2006

Analysis of trade in the Western Hemisphere utilizing a Gravity Model framework

Brian Matthew Hilbun
Louisiana State University and Agricultural and Mechanical College, bhilbu1@lsu.edu

ANALYSIS OF TRADE IN THE WESTERN HEMISPHERE UTILIZING A GRAVITY MODEL FRAMEWORK

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
In partial fulfillment of the
Requirements for the degree of
Master of Science

in

The Department of Agricultural Economics
and Agribusiness

by
Brian Matthew Hilbun
B.S. Louisiana State University, 2003
August 2006

ACKNOWLEDGMENTS

Firstly, thanks be unto Providence for divine assistance in the completion of this work. Also, I would like to thank my major professor, Dr. P. Lynn Kennedy, for all his assistance, guidance, suggestions, and direction which aided in the completion of this project.

Thanks is also due to my committee members, Dr. Gail Cramer and Dr. Michael Salassi whose input and aid also contributed significantly to the completion of this task. I also would like to thank Christiane Aust, Lucas Beverlin, Dr. David Brasington, Dr. Carter Hill, Gregory Kwentua, Dr. Kevin McCarter, Huizhen Niu, Beth Roule, and Dr. Hector Zapata for all their aid in helping me complete this thesis.

Finally, I would like to thank my mother, Edith B. Hilbun, who for all her understanding and patience truly deserves more than I could every repay her and without whose patience this work could not have come to fruition.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

With the recent proliferation of Regional Trade Agreements (RTAs) the tendency world-wide has been seemingly toward trade liberalization. This thesis is primarily concerned with the impacts RTAs have had in the Western Hemisphere regarding agricultural trade flows. Utilizing the framework of the Gravity Model, agricultural trade flows for 24 Western Hemisphere Nations were examined. In the course of the study it was expected that if RTAs were to have an effect it would be a positive Trade Creation Effect and a negative Trade Diversion Effect with positive effects for GDP of importer/exporter and population size of importer/exporter and a negative effect for that of distance. Of the five agreements examined (NAFTA, AC, MERCO, LAIA, and CACM), NAFTA and LAIA were the only positive (but non-significant) as to Trade Creation effects while AC, MERCO, and CACM were all negative (but non-significant). It was also interesting to note that of the agreements, NAFTA, had both a *positive* and significant ($p=0.023$) diversionary effect with the remaining agreements all being negative (as expected) and significant regarding trade diversion. It was also concluded that GDP (importer) and distance also had the expected signs (+,– respectively) with distance also being significant ($p=0.0001$). It was concluded that RTAs had a more pronounced effect on *inter*-industry trade versus *intra*-industry trade and that with the passage of more time, further analysis may substantiate the claim of a positive RTA effect on agricultural bilateral trade flows.

CHAPTER 1
INTRODUCTION

Trade is a dynamic activity, constantly evolving with time. The trading policies of nations are ever changing to meet current needs of constituencies all the while maintaining a steady gaze towards future needs. As such, any activities connected with international trade between nations and the study of such activities is by nature dynamic. Economics, being by nature and definition concerned with the most beneficial distribution of scarce resources, must be, by nature, a dynamic science; dynamic in the ways it views and examines international trade and its results.

Since the needs of the constituencies of nations are not static, harnessing the potential benefits international trade offers provides an avenue for nations to expand their economic horizons. Employment of these benefits allows countries to utilize their relative comparative advantages and resource endowments in providing goods and services that not only enhances the lives of others (by lowering the equilibrium market price of the respective good and/or service) but also by enhancing the production capabilities of a particular economy in allowing that producer of a good or service to take advantage of their expanded market(s). Also, potentially greater economies of scale in their production effort can be employed to that nation's particular advantage furthering opportunities that would be beneficent to international trade.

Patterns in international trade have consistently moved from that of protectionism to that of more liberalized trade policies. Trading blocs have been organized that allow nations to take advantage of mutual membership, in turn,

freeing up the lanes of commerce to ever improved flows of goods and services between respective member nations. Nations are constantly evolving in their technical abilities as well, populations continue to grow and defining economic policies that make allocations for the increase in the trade flow of goods between nations will continue to evolve as a central policy of any responsible government.

Some have argued that regional trading blocs coupled with preferential trade agreements and actual fair trade are not complementary to each other but rather adversarial. Detractors of free trade agreements and regionalism warn that with no protective measures in place, dumping of goods would be a common occurrence to the detriment of that nation's domestic producers. Some have argued that the key way to battle the dumping of goods and services is to maintain a system of tariffs in place that would stymie any potential dumping activity. Free and *fair* trade should be viewed as an attainable goal, and that through equitable bi- and multilateral trading agreements (with consistent enforcement across the board), international trade would be an engine for economic growth, enhancing national and private life. Therefore, it is the purpose of this paper to examine the trading patterns of the nations of the Western Hemisphere given the existence of various Regional Trade Agreements.

Problem Statement

With the recent proliferation in the Western Hemisphere of multi-lateral trade agreements that started in the late 1950s (e.g. North American Free Trade Agreement-NAFTA, Caribbean Community and Common Market-CARICOM, Southern Common Market-MERCOSUR, Andean Community-CAN, Latin

American Integration Association-LAIA, Central American Common Market-CACM, and most recently the Central America Free Trade Agreement-CAFTA etc.) the trend has been towards an atmosphere of ever-increasing freedom in commerce between nations. An attempt should be made to determine what effects these agreements have had on trade creation and trade diversion in the Western Hemisphere.

Objectives

General Objective

The objective of this thesis will be to generate a Gravity Equation that will have a conclusive explanatory capability as to bi-lateral trade flows in the Western Hemisphere, taking into account export flows of agricultural commodities of countries situated in the Western Hemisphere (to one another) as the dependent variable, and variables of GDP-exporter (importer), Population Size-exporter (importer), Distance between exporter and importer, and several additional variables that capture the trade effects due to common language between trading pairs, and mutual membership in a Regional Trade Agreement (RTA) as our explanatory (independent) variables. We will then analyze the relationship of the independent variable coefficients and examine to see if accepted economic relationships hold (i.e. positive effects for the coefficients of respective GDP, respective population size, and negative effects for the distance variable) and conduct a thorough discussion of the results.

Specific Objectives

- Conduct a Literature Review of the Gravity Equation as it relates to tracing agricultural commodity flows.
- Construct a Gravity Equation that captures the bi-lateral trade flows of agricultural commodities in the Western Hemisphere
- Comprehensively discuss those effects as to the trade creation/diversion effects regarding agricultural commodities in the Western Hemisphere

With the rise of Regional Trading Agreements in the Western Hemisphere (and world-wide for that matter), the question arises, "What are the origins of Regionalism and what, if any, are the benefits to be reaped?" With that question in mind, we now proceed to the next section. Also, we shall discuss the use of the Gravity Model as a tool in analyzing trade flows, examining the trade flows between countries in the presence of Regional Trading Agreements in the Western Hemisphere.

Regionalism

The concept of regionalism is not a new one. Regionalism is defined, in the context of this study as the preference of nations to trade with nations with which a common geographical region is shared. One of the obvious reasons for regionalism is that it overcomes distance as a hindrance to trade. In the literature distance is commonly referred to as a 'friction to trade', subsequently, distance is viewed (from both intuitive and econometric viewpoints) as having a negative impact on trade flows, and as a result insinuating that from both expectation and economic theory a negative sign should be the expected sign for the distance coefficient in any econometric equation (Pöyhönen,1963, Linneman, 1966,

Tinbergen, 1962). That is, the further two nations lie from each other, the more expensive the transaction costs are. Srivastava and Green assert that of all the determinants of trade intensity between nations, distance is the *single most important determinant*, with an even higher level of correlation in Srivastava and Green's study being noted between distance and trade than that which was noted by Linneman in his extensive 1966 study, *An Econometric Study of International Trade Flows* (Srivastava and Green, 1986).

There are also other underlying reasons for the rise of regionalism world-wide. It has been proposed that regionalism has been embraced due to frustration with the delay in GATT negotiations and that the United States has shifted its tendencies from that of multilateralism to that of ardent regionalism. (Baldwin, 1997) This proliferation of regional trading agreements is quite prolific. The GATT received notice of 124 regional trading agreements from 1948 to 1994, and after the WTO had been instituted in 1995, the GATT/WTO received notification of an additional 130 agreements covering both goods and services (WTO, 2006). Some of these agreements are no longer in force having been amended by subsequent agreements, etc. but as of 2002 there were 162 agreements in force with the number projected to rise to 300 by 2007 (WTO, 2006). Proponents of RTA's argue that RTA's allow countries to gradually work toward global free trade while providing a window of respite for domestic industries that need time to adjust to the specter of global competition. Also, because of the number of countries involved, conflicts regarding more sensitive areas (ex. agricultural subsidies) can be resolved much easier when the number of countries is limited.

Allowing the resolution of these issues at a regional level is much more easily tackled than at the multilateral level. Critics argue that the proliferation of RTA's has spawned issues in trade that will in the end hinder multilateral trade negotiations (ex. complex trade preferences, fear of dumping accusations and the attendant retaliatory action, etc) (GTN, 2006). The existence and creation of RTA's will be the subject of debate for some years to come. In this paper we examine to see the role, if any, RTA's play in trade creation and diversion in the Western Hemisphere.

The Gravity Model

The Gravity Model has been used since the early 1960's to describe bilateral trade flows between nations. A Finnish Economist, Pentti Pöyhönen (1963), and a Dutch Economist, Jan Tinbergen (1962), were among the first to utilize the Gravity Model in their respective studies regarding trade. Another Dutch Economist, Hans Linneman (1966), employed the Gravity Model in his exhaustive study on world trade flows. In Linneman's model, more variables that tended toward a more theoretical justification of the Gravity Model rather than the more intuitive arguments of Pöyhönen and Tinbergen were added (Deardorff, 1995). Linneman's version of the Gravity Model was said to be grounded in that of a Walrasian General Equilibrium System. The drawback to this approach was that in a Walrasian System there tend to be too many variables for the reduction of each trade flow to the Gravity Model (Deardorff, 1995). In 1974, Leamer employed both the Gravity Model and a Heckscher-Ohlin model in order to lend credence as to the motivation for the explanatory variables in his regression

analysis of trade flows, Leamer however refrained from combining both the Gravity Model and the Heckscher-Ohlin model together theoretically (Leamer, 1974). Attempts to justify the Gravity Model theoretically would be addressed by several parties. In 1979, Anderson proffered his theoretical justification for the Gravity Model, where he proposed that by modeling preferences over traded goods only, by assuming Cobb-Douglas preferences (and in an appendix CES preferences) and by making what is commonly known today as the Armington Association of the national differentiation to the origins of goods, the Gravity Model could be derived, and so was Anderson's argument for a theoretical foundation for the Gravity Model set forth. Jeffrey Bergstrand would follow Anderson in 1985, where Bergstrand posited that, like Anderson, by assuming CES preferences and accepting the Armingston Assumption for traded goods, a reduced form equation for the estimation of the flow of goods between nations could be obtained. Bergstrand employed GDP deflators as a proxy for price indices and then went on to estimate his system, testing the assumption of product differentiation. Estimates obtained by Bergstrand supported his assertion that imported goods were, for each other, better substitutes, not the original assertion of perfect substitutability (Bergstrand, 1985).

The generalized Gravity Model equation is of the form:

(1.1) $$lnX_{ij} = lnA_j + lnY_i + lnY_j + lnN_i + lnN_j + lnD_{ij} + U$$

where lnX_{ij} is the log dollar amount of the flow of goods from country *i* to country *j*, lnA_j is the intercept term, lnY_i is the log of country *i*'s income (normally GDP), lnY_j is the log of country *j*'s income (normally GDP), $ln\ N_i$ is the population of

country i, lnN_j is the population of country j, where lnD_{ij} is the distance between countries (usually capitals of the respective countries) and where U is a randomly distributed log normal error term, capturing any effects not captured in the independent variables of the model. Also, there can be other explanatory variables in the Gravity Model. For example, dummy variables that capture mutual membership of any two countries within the same RTA (capturing any trade creation effects of the model), dummy variables that capture any effects from one country's membership in a particular RTA and a trading partner who is not a member of that particular RTA (capturing any trade diversion effects), and dummy variables that capture any colonial or linguistic ties any two countries might share in common.

Analysis of the different trading blocs (utilizing the Gravity Model Framework) that currently reside in the Western Hemisphere as to the trade creation and trade diversion effects will be conducted. According to the WTO there are currently six trading blocs in the Western Hemisphere. Table 1.1 shows the pertinent listing of these agreements along with a listing of member nations. Each particular trading bloc will then be then discussed summarily as to its origins and nature.

