Gravity to CARICOM: An Analysis of CARICOM's External Trade Using an Augmented Gravity Model

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***Abstract*—The Gravity Model of International Trade - dubbed the 'workhorse' of international trade policy analysis - is put to the test to investigate the Caribbean Community's (CARICOM's) trade with external trading partners. In order to get a better understanding of the factors which have influenced CARICOM's trade with its 'traditional' trading partners, and the opportunities associated with increased trade with 'non-traditional' partners, it is important to understand the underlying factors which have impacted CARICOM's external trading past. An augmented gravity equation is formulated to analyze both import and export data against the variables of the relative size of the pair of countries involved in trade, distance, exchange rate, common border, common language, common currencies, and preferential trading schemes. Three different estimation techniques, the Ordinary Least Squares (OLS), the Least Squares Dummy Variable (LSDV), and the Poisson-Pseudo Maximum Likelihood (PPML) Estimator Models, are utilized to compare the robustness of results. These models are tested on a sample of forty (40) of CARICOM's top trading partners using data from 1980 to 2006. The results reveal that similar yet differentiated factors have impacted CARICOM's import and export patterns over the years, and that participation in preferential trading schemes does not always result in trade creation.**

***Index Terms*—CARICOM, gravity model, ordinary least squares, least squares dummy variable, Poisson-pseudo maximum likelihood estimator, trade creation, trade diversion.**

I. Introduction

Dubbed the workhorse of international trade policy analysis, the Gravity Model of International Trade has been used extensively to assess the factors which most likely predict a country's external trading pattern as well as the benefits which accrue to countries under a free trade agreement (FTA). However, despite its international acclaim, this model has not been taken advantage of in the interpretation of trade issues arising in the Caribbean Community (CARICOM)[1]. The following are only a handful of studies that are known to have utilized the gravity model to analyze CARICOM trade: Richards Elliott (2007) [1], Martinez-Zarzoso (2003) [2], Sandberg *et al.* (2002) [3], Finger *et al* (1998) [4], and Thoumi (1989) [5].[2]This study seeks to add to the existing yet limited debate on CARICOM's trade by analyzing its historical trading patterns with third-party countries using an augmented gravity model. The objectives of the study are two-fold. Firstly, it seeks to identify the factors which have influenced CARICOM's historical trade, and have impacted the selection of its preferred trading partners. Secondly, it seeks to assess the benefits which have arisen due to CARICOM's participation in preferential trading schemes.

The underlying objectives of this study are important for the following reasons. Firstly, it is necessary to understand the factors which have determined CARICOM's external trade in the past, looking specifically at trading patterns in the post-independence era leading up to the pre-global economic and financial crisis era. Secondly, it is important to understand CARICOM's trading 'past' in order to predict the factors which will determine its trade in the future. Thirdly, CARICOM's trade performance under partial scope agreements and preferential trading schemes is estimated in order to determine whether there was in actuality trade creation or trade diversion.

One major criticism of CARICOM's approach to external trade is its lack of market diversification. For many decades, CARICOM's trade was concentrated around the developed economies of the United States, Canada, and the European Union. This reliance led to severe trade dependence and reluctance on the part of exporters to search for new markets and related export opportunities. However, in recent times, CARICOM has witnessed an increase in trade with non-traditional trading partners. This begs the question: what specific factors have contributed to this change? We will seek to investigate these factors in this paper. We will refer to the United States, Canada, and the European Union as CARICOM's 'traditional' trading partners, while all other countries will be referred to as its 'non-traditional' partners.

The paper is organized as follows: In Section II a theoretical overview is presented, which is followed by the methodology in Section III. Section IV outlines the sources

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[1]The Caribbean Community and Common Market (CARICOM) is a regional integration movement, which currently takes the form of a customs union. The CARICOM countries are a group of small islands and larger nations located in and around the Caribbean Sea. They include Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, Montserrat, Suriname, St. Vincent and the Grenadines, and Trinidad and Tobago.

