of the countries in Central America or if they were driven by a particular country. In Table IV, we present results for the 1970-1995 time period, including time dummies though their coefficients are not reported. Trade area dummies have been excluded from all specifications.

It can be verified that the high value of the coefficient on distance is present for all five Central American countries. As for the coefficient on Border, which we had seen in Table III that was larger for Central America, it is in effect entirely due to Nicaragua and non-existent for the other countries in the region. In effect the point estimate for the Nicaragua Border coefficient is 6.9, almost ten times that for the whole sample (equation 2 of Table I). The size of this coefficient is probably due to the fact that Nicaragua went through a severe crisis in the eighties, in part due to the U.S. embargo on Nicaraguan exports. That crisis, from which Nicaragua is still recovering, has made this country particularly dependent on transactions with its border countries, namely Costa Rica. The coefficient on Language is negative and very large for all countries with the exception of Nicaragua, for which it is insignificant. This confirms that, controlling for the border countries of the CACM, Central American countries tend to trade less than expected with countries sharing the same language, i.e. Mexico and South America.

The high coefficient of the per capita GNP³⁴, which is larger than for the whole sample of countries (see Equation 2 in Table I) is also present for each of the five Central American countries. The coefficient of Population, which represents the size of the countries, tends to be smaller than for the whole sample. Note that the threshold values for each Central American country are almost perfectly aligned with the levels of GDP per capita, being larger the lower the GDP per capita of the country. This makes sense given the interpretation of these threshold values that we have presented above: they estimate the minimum level of bilateral exports that overcomes fixed costs and actually leads to positive trade. In sum, we interpret the country by country gravity equations as confirming most Central America specificity. These specific gravity equations have uncovered characteristics that Central American countries share among themselves and that are different from those of other countries.

³⁴ Since these are individual country specifications with time dummies, this coefficient is the same as that on the product of the exporter and importer's Population and per capita GNP, since the exporter variables do not change in the cross-section.

Figure I: Bilateral Exports Threshold Value

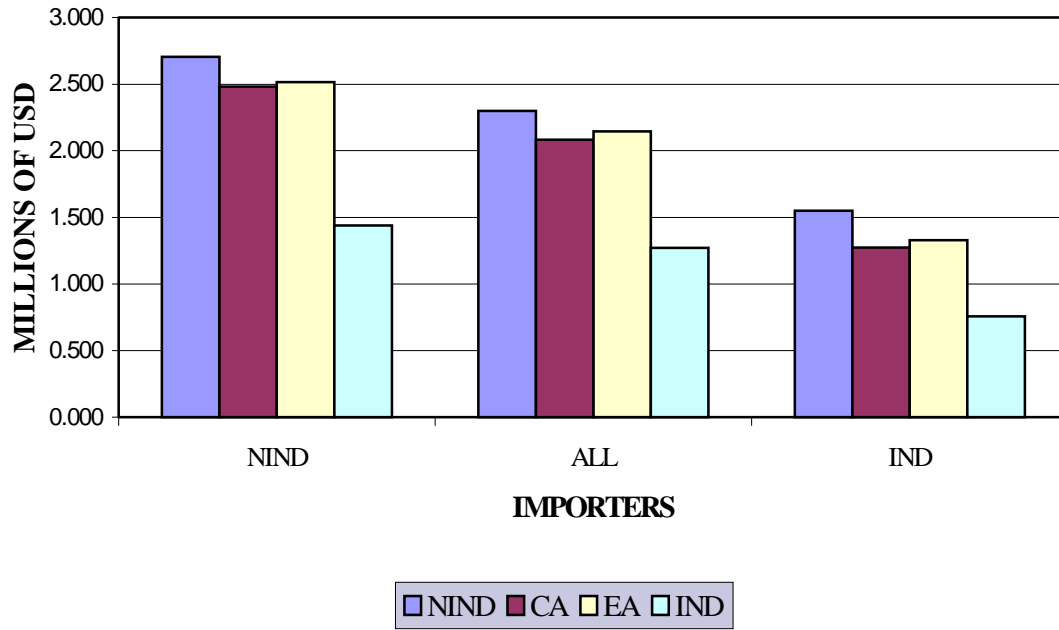


Table IV: Gravity Equations for Central American Countries, Period 70-95 (a)

Variables	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	CA5	CA4
Constant	12.095 *	11.110 *	11.389 *	-0.804	-6.982 *	1.138	8.706 *
	2.260	2.861	2.716	2.869	2.400	1.239	1.413
Distance	-2.882 *	-2.878 *	-2.682 *	-1.759 *	-1.163 *	-1.874 *	-2.573 *
	0.239	0.298	0.281	0.276	0.251	0.125	0.145
Population (size)	0.637 *	0.774 *	0.795 *	0.915 *	0.926 *	0.771 *	0.765 *
	0.090	0.120	0.112	0.106	0.140	0.057	0.057
Per Capita GNP	1.574 *	1.564 *	1.362 *	1.809 *	1.832 *	1.687 *	1.563 *
	0.115	0.160	0.130	0.146	0.185	0.073	0.072
Border	0.878	-1.919	-0.700	1.788	6.904 *	2.272 *	-0.426
	0.937	1.044	0.859	0.915	0.932	0.432	0.479
Language	-2.500 *	-2.027 *	-1.687 *	-1.215 **	0.070	-0.814 *	-1.830 *
	0.490	0.622	0.537	0.534	0.596	0.268	0.291
Threshold Value	1.592 *	1.970 *	2.019 *	1.749	2.177 *	2.224 *	2.004 *
	0.099	0.147	0.133	0.124	0.176	0.070	0.068
# Observations	265	265	265	265	265	1325	1060
Log Likelihood	-318.73	-279.54	-354.98	-268.71	-276.46	-1649.71	-1301.20
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(*): significant at 1%, (**): significant at 5%. First row indicates the coefficient value and the second its standard error.