Communidad Andina-Andean Community

The Communidad Andina (CAN) came into being in 1969 with the signing of the Cartagena Agreement. Bolivia, Colombia, Ecuador, Peru, and Venezuela are the members of CAN. The goals of CAN are:

-Promotion of balanced and equitable development of member states

-Job creation and economic growth

-Gradual creation of a Latin American Common Market

Table 1.1 Regional Trading Blocs in the Western Hemisphere

Trading Bloc	Date Instituted	Member States
CAN-Andean Community	05/1969	Bolivia Colombia Ecuador Peru Venezuela
CACM-Central American Common Market	12/1960	Costa Rica El Salvador Guatemala Honduras Nicaragua
CARICOM-Caribbean Community and Common Market	07/1973	Antigua & Barbuda Bahamas Barbados Belize Dominica Grenada Guyana Haiti Jamaica Monserrat Trinidad & Tobago St. Kitts & Nevis St. Lucia St. Vincent & the Grenadines Surinam
LAIA-Latin American Integration Association	08/1980	Argentina Bolivia Brazil Chile Colombia Cuba Ecuador Mexico Paraguay Peru Uruguay Venezuela
MERCOSUR-Southern Common Market	03/1991	Argentina Brazil Paraguay Uruguay
NAFTA-North American Free Trade Agreement	01/1994	Canada Mexico United States

In CAN there has been a Free Trade Zone in effect since 1993 (with participation by Bolivia, Colombia, Ecuador and Venezuela and into which Peru is currently (2006) being incorporated). A Common External Tariff of 13.6% (average), 20% ceiling, has been in effect in the member states since February 1, 1995. CAN has been concentrating on the creation of and strengthening of an Andean Legal System and harmonizing economic instruments and policies in order to correct/prevent distortions in competition. The structure that links up the

various bodies of CAN and enables them to function together coherently and to maximize sub-regional Andean integration is the Andean Integration System (SAI).

The highest level of the SAI is the Andean Presidential Council. The Presidential Council's responsibility lies in issuing guidelines concerning the different areas/spheres of Andean sub-regional integration. Its membership is composed of the heads of state for the member states with its chairman's post being rotated between the council's membership. Each term for the Chairman's post lasts for a period of one year.

In addition, there is the Andean Council of Foreign Affairs (ACFA) whose membership is comprised of the Ministers of Foreign Affairs of member countries. The ACFA's role is one of political leadership, ensuring the goals of sub-regional Andean integration are attained in an efficient matter and for the creation and implementation of CAN's foreign policy. The ACFA signs conventions and agreements regarding global foreign policy and cooperation with third party states and with international organizations. The will of the ACFA is expressed through two instruments: Declarations and Decisions. Declarations are non-binding statements whilst Decisions are legally binding. Both Declarations and Decisions must be reached on a consensus basis. The provision for the ACFA's authority in this regard is set forth in the Charter of the Court of Justice, specified in the Cartagena Agreement.

There is then the Andean Community General Secretariat (ACGS). The ACGS is the executive body of CAN which resides under the direction of the

Secretary General. The ACGS has the ability to propose legislation and is authorized to draw up Draft Decisions for proposal to the Andean Council of Foreign Ministers. The ACGS also monitors to ensure compliance to community commitments is fulfilled within CAN. The judicial body of CAN is the Andean Community Court of Justice (ACCJ). The ACCJ is comprised of five judges, one from each member state. The ACCJ ensures the legality of provisions laid down by CAN. The deliberative body of CAN is the Andean Parliament (AP). The AP's membership is currently made up of the membership of the deliberative bodies of each of the member states. The purpose of the AP is one of participation in the legislative process of enabling the various bodies of SAI to propose drafts of common interest.

CACM-Central American Common Market

The General Treaty of Central American Economic Integration signed on December 13, 1960 by El Salvador, Guatemala, Honduras, and Nicaragua, was the basic instrument that envisioned the CACM with Costa Rica's accession to the Treaty coming later on July 23, 1962. The CACM's aim was the unification of member state's economies by creating a common market amongst member states with joint promotion of economic development within the region. Several proposals to the General Treaty have been signed by member states and with ratification by all or some member states. Protocols signed include the Protocol containing the Standard Central American Tariff Code (CAUCA) on December 13, 1963. A Draft Treaty intended to replace the 1960 General Treaty was presented to the executives of the member countries on March 23, 1976; this Draft

Treaty recommends the creation of the Central American Economic and Social Community with the sole purpose of replacing the CACM. The CACM adopted in December, 1984 the trade classification nomenclature of the Customs Cooperation Council in Brussels through the CACM's acceptance of the Convention on Central American Tariffs and Customs Regulations. The Convention was signed by duly authorized representatives of the governments of Costa Rica, El Salvador, Guatemala and Nicaragua with implementation coming into effect on September 17, 1985. The Tariff was annexed to the Convention and was summarily approved. The Central American Tariff System (based on the International Harmonized System) came into effect January 1, 1993.

The structure of the CACM is established in three bodies as stipulated in the General Treaty:

1. Meeting of Ministers-Membership made up of the Ministers of Economy and/or External Commerce of the member states. The primary goal being to direct and coordinate economic integration.
2. Forum of Vice Ministers of Economy-Membership composed of one member and an alternate from each member country with the purpose of application and administration of the General Treaty.
3. Secretariat-Whose head is the Secretary General, elected for a three year term by the Meeting of Ministers. The Secretary General serves the needs of the other bodies.

CARICOM-Caribbean Community and Common Market

The Caribbean Community and Common Market (CARICOM) was established by the Treaty of Chaguaramas and was signed on July 4, 1973 by the Prime Ministers of Barbados, Guyana, Jamaica, Trinidad and Tobago and Trinidad. Six more countries (Belize, Dominica, Grenada, St. Lucia, St. Vincent and the Grenadines, and Montserrat) signed the Treaty of Chaguaramas on April 17, 1974. The Treaty came into force August 1, 1973 for the first six countries and May 1, 1974 for the latter six. On July 4, 1974 Antigua joined CARICOM with St. Kitts-Nevis-Anguilla following on July 26, 1974. The Bahamas joined CARICOM on July 4, 1983 (as a member of the Caribbean Community but not as a member of the Common Market). Suriname followed, becoming a member of both the Caribbean Community and Common Market on July 4, 1995. Haiti joined CARICOM on July 4, 2002.

The Treaty of Chaguaramas separates the Caribbean Community from that of the Common Market, defining each as a specific/distinct entity separate from each other. A Common External Tariff is provided by CARICOM for its member states along with the development of a common protective policy for member states, as well as, progressive coordination of external trade policies. The Structure of CARICOM is as follows:

1. Conference of Heads of Government-Supreme Organ of CARICOM. Its mission is one of policy provision and direction. Membership is made up of the Heads of State of member countries.

2. Bureau of the Conference-Instituted December 12, 1992. The Bureau's responsibilities include: initiation of proposals for development, updating Member States' consensus regarding unresolved issues from the Ministerial Councils, and aid with implementation of CARICOM decisions. The Bureau is composed of a current Chairman of the Conference, who, along with the immediately incoming and outgoing Chairmen of the Conference work together under the direction of the Secretary-General (as Chief Executive) in the executing the mission of the Bureau.

3. The Community Council of Ministers-Organ of second highest rank, the Council is responsible for planning and coordination of economic integration, cooperation, and external relations. Its membership is made up of Ministers of Community Affairs for member nations or any other Minister designated at the will/pleasure of member nations.

The principal organs are assisted in the pursuit of their objectives by several other councils namely: 1.) Council for Trade and Development (COTED)-trade promotion, 2.) Council for Foreign and Community Relations (COFCOR)-assists in inter-member nation relations, relations between member nations and international organizations, and relations between member nations and third party states, and 3.) Council for Finance and Planning (COFCAP)-this council deals with economic policy coordination and acts as a liaison between member nations in the areas of financial and monetary integration.

LAIA-Latin American Integration Association

The Latin American Integration Association (LAIA, ALADI *sp.*) was established by the Treaty of Montevideo, and was signed August 12, 1980 in Montevideo, Uruguay by the Ministers of Foreign Affairs for Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, Uruguay, and Venezuela. Their membership was followed by that of Cuba on August 26, 1999. LAIA's aim is that of integration with the result being "balanced" socioeconomic development. An area of economic preferences has been established among member countries. This area is composed of regional tariff preferences, multi and bi-lateral agreements among member nations, which as a result, creates an environment that encourages the participation in the integration process by lesser-developed countries through the agency of non-reciprocity and community cooperation. The structure of LAIA is composed of the following:

1. Council of Ministers of Foreign Affairs-Primary organ responsible for the adoption of chief guidelines. It is composed of the Ministers of Foreign Affairs for the member states.
2. Evaluation and Convergence Conference-Responsible for examination and operation of the integration process as well as evaluation of the results of preferential agreements and makes recommendations for further study to the Secretariat. Its membership consists of authorized representatives of the respective member nations.
3. Committee of Representatives-This committee is the permanent political body of LAIA. Its chief duties lies in the promotion of the conclusion of agreements, the adoption of measures deemed necessary for respective

Treaty adoption and implementation, as well as convening the Council and the Conference.

4. The Secretariat-Concerned chiefly with technical and administrative tasks. The Secretariat is headed up by a Secretary-General elected by the council for a three year term (renewable).

MERCOSUR-Southern Common Market

Known in Spanish as *Mercado Común del Sur (MERCOSUR),* MERCOSUR was established by the Treaty of Asuncion in 1991 between the governments of Brazil, Argentina, Uruguay, and Paraguay. MERCOSUR's aim is harmonized socio-economic development of member economies through advanced economic integration, the adoption of a Common External Tariff (CET), and facilitating the ease in movement of people and goods throughout the membership region. The structure of MERCOSUR is composed of:

1. Common Market Council-Organ of highest rank in MERCOSUR, chief responsibility-ensuring proper conduct of policy as regards to compliance to the Treaty of Asuncion. Membership is comprised of the Ministers of Foreign Affairs of the four member states. Member states preside over the Council on a six-month rotational basis.
2. Common Market Group-Executive Organ of MERCOSUR, the duties relegated to the Common Market Group are its assurance that compliance with the Treaty of Asuncion is maintained and to consider and implement resolutions made by the Council. The Common Market Group can also initiate measures for the opening of trade, coordinate macroeconomic policies, and negotiate agreements with countries, international agencies,

who are not members of MERCOSUR. Membership of the Common Market Group is comprised up of four permanent members, one from each member state and four alternate members, one from each member country representing either 1.) The Ministry of Foreign Affairs, 2.) The Ministry of the Economy (or equivalent) and 3.) The Central Bank.

3. Joint Parliamentary Committee-Follows the integration process and makes recommendations to the Council. The Committee has an advisory role as well as that of making decisions. Membership is comprised of 64 members, 16 from each member state with an equal number of alternates serving as well. Members are appointed by congressional body of their respective member nation and length of term is two years.

4. Trade Commission-The goal of the Trade Commission is the development of common trade policies that will be applicable across member states in the operation of a customs union. The Trade Commission would also serve to follow up on any matters relevant to the further development/refinement of common trade policies across member states. The Commission is composed of four members with four alternates, each member state being equally represented.

NAFTA-North American Free Trade Agreement

The North American Free Trade Agreement (NAFTA) is a trade agreement between Canada, The United States, and Mexico that was signed in December of 1992, entering into force January 1, 1994. NAFTA is unique in that it establishes a free trade area between developed and developing countries. The goals of NAFTA as stipulated in the agreement were:

1. Eliminate barriers to trade and ease cross border transport of goods and services between the respective member states
2. Promote an atmosphere of free competition in the free trade area
3. Increase investment in the areas of the respective member states
4. Provide for the adequate protection of intellectual rights within the areas of the respective member states
5. Create procedures that will affect the provisions of the agreement
6. Establish a framework for further regional and multi-regional integration and cooperation

There are over 40 committees charged with seeing the implementation of NAFTA. Overseeing these committees is the Free Trade Commission, whose membership is composed of representatives from each member nation with cabinet status. They meet at least once a year to oversee the performance of the integration effort. It was proposed, and agreed to, at the Commission's first meeting of the establishment of an International Coordinating Secretariat to be established in Mexico City, as of yet it has not been implemented. NAFTA calls for the elimination of all tariffs and quotas between member states within 15 years of implementation of the agreement. Regarding agricultural products, half of all existing tariffs were to be removed immediately, except for tariffs on crops that tended to be politically sensitive (i.e. Corn, etc.) with a more gradual phase-out planned for over the next 15 years.

In this thesis, it is the express purpose to examine the effects that the above mentioned RTA's have had on trade creation and trade diversion in the

Western Hemisphere. We would be remiss however if we did not also examine common ties of culture. In the literature, it has been an established practice of associating increased trade flows with a common cultural background (Linneman, 1966). Table 1.2 shows a list of countries included in the scope of this study as well as their native language spoken.

Cultural Perspective

As can be seen from Table 1.2, of the 24 nations included in this study all but 6 have Spanish as their national language. This is not to be taken that Spanish is the sole language of these countries (of those which list Spanish as their primary language) since there are many different indigenous languages employed in many of these countries as well.[1] But as can be seen from Table 1.2, Spanish colonialism has left its mark in the Western Hemisphere with Sandberg concluding that Spain had exerted a rather strong influence on the distortion of trade patterns of its former colonies (Sandberg, 2004).