[2]Richards-Elliot (2007) uses a three dummy gravity model for Barbados, Jamaica, and Trinidad and Tobago individually to analyze increased regional and extra-regional trade. Martinez-Zarzoso (2003) evaluates the determinants of bilateral trade flows among forty-seven countries, and particularly the effects of preferential agreements between several economic blocs and areas, including CARICOM, from 1980-1999. Sandberg et al (2002) investigates the determinants of intra-CARICOM bilateral trade and the CARICOM member's trade with North American and European countries using the gravity model. Finger et al (1998) investigates the effect of CARICOM on trade among its members, while Thoumi (1989) uses a gravity equation to analyze intra-Latin American and Caribbean trade, which is found to depend mainly on exporter's GNP and distance.

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of data as well as the expected coefficients for the model variables. The findings are presented in Section V, followed by the main conclusions in Section VI.

II. Theoretical Overview

The gravity model is described as an econometric method of estimating trade flows [6]. Econometric approaches for modelling trade flows have typically focused on the gravity model specification [7]. Having its foundations built in Newtonian physics, the gravity model shows how trade between two partners is affected by their sizes and proximity. The basic gravity model purports that trade (T_{ijt}) between two countries in time t is directly related to the countries' national income (Y_{it} and Y_{jt}) and inversely related to the geographical distance (D_{ij}) between them. This relationship is demonstrated in the equation below, where G is a constant:

$$T_{ijt} = \mathrm{G}\frac{Y_{it}Y_{jt}}{D_{ij}}$$

Tinbergen (1962) and Linneman (1966) were the first economists to pioneer the move of the gravity equation to the empirical analysis of international trade flows [8]. Since that time, the gravity model has acquired international acclaim due to its empirical robustness and its popularity in the conduct of ex-ante and ex-post analyses of free trade agreements (FTAs). Typically described as the 'workhorse' of international trade policy analysis , the gravity model has not only been used to study the impact of FTAs, but also the effects of General Agreement on Tariffs and Trade/World Trade Organization (WTO) membership, currency unions, migration flows, foreign direct investment, and even disasters [6].

At the heights of its popularity, the gravity model was heavily criticized for the lack of a strong theoretical background. However, [9] reveals that although the model initially had been criticized for lacking respectable theoretical foundations, it has experienced a 'swan-like' revival due to its empirical success at predicting bilateral flows, its improved theoretical foundations, and a new interest among economists in the subject of geography and trade. From a theoretical perspective, the best known rationale for the idea that bilateral trade depends on the product of GDPs comes from the work of Helpman (1987) and Helpman and Krugman (1985) [9]. In this theory, consumers seek variety in the products they consume, products are differentiated by firm, not just by country, and firms are monopolistically competitive. In recent times however, it has been agreed that it is possible to derive the gravity model from a leading number of international trade theories.

Anderson and van Wincoop (2003) [10] introduce an augmented version of the gravity equation which accounts for the inclusion of multilateral resistance terms. These multilateral resistance terms are specific to both the importer and the exporter, and serve as a proxy for the existence of unobserved trade barriers [11]. Anderson and van Wincoop argue that bilateral trade is not only a function of the distance between two countries, but is also a function of the distance of the pair from other countries [6]. In this regard, the higher the level of multilateral resistance, the more the pair of countries should trade with each other, and vice versa. Feenstra (2002) proposes introducing importer and exporter fixed effects to account for the specific country multilateral resistance term [11]. This approach is utilized in this study.

Various forms of preferential trade agreements (PTAs), including free trade agreements (FTAs) and customs unions, have long been studied by trade economists. Before Viner's 1950 study on customs unions, the conventional wisdom was that PTAs would almost always increase the welfare of all the members of the agreement. Viner's model revealed that the formation of such agreements could either increase or decrease country's welfare. Most importantly, his model introduced the two important concepts: trade creation and trade diversion. Trade creation is described as the displacement of less efficient national production in favour of more efficient partner-country production. That is, as members agree to eliminate tariffs between themselves, this leads to lower priced, zero-tariff imports from partner countries being made available to consumers. As consumers increase their demand for these goods, new trade will be created – a process called trade creation. The opposite takes place in case of trade diversion, where there is the displacement of more efficient non-partner imports in favour of less efficient partner country-sourced imports [6].

