DETERMINANTS OF WHEAT TRADE, 1999-2008

by

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Abstract

This research will identify and quantify the determinants of international wheat trade from 1999-2008. This study will focus on the following objectives: (1) Review literature on international wheat trade to develop a suitable conceptual model (2) Quantify the impact of economic variables including price, income, exchange rates, transportation costs, and trade policies; and (3) Extend previous work by further consideration of trade policies and international relationships.

Regression results indicate that economic factors continue to play a major role in wheat trade. Domestic price had the largest level of statistical significance of non-trade agreement factors in this analysis. The regression results highlight that national income, distance between nations, exchange rate, inflation and respective populations are also important in determining the flow of wheat. Openness to trade and agriculture production variables were statistically significant, demonstrating the commodity nature of wheat trade. Sharing a common border and language are also positive factors in wheat trade. Colonial heritage does have some small impacts, negative for direct colonies and positive for nations sharing a common colonizer.

This analysis extends previous international wheat trade research through the inclusion of multilateral relationships and bilateral trade agreements. This study showed that not being a member of the WTO is a positive factor in the trade of wheat.

The review of trade agreements added depth to this study by examining both trade creation and trade diversion for each agreement specifically for their effects on wheat trade. The estimated models show that nations which develop agreements with contrasting qualities from themselves are likely to see higher gains from free trade agreements. However, when nations engage in agreements with nations in a similar location or income structure, trade diversion

occurs. The analysis also shows that trade agreements can overcome factors that may have a negative impact on the trade of wheat such as distance or colonial relationships. By understanding the determinants of wheat trade, players in the wheat market can create a more transparent and fluid trading system.

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Dedication

To my family, who taught me that luck is when hard work and determination come together.

Chapter 1 - Introduction

International trade is based on the simple notion of buying a product at a given location at a low price, then transporting it to another location and selling it at a higher price. Real-world international trade, however, is a complex interaction of economic, political and social factors that encourage or deter the movement of goods from one location to another. The interworking of multilateral organizations, trade agreements, environmental controls, food safety policies, and cultural backgrounds creates a multifaceted trading system in which numerous barriers and catalysts exist, often in conflict with one another. The purpose of this thesis is to identify and quantify the determinants of international wheat trade during the time period 1999-2008. By focusing specifically on the flow of wheat, variables such as domestic price can be included in the analysis. Wheat-specific traits, together with updated policy variables, are important because of the evolving nature of trade policies, and the increased need for an efficient global supply chain. When the multilateral system was developed in the late 1940s, its purpose was to create preferential treatment to select trade partners, mainly industrial nations. International trade issues have changed since the multilateral movements following World War II. Today, the purpose of the World Trade Organization (WTO) is to provide equal treatment to all members. Concerns with reduced supplies, environmental awareness, and food safety are at the forefront of topics being addressed. Furthermore, the involvement of the developing world is crucial to creating a transparent global trade system. These new challenges and factors have raised new considerations and standards that influence trade policy.

The untangling of trade determinants is complex, even when focusing on a single commodity, given the vast diversity among market participants and national attributes.

Nevertheless, the implications of identifying the significant drivers of world wheat trade could create a more effective global marketing system.

Wheat is one of the most important staples in the world diet, and the highest volume grain commodity traded in the world, averaging almost 90,000 Million Metric Tons (MMT) per year since 1960 with current annual volumes around 110,000 MMT (USDA/FAS, Production, Supply and Disapperance Online). Figure 1 highlights the structure and competitiveness of the international wheat market over the past 10 years. Since the 1960s, the United States, Canada, Australia, Argentina and the European Union have dominated wheat exportation, consistently accounting for over 90 percent of wheat trade. In more recent years, the rise of the former Soviet Union nations of Russia,[1] Ukraine, and Kazakhstan have increased the competition in the wheat industry, as they have moved from being net importers of wheat to major exporters. Furthermore, their vast production potential, proximity to importers, and low pricing schemes have pressured established exporters to be more competitive to maintain market share. Numerous importers, seasonal availability, various wheat performance attributes, and cultural differences also make wheat a unique product on the international market.

1.1 Objectives

This research will identify and quantify the determinants of international wheat trade from 1999-2008. This study will focus on the following objectives:

1. Review the existing literature on international wheat trade to develop a suitable conceptual model for understanding the determinants of wheat trade.

[1] Formally known as the Russian Federation.

2. Quantify the impact of economic variables including price, income, exchange rates, transportation costs, and trade policies on the movement of wheat between nations.
3. Extend previous work by further consideration of trade policies and international relationships as determinants of international wheat trade.

Results will provide valuable information to industry participants, by highlighting which attributes of exporters and importers have had the greatest influence on the movement of wheat in the selected ten-year time span. A major contribution of this analysis is the quality of data used and the inclusion of up-to-date trade agreement information. With this information, industry leaders and international policy makers will have current information that identifies the major factors that drive the global wheat market, and knowledge of which variables could be adjusted to gain a more efficient market.

1.2 Project Description

To quantify the determinants of wheat trade, previous researchers developed a gravity equation. Gravity models were derived from the intuition of gravity in physics. In this application of a gravity model, the flow of goods is determined by the economic size of two trade partners, divided by the distance between them. A gravity trade model provides a unique opportunity to evaluate the determinants of the movement of wheat across borders, because current models include various additional economic and political factors that impede or facilitate the movement of goods. Using the data provided by the Global Trade Information System (2011), the trade of wheat at the four-digit Harmonized System (HS) code level will be evaluated for thirty-six exporters from the years 1999-2008. The Harmonized System is a numbering system used to identify products for customs purposes (The Harmonized System). The four digit

level, 1001, allows the inclusion of commodity wheat products, regardless of variety. These wheat trade quantity data, combined with various economic and policy factors such as domestic prices, distance between nations, exchange rates, inflation, population, openness to trade and trade agreements, will be evaluated using a gravity equation. The result is an econometric model that quantifies economic and political determinants of wheat trade.

1.3 Organization of Thesis

This thesis includes six chapters. Chapter 2 is a review of relevant literature of international wheat trade. Chapter 3 will develop the conceptual model used in this analysis. Chapter 4 presents a description of each variable included in these data. The empirical results will be discussed in Chapter 5. Finally, in Chapter 6 conclusions will be drawn and suggestions for further research and enhancements will be provided.

Chapter 2 - Review of Literature

There are several issues currently facing the international wheat market that have been studied in economic literature. This chapter will highlight some of the topics facing the wheat industry, discuss the theory of the gravity model, and finally. highlight the application of the gravity model in wheat trade.

2.1 Gravity Trade Model Foundations

Understanding the theorectical background and application of the gravity model provides a unique contribution to the literature for international wheat trade. This section is reviews the theorectical literature of the gravity model.