Spanish is the primary language of daily life and commerce in the majority of nations included in this study. Taking into account language commonality Figure 1.1 is included to show the distribution of Spanish in terms of ancestry throughout the Western Hemisphere. It is not asserted here that language commonality between two countries automatically predisposes two countries to a greater level of trade than without language commonality, but it would be a point

[1] (ex. the Guarani Language which is prominent in Paraguay, and specialists have identified twelve distinct family groups, with over forty subgroups, resulting in more than ninety *distinct* languages in Mexico alone! and these two examples of Paraguay and Mexico are only offered as to bear witness to the amount of language diversification in the region. (Photius, 2006)

Table 1.2 Countries and Native Languages

	COUNTRY	NATL. LANGUAGE
1	ARGENTINA	SPANISH
2	BELIZE	ENGLISH
3	BOLIVIA	SPANISH
4	BRAZIL	PORTUGUESE
5	CANADA	ENGLISH/FRENCH
6	CHILE	SPANISH
7	COLOMBIA	SPANISH
8	COSTA RICA	SPANISH
9	DOMINICA	ENGLISH
10	DOMINICAN REPUBLIC	SPANISH
11	ECUADOR	SPANISH
12	EL SALVADOR	SPANISH
13	GUATEMALA	SPANISH
14	GUYANA	ENGLISH
15	HONDURAS	SPANISH
16	MEXICO	SPANISH
17	NICARAGUA	SPANISH
18	PANAMA	SPANISH
19	PARAGUAY	SPANISH/GUARANI
20	PERU	SPANISH
21	SURINAME	DUTCH
22	UNITED STATES	ENGLISH
23	URUGUAY	SPANISH
24	VENEZUELA	SPANISH

of interest to keep in mind during the course of this study, to see the links, if any between and how (if) they affect international trade flows between the respective countries. It is also an interesting note that the largest economy in South America, Brazil, speaks Portuguese primarily rather than Spanish, but this difference in language is not seen as a barrier to trade between Brazil and her neighbors, given the similarities between the two languages (seeing that both Spanish and Portuguese are Romance Languages sharing Latin as a common root and are of similar construction in grammar, vocabulary, and syntax).

Figure 1.1 Hispanic Ancestry in the Western Hemisphere
source:http://comnet.org/hispanic/images/maps/map1.jpg

Thesis Organization

The organization of this paper is as follows: Chapter One will be comprised of the introduction, problem statement, and objectives. Chapter Two will be comprised of a theoretical and empirical review of international trade theory used as a structural foundation of this study. Chapter Three will discuss the methodologies employed in this study. Chapter Four will discuss the data and variables used for our analysis and the results obtained from the model used in this analysis. Chapter Five will be the concluding chapter in which a summary will be included and conclusions discussed.

CHAPTER 2
LITERATURE REVIEW

Beginnings of the Gravity Model

Newton postulated the "Law of Universal Gravitation" in 1687 describing the attraction between two forces as the result of the product of the mass of the two bodies divided by the squared distance between the two bodies multiplied by a gravitational constant (read frictional force) (Head, 2003). This gravitational relationship was first utilized when Tinbergen, in 1962, proposed that the same approximate gravitational form could be employed in the description of international trade flows. Tinbergen's equation has "flow" between country *i* and country *j* (monetary value of respective exports) as the dependent variable being equal to the product of the relative economic sizes (GDP) of said country *i* and country *j*, divided by the measured distance between country *i* and country *j* (usually the squared distances between capitals) and finally multiplied by some constant (which measures the hindrance/ease of transaction between countries). (Head, 2003) This relation can be employed not only in an economic sense, but also in the description of many different types of flows (e.g. migration, commuting, and commodity shipping to name a few) (Bergstrand, 1985).

Linneman followed in the footsteps of Tinbergen where, in his 1966 study of international trade flows, he employed a form of the Gravity Model to explain trading activity between nations. In Linneman's 1966 study, the trading patterns of 80 nations were examined (excluding communist countries). The independent variables in the model were population, GNP (income), distance and a preferential trade variable. The preferential trade variable distinguished between preferential

trade in three areas of influence (stemming from former colonial ties)-British, French and Portuguese/Belgian. Linneman conducted separate regressions for both exports and imports and found a statistically significant relationship between the import/export volumes between nations. Of all the independent variables, GNP (for importing and exporting nations) and population had the highest explanatory power in describing the fluctuations in trade volumes between countries. The remaining variables contributed less (though still significant) explanatory capability to the model. To further refine his model (in an attempt to capture hitherto unexplained variation in the model), Linneman specified an additional independent variable that took into account the commodity composition of trade between nations. Linneman's assertion being that differentiated production of goods between countries spurred trade between these nations and homogeneous production inhibited trade. Linneman also spoke of 'psychic distance' in an attempt to incorporate cultural tastes into his model. Asserting that a common cultural background would promote a closer understanding between countries, and since these countries have similar cultural tastes, production would tend to be in goods that both nations would deem desirable and thus further stimulate trade.

Linneman's research has served as a springboard for others investigating bilateral trade between nations. Srivastava and Green attempted to model trade flows that occurred between nations. They examined bilateral trade flows between 45 exporting nations and 82 importing nations. They included independent variables (as had Linneman and others) such as: distance, product

category, political instability, cultural similarity, colonial past, mutual membership in a preferential trading community, and standard demographic variables such as GDP and population. Srivastava and Green incorporated into their model additional independent variables that attempted to measure the effects of cultural similarity, political instability and membership in particular economic unions not formally included in past studies. Also in Srivastava and Green, the magnitude of trade flows between nations was not measured in an absolute sense, but rather by the 'relative strength' of trade between nations (i.e. relative volume versus absolute volume of trade flows between countries). Srivastava and Green attempted to analyze the determinants of the ties that would tend to enhance the 'relative strength' of trade between nations rather than identifying the determinants of the *volume* of trade between nations. They not only examined the determinants of aggregate trade between nations but also disaggregated the data into specific product categories. They found in their study, that of the independent variables employed in their model, those independent variables were better at explaining manufactured goods trade flows as opposed to non-manufactured goods trade flows. The two variables with the greatest clarifying ability were political instability of the exporter and cultural similarity.

Srivastava and Green's study also expanded current understanding of the determinants of trade as they relate to the effects of the demographic variables of GDP and population. This control was accomplished through the agency of a Trade Intensity Index (TII). The TII's mission was to reflect the strength of trade relations between nations (minimum value of the Index being restricted to zero)

within each of the nine Standard Industrial Trade Classification (SITC) product categories. The example cited in the study was that "if the U.S. accounted for 10% of world food exports and if India accounted for 8% of world food imports, then expected volume of U.S. food exports to India would be 0.8% (.10 x .08) of world food exports." (Srivastava and Green, 1986) By utilizing the TII, Srivastava and Green asserted that influence on trade flows exerted by the demand variables was out of proportion to nations' relative economic sizes. They also assert that, like Linneman, the demographic variables of GDP and population have explanatory power in the gravity model, but to further understand their contributions additional variables, such as cultural similarity, were needed for further clarification.

Not only has the gravity equation been used in examining bilateral trade between generalized groups of nations, it has also been utilized in examining the trade creation and trade diversion effects in particular regions and within particular trading blocs. Carrillo and Li utilized the Gravity Model in an attempt to examine to determine what influence the Andean Community and MERCOSUR preferential trading agreements had had on trading patterns from 1980-1997, focusing primarily on intra-regional, intra-industrial trade. They employed Rauch (1999) trade classifications differentiating between homogeneous and differentiated goods further subdividing their data by employing United Nations' factor intensity classification to separate trade in natural resources from trade in manufactured goods. In Carrillo and Li, the gravity equation was utilized with the fluctuations of the dollar flow of goods between

country *i* and country *j* being explained by the independent variables of GDP (income for country *i* and country *j*), a variable, DIF, that accounted for the absolute difference in per capita income between country *i* and country *j*, a variable that represented distance from country *i* to country *j*, a dummy variable capturing shared border effects, and two additional dummy variables utilized to capture the effects of two countries mutual membership in either the Andean Community (AC) or the Southern Common Marketer (MERCOSUR).

Carrillo and Li found that the AC and MERCOSUR have had an effect on intra-regional and intra-industrial trade but when compared with other crucial variables their impact was somewhat diminished. The impacts of the regional trading agreements were limited relatively to particular product classes rather than to all the products considered. The variables for distance, contiguity, etc. were found to be statistically significant across all considered product categories but that the contributions of the AC and MERCOSUR to trade flows weren't as considerable as had been conjectured previously by policy-makers. In the end, Carrillo and Li postulated that with a further push for a broader trading bloc in South America, the main determinants to furthering future trade would be those of size and distance and efforts should be made to alleviate transaction costs between regions to further economic integration.

Koo, Kennedy, and Skipnitchenko utilized the Gravity Model in analyzing the effects that Regional Trading Agreements (RTAs) have had on *agricultural* trade.

In their model, Koo, Kennedy, and Skipnitchenko employed a Gravity Model of the form:

(2.1) $x_{ij} = a_1 + a_2 y_i + a_3 y_j + a_4 d_{ij} + a_5 PTAc_{ij} + a_6 PTAd_{ij} + a_7 S_{ij} + e_{ij}$

where the dependent variable x_{ij} (the logarithm of bilateral trade flows) is explained in the variation of the independent variables: y_i, country *i*'s income expressed by the logarithm of *i*'s GDP); y_j, country *j*'s income expressed by the logarithm of *j*'s GDP; d_{ij}, a distance variable between country *i* and country *j;* $PTAc_{ij}$, a dummy variable that captures the trade creation effects as the result of countries *i* and *j*'s mutual membership in a RTA; $PTAd_{ij}$, a dummy variable that captures the trade diversion effects as the result of one country's (either *i*'s or *j*'s) membership in a RTA and the other country not being a member; and S_{ij}, which represents other variables that affect trade and not having been introduced previously into this model (e.g. common border between *i* and *j*, no port access (landlocked), colonial ties between countries *i* and *j*, sharing a common language, variables relating to monetary factors, and variables measuring the relative factor endowments of the respective countries).

The RTAs examined in this analysis were: the ASEAN Free Trade Agreement (AFTA), Andean Community (CAN), the EU, and NAFTA. Koo, Kennedy, and Skipnitchenko remarked that the set of variables that were usually included in a gravity equation could bring about endogeneity but seeing that as the flows being examined were agricultural in nature, and since policies affecting GDP or the willingness to form a RTA were not dependent on the volume of agricultural trade flows, endogeneity would not be a problem in the model.

Koo, Kennedy, and Skipnitchenko found that RTAs had, overall, a positive and significant influence on increasing trade volumes among member countries (both in inter- and intra-industrial trade classifications). Another interesting finding was that RTAs had a positive (rather than negative) trade diversion effect (in this case for NAFTA). This positive trade diversion effect can be interpreted as being due to the existence of low substitutability between traded goods. According to the authors, another reason for the positive trade creation effect could be that since there was a positive trade creation effect in the case of NAFTA, overall demand increased, offsetting any trade diversion effects. Koo, Kennedy, and Skipnitchenko concluded that RTAs increase welfare for RTA members and, to a lesser extent, non-RTA members as well.

Theoretical Underpinnings of the Gravity Model

Even though the Gravity Model had had a highly acclaimed explanatory ability, its predictive capabilities were severely hampered by its "perceived" lack of a robust theoretical foundation (Bergstrand, 1985). This lack of a strong theoretical foundation has been addressed by Anderson (1979). Using the properties of expenditure systems while maintaining homothetic preferences across regions, Anderson provides a theoretical explanation for the gravity equation as applied to trade in commodities. Anderson proposes that by the gravity equation constraining the pure expenditure system by highlighting the share of national income spent on traded goods, a stable unidentified reduced-form function of income and population is obtained. Anderson also proposed that the equation's multiplicative form is explained. Distance in the model has a

substantive and meaningful interpretation, and structural irregularities across regions are handled forthrightly by holding them identical. Anderson alludes to the possible presence of bias in this method but subsequently dismisses it as the gains to the model's estimation efficiency outweigh any additional bias. Anderson develops several gravity models in his paper, with the Pure-Expenditure-System Model being the first. Anderson states that it is the simplest gravity type model, it stems from a Cobb-Douglas expenditure system that has been rearranged. In it he specified that the monetary amount of goods from country *i* and country *j* (M_{ij}) is equal to the product of Income (Y_iY_j) divided by the $\Sigma\ Y_j$. From there, Anderson develops his Trade-Share-Expenditure System Model where expenditure share is allowed to vary across regions (unlike before). To allow for this intra-regional variation, an additional variable, 2_i, is introduced representing the share of country *i*'s production demanded in country *j* and then specifying an additional variable, N_j, that accounts for *j*'s total expenditure, thus arriving at demand for *i*'s tradable good in country *j* as being represented by the equation, $M_{ij}= 2_i\ N_j\ Y_j$.

In similar fashion, Bergstrand addresses critics of the gravity model's perceived lack of a strong theoretical foundation in asserting that the gravity model was in fact a reduced form derived from a four equation partial equilibrium model of export supply and import demand. Prices had been omitted from the original framework and critics argued that approach (price omission) was loose and did not explain the model's multiplicative form. Bergstrand addressed these concerns directly and in systematic fashion by presenting the necessary

assumptions in generating a gravity equation that was similar to the general equilibrium format. Bergstrand generated a utility function of CES form from which he was able to derive consumer demand. Bergstrand also developed a supply function, assuming all firms were profit maximizing, and finally he set the two equations (demand and supply) equal to each other representing market equilibrium. This was not the final form of the gravity model due to the omission of exporter and importer incomes. This omission of incomes was addressed by deriving the incomes exogenously using additional assumptions. The additional assumptions employed were: 1.) Trade flow from *i* to *j* was small relative to other markets; 2.) Identical utility and production functions across countries (ensuring constancy across country pairings); 3.) Perfect substitution of products; 4.) Perfect arbitrage of commodities; 5.) Zero tariffs; and 6.) Zero transport costs. Bergstrand noted that the inclusion of incomes into the model obtained the generally recognized gravity model format and posited that the variables of price and exchange rate had significant effects on trade flows.