Hence within any PTA, trade creation improves the welfare of member countries in that it replaces inefficient national production with efficient partner-country production. On the other hand, trade diversion reduces the welfare of member countries as low-cost, more efficient imports from non-members countries are now displaced by higher cost, less efficient partner country imports. This is due to the fact that the common external tariff applied by PTA members leads to imports from non-member countries being more expensive than those from PTA members. Under a Vinerian framework, the amount of welfare to be derived from any PTA depends on the extent of trade creation relative to trade diversion.

In this paper, we will look at the extent to which CARICOM's preferential trading schemes have led to trade creation or trade diversion. The main benefit of using the gravity model in this regard is that it can control for the effects of as many other trade determinants besides the PTA as necessary, therefore, isolating the effects of the FTA on trade [6].

III. Methodology

In its most basic form, the gravity model purports that trade between country *i* and country *j* is proportional to the product of their gross domestic products (GDPs) and inversely related to the distance between them. However, the basic model can be augmented to include other size and economic variables such as per capita GDP, and the real effective exchange rate. Similarly, other variables which assess transaction costs may be included in order to further explain a country's trading patterns. Such variables may include proxies for geographical distance, and other proxies for trade barriers.

In the case of imports, the following augmented gravity specification is utilized in this paper:

$$\ln M_{ijt} = \beta_0 + \beta_1 \ln(Y_{it}.Y_{jt}) + \beta_2 \ln(Ypcap_{it}.Ypcap_{jt}) + \beta_3 \ln D_{ij} + \beta_4 REER_{it} + \beta_5 contig_{ij} + \beta_6 comlang_{ij} + \beta_7 comcol_{ij} + \beta_8 colony_{ij} + \beta_9 comcur_{ij} + \beta_{10} DOM_{ijt} + \beta_{11} COL_{ijt} + \beta_{12} VEN_{ijt} + u_{ijt} (1)$$

Imports are represented as M_{ijt}. Income is measured by gross domestic product (GDP). GDP in the home and the partner countries at time *t* are represented by Y_{it} and $Y_{jt,}$ respectively. Income per capita, represented by GDP per capita, is captured as $Ypcap_{it}$ for the home country and $Ypcap_{\text{jt}}$ for the partner country. On the other hand, $contig_{ij}$, $lang_{ij}$, $colony_{ij}$, $comcol_{ij}$ are dichotomous or dummy variables which denote whether countries share a common border, a common official language, whether one was a colony of the other at some point in time and whether countries share a common colonizer. Likewise, the dummy variable $comcur_{ij}$ denotes whether countries share a common currency. The following variables, DOM_{ijt}, COL_{ijt} and $VEN_{ijt,}$ represent CARICOM's participation in partial scope agreements and free trade agreements with the Dominican Republic, Colombia and the Bolivarian Republic of Venezuela, respectively beginning in the year of entry into force of the agreement. [3] The random error term is represented as u_{ijt}.

In the case of exports (X_{ijt}), the augmented equation outlined in (1) is extended to include the following unilateral export schemes: the Caribbean-Canada Trade Agreement (CARIBCAN), the Lomé/Cotonou Trade Agreements (LOMECOT), and the Caribbean Basin Initiative (CBI), which is inclusive of both the Caribbean Basin Economic Recovery Act and the Caribbean Basin Trade Partnership Act[4]:

$$\ln X_{ijt} = \beta_0 + \beta_1 \ln(Y_{it}.Y_{jt}) + \beta_2 \ln(Ypcap_{it}.Ypcap_{jt}) + \beta_3 \ln D_{ij} + \beta_4 REER_{it} + \beta_5 contig_{ij} + \beta_6 comlang_{ij} + \beta_7 comcol_{ij} + \beta_8 colony_{ij} + \beta_9 comcur_{ij} + \beta_{10} DOM_{ijt} + \beta_{11} COL_{ijt} + \beta_{12} VEN_{ijt} + \beta_{13} CARIBCAN_{ijt} + \beta_{14} LOMECOT_{ijt} + \beta_{15} CBI_{ijt} + u_{ijt} (2)$$