(a): CA5 refers to all five countries, CA4 excludes Nicaragua.

B. Trade Creation and Trade Diversion

Another important issue is to gauge the extent to which Central American exports to different countries and groups of countries are smaller (or larger) than what is predicted by the gravity framework. Trade blocs in particular, are groups of countries that share institutional mechanisms that can favor or hamper imports from certain countries outside the bloc. The creation of trade blocs can lead to trade creation, the increase in trade between countries within the bloc due to the decrease in intra-bloc barriers to trade. However, trade blocs can also lead to trade diversion, when the decrease in internal barriers to trade leads to the substitution of suppliers outside the bloc for less efficient suppliers inside the bloc. We attempt to measure these effects by introducing dummies capturing the situation when both exporter and importer are from the same bloc (TC), when the importer is from a specific bloc and the exporter is outside the bloc, wherever it is (TD). Because we are specifically interested in whether there is trade diversion to the detriment of Central America we introduce an additional dummy variable, capturing the observations where the importer is from a given bloc and the exporter is a Central American country (TD-CA).

Table V below presents results for the whole sample and for each of the four sub-periods. We use the basic specification in column 2 of Table I³⁵, to which we add the three sets of dummy variables capturing trade creation and trade diversion for the different trade areas³⁶. In column 1 (whole sample) we find strong evidence of trade creation for EA, EFTA, CACM and the Andean Pact and weaker for MERCOSUR. NAFTA, by contrast, presents no evidence of trade creation. There is also no evidence of trade creation for the European Community in the whole period, which means that the high volume of trade between countries in this area is explained by the gravity factors. In the case of EFTA, there is evidence of trade creation in 1970 but not later in the sample³⁷. What is interesting is that the trade creation effect is largest for the CACM³⁸. As to trade diversion, the results show that most blocs are actually open to imports from the outside, as evidenced by a positive sign of the coefficient on TD for the bloc. The exceptions are NAFTA, EFTA, MERCOSUR and

³⁵ That is, for the whole period and including time dummies.

³⁶ These results are very robust to the introduction of the absolute value of the difference in per capita GNP of the importer and exporter countries as a right hand side variable.

³⁷ In the earlier years EFTA was a larger and more heterogeneous group.

the Andean Pact in 1995, which show evidence of trade deviation with countries outside their area. Note, in particular, that there is no evidence that the Central American Common Market either creates or deviates trade relative to the rest of the world. Also noticeable is a tendency for European areas, the EU and EFTA, to become more closed in the later period³⁹.

The coefficients on the TD-CA dummies capture whether a particular bloc is closed (open) with respect to Central America, *over and above* its degree of openness to the whole set of outside countries. Openness towards Central America differs from overall openness in the cases of East Asia and MERCOSUR, which are more closed to Central America than to other countries; EFTA and the EC, on the other hand, are more open to Central American exports than what is predicted by the basic gravity framework. When we look at 1995 only, the same evidence emerges. In 1995 NAFTA seems more open to imports from Central America than from other regions. This is probably due to the fact that there is a lot of trade between the two regions, whatever the period, and not that it increased in later years.

If we are interested in whether the bloc is closed (or open) to Central American exports, in absolute terms, then we have to test whether the sum of the coefficients TD and TD-CA is smaller or different from zero. Table VI presents the test for openness or closeness of each trade bloc with respect to Central America. The results for the whole period show that only for MERCOSUR can we conclude with statistical confidence that the trade area originates trade diversion with respect to Central America. In 1995, in turn, both MERCOSUR and East Asia present trade diversion against Central America. The latter result also make Central America different from the rest of the world since there is evidence supporting the openness of East Asia with respect to the typical exporting country in the sample.

³⁸ The coefficient can be interpreted as saying that countries trade among themselves $\exp(TC)$ times more than otherwise similar countries.

³⁹ We also analyzed some interaction effects between blocs and border, in order to see if trade agreements had the same impact for countries sharing borders than otherwise similar countries. We found that only East Asia presents a positive and significant effect, signaling that countries sharing borders in this region had a bigger trade creation effect.