Later, Bergstrand (1989) attempts, by using the framework of the General Equilibrium Model of World Trade (two differentiated product industries with each product utilizing two factors of production), to show how the Gravity Model fits into the Heckscher-Ohlin model of inter-industry trade and the Helpman-Krugman-Markusen models of intra-industry trade. Bergstrand expands the framework of the Gravity Equation to include factor endowment variables in the spirit of the Heckscher-Ohlin Model and taste variables after that of Linder. He provides an "explicit theoretical foundation for exporter and importer incomes

and per capita incomes consistent with traditional (and newer) trade theories." (Bergstrand, 1989) To accomplish this Bergstrand defines consumer demand as a CES utility function, makes the assertion that the firm in *i* is profit maximizing, and that each firm in the two industries posited produce a differentiated product that can be characterized as being *Chamberlinian Monopolistic Competition* by nature by using two factors of production namely Capital (K) and Labor (L). Bergstrand then states that firms distribute their output after a Constant Elasticity of Transformation function. Bergstrand then further expands on the Gravity Equation in a Multi-Industry World stating that when you proceed with more than two factors and more than two industries, the Gravity Equation could not be used in inferring relative factor intensities of industries. Bergstrand reiterates that his goal was to shed further light on developing a Gravity Equation that was consistent with the theories of inter and intra-industry trade. He further states using a two-industry, two-factor, N-country Heckscher-Ohlin-Chamberlin-Linder model, one could interpret exporter and per-capita income as national output in terms of units of capital and the country's capital-labor endowment ratio. Bergstrand also proposed that between 40%-80% of the variation across countries was explained by the generalized gravity equation in one-digit SITC trade flows. He stated that importer per capita income coefficients suggested that manufactures tended to be luxuries and that raw materials tended to be necessities for everyday life (such as fuels and chemicals).

The perceived disparities between the gravity equation and the Heckscher-Ohlin (H-O) Model of trade have also been addressed by Deardorff. Some have

argued that the success of the gravity equation was proof against the H-O model while Deardorff argues that at some of the equilibria in the H-O model yields interpretations that are consistent with that of the gravity equation. There are two keys to the results being sought by Deardorff, that there are two different types of H-O equilibria, the first equilibrium being with frictionless trade and the second equilibrium without frictionless trade.

In frictionless trade, there are no impediments to trade because trade is just as viable an economic alternative as domestic production of a particular commodity. Deardorff asserts then that a change of mind must happen in the logic of thought as to trade because now, with no impediments, by 'demanders' indifference to equally priced sources of supply, this allows the entry of foreign suppliers into an otherwise domestic supplier's market. Just as demanders are indifferent to equally priced sources of supply, so suppliers are indifferent to whom they sell. Deardorff argues that in the absence of trade impediments, trade flows are not bound to be small and because of the indifference of both suppliers and demanders trade flows become larger, falling more into a configuration akin to that of the gravity-equation (accounting for identical, homothetic tastes across countries), and, of course, in frictionless trade, distance is not being taken into account.

Deardorff proceeds to state the case where there is trade in the presence of trade impediments. The H-O model, where there are impediments to trade, must then have Factor Price Equalization (FPE). Because, if two countries had FPE and the presence of a trade impediment, trade would simply not be conducted

between the two countries, rather country i would consume its own production rather than paying the country j's price (same as their own) plus an additional trade impediment premium from country j. Deardorff says that in the presence of trade barriers, while not explicitly being the case, one nation specializes in the manufacture of a good and is it's (the good's) lowest cost producer. With this assumption in hand, Deardorff proceeds to study bilateral trade flows in the H-O model and asserts that they are the same as in models with differential products and hence the emergence of the gravity model once again.

CHAPTER 3
METHODOLOGY

Gravity Model Form and Function

The Log-Linear form of the Gravity Model has been established by the rather rigorous theoretical studies of Anderson (1979) and Bergstrand (1985 & 1989). The econometric specification of the Gravity Model has been further improved upon by the efforts of Mátyás (1997), Cheng and Wall (1999), Breuss and Egger (1999), and Egger (2000). Refinement of the explanatory variables has been addressed in the works of Bergstand (1985), Srivastava and Green (1986), Helpman (1987), Deardorff (1995), Wei (1996), and Feenstra, Markusen, and Rose (2000).

The Gravity Model was first utilized by Pentti Pöyhönen in 1963 and was of the form:

$$a'_{ij} = cc_i c_j \frac{e_{ii}^{\alpha} e_{jj}^{\beta}}{(1+\gamma r_{ij})^{\delta}} \tag{3.1}$$

where a'_{ij} is the estimated value of exports from country i to country j, e_{ii} is the national income of country i, e_{jj} is the national income of country j, r_{ij} is the distance from country i to country j, α and β are the national income elasticities of exports and imports, γ is the transportation cost (per nautical mile), δ is the parameter signifying isolation, c_i is country i's export parameter, c_j is country j's import parameter, and c is a constant.

The general specification for the Gravity Model calls for the dependent variable, X_{ij} -(the volume of exports from country i to country j), to be the function of income, $Y_{i(j)}$-normally taken as the GDP for both country i and j,

population, N_{ij}-for both country *i* and *j*, the distance between country *i* and *j,* d_{ij}-usually the distance between the respective capitals, and dummy variables PTA_c (for trade creation effects) and PTA_d (for trade diversion effects) that capture the effects individual RTAs have on trade flows (Ghosh and Yamarik, 2004). In addition, as has been mentioned previously, different variables that account for a common border, language commonality, and common colonial ties have been added to the Gravity Model with varying degrees of success. The Gravity Model is unique in that its primary focus is on the *volume* of trade rather than the particular commodity *composition* of trade (Helpman, 1999). The resulting equation framework of the Gravity Model allows for the prediction of bilateral trade flow volumes between any two nations.

Additional Explanatory Variables in the Gravity Model

Often other variables are introduced into the Gravity Model to assist in explaining variations in bilateral trade flows. The more common of these variables are size of population variables for the importing/exporting country (a convenient proxy for insight into any economies of scale present). Anderson (1979) and Bergstrand (1985 and 1989) developed theoretical foundations for the Gravity Model using the Monopolistic Competition framework. Deardorff (1998) demonstrated that the Gravity Model could be derived using the Ricardian and Heckscher-Ohlin theorems. These two approaches serve to show the underlying empirical nature of the Gravity Model in its ability to predict bilateral trade flows. Distance is utilized in the Gravity Model as a proxy for transaction costs and that

apart from distance, transaction costs are also a function of public infrastructure. The basic Gravity Equation as specified by Anderson (1979) is as follows:

(3.2) $$M_{ijk} = \alpha_k Y_i^{\beta_k} Y_j^{\gamma_k} N_i^{\xi_k} N_j^{\varepsilon_k} d_{ij}^{\mu_k} U_{ijk}$$

where M_{ijk} is dollar flow of good *k* from country *i* to country *j,* α_k is the intercept term, $Y_{i(j)}$ are incomes in country *i(j)*, $N_{i(j)}$ are populations in country *i(j)*, d_{ij} is the distance from country *i* to country *j*, and U_{ijk} is a lognormally distributed error term and $E(lnU_{ijk})$=0.

The Gravity Model is validated in that it is applicable across cross-country pairs. The symmetrical aspect of the Gravity Model is established in the fact that one obtains the same results in analyzing bilateral trade flows from either the direction of *i* to *j* or *j* to *i*. Other variables of interest in the Gravity Model have to do with dummy variables that indicate mutual membership in a RTA, language commonality, border contiguity, and commonality of colonial heritage to name just a few. Carillo and Li (2002) incorporated dummy variables in their model, attempting to isolate any trade creation/diversion activity in the variations observed in bilateral trade flows. Their model was of the form:

(3.3) $$\log(M_{ij}) = \beta_0 + \beta_1(Y_i) + \beta_2(Y_j) + \beta_3\log(DIF_{ij}) + \beta_4 D_{ij} + \beta_5 AD_{ij} + \beta_6 PTAC + \beta_7 PTAM + \beta_8 DUM90 + u_{ij}$$

where M_{ij} is the monetary value of *i*'s export to *j*, β_0 is the intercept $Y_{i(j)}$ is the Income of Country i(j), DIF_{ij} is the absolute difference in per capita income (testing for the Linder Hypothesis), D_{ij} is the distance between country *i* to country *j*, AD_{ij} is a dummy variable controlling for contiguity, *PTAC* is a dummy variable capturing trade creation effects owing to mutual membership to CAN

between trading pairs, *PTAM* is a dummy variable capturing trade creation effects owing to mutual membership to MERCOSUR between trading pairs, *DUM90* is a dummy variable that accounts for the re-opening of credit market/trade reform undertaken after 1990 and u_{ij} is a log normally distributed error term (to account for any unexplained variation in the model). At first observation, the dummy variables included in the model were not significant but with further analysis it was exhibited by Carillo and Li that *PTAC* was significant for the aggregated differentiated product category and *PTAM* was not, *PTAC* was significant (to a lesser degree) for goods in the aggregated category, and both *PTAC* and *PTAM* had a positive/significant effect on capital intensive goods.

With its appearance over 40 years ago, the Gravity Model has provided a useful, intuitive insight into bilateral trade flows. Many have made contributions to the development and refinement of the Gravity Model, and its usefulness to researchers and analysts has not suffered for these additions. The general form of the Gravity Model has been established as being log linear in form with the basic variables of Income, Population, and Distance deemed requisite to the successful formulation of the basic Gravity Model, with additional variables added in conjunction with these key variables, the underlying foundation for the assumptions of the Gravity Model will have been made and results can be taken as analytically worthy.

Theoretical Linkages Between Economic Theory and the Gravity Model

According to economic theory, some of the factors that directly affect the volume of trade are: income, population, transaction costs, and the presence/absence of trading agreements. In the case of income, where countries

enjoy a relatively high level of income, theory purports that these countries tend to trade more. Theory also purports that where transaction costs are held in check and if there is the existence of a RTA, the potentiality of exporting goods and services is seen as being more likely than in the scenario of high transport costs and the presence of higher external tariff barriers due to the non-existence of a RTA. Of the combination of economic variables (income, population, distance, etc.), the variables that have been listed as being essential to the composition of the Gravity Model provide unique insight into the trade potentialities existing between two nations. An important determinant of potential trade restriction (or 'friction to trade') is the distance variable in the Gravity Model. The reason being that the higher the restrictions to trade the less two nations will be inclined to trade with one another, opting for alternatives where restrictions are less (usually a neighboring country closer in proximity). Restrictions to trade lead to heightened transaction costs and minimization of transaction costs is often one of the goals of trading nations. In addition to the fundamental variables discussed, auxiliary variables such as language commonality, common colonial heritage, border contiguity and common currency are added to the Gravity Model in an attempt to further refine the Gravity Model, offering deeper insight and a heightened explanation of the variance exhibited in bilateral trade flows. Income and Transaction Cost's impact on the flow of trade can also be explained within the framework of the partial equilibrium model.

Income's Impact on Trade (Case: Importing Country)

The effects of income changes for the importing country in the partial equilibrium model are illustrated in Figure 3.1. For a small country case, the

initial equilibrium is at E_0. Because this is a small country case, world price, $P_{w,}$ is fixed and equal to world excess supply, $ES_{w.}$ With an increase in income in the importing country, the demand curve in the Importing Country shifts from D_0 to D_1. This in turn, causes the excess demand curve *ED* to shift from ED_0 to ED_1. The increase in quantity demanded triggers an increase in quantity supplied from the world from the initial quantity, Q_{world0}, to Q_{world1}. Domestic quantity consumed has increased from Q_0 to Q_1.

With a fall in income in the importing country, the demand curve shifts in the importing country from D_0 to D_2, this in turn shifts the *ED* curve, in the world market, leftwards from ED_0 to ED_2. As can be seen from Figure 3.1, with a decrease in income in the importing country quantity demanded has decreased from Q_0 to Q_2 and the quantity supplied by the world market has fallen from Q_{world0} to Q_{world2}.

To recount, with greater demand, quantity demanded increases in the domestic market from Q0 to Q1 and in the quantity supplied, by the world market, increases from Qworld0 to Qworld1. Decreases in income work as above; but in reverse, with domestic quantity demanded falling from Q0 to Q2 and quantity supplied by world falling from Qworld0 to Qworld2.

As applied to the Gravity Model, increases in j's income, Yj, should translate as a positive coefficient in the econometric model, reflecting the positive relation between increasing income, Yj, and bilateral trade flows, Xij. Decreases in j's income, Yj, would tend to indicate that there might be contractions in bilateral trade flows between trading partners, this being reflected as a negative

relationship between the explanatory variable of income, Yj, and the dependent variable, bilateral trade flow, Xij.

Income's Impact on Trade (Case: Exporting Country)

We now turn our attention to Figure 3.2 to see the effects income has in the case of the exporting country. We are at initial equilibrium, E_0, with initial world quantity at Q_{world0}. With a rise in exporter's income, the demand curve, D_0, shifts to the right to D_1 indicating a greater quantity of domestic demand, Q_1 . This increase in income in turn shifts the excess supply curve, ES_0, leftward to ES_1 indicating that, to make up for increased domestic demand, a lesser quantity is supplied by the exporter (from Q_{world0} *to* Q_{world1}).

In the case of a decrease in exporter's income, the exporter's demand curve would shift, in Figure 3.2, to the left from D0 to D2, this shift to D2 would in turn cause a rightward shift of the excess supply curve (because less is consumed domestically, more quantity is available for world consumption), from ES0 to ES2. Quantity supplied to the rest of the world would increase from Qworld0 to Qworld2.

In the Gravity Model, an increase in Exporter Income raises demand at home. Demand in turn not only drives up the domestic price but also helps increase the world price of the particular commodity(s) in question. A higher price for a particular item, with enhanced revenue potential then spurs heightened activity/production on the part of the exporter/producer. This increases the levels of bilateral trade, reflected as a positive relationship between country *i*'s income

parameter, Y_i, and bilateral trade flow, X_{ij}. With lessened domestic demand, excess supply is greater as a result and the quantity supplied to the world becomes greater.