Based on Newton's gravity equation in physics, gravity models were developed to quantify spatial flows (Yeboah et al. 2007). These equations have been used to study various types of spatial movement such as migration, commuting, tourism and commodity shipping (Bergstrand 1985). Early gravity models applied to international trade were developed by Tinbergen (1962), Poyhonen (1963), and Linneman (1966). These early economists theorized that trade was determined simply by the relative size of each economy divided by the distance between the two nations. It was their hope that from this basic model, they could determine a standard pattern of trade flows that would occur without impediments to trade. Tinbergen (1962) outlined the basic parameters of the gravity equation, using the factors of national income, distance as an approximation of transportation costs, adjacency, and a preferential trade agreement qualitative variable for the British Commonwealth for his study of 1959 trade flows. Tinbergen (1962) concluded that exporter income was the most important factor in the study of world trade flows, while preferential trade agreements (PTAs) did not have as large of an impact

as expected. However, early applications such as Tinbergen (1962) provided little theoretical foundation for the gravity model.

Anderson (1979) began the work of developing the theoretical framework for these gravity model equations. Anderson derived a gravity equation from an expenditure system based on a Constant Elasticity of Supply (CES) utility function. The use of the CES, rather than the Cobb-Douglas system, allowed for a non-unity income elasticity and differentiation between traded and non-traded goods. Anderson included two important assumptions, (1) identical preferences among consumers, and (2) the recognition that goods are differentiated by region of origin.

Anderson's work was extended by Bergstrand (1985), who advanced the gravity model theory by identifying basic assumptions of a general equilibrium equation that mirrors a traditional gravity model for the purposes of international trade analysis. He called this equation a generalized gravity equation, because variables are specified with behavioral context, and additional variables are included due to their anticipated ability to influence the decision to trade. An important aspect of the gravity equation is the elasticity of substitution, particularly among importables (σ) and between domestic and imported products (μ). The value of σ and μ creates some ambiguity in the expected impact of given variables. For example, when σ exceeds unity, the exporter's income will have a positive effect, and GDP deflator will have a negative coefficient. Bergstrand (1985) found that σ exceeded unity while μ was less than unity. Bergstrand (1985) concluded that the generalized gravity equation performs similarly to a basic gravity model, shown in the similarities of coefficient signs. Positive coefficients were noted for importer income, adjacency and preferential trade agreements, while distance exhibits a negative sign.

Bergstrand (1989) expanded the microeconomic foundations of the generalized gravity equation with the inclusion of factor-endowment variables and national "taste" preferences in a monopolistic competition setting. Similar to previous work, Bergstrand (1989) derived the consumer and firm/country demand and supply functions, respectively, including income and resource constraints. He described that exporter national output can be substituted with exporter Gross Domestic Product (GDP). On the importer side, GDP is the given nation's purchasing power.

Bergstrand (1989) also discussed the nature of luxury versus necessity goods. He noted that luxury goods, being capital intensive, would result in the elasticity of substitution to exceed unity, causing the coefficients for exporter and importer per capita incomes to be intuitively positive. This is important to keep in mind, as wheat is likely to be a necessity good, which would theoretically have the opposite effect. The income elasticity classification of wheat is important because it provides some insight to how the income coefficient will be signed. Traditionally, wheat is considered to be a capital-intensive, necessity good. Therefore, as income increases for exporters and importers, the quantity of wheat traded will decrease. Furthermore, to test the above theories empirically, Bergstrand (1989) developed a generalized gravity equation. In this analysis he tested nine, one-digit Standard International Trade Classification (SITC) code categories for the years 1965, 1966, 1975 and 1976. United Nations (UN) Statistics Division maintains the SITC, a trade classification system used to categorize goods into 97 sections for trade reporting purposes. Bergstrand (1989) looked at classifications 0-8 which include Food and Live Animals (SITC 0), Beverages and Tobacco (SITC 1), Raw Materials (SITC 2), Fuels (SITC 3), Animal and Vegetable Oils and Fats (SITC 4), Chemicals (SITC 5), Manufactures Classified Chiefly by Material (SITC 6), Machinery and Transportation Equipment (SITC 7) and finally

Miscellaneous Manufactures (SITC 8). Bergstrand (1989) noted that products that tend to be capital-intensive showed positive and significant exporter per-capita income coefficient estimates, including Food and Live Animals (SITC 0). As expected, luxury and non-luxury goods received significant positive and negative coefficients respectively, for importer per capita income.

Anderson and van Wincoop (2003) contributed to the gravity equation literature by modifying previous theoretical work to a more simplified statement of a gravity model. Anderson and van Wincoop criticized the findings of McCallum (1995) for a lack of theoretical foundation in a gravity equation. Anderson and van Wincoop (2001) explained that trade resistance comes from three sources (1) bilateral trade barriers, (2) exporters resistance to trade with all regions, and (3) importers resistance to trade with all regions. Thus, Anderson and van Wincoop (2001) revised the gravity equation by modifying the CES expenditure system to create a more simple form of the gravity model by linking trade costs to both bilateral and multilateral barriers. Thus the gravity equation, in this simplified form implies: "Bilateral trade, after controlling for size, depends on the trade barrier between [nations] i and j, divided by the product of their multilateral resistance (page 8)."

Anderson and van Wincoop (2001) claimed that the analysis done by McCallum (1995) overstated border effects between the United States and Canada through the omission of multilateral resistance terms. Anderson and van Wincoop (2001) found that the border between the United States and Canada reduced trade by 44 percent, compared to the estimated 2,200 percent presented by McCallum (1995).

The theoretical foundation derived by Anderson (1979), Bergstrand (1985, 1989), and Anderson and van Wincoop (2001) is imperative to the development of the gravity trade model

for this analysis. Because of their work, a gravity equation can be derived from a four-equation partial equilibrium model and reduced into gravity-type equation. The next section will discuss this theoretically consistent gravity model in international trade.

2.2 Gravity Trade Model Applications

In this section, gravity model research related to wheat trade and agricultural products are reviewed. Koo and Karemera (1991) analyzed factors influencing international wheat trade using a commodity-specific gravity trade model. The study focused on evaluating the influence of trade policies on commodity flows. The authors designed a quantity-dependent commodity-specific gravity trade model for wheat. Independent variables included in their base model were economic factors such as national income, transportation cost, domestic price, exchange rates, and inflation. Additional variables reflected trade policies or barriers used by both wheat importers and exporters including, but not limited to, foreign currency restrictions and trade promotion programs such as long term agreements (LTA) (Koo and Karemera 1991). Canada and Australia commonly used LTAs. In these respective countries, national wheat promotion boards govern LTAs that provide a minimum amount of wheat that was sold to a given exporter each year (Anjaria 1987). The study found that the quantity of wheat traded was not dependent on exporter production capacity, importer disposable income, or transportation costs, which was approximated by distances between ports. The authors further noted that LTAs had the most significant positive effect on wheat trade, while protectionist policies provided the greatest limitations for wheat movement. The empirical framework for this thesis will be based on the findings of Koo and Karemera (1991). The variables included in the regressions will closely follow this study, with extensions to reflect current policies and trade agreement in wheat trade.