Table V: Effect of Trade Creation and Trade Diversion, whole Period and per Year

Variables	1970-1995	1970	1980	1990	1995
Constant	-14.248 * 0.255	-14.543 * 0.496	-18.591 * 0.658	-15.836 * 0.519	-16.425 * 0.476
Distance	-0.794 * 0.022	-0.688 * 0.041	-0.815 * 0.050	-0.760 * 0.044	-0.820 * 0.040
Population (size)	0.961 * 0.009	0.832 * 0.017	0.983 * 0.020	0.952 * 0.017	1.036 * 0.015
Per Capita GNP	1.234 * 0.010	1.239 * 0.022	1.388 * 0.025	1.178 * 0.017	1.224 * 0.016
Border	0.667 * 0.093	0.626 * 0.173	0.723 * 0.209	1.217 * 0.181	0.181 0.170
Language	0.780 * 0.043	0.553 * 0.081	0.868 * 0.098	0.746 * 0.084	1.011 * 0.073
EA (TC)	1.673 * 0.106	1.785 * 0.200	1.339 * 0.245	2.273 * 0.211	1.388 * 0.178
EA (TD)	0.489 * 0.049	0.460 * 0.095	0.417 * 0.112	0.810 * 0.096	0.151 b 0.088
EA (TD-CA)	-0.819 * 0.174	0.044 0.370	-0.559 0.407	-1.576 * 0.344	-0.788 * 0.254
NAFTA (TC)	0.561 0.776	-- --	-- --	-- --	0.273 0.652
NAFTA (TD)	-0.033 0.152	-- --	-- --	-- --	-0.490 * 0.135
NAFTA (TD-CA)	0.956 b 0.510	-- --	-- --	-- --	1.018 ** 0.426
EC (TC)	0.079 0.113	0.689 b 0.416	0.143 0.320	0.276 0.208	-0.271 b 0.150
EC (TD)	0.738 * 0.051	1.170 * 0.115	1.076 * 0.119	0.892 * 0.094	0.011 0.081
EC (TD-CA)	0.465 * 0.147	0.286 0.371	0.788 ** 0.371	0.033 0.276	0.800 * 0.203
EFTA (TC)	0.909 * 0.216	1.345 * 0.284	0.781 0.499	-0.187 0.561	0.278 0.647
EFTA (TD)	0.408 * 0.064	0.755 * 0.101	0.779 * 0.141	0.092 0.137	-0.557 * 0.138
EFTA (TD-CA)	1.156 * 0.209	0.425 0.327	1.666 * 0.462	1.315 * 0.451	1.318 * 0.453

Table V: Effect of Trade Creation and Trade Diversion, whole Period and per Year
(continued)

Variables	1970-1995	1970	1980	1990	1995
MERCOSUR (TC)	1.060 b 0.552	--	--	--	1.020 ** 0.473
MERCOSUR (TD)	0.077 0.136	--	--	--	-0.196 b 0.119
MERCOSUR (TD-CA)	-2.920 * 0.589	--	--	--	-2.835 * 0.495
CACM (TC)	3.733 * 0.225	3.780 * 0.419	3.996 * 0.520	3.383 * 0.450	3.726 * 0.377
CACM (TD)	0.201 * 0.068	0.060 0.140	0.189 0.156	0.240 b 0.133	0.147 0.111
ANDEAN (TC)	1.753 * 0.428	--	--	--	1.431 * 0.365
ANDEAN (TD)	-0.073 0.125	--	--	--	-0.329 * 0.110
ANDEAN (TD-CA)	-0.419 0.434	--	--	--	-0.531 0.368
Threshold Value	1.890 * 0.012	1.761 * 0.025	2.191 * 0.029	1.905 * 0.024	1.565 * 0.019
# Observations	17828	4556	4556	4556	4556
Log Likelihood	-30331.41	-6553.14	-8155.39	-8091.34	-7140.37
Year Dummies	Yes	No	No	No	No

(*): significant at 1%, (**): significant at 5%, (b): significant at 10%. First row indicates the coefficient value and the second its standard error.

Table VI: Testing for Trade Diversion Relative with Central America (a)

Period		Central American Countries as Exporters					
		East Asia	EU	EFTA	NAFTA	Andean P	Mercosur
1970-1995	Prob>F	0.05	0.00	0.00	0.06	0.24	0.00
	Sign	=	>	>	=	=	<
1995	Prob>F	0.01	0.00	0.08	0.20	0.02	0.00
	Sign	<	>	=	=	<	<

(a) Test of the Null Hypothesis $TD + TDCA = 0$ on coefficients from Table V.

We next undertake a simple exercise that can help us understand whether Central America exports more or less than otherwise predicted by the model. We compute the average predicted volume of bilateral exports between Central America and certain importer countries, using the coefficients that emerge from the basic specification for the sample of 68 countries⁴⁰. We then compare this value with the average of actual Central American exports to that country. If the predicted value is above the actual value of exports then we may conclude that other factors beyond the gravity variables are hindering exports from Central America to that country. Because we have excluded trade area dummies, those factors may include the effect of specific trade areas (of which the country but not Central America is a part) on openness to Central American exports as estimated in the previous subsection. But what explains the difference between actual and predicted trade are not limited to the above: it also includes the lack of bilateral agreements between Central America and the country under consideration capable of securing “normal” access to those markets. Whichever of the two interpretations is correct, the policy implication is the same: Central American countries as a whole need to do more to facilitate exports to those areas. The idea is that some policy (or lack thereof) is preventing the gravity factors from making their force felt.