Effects of Transaction Costs on Trade

The effects that transactions costs have on trade can be seen in Figure 3.3. When the term 'transaction costs' is employed all costs that are related to transportation and handling, language commonality, and common colonial heritage are included. The more distant two potential trading partners are, the higher the transaction costs will be. This increased distance is represented in Figure 3.3 as a leftward shift in the excess supply curve (for the rest of the world) from ES_0 to ES_1. With an increase in prices due to increased transaction costs, quantity demanded would fall from *QWrld0* to *QWrld2* and as a result of higher prices, a reduction in bilateral trade ensues. This is reflected in the Gravity Model as being a negative relationship between transaction costs, in our case D_{ij}, and bilateral trade flow, X_{ij}. The closer two potential trading partners are to each other, transaction costs will be less, this close proximity leads to a rightward shift of the excess supply curve from ES_0 to ES_2 in figure 3.3. World quantity demanded increases from *QWrld0* to *QWrld1*. We see a positive relationship between a decrease in distance and transaction costs and bilateral trade flows. That is, in the Gravity Model, with an increase in transaction costs, the rate of return decreases, and this is seen as being a negative relationship. We would then expect the parameter coefficient for transaction cost(s) in the Gravity Model, D_{ij}, to be negative in sign.

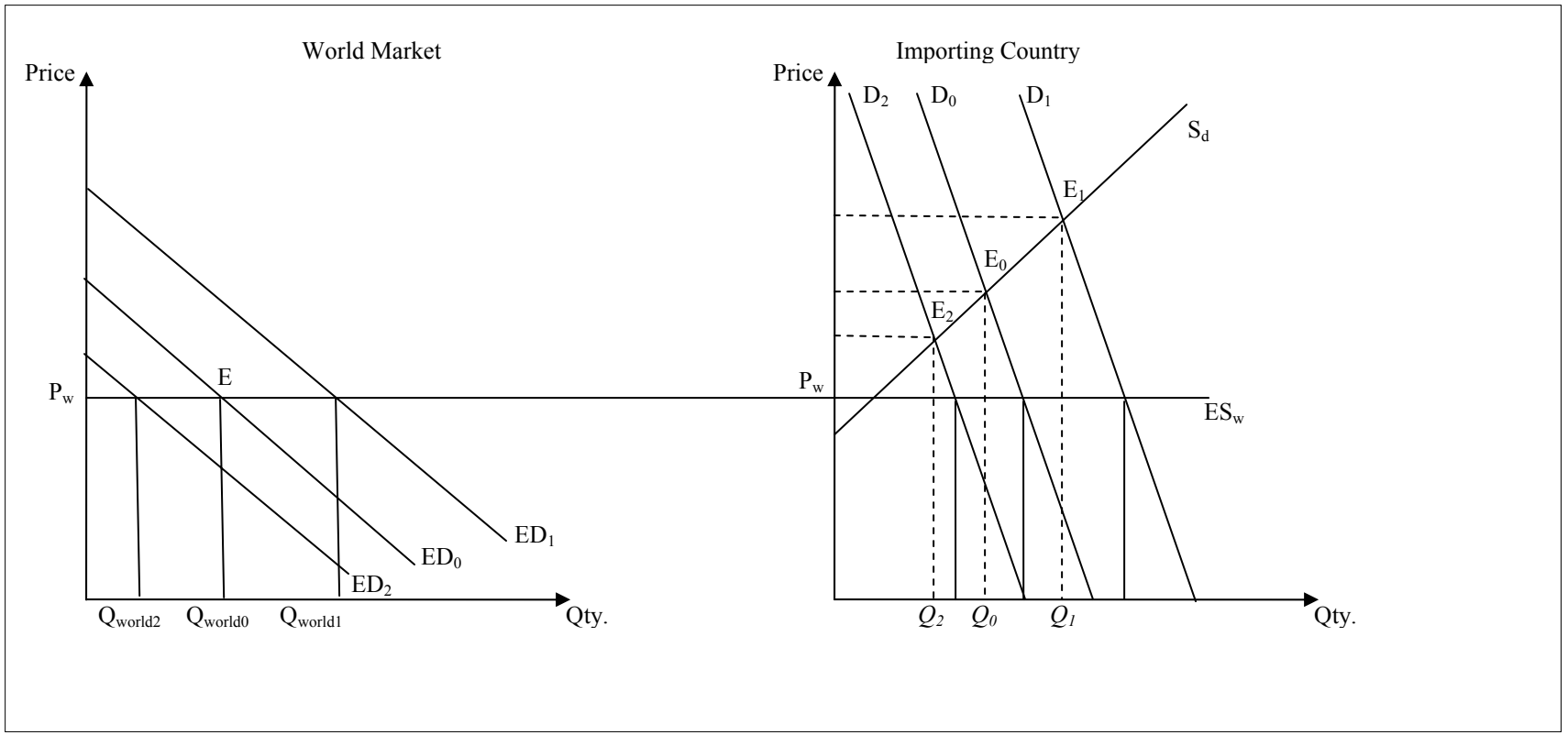

Figure 3.1 Income's Impact on Trade (Case: Importing Country)

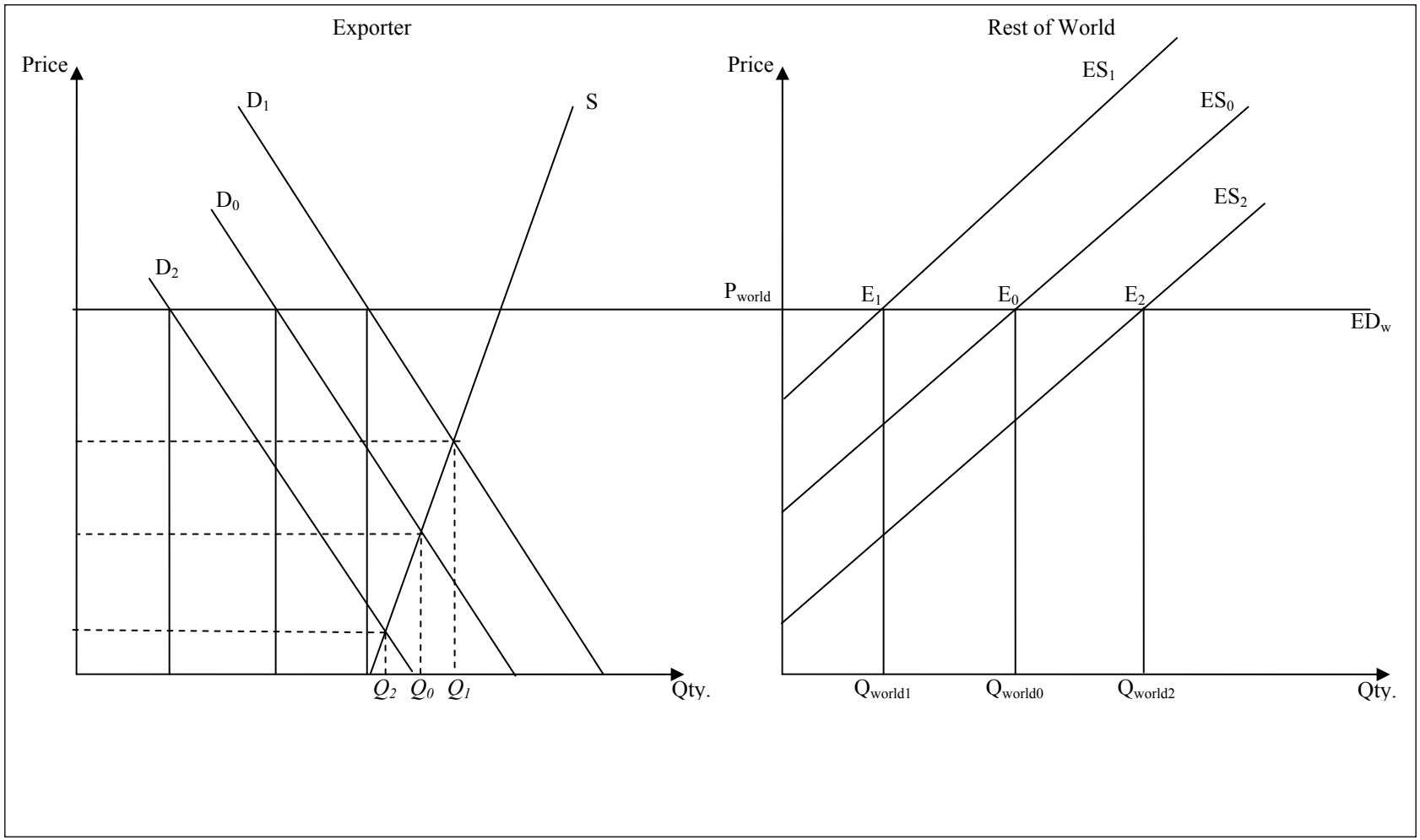

Figure 3.2 Income's Impact on Trade (Case: Exporting Country)

Effects of Trade Creation and Trade Diversion

Two countries' membership in the same RTA indicates that there is a favorable trading environment (through the lowering of transaction costs) between those two nations as opposed to nonmember trade. Membership in a RTA can lead to changes in trading patterns between nations as those nations realign themselves into different trading groups. The trading policy dynamic is constantly evolving. Because not all nations are members of the *same* RTA and because there is the possibility that no two nations may belong to the same *combination* of RTA agreements, any analysis of trade creation and trade diversion effects that RTAs have on bilateral trade flows must be examined on an individual, country by country case.

As nations tend to center trading activities to particular geographical regions, and more specifically to members of their same RTA(s), trade creation effects should be noticeable in the aggregate flows of bilateral trade between nations who are joint members of a particular RTA. As nations seek to reduce transaction costs, they will be ever vigilant as to ways to accomplish these reductions, this desire for managing costs is the *raison d'etre* of RTAs. This is in essence the definition of *Trade Creation*. In the Gravity Model then, on our variables that we have designated as being Trade Creating by nature, we would expect a positive relationship between the RTA dummy variable parameter, e.g. *AC*, coefficient and the dependent variable of bilateral trade flows, X_{ij}. Consequently, as the patterns of trade for a commodity shifts from one country pairing to a more amicable country pairing, there will be losses in trade between member and non-member nations as nations seek to take advantage of the reduced

costs that come from trading with fellow RTA members. This activity is principally known as *Trade Diversion*, principally with trade diversion, we would expect a negative relationship between the RTA dummy variable parameter, e.g. *AC*, coefficient and the dependent variable of bilateral trade flows, X_{ij}**.** Trade creation and trade diversion effects were first remarked upon by Viner (1950). Viner concluded that trade creation has occurred when, in the process of economic integration, domestic production of a particular item/commodity is outsourced to a member producer whose resource costs are lower. This movement in production is a result of the allocation of free trade resources and as a result, enhanced positive welfare effects of those involved. In the case of trade diversion, there would be a shift in production away from a non-member state to a state that is a member within the same RTA, to a fellow, member producer whose resource costs are higher than those of the original non-member producer. This movement towards a fellow RTA member producer, whose resource costs are higher, is representative of a movement away from the free trade allocation of resources and could entail negative impacts to welfare.

The graphic results from trade creation and trade diversion of RTAs and their subsequent effect on trade flows can be seen in Figures 3.4 and 3.5 respectively. As to trade creation, in Figure 3.4, before the presence of a RTA between country *i* and *j,* country *j*'s prices was P_j, where $P_j = P_i(1+\tau)$, with τ being an external tariff applied to good(s) from *i*. With the implementation of a RTA between *i* and *j*, the tariff (τ) is removed, and imports for *j* are now the difference between *Qty4* and *Qty1* (*Qty4* - *Qty1*). From Figure 3.4, with the removal of the

tariff (τ), imports for *j* are now greater than previous (with the tariff (τ) in place, with previous imports (*Qty3 – Qty2*) < (*Qty4 - Qty1*), new imports. Domestic production of that particular commodity is displaced by the imported quantity, (*Q2-Q1*), while consumption increases by the quantity (*Qty 4-Qty3*). The trade effect is taken to be the sum of the areas *b* and *d* (*b* + *d*). Theoretically, trade creation implies that a RTA generates bilateral trade, by lowering prices with the removal of barriers and encouraging consumption, that would have not happened but for the trade creation effect of the RTA.

In Figure 3.5 we now see graphically the effects RTAs exhibit as to trade diversion. Before the RTA between country *i* and *j*, country *j* had a tariff (τ) on imports. Country *k*'s price (with tariff) in *j*'s market is $P_j(1+\tau)$. Before the existence of the RTA, *j* imports (*Q3-Q2*) from *k*. With the implementation of a RTA (and the resulting reduction/absolution of the tariff, τ) between *i* and *j*, *j* now imports (*Q4-Q1*), with all imports coming from new RTA trading partner, country *i*. The term *trade diversion* signifies a diverting away of trade that had existed previously. The net trading effects under the RTA for *i* is the sum of the areas (*b*+*d*), which represent displaced domestic production (*b*) and heightened domestic consumption due to lowered prices (*d*), and the area (*e*), which represents the amount of trade that was diverted from country *k* to country *i* as a result of the lower transaction costs between *i* and *j*. Producers in the domestic market face market share loss due to the RTA's lowering transaction costs (*Q2-Q1*), while consumers enjoy the added consumption (*Q4-Q3*).