There are three different estimation techniques that will be utilized in this paper: the Ordinary Least Squares (OLS) model, the Least-Squares Dummy Variable (LSDV) model, and the Poisson-Pseudo Maximum Likelihood (PPML) model. The Ordinary Least Squares (OLS) method has traditionally been the usual technique for estimating the coefficients of the gravity model specification in its log-linear form [7]. In this paper, we will utilize a pooled OLS method to estimate the augmented gravity equation. The main advantage of using this estimation technique is its simplicity. The main disadvantage, however, is the loss of information which occurs due to the elimination of zero trade flows. Another disadvantage of the OLS model is that it posits no difference in intercept and slopes across country and time period [12].

The Least Squares Dummy Variable (LSDV) Model, an OLS with fixed effects specification, is also a popular method for estimating the gravity model. The main advantage of using this model is that it controls unobservable confounding variables which differ across entities/countries and time [13]. The effects of the explanatory variables are mediated by differences across countries and time periods. In other words, by adding a dummy variable for each country and for each year, an estimate of the pure effect of the explanatory variable on the explained variable is generated, hence absorbing the effects particular to each country and to each year. As a result, the LSDV specification controls for unobserved heterogeneity. Unbiased estimates of the impact of distance and other bilateral variables on bilateral trade flows can be obtained by incorporating importer and exporter dummies [14]. The LSDV model, which contains time and entity fixed effects, may be estimated as follows:

$$Y_{ijt} = \beta_0 + \beta_1 X_{1,it} + ... + \beta_k X_{k,ijt} + \gamma_2 E_2 + ... + \gamma_n E_n + \theta_2 T_2 + ... \theta_t T_t + u_{it}$$

The dependent and independent variables are represented by Y_{ijt} and $X_{k,ijt}$ respectively. β_k is the coefficient for the independent variables, while u_{it} is the error term. E_n represents entity/country dummies, while T_t depicts time as a binary variable. There are n − 1 entities and t − 1 time periods included in the model in order to avoid the issue of perfect multicollinearity. γ_n and θ_n are the coefficients for binary entity and time regressors, respectively.

The Poisson Pseudo Maximum Likelihood (PPML) model is a nonlinear estimation method which was popularized by Santos Silva and Tenreyro (2006) [15]. The PPML method has become increasingly popular in the estimation of gravity model for the following three reasons [16]. Firstly, it is consistent with the presence of fixed effects. This is quite an unusual property for nonlinear maximum likelihood estimators. Secondly, the PPML estimator naturally includes observations for which the observed trade value is zero. This solves the problem of sample selection bias which may be problematic with the use of the OLS. Thirdly, the interpretation of coefficients is quite straightforward, even though the dependent variable is typically measured in levels rather than in logarithms. The independent variables, which are entered in the model as logarithms, are still interpreted as simple elasticities. According to Herrera (2013), the main disadvantage of using this model is that it may present

[3]The econometric model took into account the year that the agreements first entered into force. The CARICOM-Dominican Republic Free Trade Agreement entered into force for three CARICOM countries namely, Jamaica, Barbados and Trinidad and Tobago on 1st December 2001. The model takes into account this preferential treatment starting from 2002. Both the CARICOM-Colombia and the CARICOM-Venezuela partial scope agreements came into effect for all CARICOM countries on the 1st January 1995 and 1st January 1993, respectively.

[4]CARIBCAN preferences came into effect for all CARICOM countries in the year 1986. Lomé I took effect in 1975, and after the expiry of Lomé IV, the Cotonou Agreement came into effect in 2000. The CBI began with the granting of unilateral preferences under the CBERA in 1983 for all CARICOM countries except Suriname, and was later expanded in 2000 under the CBTPA. Preferences under the latter were restricted to only seven CARICOM countries.

limited-dependent variable bias when a significant part of the observations is censored [11].