Table VII and Figure II present the results for a series of important exports markets: Brazil, Germany, Mexico, South Korea, the United States and Venezuela. These countries are both large and representative of a specific trade area⁴¹. In this way we can illustrate the

⁴⁰ That is, equation 2 in Table I, which includes time dummies but not trade area dummies.

⁴¹ Respectively MERCOSUR, European Union, NAFTA, East Asia, NAFTA and the Andean Pact.

importance of Central American trade with its most relevant partners. The results⁴² show that Central America tends to trade more than predicted with developed countries, that is the United States⁴³ and Germany, and less than predicted with South Korea, Brazil, Venezuela and Mexico. So, given the respective levels of development, distance and other factors determining bilateral trade, it can be expected that trade agreements with the latter countries will bear fruit.

Table VII: Comparison of Predicted and Effective Trade, Period 1970-1995 (a)

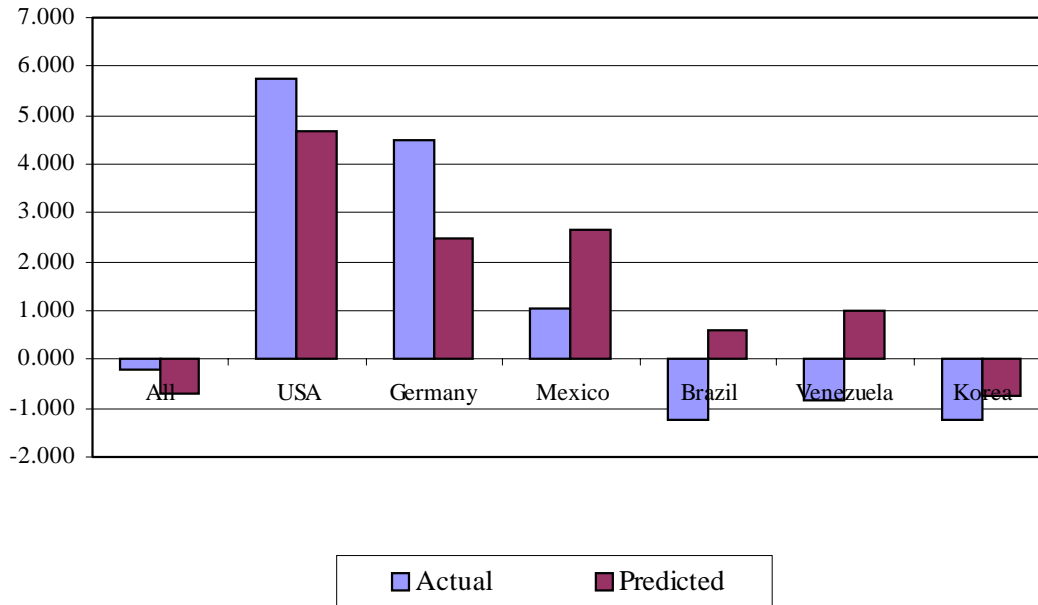
	General	Central American Countries as Exporters						
		All	Mexico	USA	Germany	Brazil	Venezuela	Korea
Effective	2.149	-0.204	1.045	5.732	4.473	-1.249	-0.834	-1.230
	3.397	2.372	2.114	1.311	0.809	1.607	1.892	1.598
Predicted	2.076	-0.702	2.642	4.686	2.463	0.575	1.013	-0.745
	3.051	2.124	1.100	0.990	1.252	1.274	0.791	1.914
Test of Difference (t)	2.136	5.713	-4.568	5.763	12.574	-5.499	-5.828	-1.003
Signif. Level	4%	0%	0%	0%	0%	0%	0%	33%
Meaning	Diff.	Diff.	Diff.	Diff.	Diff.	Diff.	Diff.	No Diff.

(a): First row indicates the mean value and the second the standard deviation.

⁴² These specifications use the absolute value of the difference in per capita GDP's as a right hand side variable. Given that the dependend variable is expressed in millions and in logarithm, negative values do not refer to negative exports but to export levels below 1.

⁴³ We should note that the results for the U.S. are probably due to the existence of the Caribbean Basin Initiative (CBI), rather than some explicit NAFTA effect. We examined the effect of NAFTA on Central American exports, obtaining however inconclusive results. For this reason, we address the impact of NAFTA through the effect of the real exchange rate level and volatility on next sections.

Figure II: Actual Versus Predicted Central American Exports



IV. REAL EXCHANGE RATE AND IMPORT DUTIES EFFECTS

In this section we try to determine the effect of the exchange rate level and the exchange rate volatility on the volume of Central American exports. To pursue this goal, we select the sub-sample of Central American countries (as exporters) and examine both total bilateral exports and bilateral exports of Food and Manufactures⁴⁴. These two trade categories account for most of the exports from Central America.

Since Mexico is the major competitor of Central American countries in their most important markets, we compute the ratio of the level of the bilateral real exchange rate of each Central American country with a given country to the same variable for Mexico. A decrease in the resulting index can be interpreted as a decrease in the Central American country's competitiveness *relative* to Mexico's⁴⁵. The expected sign of the coefficient is thus

⁴⁴ These two sectors correspond to the Standard Industry Trade Classification (SITC) trade categories number 0 and 8 respectively.