The trading environments of countries develop differently when they operate in the atmosphere of RTA induced trade as opposed to no RTA trade. With the reduction of trade barriers, firms face stricter competition from foreign competitors. This atmosphere fosters a competitive and innovative spirit within firms to ever strive for market mastery. The ability of particular companies to monopolize markets or industries is hampered by the external competition that comes from freedom of trade. Innovation is the optimal strategy for any competitive firm, which seeks to reduce transaction costs that they incur by employing advances in technology, hiring a more diverse, educated, technical savvy work force, and by utilizing infrastructure improvements that streamline their distribution efforts, speeding supply while lowering overall costs. RTA membership provides a plethora of opportunities for producers that normally would have not looked to external, foreign markets for additional sources of revenue opportunities for market expansion and consumers in RTA countries benefit by the enhanced/enlarged portfolio of products that are offered for their consideration. The growth of markets leads to an increased demand in products, increased demand in products leads to increases in trade transactions that take place, whether domestically or internationally.

Not only is increased trade possible, but with the lowering of transaction costs, by removal of tariffs, etc. many RTAs promote the freedom of flows for capital as well as populations. With technical innovations, it is conceivable that trading blocs will provide investors with opportunities for investment in regional economies as those nations tend to diversify and upgrade their infrastructure.

With the competition that comes from free trade, nations cannot rely on a second rate infrastructure to carry the load for their economic. Roads, railways, ports, etc. will have to be at full operating capacity to insure against costly delays in distribution, equipment such as locomotives, airplanes, etc. will have to be updated to avoid needless delays from equipment failure/malfunction. These challenges stemming from RTA implementation could be a golden opportunity; time now will be the judge.

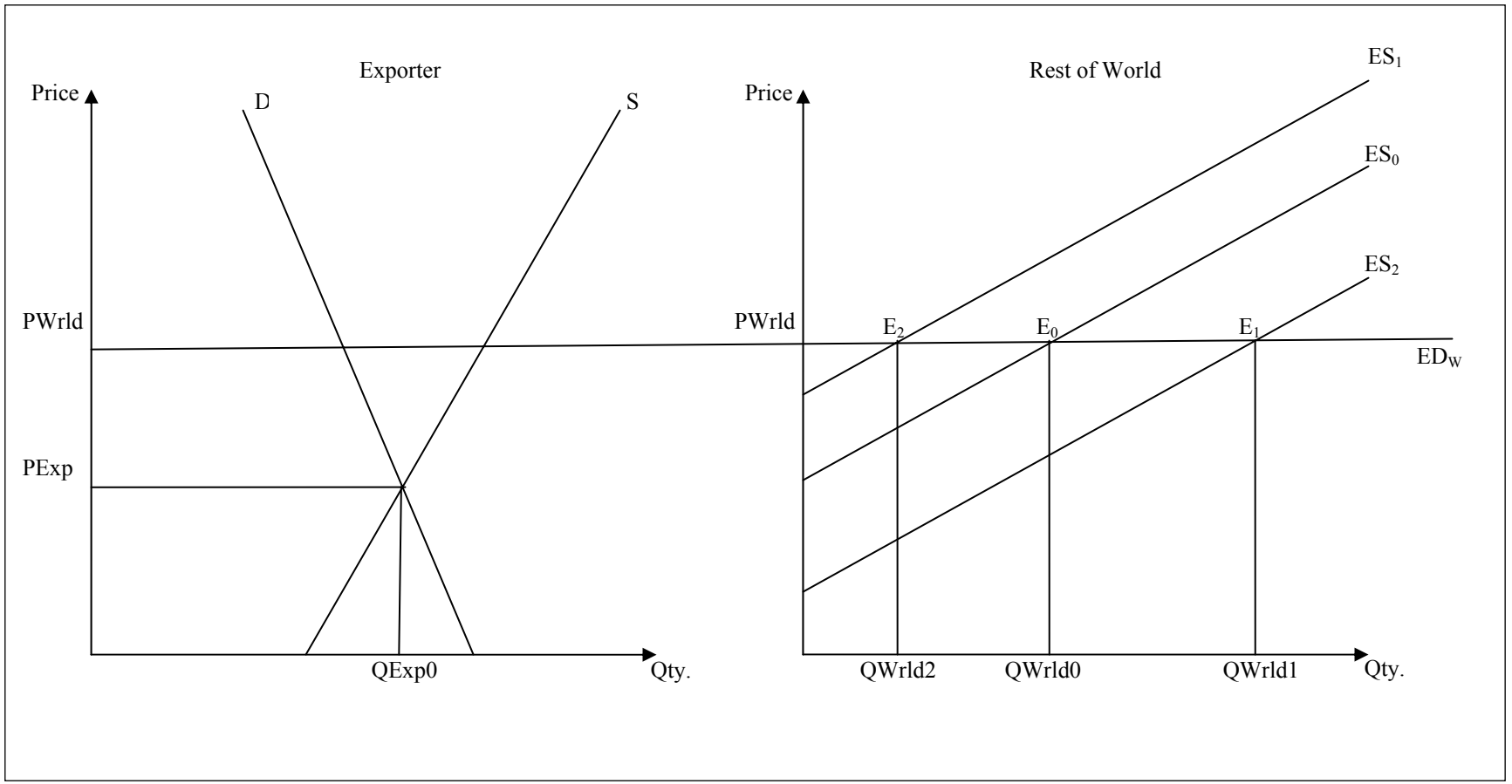

Figure 3.3 Effects of Transaction Costs on Trade

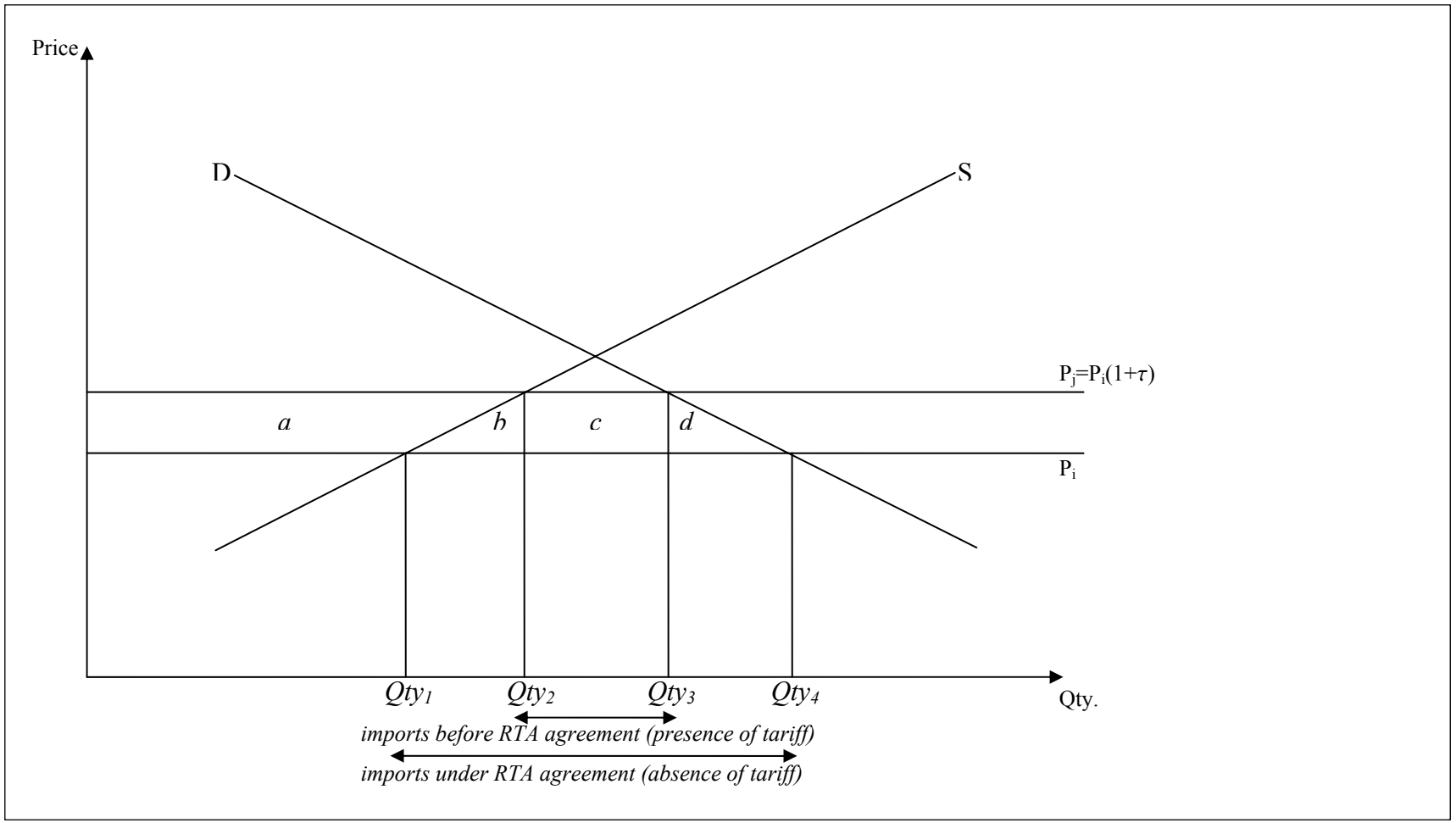

Figure 3.4 RTA Trade Creation Effects

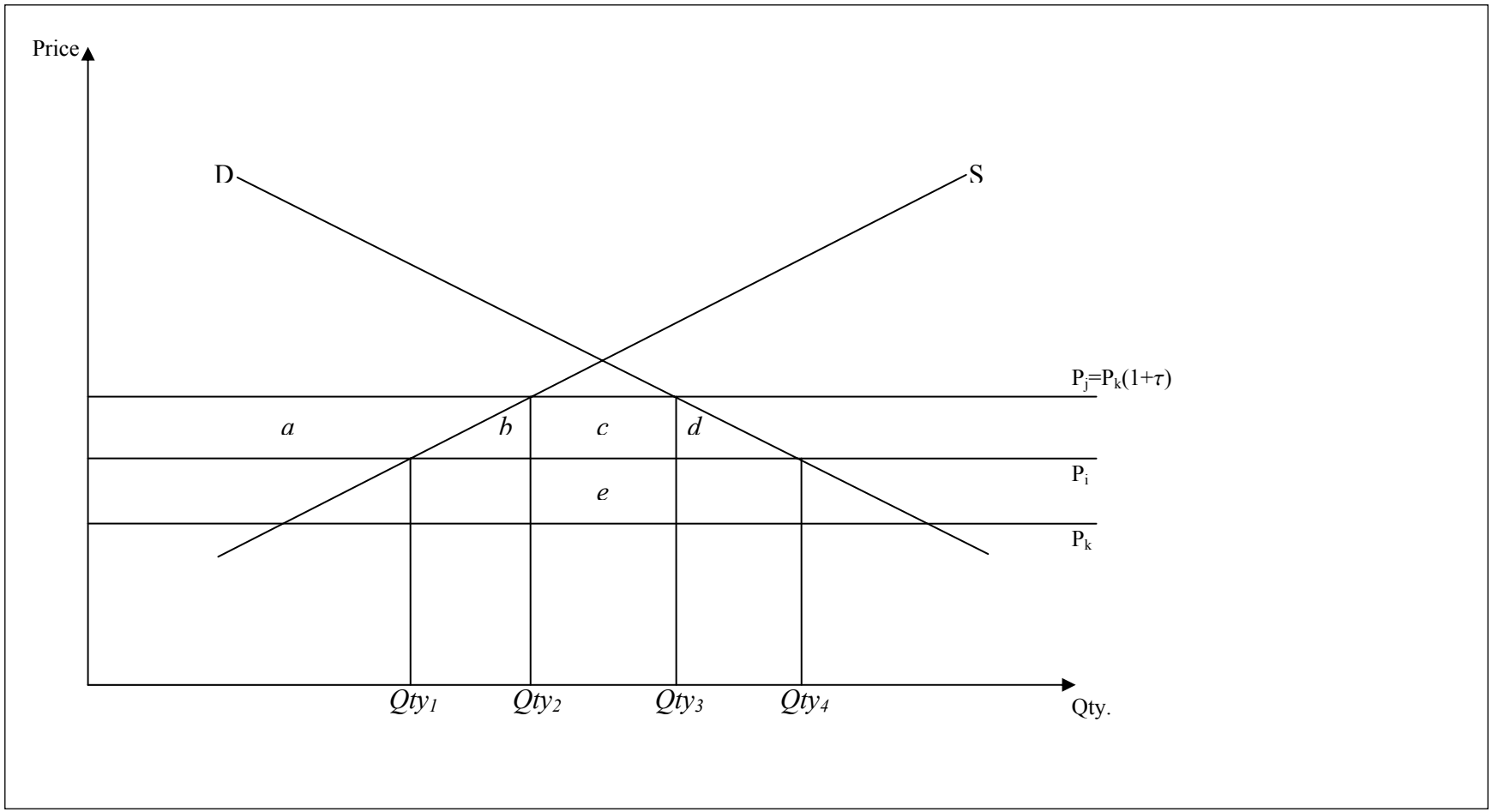

Figure 3.5 RTA Trade Diversion Effects

CHAPTER 4
GRAVITY MODEL RESULTS

Estimation Method

Employing the guidelines of the gravity model of trade flows as directed by the previous literature, the model that will be employed in the course of this study will be log-log in form. Utilizing the standard variables of the gravity model (i.e. population for countries *i* and *j*, and national income for countries *i* and *j*), this specific gravity model will also have additional variables that take into account distance, d_{ij}, which was calculated as between capital cities, a language dummy variable, *lang*, (= 1 for mutual language, 0 otherwise) and is introduced to capture any effects language commonality exerted over bilateral trade, dummy variables for five RTAs existing in the Western Hemisphere (*NAFTA, AC, MERCOSUR, CACM, LAIA*) whose value is 1 if both countries are members of the same trading group, 0 otherwise. These variables are introduced to capture the effects (if any) these trading agreements have had on bilateral trade flows. Dummy variables are also introduced for the five RTAs existing in the Western Hemisphere that attempt to capture any trade diversion effects these RTAs might have had on bilateral trade flows (*NAFTAD, ACD, MERCOSURD, CACMD, LAIAD*), where the dummy variable value is 1 if one country is a member of the aforementioned trading group and its trading partner being considered is not a member of that *same* RTA, 0 otherwise.