Grant and Lambert (2005) used a gravity trade model to focus on the effect of regional trade agreements (RTAs) on the flow of agricultural goods. The authors evaluated wheat at the two-digit Harmonized System (HS) level. The Harmonized System is a numbering system used to identify products for customs purposes; the two digit level classifies the main category of a product like animals or cereal grains (Export.gov).

An interesting aspect of Grant and Lambert's (2005) work was the inclusion of variables that capture the two types of effects that occur when a trade agreement is signed into force: (1) welfare effects of agreement partners, known as trade creation, and (2) changes in commodity trade, known as trade diversion. The first effect trade agreements can have is on the welfare of each agreement partner. When nations engage in an agreement, the reduction of tariffs reduces trade costs and can encourage the movement of goods between those two nations increasing welfare. In their study, Grant and Lambert (2005) quantified these effects through a trade creation variable. Trade creation variables were qualitative, taking on the value of one when the year is greater than or equal to when the agreement was signed. These types of agreements are common in literature. For example, Tinbergen (1962) looked at the effects of British Commonwealth preference and Koo and Karemera (1991) quantified the Economic Community trade agreement effect.

When trade costs are decreased between nations through a trade agreement, this also affects the world market, particularly for nations who are not directly involved in the agreement. The reduction in trade costs brought about by the agreement can make agreement partners more competitive. If this cost is reduced enough, the agreement can cause diversion of trade from a traditionally more cost effective producer to an agreement partner. This change in trade pattern is called trade diversion. Trade diversion variables included by Grant and Lambert (2005) were

also qualitative, taking on the value of one, when the trade occurs between an agreement and non-agreement member and the year is greater than or equal to when the agreement was signed.

Grant and Lambert (2005) concluded that the North American Free Trade Agreement (NAFTA), Asian Pacific Economic Cooperation (APEC), and AFRICA RTAs all had positive and significant effects at the one percent level on wheat trade creation. This implies that NAFTA, APEC and AFRICA had positive welfare effects on agreement members by encouraging the flow of wheat among agreement members. Trade diversion variables were negative and significant at the one percent level for the EU-15, APEC and AFRICA for wheat, implying that these agreements caused member nations to divert trade of wheat from a more efficient producer to trade with an agreement member. The magnitude of the relationship between trade creation and diversion is further discussed by Grant and Lambert (2005).

Since the work of Koo and Karemera (1991), the use of bilateral and regional trade agreements has become more common in the global trading system. To accurately reflect the development and use of trade agreements, similar trade creation and diversion elements such as those presented in Grant and Lambert (2005) will be included in the model in this analysis. The addition of these variables will highlight the positive or negative influence of each agreement on wheat and more accurately reflect current, up-to-date, policy trends in international trade.

Vollrath, Gehlhar and Hallahan (2009) evaluated bilateral protection for agricultural industry products, including wheat, for the years 1986, 1996, 2000 and 2004. They incorporated additional variables including, land/labor ratio, exchange rate misalignment, border protection and colonial heritage. Land/labor ratio takes a similar approach to Bergstrand's (1989) capital/labor endowment factor, except focuses on physical land size rather than capital. A Measure of exchange rate misalignment attempted to compensate for the potential of over- or

under-exchange rate valuation. Border Protection (BP) was described as one plus ad-valorem subsidy and tariff equivalents (AVE). According to the World Trade Organization (WTO), an AVE is the tariff expressed as a percentage of price. A major result was the positive significance of relative endowment factors, for agricultural markets. Moreover, border protection showed no effect on agricultural trade as a whole. The authors found that the bilateral protection variable for wheat was insignificant for all four years included in the study. Furthermore, the significance of Importer Income, Income Differences, Exchange Rate Misalignment and Colonial Heritage varied by year.

Gravity models have been frequently used outside specific commodity or good flows. Trade policies are often examined using a gravity equation including: Baier and Bergstrand (2007) and Bayoumi and Eichengree (1995) who analyzed trade agreements, Rose (2000) who evaluated the effects of common currencies and Anderson and van Wincoop (2001) who discussed national borders as a trade barrier. These and other articles provide insight to the use and potential of gravity trade equations. However, many of the theories and applications of these studies are beyond the scope of this analysis.

With the foundation of the above literature, the following chapter is dedicated to the development of a conceptual gravity trade model.

Chapter 3 - Conceptual Model

This study is based on a gravity trade model that reflects the specific attributes of international wheat trade. The literature described in the previous chapter serves as a building block to formulate and evaluate a wheat-specific gravity trade model. The purpose of this chapter is to describe the development of this model and to identify the three regressions that will be performed for this analysis.

The gravity trade model suggests that the bilateral flow of goods is based on the economic size of the two trading partners and the distance between them. The theoretical gravity model takes the following form (Tinbergen 1962):

$$X_{ij} = G\, Y_i Y_j / D_{ij} \quad (1)$$

where *i* and *j* represent the exporter and importer, respectively. The flow of goods is noted by *X*, *Y* is the economic mass of each nation, commonly estimated by country income, *D* is the distance between the two nations, and *G* is a constant. Koo and Karemera (1991) extended this basic framework with the additions of tariff (T_j), prices (P_i and P_j), exchange (E_{ij}) rate, and inflation (I_i and I_j) variables, using a log-log specification resulting in the model below.

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{\beta_3} T_j^{\beta_4} P_i^{\beta_5} P_j^{\beta_6} E_{ij}^{\beta_7} I_i^{\beta_8} I_j^{\beta_9} * e_{ij} \quad (2)$$

where β_0 is the constant *G*, β_n are the parameters to be estimated, and *e* is an error term. Exporter income (Y_i) can represent the production capacity of a nation, and importer income (Y_j) represents the nation's purchasing power (Koo and Karemera 1991). The flow of goods should be positively related to income for exporters and negatively related for importers. The trade barriers of distance (D_{ij}) and tariffs (T_j) are expected to have a negative influence on trade flows. Price variables (P_i and P_j) reflect the domestic price of wheat in each nation. Products are expected to move from a location with a low price to a location with a higher price. The

adjustment of the exporter price upward or importer price downward should decrease the flow of goods between nations. Inflation (I_i and I_j) complicates the world market, an exporter with relatively higher inflation is more competitive in the world market because it effectively decreases the value of the good. Inversely, high inflation in an importing nation leads to lower price goods and the decrease of trade. Exchange rates (E_{ij}) also play a strong theoretical role in international trade. As a currency strengthens against another, it will encourage imports but reduce exports of that nation.