IV. Data

The data utilized in this study are eclectic. Import and export data were retrieved from the World Integrated Trade Solution (WITS) online trade database [19]. Data were collected for the fifteen CARICOM countries (each represented as country *i*) as well as forty (40) of its main trading partners (each represented as country *j)*. The forty trading partners under observation include *Argentina, Belgium, Brazil, Canada, Chile, China, Colombia, Costa Rica, the Dominican Republic, El Salvador, France, Germany, Guatemala, Honduras, India, Indonesia, Iceland, Israel, Italy, Japan, Mexico, Mozambique, Malaysia, Nicaragua, the Netherlands, New Zealand, Poland, Puerto Rico, Russia, Singapore, Slovakia, Slovenia, South Korea, Spain, Switzerland, Thailand, Turkey, the United Kingdom, the United States and Venezuela.* Data were collected for the years 1980 to 2006 in order to get a better understanding of CARICOM's external trading patterns post-colonial independence and pre-global financial and economic crisis periods.

Data on GDP, GDP per capita and the real effective exchange rate were retrieved from the World Bank's World Development Indicators database [18]. Data on weighted distance, as well as the indicator variables for common language, colony and common colonizer were collected from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) [19], which provides information on geographic and other trade-related variables. Indicator variables were generated to capture the presence of FTAs between CARICOM and the following countries: the Dominican Republic, Colombia, and Venezuela. Preferential schemes between CARICOM and the European Union (i.e. the Lomé and Cotonou Agreements), the United States (i.e. the Caribbean Basin Initiative), and Canada (i.e. The Caribbean-Canada Trade Agreement) were also taken into account.

Table I lists the expected signs for the coefficients of the independent variables. It is expected that trade flows (i.e. both imports and exports, which are considered separately) are positively related to joint GDP and GDP per capita. It is also believed that the more distant two countries are, the less inclined they will be to trade. Hence, trade flows are expected to be negatively related to distance, and are viewed as proxy for transportation costs. The impact of the real effective exchange rate on trade flows may be different depending on the direction of trade. In the case of exports, as the real effective exchange rate increases, exports are expected to fall. On the other hand, an increase in the real effective exchange rate should trigger an overall increase in imports. Countries that share a common border are expected to trade more due to close proximity to trading partners' markets.[5] A common language, a common colonizer, as well as a shared colonial past are also thought to positively influence trade flows. Therefore, it is believed that CARICOM will trade more with countries where English is the official language, and that trade with the United Kingdom will be greater than trade with other countries because of its colonial history.[6] CARICOM countries are also expected to trade more with countries that have been colonies of the United Kingdom. Countries that have a common currency are also expected to trade more due to the ease of exchange.[7] It is expected that CARICOM's trade under all of its preferential trading schemes have resulted in trade creation.

TABLE I: Expected Signs for Coffcients of Independent Variables

Independent Variable	Coefficient	Expected Sign
Joint GDP($Y_{it}.Y_{jt}$)	β_1	+
Joint GDP per capita ($Ypcap_{it}.Ypcap_{jt}$)	β_2	+
Distance (D_{ij})	β_3	-
Real Effective Exchange Rate ($REER_{it}$)	β_4	Exports (-)/ Imports (+)
Contiguity ($contig_{ij}$)	β_5	+
Common Official Language ($comlang_{ij}$)	β_6	+
Common Colonizer ($comcol_{ij}$)	β_7	+
Colony ($colony_{ij}$)	β_8	+
Common Currency ($comcur_{ij}$)	β_9	+
CARICOM-DR (DOM_{ijt})	β_{10}	+
CARICOM-Colombia (COL_{ijt})	β_{11}	+
CARICOM-Venezuela (VEN_{ijt})	β_{12}	+
Caribbean-Canada Trade Agreement ($CARIBCAN_{ijt}$)	β_{13}	+
Lomé and Cotonou Trade Agreements ($LOMECOT_{ijt}$)	β_{14}	+
Caribbean Basin Initiative (CBI_{ijt})	β_{15}	+

V. Findings

Initially, the pooled OLS model was estimated and several specification tests were performed. A Breusch-Pagan test was conducted to verify the presence of heteroskedasticity. The null hypothesis of constant variance was rejected; hence, the presence of heteroskedasticity was confirmed. The pooled OLS model was, therefore, re-estimated to account for heteroskedasticity by estimating robust standard errors. To see if entity and time fixed effects are needed in the model, a joint test is run to see if the dummies for all countries and time periods are equal to zero. This procedure is a standard F-test. The null hypothesis of no fixed effects is rejected. Hence, the LSDV is run which accounts for both entity and time fixed effects, and controls for unobserved heterogeneity in the data. Importantly, the results of the standard F-test also indicate that the pooled OLS estimation yields biased and inconsistent estimates.