⁴⁵ Whenever we use the RER level variable (which is actually an index) and we conduct estimate for the five Central American countries, we introduce country dummies to correct for the initial level of each country's RER.

positive. Since both the dependent and independent variables are computed as logarithms, the coefficient can be interpreted as an elasticity⁴⁶. Exchange rate volatility is measured as the standard deviation of the monthly exchange rates for the year, divided by the mean level of the exchange rate⁴⁷. In this way we obtain a measure of volatility that is comparable across countries. In Table VIII, we present results introducing each of the above variables, level or volatility, and with both entered together. As we can verify, the results do not change substantially across specifications.

In Table VIII we present results for Central America's Total bilateral exports and exports of Food and Manufactures. The exporter countries considered are the five Central American countries and the importers are all the countries in the sample. For total exports we can verify that both the level of the real exchange rate and its volatility come out with the expected signs, positive and negative respectively, and with a significance level of 1 percent. The size of the coefficient on the exchange rate level tells us that a 1 percent change in relative competitiveness with respect to Mexico leads approximately to a 1.55 percent decrease in Central America total exports. In turn, a 1 percent increase in real exchange rate volatility leads approximately to a 0.39 percent decrease in bilateral exports of Central America. When both the level and the volatility are entered together, their effects slightly decrease, even though they continue to be highly significant (at 1 percent and 5 percent significance levels respectively).

As to Food (columns 4 through 6), we can verify that both the level and volatility come out as highly significant and with the expected signs. When both are entered together in column 6, they keep their signs and significance but the size of the effects decreases. The quantitative effects are substantial: a 1 percent decrease in competitiveness relative to Mexico leads approximately to a 3.6 percent decrease in Food exports while a 1 percent increase in volatility leads to a 0.85 decrease in the volume of Food exports. With Manufactures, which includes textile exports among other items, the results are equally stark. The exchange rate level keeps the positive sign and significance whatever the specification and its coefficient in column 9 is very similar to that on Food: a decrease of 1 percent in

⁴⁶ Actually, as an approximation to an elasticity, for the reasons explained above and having to do with Tobit method of estimation.

⁴⁷ This variable represents the volatility of the real exchange rate, for each Central American country, with respect to its trading partners. That is, the volatility of the bilateral real exchange rate.

relative competitiveness leads to a 3.4 percent decrease in the volume of Central American exports. In turn, the negative effect of volatility is smaller than for Food but bigger than for total exports. We can also note the larger coefficient on Distance when the dependent variable is Food exports (around 3.8) and particularly for exports of Manufactures (around 4.1).

It is important to study country by country sensitivity to the exchange rate level⁴⁸ and volatility to check where the overall results for the region are coming from⁴⁹. In addition, we are interested in knowing whether NAFTA ratification implied a disadvantage for Central American exports. In this line, we analyze the effects of U.S. imports duties on Central America exports. This is a specially important issue given the lower import duties facing Mexican exports relative to Central American ones and the increase in this divergence in the context of NAFTA. Figure III presents the evolution of relative U.S. import duties on Central America versus Mexico: the dramatic increase after NAFTA ratification is evident. In turn, Table IX presents the average levels of the real exchange rate and relative duties variables, before and after NAFTA ratification. The Relative Duties variable in Tables IX and X is the ratio of import duties to import value, levied by the U.S. on its imports from Central America, divided by the analogous ratio for Mexico. This variable takes the value 0 for exports of Central America to all countries and the value of relative duties in the case of exports to the United States. For parsimony, we present in Table X only the coefficients on the variables of interest but all specifications have included the standard gravity variables reported in Table VIII⁵⁰. We compute results for Total, Food and Manufacture exports and for the 1986-1996 period when addressing the effects of real exchange rate and for the 1989-1996 period when analyzing import duties effects⁵¹.

For Total exports, we observe that the coefficient on the exchange rate level is positive and significant at the 1 percent significance level for El Salvador, Honduras and Nicaragua.

⁴⁸ As explained above, the real exchange rate level is the level of the bilateral country-U.S. real exchange rate divided by the Mexico-U.S. real exchange rate.

⁴⁹ This is the purpose of the results presented in Table X.

⁵⁰ That is, the product of importer and exporter country's population and the product of their per capita GDP, bilateral distance, border, language and year dummies. All specifications have also included exporter country dummies.

⁵¹ The reason for choosing this shorter period is that we have data on imports duties applied by the U.S. only since 1989. Also, we only present results for total exports due to problems we detected with the measurement of specific sector import duties. We have checked, however, the results for the RER level and volatility for both periods 1986-1996 and 1989-1996, and the results do not change substantially.

A positive sign indicates that increased competitiveness relative to Mexico leads to a higher volume of total exports by Central America⁵². As for exchange rate volatility, the coefficient is negative and significant only for Costa Rica.

We can learn more by examining the data at a less aggregated level: Food and Manufactures. For the Food sector, the coefficient on the exchange rate level appears positive and significant for El Salvador and Nicaragua only. Exchange rate volatility, on the other hand, seems to be an important determinant of Food exports only for Nicaragua. Overall, the level and volatility of the exchange rate have an effect on Food exports. It is in Manufacture exports, however, that the results are striking: both exchange rate level and volatility come out as significant and with the expected sign for almost all the countries. The exchange rate level coefficients are all bigger than the value of 2⁵³, indicating that when Central American competitiveness relative to Mexico decreases by 1 percent, the volume of its exports decreases by more than 2 percent. As to volatility, the effect on individual countries fluctuates from an elasticity around -0.37 for Costa Rica to -0.9 for Nicaragua.