Because the model developed for this study is focused on wheat trade, the equation can reflect qualities that are specific to this market. Koo and Karemera (1991) suggested that the tariff variable (T_j) in Equation 2 could be expanded to include factors that further encourage or deter trade. To expand this T_j variable several variables will be included in this model. The first variables included will look specifically at production and demand for wheat. Population explains demand for wheat for both importers and exporters. It is expected that an increased population in an exporting nation (POP_i) will have negative effects on the trade of wheat. On the other hand, an increased population in an importing nation (POP_j) will have negative effects on the trade of wheat. In this model, capacity to produce value added agriculture goods (PAG_i) will also be included. This variable will denote the production of value added agriculture goods as a percentage of GDP. Because wheat is a commodity good, as the percentage of value added agriculture production increases, the amount of wheat exported is expected to decrease. To quantify attitudes towards trade in general, an openness to trade variable was developed denoted as PT_i and PT_j. This variable notes that the level of trade as a percentage of GDP increase, the more open a nation is to trade and the greater the amount of wheat flow can be expected. To capture the full effect of income, ability to produce and willingness to trade, interaction terms

among these variables are included in the model (Y_i*PT_i, Y_j*PT_j, and Y_i*PAG_i). The interaction terms between PT_i, PT_j, PAG_i, and Y_i, scale this relationship such that the openness to trade or ability to produce of a nation with a larger income can more accurately be compared to those of smaller nations.

Grant and Lambert (2005) provided some justification for additional qualitative variables that provided additional descriptive power to the model, including colonial relationships, common languages and contiguity of nations. Each of these variables highlight commonalities among nations that aid in international trade. A colonial relationship often implies similarities in political structure, culture and language. Common languages are perceived to allow nations to communicate more easily with one another and may represent cultural similarities. Contiguity is a signal of distance but can also host some common culture relations.

Multilateral relations will be noted with the variables $NONWTO_i$ and $NONWTO_j$. These variables will signify the nations which do not hold membership in the WTO. These variables will quantify the effects that the WTO has on wheat trade in terms of trade liberalization. If the WTO has effectively reduced trade barriers for the wheat market, this should have a negative effect on nations who have not obtained membership in this organization.

During the span of this analysis, there has been an increase in the quantity of wheat traded. In order to account for this increase in wheat movement a set of yearly qualitative variables were included in the model. The year 1999 will serve as the comparison year.

The additions of these variables result in the following equation:

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{\beta_3} P_i^{\beta_4} P_j^{\beta_5} E_{ij}^{\beta_6} I_i^{\beta_7} I_j^{\beta_8} POP_i^{\beta_9} POP_j^{\beta_{10}} PAG_i^{\beta_{11}} PT_i^{\beta_{12}} PT_i^{\beta_{13}} (Y_i * PT_i)^{\beta_{14}}$$

$$\left(Y_j * PT_j\right)^{\beta_{15}} (Y_i * PAG_i)^{\beta_{16}} \mu^{CONTIG\beta_{17}}\ \mu^{LANG\beta_{18}} \mu^{COLONY\beta_{19}} \mu^{NONWTO_i\beta_{20}} \mu^{NONWTO_j\beta_{21}}$$

$$\mu^{Year\beta_{22}} * e_{ij} \quad (3)$$

Equation three will be the first regression performed in this analysis.

For the bilateral perspective, 37 trade agreement variables similar to those presented by Grant and Lambert (2005) will also be included in the model. This will be a major contribution to the current wheat trade literature, as the evaluation of trade agreements at the commodity level is not common. It is important to remember that trade agreements have two effects (1) trade creation, which is the value of trade created between partners when a trade agreement is in place and (2) trade diversion which is the value of trade created as a result of diverting trade from non-agreement partners. Using the list of trade agreements reported to the WTO that involves a nation included in the dataset will be expressed in trade creation terms with the variable *CTRADE*, which will take the value of one if a trade agreement between the two trading partners is active. The inclusion of this variable results in the equation below and will serve as the second regression performed in the analysis.

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{\beta_3} P_i^{\beta_4} P_j^{\beta_5} E_{ij}^{\beta_6} I_i^{\beta_7} I_j^{\beta_8} POP_i^{\beta_9} POP_j^{\beta_{10}} PAG_i^{\beta_{11}} PT_i^{\beta_{12}} PT_i^{\beta_{13}} (Y_i * PT_i)^{\beta_{14}}$$

$$\left(Y_j * PT_j\right)^{\beta_{15}} (Y_i * PAG_i)^{\beta_{16}} \mu^{CONTIG\beta_{17}}\ \mu^{LANG\beta_{18}} \mu^{COLONY\beta_{19}} \mu^{NONWTO_i\beta_{20}} \mu^{NONWTO_j\beta_{21}}$$

$$\mu^{Year\beta_{22}} \sum_{l=1}^{37} \alpha_l\ CTRADE *\ e_{ij} \qquad (4)$$

In order to quantify the full effect of trade agreements, a trade diversion variable is included in the model for each applicable agreement. Trade diversion occurs when a trade agreement reduces costs for agreement members, such that trade is diverted from more cost effective producers. Trade diversion captures the impacts that agreements have on the market. The addition of trade diversion variables (*DTRADE*) results in the complete model. Equation 5 below is the complete conceptual model and will be the third and final regression of this analysis.

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{\beta_3} P_i^{\beta_4} P_j^{\beta_5} E_{ij}^{\beta_6} I_i^{\beta_7} I_j^{\beta_8} POP_i^{\beta_9} POP_j^{\beta_{10}} PAG_i^{\beta_{11}} PT_i^{\beta_{12}} PT_i^{\beta_{13}} (Y_i * PT_i)^{\beta_{14}}$$

$$\left(Y_j * PT_j\right)^{\beta_{15}} (Y_i * PAG_i)^{\beta_{16}} \mu^{CONTIG\beta_{17}}\ \mu^{LANG\beta_{18}} \mu^{COLONY\beta_{19}} \mu^{NONWTO_i\beta_{20}} \mu^{NONWTO_j\beta_{21}}$$

$$\mu^{Year\beta_{22}} \sum_{l=1}^{37} \alpha_l\ CTRADE\ \sum_{i=1}^{35} \gamma_m\ DTRADE * e_{ij} \qquad (5)$$