Given the presence of heteroskedasticity in the data, and the presence of entity and fixed effects, estimation using a

[5]Belize shares a common border with Mexico and Guatemala. Guyana shares a common border with Venezuela and Brazil. Suriname has a common border with Brazil, while Haiti shares borders with the Dominican Republic.

[6]With the exception of Suriname and Haiti, whose official languages are Dutch and French respectively, the official language of all other CARICOM countries is English. In like manner, with the exception of Suriname and Haiti whose colonizers were The Netherlands and France respectively, the United Kingdom was the colonizer of all other CARICOM countries. For the purposes of this paper, we refer to the common language of CARICOM countries as English, and the common colonizer is the United Kingdom.

[7]The Bahamas is the only CARICOM country that has a common currency, the US dollar, with three of its trading partners: the United States, Guatemala and the Dominican Republic.

nonlinear method is preferred. In this case, the nonlinear PPML model is preferred as it not only accounts for heteroskedasticity, but it also takes into account entity and fixed effects.

A. Imports

Table II reports the estimation outcomes resulting from the three different estimation techniques employed. The dependent variable is the logarithm of imports in all cases, except in the PPML model, where the variable is introduced in the levels.

TABLE II: REGRESSION RESULTS FOR EQUATION (1)

VARIABLES	(1) Pooled	(2) LSDV	(3) PPML
$\ln(Y_{it}.Y_{jt})$	0.876***	1.982***	0.757***
	(0.0100)	(0.193)	(0.0118)
$\ln(Ypcap_{it}.Ypcap_{jt})$	-0.0252*	-1.391***	-0.0424
	(0.0148)	(0.196)	(0.0307)
$\ln D_{ij}$	-0.756***	-1.081***	-0.589***
	(0.0280)	(0.0776)	(0.0829)
$\ln REER_{it}$	-0.134	-0.532***	-0.0581
	(0.110)	(0.135)	(0.194)
$contig_{ij}$	1.209***	1.166***	0.350**
	(0.0748)	(0.114)	(0.140)
$comlang_{ij}$	0.755***	0.435***	0.561***
	(0.0497)	(0.0871)	(0.0746)
$comcol_{ij}$	-0.746***	-0.474***	-0.589***
	(0.0884)	(0.164)	(0.204)
$colony_{ij}$	1.429***	1.166***	0.168*
	(0.0709)	(0.132)	(0.0963)
$comcur_{ij}$	0.272	-0.795***	0.383***
	(0.287)	(0.247)	(0.101)
DOM_{ijt}	0.394***	0.00471	-0.626***
	(0.127)	(0.142)	(0.198)
COL_{ijt}	0.0999	0.294*	0.303*
	(0.124)	(0.161)	(0.160)
VEN_{ijt}	0.454***	0.0749	1.093***
	(0.153)	(0.231)	(0.212)
Constant	-1.932***	-0.0493	0.219
	(0.581)	(1.466)	(1.160)
Observations	9,232	9,232	9,232
R-squared	0.575	0.709	0.723
Country FE		YES	YES

Robust standard errors in parentheses.
***p<0.01, **p<0.05, *p<0.1

As was expected, the coefficients of the following variables impacted imports positively: joint GDP, contiguity, common official language and colony. A 1% increase in joint GDP, that is product of the GDP of a CARICOM country and its trading partner, resulted in a 0.76% increase in the level of imports into the CARICOM market. In like manner, CARICOM countries that share a common border with their trading partners were inclined to import more from them. Having a common official language, and trade with its former colonizer also impacted CARICOM's imports positively. Hence, we can infer that CARICOM imported more from countries whose official language is the English Language, which is expected to facilitate the ease of exchange. Familiarity with the market which is induced by a long-standing colonial relationship is also an underlying reason for increased imports. Although the common currency coefficient had both ambiguous and statistically insignificant effects under both the Pooled and the LSDV models, it was positive and statistically significant under the PPML model. This reveals that The Bahamas is more inclined to import from countries such as the United States, Guatemala and the Dominican Republic since they utilize the same domestic currency.