Gravity Model Equation

The specific gravity model employed in this analysis is of the following form:

$$(4.1)\quad logX_{ij} = a_1 + a_2\, log(Yi) + a_3\, log(Y_j) + a_4 log(d_{ij}) + a_5 log(Pop_i) + a_6 log(Pop_j) + a_7 lang + a8NAFTA + a_9 AC + a_{10} MERCO + a_{11} LAIA + a_{12} CACM + a_{13} NAFTAD + a_{14} ACD + a_{15} MERCOD + a_{16} LAIAD + a_{17} CACMD + e_{ij}$$

where $logX_{ij}$ is the log bilateral trade flow ($) from country *i* to country j, a_1, the intercept term, $log(Yi)$, the log of country i's income (GDP), $log(Y_j)$, the log of country j's income (GDP), $log(d_{ij})$, the log of distance between country *i* and country *j*, $log(Pop_i)$, the log of country i's population, $log(Pop_j)$, the log of country j's population, *lang,* a dummy variable for language commonality (=1 true, 0 otherwise), *NAFTA*, a dummy variable accounting for mutual *NAFTA* membership between *i* and *j* (=1 if true, 0 otherwise), *AC,* a dummy variable accounting for mutual *AC* membership between *i* and *j* (=1 if true, 0 otherwise), *MERCO,* dummy variable accounting for mutual *MERCOSUR* membership between *i* and *j* (=1 if true, 0 otherwise), *LAIA,* a dummy variable accounting for mutual *LAIA* membership between *i* and *j* (=1 if true, 0 otherwise), *CACM,* a dummy variable accounting for mutual *CACM* membership between *i* and *j* (=1 if true, 0 otherwise), *NAFTAD,* a dummy variable that accounts for country *i* being a member of *NAFTA* and country *j* not (=1 if true, 0 otherwise), *ACD,* a dummy variable that accounts for country *i* being a member of *AC* and country *j* not (=1 if true, 0 otherwise), *MERCOD,* a dummy variable that accounts for country *i* being

a member of *MERCOSUR,* and country *j* not (=1 if true, 0 otherwise), *LAIAD,* a dummy variable that accounts for country *i* being a member of *LAIA* and country *j* not (=1 if true, 0 otherwise), *CACMD,* a dummy variable that accounts for country *i* being a member of *CACM* and country *j* not (=1 if true, 0 otherwise), and e_{ij}, log normally distributed error term

Data Employed

Standard Industrial Trade Classification Revision 3 agricultural commodity data for classes 0 (food and live animals), 1 (beverages and tobacco), and 4 (animal, vegetable oils, fats, and wax) was obtained from the United Nations' COMTRADE database and was used in this analysis. After examining the data available from the United Nations, it was determined that 2001 was the year that would have the requisite export information for all twenty-four countries included in this study. Those twenty- four countries being: Argentina, Belize, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Dominica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, the United States, Uruguay, and Venezuela. Gross domestic product (2001) and population (2001) information were from the International Monetary Fund's International Financial Statistics Database and Browser 2006, the physical distance between capital cities was calculated using Environmental Systems Research Institute's geographic information systems software package, ArcView3.x.[2] The information on language commonality, etc. was obtained from the Central Intelligence Agency World Factbook (2005).

[2] Sincere thanks to Huizhen Niu for her calculation of *i* to *j* distances used in this study.

The Variables

Total bilateral trade flow in *agricultural* commodities for country pairs, *i* and *j*, in log form is the dependent variable for this study. Table 4.1 contains the variables that were considered in the gravity model. The independent variables are income for *i* and *j*, population for *i* and *j*, distance between *i* and *j* and dummy variables for *NAFTA, AC, MERCOSUR, LAIA,* and *CACM*, and dummy variables for possible trade diversion for *NAFTA, AC, MERCOSUR, LAIA*, and *CACM.* Table 4.2 shows the sources from where the data was obtained.

Results

In this thesis it was our express purpose to develop a gravity model that would determine the bilateral trade flows of agricultural commodities in the Western Hemisphere and account for the trade creation and possible trade diversion effects of RTAs included in the model. In this section, we will examine the results of the gravity model that were obtained and analyze the results to see if trade creation and trade diversion effects were captured in the parameters of our specific model. In estimating the model, Ordinary Least Squares Regression was employed using *SAS,* version 9.0 for Windows (English).

The reasons that nations trade have been attributed to their incomes and populations. Nations normally trade less when the transaction costs outweigh the cost savings that would be incurred in engaging in trade. We saw earlier the impact that increased distance had on transaction costs. The further the distance, the higher the transaction costs to engage in trade, thus lessening trade activity

Table 4.1 Variables Utilized in the Gravity Model

Variable	Description	Expected Sign
$LogX_{ij}$	Log of bilateral trade flow from *i* to *j*	
a_1	Intercept term	(+/–)
$LogY_i$	Log of GDP for *i*	(+)
$LogY_j$	Log of GDP for *j*	(+)
$LogN_i$	Log of population for *i*	(+)
$LogN_j$	Log of population for *j*	(+)
$Logd_{ij}$	Log of distance from *i* to *j*	(–)
Lang	Dummy variable for language commonality	(+)
NAFTA	Dummy variable for mutual *NAFTA* membership between *i* and *j,* employed for trade creation	(+)
AC	Dummy variable for mutual *AC* membership between *i* and *j,* employed for trade creation	(+)
MERCO	Dummy variable for mutual *MERCOSUR* membership between *i* and *j*, employed for trade creation	(+)
LAIA	Dummy variable for mutual *LAIA* membership between *i* and *j,* employed for trade creation	(+)
CACM	Dummy variable for mutual *CACM* membership between *i* and *j*, employed for trade creation	(+)
NAFTAD	Dummy variable where either *i* or *j* is a member of *NAFTA* but not both, employed for trade diversion	(+/–)
ACD	Dummy variable where either *i* or *j* is a member of ACD but not both, employed for trade diversion	(+/–)
MERCOD	Dummy variable where either *i* or *j* is a member of *MERCOSUR* but not both, employed for trade diversion	(+/–)
LAIAD	Dummy variable where either *i* or *j* is a member of *LAIA* but not both, employed for trade diversion	(+/–)
CACMD	Dummy variable where either *i* or *j* is a member of *CACM* but not both, employed for trade diversion	(+/–)

Table 4.2 Variable Sources

VARIABLE	SOURCE
Bilateral Trade Flow (2001)	United Nations' COMTRADE Database (2005)
GDP (2001)	International Monetary Fund's International Financial Statistics Database and Browser (2006)
Population (2001)	International Monetary Fund's International Financial Statistics Database and Browser (2006)
Language Information	Central Intelligence Agency's World FactBook (2005)
RTA Membership	World Trade Organization Web Site

between a particular pair of nations. With the advent of RTAs, the issue of transactions costs was met head on, that nations, with a reduction in certain 'frictions to trade' (e.g., lowering of tariff barriers between i and j) would trade more with each other (i.e. *trade creation*) than where 'frictions to trade' were more prevalent (the presence of tariff barriers etc.) i.e. *trade diversion.*

The estimated *OLS* gravity model equation that was obtained is of the form:

(4.2) $logX_{ij}$ (bilateral trade flow) $= -25.29 - 0.17 * log(Yi) + 0.12 * log(Y_j)$

$- 2.45 * log(d_{ij}) + 2.62 * log(Pop_i) + 1 * log(Pop_j) + 0.74 * lang$

$+ 0.39 * NAFTA - 2.60 * AC - 1.15 * MERCO + 1.35 * LAIA$

$- 0.36 * CACM + 2.07 * NAFTAD - 2.00 * ACD$

$- 1.86 * MERCOD - 2.15 * LAIAD$

$- 2.20 * CACMD$

Table 4.3 gives a summary of statistical information for the parameters included in the model, discussion of the parameter values will then follow. Specificity tests showed the model to be correctly specified and the residuals of the model were largely normal. Tests for heteroscedasticity (Breusch-Pagan and White's LM tests both highly significant) were positive, indicating the presence of heteroscedasticity, so remedial measures were taken to obtain robust results for our model. This was accomplished in SAS utilizing the 'PROC MODEL' command, and within 'PROC MODEL' the equation was fitted to the dependent variable (the log of bilateral trade flows) utilizing the 'HCCME' procedure

Table 4.3 Empirical Results for the Gravity Model Equation

Variable	Estimate	S.E.	t-value	p-value
Intercept	–25.29	5.50	-4.60	<0.0001
lgdpi	–0.17	0.19	–0.93	0.3546
lgdpj	0.12	0.17	0.71	0.4764
lpopi	2.62	0.29	9.28	<0.0001
lpopj	1	0.26	3.87	0.0001
ldistance	–2.45	0.48	–5.07	<0.0001
NAFTA	0.39	2.71	0.15	0.8845
AC	–2.60	1.89	–1.38	0.1689
MERCO	–1.15	2.10	–0.55	0.5833
LAIA	1.35	1.37	0.99	0.3230
CACM	–0.36	1.85	–0.19	0.8457
LANG	0.74	0.58	1.27	0.2058
NAFTAD	2.07	0.91	2.27	0.0233
ACD	–2.00	0.77	–2.62	0.0091
MERCOD	–1.86	0.84	–2.21	0.0278
LAIAD	–2.15	0.82	–2.62	0.0089
CACMD	–2.20	0.75	–2.93	0.0035
R^2		0.5278		
Adj. R^2		0.5136		
SSE		17435.9		
MSE		32.59		

(where HCCME=1). The results that were obtained from this procedure are the results that are reported within the confines of this thesis.

The model coefficients had the expected signs for the most part with the exceptions of $LGDP_i$, the trade creating dummy variables *AC, MERCO, CACM* and the trade diverting dummy, *NAFTAD*. The log of country *i*'s GDP was negative and non-significant (p=0.3546). This is not as unusual as might be expected. In the Gravity Model, when *total* trade flows are examined, it is normally accepted that the standard sign for country i's GDP is to be positive. In this case the sign is negative. This *apparent* contradiction is just that, *apparent*. In agricultural trade, when an exporter's income rises at home, that usually drives up domestic demand for agricultural products in the domestic market, with increased income/demand, come lessened exports of that particular commodity from country *i* to *j*, hence our negative sign on $LGDP_i$. The log of country *j*'s GDP had the expected sign (+) but was not significant (p-value 0.4764), the logs for both country *i* and *j*'s populations had the expected sign (+) and were both highly significant (p-value 0.0001).

Because of the significance of the parameter coefficients for the populations of both country *i* and *j*, it can be projected that with a 1% increase in country *i*'s population, there would be a 2.62% increase in *agricultural* bilateral trade flows between *i* and *j* (because of the log-log nature of the model, the parameter coefficient value is the elasticity-for the continuous variables of gdp and population), with a 1% increase in country *j*'s population, there would be a 1% increase in *agricultural* bilateral trade flows between *i* and *j*.

The log of distance had the expected sign (–) and was highly significant (p-value <0.0001) and with a 1% increase in distance between i and j there would be a corresponding 2.45% decrease in *agricultural* bilateral trade flows between *i* and *j*. The trade creating dummies, *NAFTA and LAIA* were not significant but both had the expected sign (+) while the trade creating dummy variables *AC*, *MERCO*, and *CACM* had negative signs (–) and were all insignificant, the language commonality dummy variable, *lang,* had the expected sign (+) but was insignificant (p-value 0.2058), and the trade diverting dummies, *ACD, MERCOD, LAIAD,* and *CACMD,* all had the expected sign (–) and were all highly significant (p-value <0.01 for all). The trade diversion effects from *ACD, MERCOD, LAIAD,* and *CACMD* are quite marked, resulting in trade diversion effects of 0.86%, 0.84%, 0.88% and 0.88% (respectively) decrease in bilateral trade between members/nonmembers of these particular RTAs. (The elasticity for dummy variables is obtained from the expression e^b-1, where *e* is the exponential function raised to the coefficient parameter value, *b*, in our case *b*= –2 (for *ACD)*, subtracted from1) For trade diversion effects the trade diverting dummy, *NAFTAD,* did not have the expected sign (–) rather it was positive (+) and was significant at the 5% level (p-value 0.0233). Using our relation from above, e^b-1, we can say that NAFTA has contributed a 6.92% increase in bilateral trade flow between NAFTA member/nonmember trading pairs.