Finally, with respect to the effect of U.S. import duties on Central American exports relative to U.S. duties on Mexican ones: the variable comes out with the expected negative sign and significant for El Salvador, Guatemala and Honduras. Exports of these countries to the U.S. turn out to be highly affected by its divergence in tariffs, in the context of NAFTA. A 1 percent increase in relative duties levied by the U.S. leads to a 1.8 percent decrease of total exports for El Salvador, a 2.5 percent decrease for Guatemala and a 3.3 percent decrease for Honduras.

Summing up, it seems that Central American exports are affected by the level of relative competitiveness with respect to Mexico and by the volatility of its bilateral real exchange rate. The effects are particularly strong for Manufacture and for Food, the main export sectors of Central America. In addition, when exporting to the U.S., Central American exports are also strongly affected by the import duties levied by the U.S. relative to the U.S. duties applied to Mexican ones.

⁵² It is interesting to note that El Salvador and Nicaragua were the only two Central American countries in the sample period to experience major devaluations.

⁵³ In particular, Nicaragua presents a coefficient value of more than 5.

**Table VIII: Effect of the Real Exchange Rate on Central American Exports
1986-1996 (a)**

Variables	Total Exports			Food Exports (SITC #0)			Manufacture Exports (SITC #8)		
Constant	-22.763 *	-19.780 *	-22.220 *	-32.909 *	-23.831 *	-32.139 *	-19.463 *	-14.938 *	-19.346 *
	1.722	1.437	1.720	2.568	2.013	2.586	2.350	1.669	2.365
Distance	-2.907 *	-2.936 *	-2.932 *	-3.740 *	-3.758 *	-3.817 *	-4.107 *	-4.093 *	-4.121 *
	0.116	0.121	0.116	0.165	0.171	0.163	0.129	0.134	0.127
Population (size)	1.412 *	1.400 *	1.398 *	1.438 *	1.500 *	1.434 *	1.134 *	1.150 *	1.137 *
	0.053	0.053	0.053	0.073	0.073	0.072	0.062	0.063	0.062
Per Capita GNP	2.781 *	2.784 *	2.750 *	3.313 *	3.273 *	3.267 *	2.462 *	2.655 *	2.432 *
	0.060	0.058	0.059	0.087	0.085	0.087	0.087	0.087	0.086
Border	2.477 *	2.475 *	2.411 *	3.094 *	3.403 *	2.955 *	1.614 *	1.758 *	1.585 *
	0.424	0.438	0.420	0.565	0.586	0.558	0.402	0.422	0.398
Language	1.949 *	1.889 *	1.847 *	-0.935 *	-0.961 *	-1.056 *	2.209 *	2.612 *	2.168 *
	0.238	0.244	0.236	0.344	0.352	0.341	0.275	0.284	0.273
RER level (relative)	1.548 *	---	1.488 *	4.023 *	---	3.599 *	3.681 *	---	3.427 *
	0.238	---	0.251	0.431	---	0.453	0.472	---	0.485
RER Volatility	---	-0.389 *	-0.211 *	---	-1.240 *	-0.853 *	---	-0.873 *	-0.528 *
	---	0.080	0.089	---	0.116	0.124	---	0.101	0.106
Threshold Value	3.890 *	4.044 *	3.851 *	5.041 *	5.271 *	4.973 *	3.537 *	3.752 *	3.500 *
	0.059	0.062	0.059	0.090	0.095	0.089	0.078	0.083	0.077
# Observations	3695	3630	3630	3695	3630	3630	3695	3630	3630
Log Likelihood	-7726.29	-7751.46	-7607.33	-6819.24	-6859.27	-6701.14	-4057.36	-4153.81	-4024.11
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figure III: Relative Duties for Total Exports, 1989-1996