On the opposite extreme, the coefficients for distance and common colony were both negative. Distance proved to be an impediment to imports in the CARICOM market. A 1% increase in distance reduced imports by 0.6%. Hence, the farther the distance from the CARICOM market to a target market, the less inclined CARICOM countries are to import from it. Countries that share a similar colonial background as CARICOM are highlighted as markets where CARICOM is less likely to import from. This may be due to the fact that the majority of such countries are also raw material and primary commodity exporters. Given that the structure of exports is similar, there is no trade complementarity. Hence, this situation does not facilitate exchange.

The CARICOM-Dominican Republic Free Trade Agreement resulted in import diversion for CARICOM. The results of the PPML model reveal this finding. Import diversion is estimated at 69% from 2002-2006. On the other hand, both the Colombian and Venezuelan partial scope agreements were deemed advantageous to the CARICOM market. The results of the PPML model reveal positive and statistically significant coefficients for the variables COL_{ijt} and VEN_{ijt}, which is indicative of import creation in the region of 50% and 108%, respectively.

B. Exports

Table 3 reports the estimation outcomes resulting from the three different estimation techniques employed. The dependent variable is the logarithm of exports in all cases, except in the PPML model, where the variable is introduced in the levels.

The coefficient of the joint GDP variable is statistically significant at the 1% level in all three cases. The results of the PPML model reveal that a 1% increase in joint GDP results in a 0.85% increase in exports. Hence, the results signal a positive correlation between GDP and exports. The higher the level of GDP of a trading partner, the greater are the level of CARICOM exports to that country.

On the contrary, the coefficient for the variable that captured distance was negative across the three estimation techniques. This signals that an increase in distance between CARICOM and its trading partners resulted in a decrease in the level of exports to those specific markets. The correlation is as anticipated given an increase in distance, which serves as a proxy for transportation costs, is likely to affect the ease with which CARICOM exporters can get to their goods to market. The results of the PPML model reveal that a 1% increase in distance causes exports to decrease by 0.8%.

Some variables had either ambiguous or statistically significant coefficients under the Pooled and the LSDV estimation techniques, but reflected statistically significant coefficients under the PPML estimation technique. The REER and the common official language coefficients were both positive in this regard. The positive coefficient on the REER variable indicates that an increase in REER leads to an increase in exports. This is not as expected, and runs contrary to economic theory which purports a negative correlation between exchange rate appreciation and export levels. On the

other hand, the contiguity coefficient was negative and is indicative that CARICOM countries that share a border with its trading partners are less likely to export to them. Contiguity, which is also an indication of geographical proximity, is thought to be a favourable condition for increased exports due to closeness to market. In the case of CARICOM countries, contiguity negatively affects the level of exports to trading partners.

In the case of preferential trading schemes, CARICOM's free trade agreement with the Dominican Republic proved to be advantageous. All three estimation techniques revealed some amount of export creation owing to the existence of this agreement. Although the PPML method has the lowest and the less statistically significant of the coefficients, we utilize this result as it is the most robust of the three. Export creation is estimated at 62% for the years 2002 to 2006. On the other hand, statistically significant coefficients for the VEN_{ijt}, $CARIBCAN_{ijt}$ and CBI_{ijt} variables under the PPML model reveal the presence of export diversion from the entry into force of these agreements until 2006. Export diversion is estimated at 77%, 113%, and 69% for the Venezuelan, CARIBCAN and CBI agreements, respectively. All the other coefficients of preferential trading schemes were statistically insignificant.