It is interesting to note that of the trade creating dummies, *AC, MERCO,* and *CACM* are negative in sign and not significant to the model. In this model the examination was of agricultural commodity trade between countries. As the

nations of the *Andean Community, MERCOSUR* and *CACM* are fairly self-reliant in agricultural production, it is not surprising to see the negative, non-significance of these results. In a model where both agricultural and *non*-agricultural production information were included, a negative, non significant result would have been viewed with some concern. Many RTAs are formed to help in the area of intra-industry trade. In this study, we are examining primarily *inter*-industry trade in agricultural commodities. With *NAFTA* and *LAIA* we are encouraged to see the expected sign (+) but we notice that they are not significant in their explicative capability as to the variability in the log of bilateral trade flows from country *i* to *j*. This could be that when RTAs are formed, there are usually time constraints to when/how barriers are reduced in certain areas. It has been noted that agriculture remains an area that is very sensitive to quick changes (as to government interaction between the producers, reductions in domestic levels of production etc.). Many agreements, among them *NAFTA* and *LAIA,* have specific time tables for the elimination of certain restrictions to trade. *NAFTA* had a 10-15 year goal of reducing/eliminating all external tariff barriers between trading members. As this research was conducted in 2006, and with *NAFTA* having been formed in 1994, the time limit has not yet been reached for total tariff elimination. In the case of *NAFTA*, the United States was already the largest *foreign* trading partner for both Canada and Mexico, so *NAFTA*'s effect was really in the easing of commodity movements with additional benefits to be observed (in the future) with the sun-setting of existing tariff protection schemes. With the trade diverting dummies, most had the expected signs and were significant with the exception of

the trade diverting dummy, *NAFTAD*. *NAFTAD* was positive and significant at the 5% level. Normally with trade diverting dummies we would expect a negative effect and with *NAFTA* we do not obtain that result. It could be explained that, with *NAFTA*, the ease of shipment of agricultural commodities had induced some benefits, not markedly observed in this model, that have had a positive effect on *NAFTA* members' trade with non-*NAFTA* members. It is possible that in some instances, when an agreement has boosted incomes in member countries, the positive income effect trickles over to non-member trade. This is where a member nation that, because of increases in income, increases trade with non-member nations for the purchasing of commodities that are not obtained from within the framework of their RTA. This trickle down effect could then lead to *positive* trade diversion effects and is offered here as an explanation as to the positive sign of the trade diversion dummy coefficient for *NAFTA*.

CHAPTER 5
SUMMARY AND CONCLUSIONS

Summary

In this study, it was initially proposed that Regional Trade Agreements (RTAs) would have a positive effect on bilateral trade flows. That is, if two nations were members of the same RTA, a noticeable *increase* of trade should be observed between the trading pair. In this regard we see that of the five RTAs analyzed (*NAFTA, AC, MERCOSUR, LAIA, and CACM*), none of them were significant in their explanatory capacity as to significant increases in *agricultural* bilateral trade flows. This fact is not as disturbing as one would initially suspect, keeping in mind that agriculture is a highly protected commodity class and that the lifting of economic barriers to allow the free flow of goods in the field of agricultural commodities has not yet been fully realized. It is also important to note that of the RTAs included that were not significant, *NAFTA* and *LAIA* had the expected sign (+). With the advent of lowered tariff restrictions, trade flows will be less inhibited through reductions in tariff levels. Once this occurs, a more significant explanatory contribution (from these RTA dummy variables) as to the flow of *agricultural* bilateral trade between those member states may be observed.

Not only have the trade creating effects of RTAs been examined, it was also the purpose of this study to examine the possible negative effects RTA membership could have in diverting trade from traditional nation trading pairs. The traditional pair of trading nations would then be replaced by non-trading pairs of trading nations who were mutual members of the same RTA. Of the five agreements (*NAFTA, AC, MERCOSUR, LAIA*, and *CACM*), all, with the

exception of *NAFTA*, had the expected negative sign and all, except *NAFTA*, were highly significant, with p <0.0001. *NAFTAD* was significant at the 5% level, although positive (+) in sign. These results tend to indicate that. when nations do join a RTA, trade *is* diverted from traditional trading pairs to pairs of countries enjoying mutual membership in the same RTA. This reallocation of resources from traditional trading sources to new nations was defined earlier as *trade diversion.* With the trade diverting dummy for NAFTA *(NAFTAD)* it is interesting to note the positive nature of the trade diversion dummy. Stemming from this positive sign on *NAFTAD*, it can be deduced that membership in a RTA is not automatically negative when it comes to possible trade diversion effects. Some nations, while enjoying the mutual membership effects in a RTA, could experience enhanced income effects from increased mutual RTA trade which would in turn lead to an increase in trade with non-RTA members in a nation's bid to obtain items that are demanded by its population but not readily available from within the framework of RTA member states. We conclude then that not all diversion effects are *negative* in nature.

As to the variables that were considered key to the foundation of the Gravity Model, (GDP, population, and distance), it is interesting to note that in the case of GDP, the log of GDP for the exporting country, *i*, was negative but insignificant while the log of GDP for the importing country, *j*, was positive but also insignificant. As has been offered earlier, in the generalized Gravity Model, where all trade flows are observed (inter- and intra-industry trade) the generally expected result would be a positive relation between the logs of both country *i* and

j's GDP to bilateral trade flows. In this particular case, we are examining the result of the logs of country *i* and *j*'s GDP to *agricultural* bilateral trade flows. Given how the market reacts in the exporter's market with a rise in income (the demand for agricultural commodities goes up, exports go down) it is not surprising to see an inverse relationship with respect to income.

Another determinant of *agricultural* bilateral trade flows is the population of the respective trading pair. In our model we saw both significance in the population for the exporting country (*i*) and the importing country (*j*). Populations are determinants of demand. The greater the population, according to economic theory, the greater will the demand be for goods and services. Since the focus of this thesis was on the flow of agricultural commodities across trading partners, population's level of explanatory significance in the model is not surprising.

With distance we noticed the significant ($p<0.0001$) relationship between the variation in the log of distance with the log of bilateral trade flows. This is in agreement with the tenants of the Gravity Model and is also in agreement with economic theory. The farther country *i* and country *j* are from each other, the higher the transaction costs. In turn, the higher the transaction costs, the greater friction to trade will be between *i* and *j*, and thus, more economical alternatives to trade would be investigated by *i* and/or *j*. This investigation of more efficient, less costly trading structures would then lead to a lessened bilateral trade flow between the original trading nation pair, *i* and *j*.

Finally, it was noticed that language did play a role in the flow of bilateral trade. The language commonality variable, *lang*, was positive (+) but insignificant, indicating that language commonality between a trading pair in the Western Hemisphere does not play as important a role in trade between countries as it would with more diverse trading pairs/blocs. This result should not diminish the fact that sharing a common language allows countries to better understand their target market through having common cultural norms and not having to bridge a 'psychic gap' of any great magnitude. Learning a different language to conduct bilateral trade would present to a potential barrier to trade.

Conclusions

We have seen that RTAs could have a positive effect (yet insignificant) on bilateral trade flows, and that with some of the other RTAs (e.g. *NAFTA*, etc.) sufficient time will have to be allowed to pass before noticeable results could be obtained. We have also seen that not all trade diversion effects are negative in nature, (e.g. *NAFTA*) but can, with increased income, have a positive effect on a RTA member's trade with non-RTA members. We saw the importance of population and, to a lesser degree, income as to explaining the variability in *agricultural* bilateral trade flows and these observations are in agreement with the literature. Language was also observed as occupying an important place (yet insignificant) in its' descriptive capability as to the variability in *agricultural* bilateral trade flows and this too, is in agreement with the attendant literature (as regards the sign of the parameter coefficient). It is felt, then, that this thesis has accomplished what was stipulated from the beginning: to develop a gravity model

framework that would describe the relationship between the flows of agricultural commodity trade in the Western Hemisphere and population, income, distance, language commonality, and RTA membership.

Further Study

By establishing the importance of RTAs to agricultural commodity trade, it would be an interesting to see the continued effects of liberalized trade on bilateral trade flows of agricultural commodities with the passage of time. As time passes, more barriers to trade may be removed. If our reasoning is correct, a more noticeable increase as to agricultural commodity trade flows should be observed in the Western Hemisphere. Further quantitative analysis and empirical work as to impact of RTA membership remains to be done and promises to be a rich area for concentrated effort of study well into future years.

BIBLIOGRAPHY

Anderson, J. (1979) "A Theoretical Foundation of the Gravity Model." *American Economic Review* 69(1), 106-16

ArcView 3.x. Enviornmental Systems Research Institute. Geographic Information System Software for the Calculation of Distance Utilizing Transverse Mercator Projection

Baldwin, R. (1997) "The Causes of Regionalism." *The World Economy* 20(7), 865-888

Bergstrand, J. (1985) "The Gravity Model in International Trade: Some Microeconomic Foundations and Empirical Evidence." *The Review of Economics and Statistics* 67, 474-81

Bergstrand, J. (1989) "The Generalized Gravity Equation, Monopolistic Competition and the Factor-Proportions Theory in International Trade." *The Review of Economics and Statistics* 71, 143-53

Breuss, F. and Egger, P. (1999) "How reliable are Estimations of East-West Trade Potentials Based on Cross-Section Gravity Analyses?" *Empirica* 26(2), 81-95.

Carrillo, C. and Li, C. A. (2002) "Trade Blocks and the Gravity Model: Evidence from Latin American Countries. Economics Discussion Papers 542, University of Essex, Department of Economics.

Central Intelligence Agency. *World FactBook.* Web Accessed: http://www.cia.gov/cia/publications/factbook/. January 28, 2006.

Cheng, I.H. and Wall, H. J. (1999), "Controlling for Heterogeneity in Gravity Models of Trade." Federal Reserve Bank of St. Louis Working Paper 99-010A.

Deardorff, A.V. (1995) "Determinants of Bilateral Trade: Does Gravity Work In a Neoclassical World?" NBER Working Paper No. 5377. National Bureau of Economic Research. New York.

Egger, P. (2000) "An Econometric View on the Estimation of Gravity Models and the Calculation of Trade Potentials." *The World Economy.* 27(2). 297-312(16)

Feenstra, R., Markusen, J.A., and Rose, A. (1998) "Understanding the Home Market Effect and the Gravity Equation: The Role of Differentiating Goods." NBER Working Papers No. W6804. National Bureau of Economic Research. New York

Ghosh, S. and Yamarik, S. (2004) "Are Regional Trading Arrangements Trade Creating?: An Application of Extreme Bounds Analysis." *Journal of International Economics.* 63(2). 369-395.

GTN. (2006) "Regionalism Summary." Global Trade Negotiations Home Page. Center for International Development. Harvard University. Web Accessed: http://www.cid.harvard.edu/cidtrade/issues/regionalism.html. February 15, 2006

Head, Keith. (2003) "Gravity for Beginners." Working Paper. Faculty of Commerce. University of British Columbia Web Accessed: http://strategy.sauder.ubc.ca/head/gravity.pdf. January 28, 2006

Helpman, E. (1987) "Imperfect Competition and International Trade: Evidence from Fourteen Industrial Countries." *Journal of the Japanese and International Economics.* 1:62-81

International Monetary Fund. (2006) International Financial Statistics. Database and Browser. Publication Services. International Monetary Fund. Washington, D.C.

Koo, W., Kennedy, P.L., Skripnitchenko, A. (2006) "Regional Preferential Trade Agreements: Trade Creation and Diversion Effects." *Review of Agricultural Economics.* 28(3) *forthcoming*

Krueger, A.O. (1999) "Trade Creation and Trade Diversion Under NAFTA." NBER Working Papers No. W7429. National Bureau of Economic Research. New York

Leamer E.E. (1974). "The Commodity Composition of International Trade in Manufactures: An Empirical Analysis", Oxford Economic Papers, 26. 350-374.

Linneman, H. (1966) *An Econometric Study of International Trade Flows.* Amsterdam. North Holland Publishing Co.

Mátyás, L. (1997) "The Gravity Model: Some Econometric Considerations. *The WorldEconomy* 21(3), 397-401

Pöyhönen, P. (1963) "A Tentative Model for the Volume of Trade between Countries." *Weltwirtschaftliches Archiv*. Band 90. Heft 1. 93-100

Sandberg, H.M. (2004) "The Impact of Historical and Regional Linkages on Free Trade in the Americas: A Gravity Model Analysis Across Sectors." *Selected Paper Presented at the American Agricultural Economics Association Annual Meeting, Denver, CO., August 1-4, 2004*. Web Accessed: http://agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=14399. January 31, 2006.

Srivastava, R.K. and Green, R.T. (1986) "Determinants of Bilateral Trade Flows." *The Journal of Business* 59, No. 4, Part 1. 623-640

Statistical Analysis Software (SAS) SAS System For Windows version 9.0.

Tinbergen, J. (1962) *Shaping the World Economy: Suggestions for an International Economic Policy.* The Twentieth Century Fund. New York

Viner, J. (1950) *The Customs Union Issue*. Carnegie Endowment for International Peace. New York

Wei S.J. (1996), "Intra-National Versus International Trade; How Stubborn are Nations in Global Integration?" NBER Working paper, 5939. National Bureau of Economic Research. New York.

World Trade Organization. 2006 "Proliferation of Regional Trade Agreements-Implications for Multilateral Regime." Web Accessed: http://www.wto.org/english/tratop_e/region_e/regfac_e.htm. February 15, 2006

VITA

Brian Matthew Hilbun was born in Baton Rouge, Louisiana, United States of America on August 22, 1972. He is a current resident of Ethel, Louisiana. In 2003, he received his Bachelor of Science in mathematics from Louisiana State University. After receiving his diploma from LSU, Brian accepted a transportation facilitator's position with *The Morning Advocate* a local newspaper in Baton Rouge. Because of his interest in world affairs, Brian decided in 2005 to re-enter LSU to pursue his master's degree in agriculture economics with a concentration in international trade.