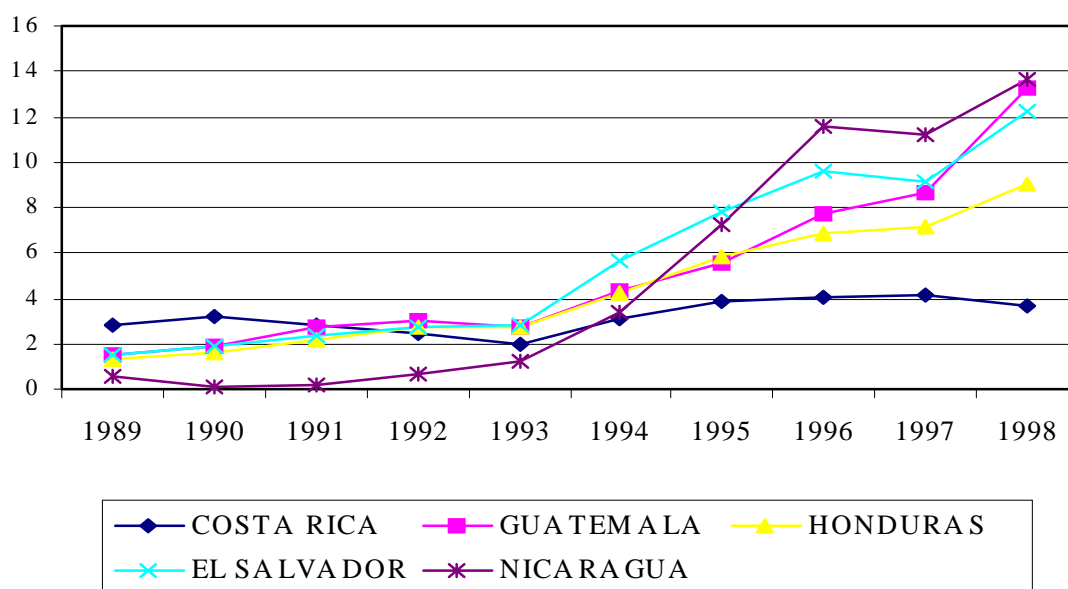


Table IX: Average RER -Level and Volatility- and Relative Duties Before and After NAFTA (a)

Variables	Costa Rica		El Salvador		Guatemala		Honduras		Nicaragua	
	Before	After	Before	After	Before	After	Before	After	Before	After
I.- Variables in log										
RER level	3.464	3.440	0.880	0.670	0.255	0.192	0.086	0.468	-3.238	-2.862
RER volatility	-3.199	-3.806	-2.736	-3.623	-2.804	-3.484	-2.937	-3.544	-1.526	-3.453
Relative Duties	0.953	1.291	0.789	2.013	0.832	1.738	0.703	1.710	-0.952	1.884
II.- Variables in levels										
RER level	32.579	31.706	2.442	1.994	1.333	1.232	1.203	1.631	0.048	0.058
RER volatility	0.064	0.029	0.096	0.032	0.109	0.038	0.090	0.036	0.349	0.038
Relative Duties	2.631	3.658	2.267	7.665	2.374	5.848	2.105	5.643	0.541	7.409

(a) In order to be consistent with the results presented in Table IX, the period considered for the RER variables is 1986-1996 and for the relative duties variables is 1989-1996.

Table X:
Effect of RER and U.S. Barriers to Imports
on Central American Exports per Country

Variables	Central America	Estimations per Country				
		Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua
A.- Period 1986-1996						
Total Exports						
RER Level	1.488 *	-1.099 **	2.453 *	-0.483	1.618 *	1.000 *
	0.251	0.530	0.761	0.560	0.430	0.315
RER Volatility	-0.211 **	-0.462 *	0.152	-0.185	0.176	-0.150
	0.089	0.133	0.189	0.148	0.206	0.186
Food Exports						
RER Level	3.599 *	-2.400 *	3.712 *	0.079	-0.302	7.494 *
	0.453	0.761	1.140	0.742	0.494	1.146
RER Volatility	-0.853 *	-0.186	0.205	0.124	0.030	-0.893 *
	0.124	0.192	0.286	0.197	0.242	0.304
Manufactures Exports						
RER Level	3.427 *	2.025 *	2.537 *	2.521 *	2.599 *	5.149 *
	0.485	0.696	0.781	0.485	0.485	1.169
RER Volatility	-0.528 *	-0.377 **	-0.389 b	-0.035	-0.545 **	-0.903 *
	0.106	0.175	0.200	0.131	0.218	0.282
B.- Period 1989-1996						
Total Exports						
Relative Duties	-0.992 **	-1.050	-1.839 **	-2.454 **	-3.332 *	0.134
	0.457	0.902	0.912	1.018	1.282	0.970

(*): significant at 1%, (**): significant at 5%, (b): significant at 10%. First row indicates the coefficient value and the second its standard error.

(a): For reasons of parsimony we have reported only the results on the variables of interest. But all specifications include the product of importer and exporter country's population and the product of their per capita GDP, bilateral distance, border, language and year dummies.

V. CONCLUSIONS

The gravity approach to the study of bilateral trade postulates that bilateral trade flows are positively related to the importer and exporter countries economic size as measured by GDP and negatively related to resistance factors such as geographical distance and divergent cultural characteristics. It has been remarkably successful in explaining bilateral trade flows. We add data on the five Central American countries of this study to a widely used data set on bilateral trade flows, which includes data for the 65 most important trading countries in the world. Using the periods 1970, 1980, 1990 and 1995 we estimate bilateral export equations using the Tobit estimation method, which corrects for censored variables. Our extended dataset confirms previous results mentioned above.

The first question answered by this paper is whether Central America is different as far as the standard gravity variables go. We find that the coefficient on bilateral distance is much more negative for Central America, meaning that costs associated with distance are more harmful for Central America than for the typical exporter. Moreover, the coefficient on the dummy indicating shared language is negative for Central America, in contrast with the typical positive value. We find evidence that Central American exports are more sensitive to importer country's GNP per capita than with the typical country's exports. In particular, this sensitivity is higher than for East Asia and for the sub sample of developing countries as a whole.