In order to more accurately interpret the coefficients of the dummy variables, this study will use the same nonlinear transformation performed by Grant and Lambert (2005). Following Grant and Lambert (2005), the simplified semi-logarithmic regression equation of the form

$$\ln V = \alpha + \sum_i \beta_i \ln X_i + \sum_i \gamma_i D_i + \varepsilon_{ij} \qquad (6)$$

where *Xi* represents continuous explanatory variables and D_i is a set of dummy variables. The coefficient of the continuous variable is

$$\beta_i = \frac{\partial \ln V}{\partial \ln X_i} = \frac{\partial V}{\partial X_i}\frac{X_i}{V}. \qquad (7)$$

Thus the coefficient of a continuous variable is the elasticity of V for a small change in the explanatory variable X_i. However, a dummy variable is a discontinuous variable and the derivative of *V* with respect to a small change in D_i does not exist. Instead, the percentage change in *V* going from V_0 to V_1 for a discrete change in D_i from 0 to 1, can be calculated as,

$$\left[\frac{V_0 - V_1}{V_1}\right] * 100 = \left[\frac{\exp\left(\alpha + \sum_i \beta_i \ln X_i + \gamma * 1 + \varepsilon_i\right) - \exp\left(\alpha + \sum_i \beta_i \ln X_i + \gamma * 0 + \varepsilon_{i)}\right)}{\exp\left(\alpha + \sum_i \beta_i \ln X_i + \gamma * 0 + \varepsilon_{i)}\right)}\right] = (\exp(\gamma) - 1) * 100 \qquad (8)$$

With the conceptual model in place, the next chapter focuses on the discussion of the data used for this analysis.

Chapter 4 - Data

This chapter takes an in-depth look at each variable used in this analysis. The data used for this research are annual data from 1999-2008, including 6,351 observations. The quantity of wheat traded data were provided by Global Trade Information Services Inc., a data collection company that provides trade data for several government entities, including the United States Department of Agriculture Foreign Agricultural Service (USDA/FAS). These data are unique because they were collected directly from the customs organizations of each exporter. The data are superior to publically available data because of the the larger number of import partners reported for each exporter. This large number of observations results in a final data set that is a more accurate representation of the international wheat market then those used in previous studies. The 36 exporters included in the data set account for approximately 93 percent of total wheat traded in terms of quantity exported for the 2008/2009 Marketing Year (USDA/FAS Production, Supply and Disappearance Online). Table 1 provides the definition and source of each variable included in the model, and summary statistics are provided in Table 2.

Quantity: The wheat trade variable (X_{ij}) is defined to be the quantity of wheat in metric tons (MT), classified under the HS code 1001, which was exported from exporter (i) to importer (j) for 36 of the top wheat exporting nations and 86 importing partners[2]. A list of all importers and exporters included in the analysis and number of observations reported for each nation can be found in Table 3 (exporters) and Table 4 (importers). These data were provided by Global Trade Information Services (GTIS), with a quantity range from 1 metric ton (MT) to 7,282,273 MT, with a mean value of 135,904.6 MT, and a standard deviation of 422,038.8 MT (Table 2).

[2] An exporter can also be listed as an importer.

The Australian government maintains a confidentiality scheme when reporting wheat trade data. For each year, Bulgaria, Chile, Colombia, Denmark, Ecuador, Eritrea, Finland, Germany, Greece, Madagascar, Peru, Russia, Tunisia and Turkey[3] exhibited discrepancies in the data. Due to the inability to estimate the missing quantities, these observations between Australia and given importer were omitted from the final data set. However, observations for these importers can be found in the data set because they traded with other exporters besides Australia.

Income: National income, or economic size, is approximated by GDP, provided by the USDA Economic Research Service (ERS), in 2005 United States dollars (USD). Exporter income (Y_i) can be interpreted as the production national output (Bergstrand 1989), as this variable increases in value exports should increase. Exporter GDP ranges from 5.59 to 13,228.90 billion 2005 USD with a mean value of 16,353.17 (Table 2). Importer income (Y_j) is representative of purchasing power (Bergstrand 1989), as this variable increases imports will also increase. Importer GDP variable ranges from 0.72 to 13,228.90 billion 2005 USD with a mean value of 676.72[4]. From the summary statistics in Table 2, it is clear that there is a large difference in the income level of importers and exporters, with almost a 1,000 billion 2005 USD difference in mean value.

Transportation Costs: Several variables for barriers and subsidies to trade were collected from the Distance Dataset provided by Centre d'Etudes Prospectives et d'Informations Internationales (CEPII), a French international economics research center (Mayer and Zignago

[3] Afghanistan, Botswana, North Korea, Lesotho, Libya, Rwanda, Somalia, Vanuatu, Zambia and Zimbabwe also showed discrepancies, but were not included in the final regression, because no domestic price data was available for these nations through the UN/FAO.

[4] The U.S. is both an importer and an exporter of wheat, making the maximum exporter GDP equal to the maximum importer GDP.

2006). This database provides four separate distance variables weighted and non-weighted bilateral distances in kilometers that were tested for use as an approximation of transportation costs (D_{ij}). Below is a description of how these distances were calculated:

> The simple distances are calculated following the great circle formula, which uses latitudes and longitudes of the most important city (in terms of population) or of its official capital… The two weighted distance measures use city-level data to assess the geographic distribution of population inside each nation. The idea is to calculate distance between two countries based on bilateral distances between the largest cities of those two countries, those inter-city distances being weighted by the share of the city in the overall country's population (Mayer and Zignago 2006).

The distance variable used in the model was a non-weighted distance between the "most important city." As distance between two trading partners increases, the cost of transportation increases, and the quantity traded is expected to decrease. Distance for this analysis had a mean value of 3,535.89 Kilometers (kms) with a standard deviation of 3,908.74 kms (Table 2).

Domestic Price: Price data were provided by the United Nations Food and Agriculture Oraganization (UN/FAO). Domestic prices, noted P_i and P_j, are considered to be exogenous to the model, and the centerpiece of traditional trade theory. Domestic price for exporters (P_i) ranged from 55.9 to 655.1 USD/MT with a mean value of 148.8 USD/MT (Table 2). The domestic price for importers (P_j) ranges from 48.4 to 1,583.8 USD/MT, with a mean value of 210.7 USD/MT. It is expected that wheat, like all goods, will move from a location with low prices to a location with higher prices. Therefore, as an importer's domestic wheat price increases, it will have a positive effect on trade. Similarly, as an exporters domestic wheat price increases, it will have a negative effect on trade, holding all else constant.