TABLE III: REGRESSION RESULTS FOR EQUATION (2)

VARIABLES	(1) Pooled	(2) LSDV	(3) PPML
$\ln(Y_{it}.Y_{jt})$	0.819***	1.179***	0.849***
	(0.0175)	(0.307)	(0.0397)
$\ln(Ypcap_{it}.Ypcap_{jt})$	0.145***	-0.135	-0.00260
	(0.0246)	(0.308)	(0.0519)
$\ln D_{ij}$	-1.002***	-0.791***	-0.753***
	(0.0469)	(0.113)	(0.0860)
$\ln REER_{it}$	1.219***	0.0580	1.259***
	(0.175)	(0.223)	(0.249)
$contig_{ij}$	0.0948	0.429	-0.883***
	(0.277)	(0.298)	(0.335)
$comlang_{ij}$	0.433***	0.131	1.693***
	(0.0977)	(0.142)	(0.215)
$comcol_{ij}$	-0.457***	-0.514*	-1.906***
	(0.143)	(0.269)	(0.303)
$colony_{ij}$	2.522***	2.590***	-0.139
	(0.282)	(0.215)	(0.346)
$comcur_{ij}$	0.524	-0.728**	-0.163
	(0.409)	(0.341)	(0.302)
DOM_{ijt}	1.934***	3.024***	0.525*
	(0.208)	(0.336)	(0.295)
COL_{ijt}	-1.599***	-0.429	-0.389
	(0.253)	(0.310)	(0.335)
VEN_{ijt}	-0.624***	-0.289	-0.739**
	(0.189)	(0.273)	(0.288)
$CARIBCAN_{ijt}$	0.645***	-0.878***	-1.123***
	(0.137)	(0.254)	(0.250)
$LOMECOT_{ijt}$	0.975***	2.688***	-0.128
	(0.271)	(0.357)	(0.277)
CBI_{ijt}	1.509***	-0.410**	-0.633**
	(0.141)	(0.190)	(0.285)
Constant	-9.343***	-9.576***	-7.697***
	(0.900)	(1.823)	(2.462)
Observations	7,542	7,542	7,542
R-squared	0.439	0.566	0.596
Country FE		YES	YES

Robust standard errors in parentheses.
***p<0.01, **p<0.05, *p<0.1

VI. CONCLUSIONS

The augmented gravity model, which is noted for its empirical robustness, describes the determinants of CARICOM's external trade well. This is especially true when the PPML method is applied, which results in R-square values of 72% and 60% for Equations (1) and (2), respectively. The PPML model is preferred in this regard as it not only accounts for heteroskedasticity, but it also takes into account entity and fixed effects.

The first objective of this paper was to find out the factors which influence CARICOM's historical trading patterns with third partners. As was evidenced in the regression results of Equation (1), the coefficients for joint GDP, distance, contiguity, common language, common colonizer, colony and common currency were all found to impact imports in different ways. Joint GDP, contiguity, common language, colony, and common currency were found to impact imports positively, while distance and common colonizer were found to impact imports negatively. On the other hand, the factors which influenced CARICOM exports positively as evidenced in the regression results of Equation (2) were joint GDP, the REER, and common official language. Distance, common colonizer, and contiguity variables were found to have negative coefficients, which is indicative of a negative relationship between them and CARICOM exports.

The second objective was to assess the benefits which have accrued to CARICOM given its participation in preferential schemes. Equation (1) reveals positive coefficients for the partial scope agreements between CARICOM and Venezuela, and CARICOM and Colombia. Given the traditional interpretation of import creation, we can infer that CARICOM's imports from these two countries were cheaper alternatives to more expensive domestic and third-party sources. This is especially true for the agreement with Venezuela. Whilst the CARICOM's imports from the Dominican Republic resulted in trade diversion of 69%, export creation was recorded at 62% from 2002-2006. Equation (2) also reveals export diversion in the cases of the Venezuelan, CARIBCAN and CBI agreements in the amounts of 77%, 113% and 69% respectively. This indicates that CARICOM's exports to these markets came mainly as a result of the market access provided under the agreements and not as a result of the efficiency of its trade with the partner. In this sense, trade with these preferred partners is seen as a diversion from more lucrative markets. An important conclusion can also be drawn as it relates to preferential trading schemes with CARICOM's traditional trading partners. It is revealed that these arrangements have resulted in export diversion rather than export creation.

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