The second issue we address is whether there is evidence of trade creation and, particularly, trade diversion with respect to the countries outside the trade area and Central America. We find robust evidence that the Central American Common Market has very strong trade creation effects (the largest for the sample of trade areas), confirming previous results by other researchers. Moreover we find that Central America trades more with the European Union and EFTA than predicted by the gravity framework (economies' size and income per capita, bilateral distance). On the other hand, Central America trades less with MERCOSUR and East Asia than otherwise predicted by the model. There is evidence of MERCOSUR trade diversion, particularly with Central America and East Asia is not closed with countries other than Central America.

The last issue addressed is the impact of the real exchange rate level and volatility on Central American exports and, in particular when exporting to the U.S., the impact of U.S. imports duties. Given that most of Central America's exports are destined for the United States market where they compete with Mexican exports, we use the level of the real exchange rate of each Central American country relative to the Mexican equivalent. We find evidence that when Central America becomes more competitive relative to Mexico it exports more. This effect is particularly strong and significant for Food and Manufactures products, which account for most of the region's exports. As for volatility, we find it has a significant negative effect on the volume of Total, Food and Manufactures exports but it is stronger for the latter two. Country estimations show that the level and the volatility of the real exchange rate affect bilateral exports in the expected way. For Total and Food exports, the effects are significant for some countries and not for others. For Manufacture exports, the level and the volatility of the real exchange rate are important determinants (statistically and economically) of each and every one of the Central American countries. We also show that higher U.S. import duties on Central American exports relative to Mexican ones decrease the volume of Central American exports.

REFERENCES

- Anderson, James (1979), "A Theoretical Foundation for the Gravity Equation", *American Economic Review*, 69, p. 106-116.
- Bayoumi, Tamin and Barry Eichengreen (1995), "Is Regionalism Simply a Diversion? Evidence from the Evolution of the EC and EFTA", *NBER Working Paper* 5283.
- Bergstrand, J. (1985), "The Gravity Model in International Trade: Some Microeconomic Foundations and Empirical Evidence", *Review of Economics and Statistics*, 67, p. 474-481.
- Brada and Mendez (1985), "Economic Integration Among Developed, Developing and Centrally Planned Economies: A Comparative Analysis", *The Review of Economics and Statistics*, 67 (4): 549 - 556.
- Deardorff, Alan (1984), "Testing Trade Theories and Predicting Trade Flows", Chapter 10 in Ronald Jones and Peter Kenen, eds., *Handbook of International Economics*, Volume 1, North-Holland, New York.
- Deardorff, Alan (1995), "Determinants of Bilateral Trade: Does Gravity Work in a Bilateral World ?", *NBER Working Paper* 5377.
- Eaton, Jonathan and Akiko Tamura (1994), "Bilateralism and Regionalism in Japanese and U.S. Trade and Direct Foreign Investment", *NBER Working Paper* 4758.
- Eichengreen, Barry and Douglas Irwin (1996), "The Role of History in Bilateral Trade Flows", *NBER Working Paper* 5565.
- Evenett and Keller (1998), "On Theories Explaining the Success of the Gravity Equation", *NBER Working Paper* 6529.
- Frankel, Jeffrey, Ernest Stein and Shang-Jin Wei (1993), "Continental Trading Blocs: Are They Natural or Super-Natural ?", *NBER Working Paper* 4588.
- Frankel and Romer (1996), "Trade and Growth: An Empirical Investigation", *NBER Working Paper* 5476.
- Helpman, Elhanan (1987), "Imperfect Competition and International Trade: Evidence from Fourteen Industrial Countries", *Journal of the Japanese and International Economies*, 1, p. 62-81.
- Helliwell (1997), "National Borders, Trade and Migration", *NBER Working Paper* 6027.
- Hummels, David and James Levinshon (1995), "Monopolistic Competition and International Trade: Reconsidering the Evidence", *Quarterly Journal of Economics*, 11, p. 799-836.

- Kemp, M. and Wan, Henry (1976), “An Elementary Proposition Concerning the Formation of Customs Unions”, *Journal of International Economics*, 6, 95-97.
- McMillan, John (1993), “Does Regional Integration Foster Open Trade? Economic Theory and GATT’s Article XXIV”, in Kym Anderson and Richard Blackhurst (eds.), *Regional Integration and the Global Trading System*.
- McCallum, John (1995), “National Borders Matter: Canada-U.S. Regional Trade Patterns”, *American Economic Review*, 85 (3): 615 – 623.
- Rauch, J. (1996), “Networks Versus Markets in International Trade”, *NBER Working Paper* 5617.
- Thursby, Jerry and Marie Thursby (1987), “Bilateral Trade Flows, the Linder Hypothesis, and Exchange Risk”, *The Review of Economics and Statistics*, 69, p. 488-495.
- Tinbergen, J. (1962), “Shaping the World Economy: Suggestions for an International Economic Policy”, New York, *The Twentieth Century Fund*.
- Summary (1989), “A Political-Economic Model of U.S. Bilateral Trade”, *The Review of Economics and Statistics*, 71 (1), p. 179 - 182.
- Wei, Shang-Jin (1996), “Intra-National versus International Trade: How Stubborn Are Nations in Global Integration ?”, *NBER Working Paper* 5531.
- Wei, Shang-Jin and Frankel, Jeffrey (1995), “Open Regionalism in a World of Continental Trading Blocs”, *NBER Working Paper* 5272.