Exchange Rate: Provided by the USDA/ERS, exchange rates for the importer and exporter are the real historical rates for the base year of 2005 in terms of United States dollars. To obtain E_{ij}, rates for importers were calculated by taking the reciprocal of the given value and

were then multiplied by the exporter exchange rate. This results in an exchange rate in terms of exporter currency over of importer currency. The value of the exchange rate variable ranges from 0.000to 764.39 with a mean value of 9.29 (Table 2) [5]. As a currency strengthens against its trade partner's exchange rate, it increases purchasing power or decreases the level of wheat traded. Exporters with a weak currency and importers with a strong currency have positive trade expectations. Thus, as this value decreases, wheat trade is expected to increase.

Inflation: Historical inflation rates were provided by the USDA/ERS for each exporter (I_i) and importer (I_j). Inflation is an increase in prices caused by the increase of the supply of money often brought about by the decrease in government or personal spending. Exporter inflation rates range from 15.04 to 105.74, with a mean value of 81.08. Importer inflation rates have a mean value of 80.9 and range from 4.2 to 127.52 (Table 2). High inflation rates for exporters result in negative effects because the value of the good is actually increasing, making it more difficult to trade. However, high inflation rates for an importer results in a higher domestic value of wheat, and thus encourages a greater use of foreign goods and positive effects.

Population: Provided by the World Bank World Development Indicators (World Data Bank), total population accounts for all residents of a given nation, regardless of legal status. Population for exporters (POP_i) ranged from 0.396 to 304 million with a mean of 58.9 million (Table 2). Population for importers ranged from 0.388 to 1,320 million, with a mean of 51.3 million. It is assumed that an increase in exporter population will decrease the trade of wheat. Furthermore, importer population can be considered an approximation for the demand of wheat, implying that an increase in an importer's population will have a positive impact on the quantity of wheat traded.

[5] The lowest exchange rate value included in the dataset is 0.0000258, rounding results in the value of 0.000.

Exporter Percent Agriculture: This variable (PAG_i) measures the percentage of an exporter's GDP that comes from value added agricultural production. According to the World Databank "Agriculture corresponds to International Standard Industrial Classification (ISIC) divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production." Value added is the "net output of a sector after summing all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources." The value of this variable ranges from 0.36 to 15.86 percent, with a mean of 3.97 percent and a standard deviation of 3.28 (Table 2). This variable was included in the model to signify wheat's production relative to other agricultural goods. Because wheat is a commodity good, it is expected that as PAG_i increases, the potential export decreases. The values for Canada in 2007 and 2008 were unavailable, a simple linear regression was performed to recover these values accounting for 0.006 percent of the exporter percent trade data used.

Openness to Trade: Anderson (1979) described openness to trade as "share of national expenditure accounted for by spending on tradeables (page 106)." To fulfill this definition, percent trade variables are included in the regression as an approximation for a nation's openness, or willingness to trade. This is not common in current literature but should provide some insight to the trade of wheat. The data for these variables were collected from the World Data Bank. Percent trade is the "sum of exports and imports of goods and services measured as a share of gross domestic product." Two variables were created with this information, one for exporters (PT_i) and one for importers (PT_j). Exporter percent trade has a mean value of 78.44 and a standard deviation of 41.67. Importer percent trade has a mean of 82.6 with a standard

deviation of 40.18 (Table 2). It is expected that as the value of this variable increases, for importers or exporters, it will have a positive effect on wheat trade.

Interaction between Income and Percent Agriculture: This variable was included to capture the relationship between the economic size of the nation and the percentage of value added agriculture goods traded. Intuitively, as income increases, value added production of agricultural goods will increase, overtaking commodity products like wheat. This variable (Y_i*PAG_i) will show the effects of an increase in income on the production of commodity goods.

Interaction between Income and Percent Trade: The purpose of this interaction term (Y_i*PT_i and Y_j*PT_j) is to capture the potential relationship between income and percent trade. This variable was included as an additional aspect of openness to trade, while accounting for the economic size of the nation. Logically, as income increases for a normal good, so should trade. However, because wheat is a low-value commodity good it could be a necessity good, and trade will not be increased at the same rate for all levels of openness. This variable will assist in quantifying the rate at which income and openness interact.

Adjacency: This characteristic is denoted by *CONTIG*, a qualitative variable if the exporter and importer share a common border (CEPII) (Mayer and Zignago 2006). If two nations are contiguous, it is expected that this will have a positive impact on trade because of the relative low cost of transporting goods across adjacent borders and potential cultural similarities. The variable *CONTIG* has a mean value of 0.163 (Table 2).

Language: Two variables were provided for common language by CEPII (Mayer and Zignago 2006). The variable *CLE* notes a common language spoken by more than nine percent of the population in both nations; it has a mean value of 0.145. The official common language shared between two nations is noted by *CLO*. This variable has a mean value of 0.128 (Table 2).

If two nations share a common language, official or otherwise, it is expected that they will be more likely to trade because of cultural similarities and ease of communication.

Colonial Relationship: The final CEPII (Mayer and Zignago 2006) variables are qualitative concerning colonial relationships which are denoted by three variables: *COL*, *CCOL* and *COL45*. The variable *COL* signifies any sort of colonial link, past or present. The variable *COL* has a mean value of 0.082 (Table 2). The variable *CCOL* has a mean value of 0.024, and represents a common colonizer after 1945(Table 2). The variable *COL45* denotes a colonial relationship after 1945 and has a mean value of 0.029 (Table 2). These variables are relevant to international trade because they represent potential similarities in political structure and culture, and a historical relationship between trading partners, thus increasing trade. Table 5 lists the colonial linkages that can be found in the dataset.

Non-WTO: This is a qualitative variable that signifies that a given nation is not a member of the World Trade Organization. Two qualitative variables were created to show the impact that WTO membership has on exporters ($NONWTO_i$) and importers ($NONWTO_j$). This variable takes on the value of one while the year is less than the year that country entered into membership. The variable $NONWTO_i$ has a mean of 0.110 and $NONWTO_j$ has a mean of 0.146 (Table 2). Table 6 displays the nations included in the data that are not members of the WTO, or that entered the organization after 1999.

Year: The quantity of wheat exported as increased during the ten year period of this analysis. To control for this increase, a yearly qualitative variable was developed for 2000-2008.

Trade Creation: Thirty-seven *CTRADE* variables were created to quantify the welfare effects of a trade agreement for trade agreement partners[6]. Trade creation qualitative variables were developed for each applicable agreement that was reported to the WTO.[7] These variables take on a value of one when the year is greater than or equal to the year of the agreement. A complete list of each agreement, year initiated and countries involved can be found in Table A.1. If the coefficient of a *CTRADE* variable is positive, the agreement had positive welfare effects on the agreement members. If the coefficient on a *CTRADE* variable is negative, trade of wheat decreased between partners because of the agreement. Table 7 lists the summary statistics for all of the *CTRADE* variables included in the analysis.

Trade Diversion: A trade diversion binary code was developed for each of the 35 applicable agreements as reported to the WTO to quantify the market effects of trade agreements[8]. These qualitative variables take on a value of one when an agreement member imports from a non-member and the year is greater than or equal to the year the trade agreement was signed. Coefficients for *DTRADE* variables can be positive or negative, signifying that the average trade diversion from non-member sources brought about by the agreement. If the coefficient of a *DTRADE* variable is negative, the trade agreement decreased trade costs such that trade with non-agreement members was reduced. Table 8 provides the summary statistics for the *DTRADE* variables.

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[6] Fifty-five agreements were available for evaluation. However, 18 agreements did not have consecutive trade observations and were removed from the analysis due to an inability to account for when no trade occurred after an agreement was signed into force.

[7] It is important to note that Russia, Kazakhstan and Ukraine (until 2008) are not members of the WTO and therefore not required to report trade agreements to the WTO.

[8] Two agreements were removed from the original 37 applicable agreements, because they did not trade outside of their agreement partners and therefore do not show any trade diversion.

Three regressions will be performed of this Model. The first regression includes the first 34 variables in the model. The second regression will include the trade creation variables and the final regression will include all of the variables described in this chapter. Now that there is an understanding of each variable included in the model the following chapter will discuss the regression results.

Chapter 5 - Regression Results

In this chapter, regression results identify and quantify the characteristics of a nation that have the greatest influence on the movement of wheat across international borders. The regressions presented were estimated in partial logarithmic form due simplicity in interpretation of the coefficients. A Breusch-Pagan/Cook-Weisberg test confirmed heteroskedasticitity in the model, indicating that the errors of the regressions do not have a constant variance (Maddala and Lahiri 2009). Because heteroskedastic errors exist, the regressions were run with robust standard errors which will correct the variance of e_{ij} in the regressions.

Several variables were tested for inclusion in the model. First, each of the available distance calculations was tested; the distance with the highest level of significance was selected. The non-weighted distance between economic centers (D_{ij}) was selected for this analysis. In an attempt to more accurately reflect transportations costs, D_{ij}^2 was also included in the model, as it was anticipated that some non-linear costs could be associated with shipping that would cause a quadratic term to account for some of this expense. However, high levels of collinearity resulted in the removal of this variable. A variable *FUEL* was also included in the model to proxy the increased costs of shipping with rising fuel cost over the given time period. The variable produced unexpected results being positive, yet significant. An interaction between D_{ij} and *FUEL* was also tested, but made no impact on the sign of *FUEL*. One explanation for this positive coefficient is the correlation between fuel and food prices. Nevertheless, because no economic theory could support such a claim the variable was removed, with the regression results that include *FUEL* reported in Appendix A2, Table A2.

5.1 Economic Variable Results

This section will review each of the economic variables in the regression results. Three regressions will be presented in this analysis. All three regressions included the economic variables of the model. The estimated coefficients represent elasticities. Over 28 percent of the variation in wheat traded was explained by Regression 1 (Table 9). The explanatory power of the model increased with the inclusion of each set of trade agreement variables, as seen in Regression 2 and Regression 3.

5.1.1 Marginal Effects

The interaction terms (Y_i*PT_i, Y_j*PT_j and Y_i*PAG_i) included in the estimation alter the interpretation of the elasticities *for* Y_i, Y_j , PT_i , PT_j and PAG_i reported in Table 10. These marginal effects were evaluated at the mean and discussed accordingly below.

The marginal effect of exporter income (LNY_i) is positive in Regression 1 with a value of 0.280. In Regression 2 and Regression 3, the marginal effect, evaluated at the mean, becomes negative with a value of -0.070, and -0.164 respectively. The change in sign is a result of *Yi*PAG* becoming more negative and LNY_i decreasing in value. This indicates that at the margin, as trade agreements are included, increasing exporter income has a negative effect on the trade of wheat. The labor-capital endowment factor was discussed by Bergstrand (1989), this positive coefficient implies that wheat is a capital-intensive good follows Bergstrand's 1989 findings about food goods. This result indicates that as LNY_i increases, it is likely that the investment in agricultural production technology increases, which eventually results in a surplus product and increased ability to export. Thus, as nations become more affluent, they will have increased wheat supplies and more incentive to export.

The marginal of importer income (LNY_j) reflects expected results as it is negative in all three regressions. In Regression 1, a one percent change in the importer income results in a negative 0.270 percent change in the quantity of wheat traded. Similar interpretations can be made for Regressions 2 and 3. The smaller the income of an importer, the more likely they are to import wheat. As nations become more affluent, they are more likely to import more processed or value added goods rather than commodity goods such as wheat. This result is similar to those found by Koo and Karemera (1991), who found a coefficient value of -0.1305 which was significant at the one percent level. In comparison to the analysis by Grant and Lambert (2005) we see they also find Y_j to be significant at the one percent level with a coefficient of -0.63.

Exporter Percent Trade (PT_i) is not significantly different from zero in any of the three regressions. This indicates that for the trade of wheat, the willingness to trade of a nation does not influence the movement of wheat. One explanation for this may be that because wheat is a staple good, its exporters are not reliant on current trading volume relative to other goods. However, importer Percent Trade (PT_j) is significant for all three regressions and results in a negative marginal effect ranging from -0.001 to -0.004. The negative sign produced in for the marginal effects is logical because as trade increases, the quantity of wheat traded is expected to become smaller. A nation that is affluent will decrease the importation of staple goods and move toward higher value products. Because variable was included as a modification of a definition by Anderson (1979) there is no study for which these variables can be compared to.

Exporter Percent Agriculture (PAG_i) is significant at the one percent level for all of the regressions ranging from -0.131 to -0.185. The marginal effect of this variable is negative in all three regressions. This indicates that value added agricultural products are more likely to be traded more than a commodity product like wheat. This follows trade theory logic. As nations

become more affluent, they are likely to trade more value added goods, rather than commodity goods.

5.1.2 Coefficient Results

The partial logarithmic form of the regressions allows the coefficients of the estimators in this analysis to be interpreted as elasticities. Table 9 presents the results of the first 33 variables for this analysis, the results are discussed below.

The influence of distance as an approximation for transportation costs is confirmed in all three regressions presented as LND_{ij} presents a negative coefficient. This coefficient is significant at the one percent level for Regression 1 and Regression 2; however the significance declines to the five percent level in Regression 3. The value of the coefficient also increases with each successive regression, from -0.442 to -0.140 percent. This implies that distance becomes smaller in magnitude to the trade of wheat with the inclusion of trade agreement effects. Trade agreements may reduce tariffs in a manner that compensate of the costs of shipping. When tariffs are lower, nations can afford to import products from greater distances. These results are more logical than the findings of Grant and Lambert (2005) and Koo and Karemera (1991) who both found insignificant coefficients for distance.

The domestic price of a good, LNP_i and LNP_j, are both significant at one percent with the largest estimated elasticities for economic variables. These factors maintain their sign and significance throughout all three regressions. This confirms classical trade theory, as it highlights the movement of goods from an area with a low domestic price to an area with a high domestic price. For an exporting nation LNP_i, a one percent increase in domestic price would decrease the quantity exported by 3.996 to 3.666 percent. This is logical because as the price of the good

increases domestically for an exporting nation, there is less incentive to sell the product on the world market.

A one percent increase in the domestic price of wheat for an importing nation (LNP_j) would cause a 1.903 to 2.548 percent increase in the quantity of wheat traded. Increases in domestic price for importers encourage consumers to demand more wheat from the international market and thus increase quantities imported.

These price coefficients are smaller than those found by Koo and Karemera (1991) who found an export unit price of 7.5924 and an import unit price of -7.4692. This difference could be a result of the number of variables included in the model. It could also be reflective of the different sources of price approximation. In this study price data is exogenous from quantity data as it was collected from the UN/FAO. Koo and Karemera (1991) however, used the average exporting price for each exporter and average importing price for each importer for their observations which could have influenced their results.

The exchange rate (E_{ij}) is positive and statistically significant at the one percent level for all three regressions. Therefore, for a one percent increase in an importers currency relative to the exporters currency results in quantity of wheat traded increasing by 0.169 to 0.184 percent. This result is a confirmation of basic economic theory. As importer currency strengthens, importers are able to purchase more product of the international market.

Inflation for exporting nations (LNI_i) is significant at the one percent level in Regression 1, and the five percent level in Regressions 2, and the ten percent level in Regression 3. The coefficients of the estimators range from -0.895 to -0.379, and increase in magnitude with each regression. This indicates that as the inflation rate for an exporting nation increases, the value of wheat increases domestically, discouraging producers to export. These results are similar in sign

and significance in Regression 1 to Koo and Karemera (1991) who found an exporter inflation coefficient of -2.1620. Differences in the size of the coefficient are likely due to an increased number of variables used in the regression for this analysis.

On the other hand, the inflation value for the importing nations (LNI_j) exhibited a positive coefficient significant at the one percent level for Regression 1 and Regression 2, and at the ten percent level for Regression 3. For this variable, a one percent increase in the inflation rate would result in a 0.929 percent increase in the quantity of wheat imported by that nation for Regression 1. As the value of wheat increases in importing nations due to inflation, consumers demand a relatively lower priced product from the international market. The magnitude of this coefficient decreases in Regressions 2 and 3 as trade creation and trade diversion variables are included in the regression. This shows that the potential decrease in tariffs from trade agreements partially offsets the effects of inflation.

Exporter population ($LNPOP_i$) is negative and significant at the one percent level for Regression 1, but is insignificant in Regression 2 and Regression 3. In Regression 1, as the value of exporter population increases by one percent the value of quantity exported will decrease by 0.412 percent. This is logical because an increased population in an exporting nation implies and increased domestic demand. As trade agreements are included, domestic demand becomes insignificant.

Importer population ($LNPOP_j$) is an indication of the demand for wheat. This coefficient is significant at the one percent level for all three regressions. In Regression 1, a one percent increase in importer population results in a 0.901 percent increase in wheat exports. The coefficient value increases to 0.902 in Regression 2 and decreases 0.717 in Regression 3. This shows that this variable becomes less impactful as the effects of trade agreements are taken into

account. This decrease in elasticity could indicate that trade agreements are simply reducing the relative price of wheat and importers are demanding more regardless of population.

This concludes the discussion of continuous variables. The next section will discuss each of the qualitative variables included in this analysis.

5.2 Qualitative Variables

In this section, each of the qualitative variables will be reviewed. It is important to remember that the coefficients of these variables must be interpreted carefully using the non-linear transformation shown in Chapter 3. The results of this transformation are shown in Table 11, Table 12 and Table 13.

The variable *CONTIG* is significant at the one percent level for all three regressions, with a positive coefficient ranging from 1.291 to 1.666, which results in a 263.713 to 429.161 percent change in wheat flow when nations share a common border. The coefficient value gets larger with the inclusion of the trade agreement variables. This could indicate that nations are more likely to engage in trade agreements when they share a common border, as expected. The coefficients of contiguity are larger in this analysis than those found by Grant and Lambert (2005) who found a coefficient of 0.60, significant at the one percent level.

A common language with over nine percent of the population using a common tongue in each nation is significant at the one percent level across all three regressions. The variable *CLE* has a positive coefficient ranging from 1.041 to 1.198. These coefficients exhibit a 183.211 to 305.316 percent increase in wheat traded between nations in which nine percent of the population shares a common language. The variable *CLE* rises to its highest point with the inclusion of trade creation variables but then decreases to its lowest point when trade diversion variables are introduced. This could imply that a common language is important in the trade

agreement process with an increased ability to communicate with other nations resulting in more agreements. Common Official Language, *CLO*, is significant at the ten percent level in Regression 1 and Regression 2 but at the one percent level in Regression 3. The coefficients are positive ranging from 0.267 to 0.523, and increases with each regression. This suggests that a common official language is important in trade agreements increasing trade 30.602 to 68.660 percent. Similar to *CLE, CLO* might indicate that an increased ability to effectively communicate with other nations results in a larger number of trade agreements between nations who share a common language. The results of *CLO* in this analysis were similar to those found by Grant and Lambert (2005) who found a coefficient of 0.36 significant at the one percent level.

Colonial relationships were represented by three separate qualitative variables. The variable *COL*, indicating a past or present colonial tie is significant but negative at the one percent level for all three regressions. This coefficient ranges from -0.976 to -0.737.This implies that colonial relations actually have a negative effect, decreasing wheat trade between 52.819 to 62.327 percent among importers and colonially linked exporters.

The variable *CCOL*, noting common colonies, exhibits a positive coefficient ranging from 0.896 to 1.247 that is significant at the one percent level for all three regressions. Colony origins often results in similar cultures and political structures which is increasing trade between 144.995 to 250.759 percent. The coefficient of *CCOL* increases with the inclusion of trade creation and trade diversion variables, again highlighting the importance of a colonial relationship in the presence of trade agreements.

The variable *COL45* is insignificant for all three regressions. This implies that even though there are several nations with colonial relationships after 1945, they have no positive or negative influence on the movement of wheat. The variable is similar to the colonial heritage

variable used by Vollrath, Gelhar and Hallahan (2007). The authors found positive and significant coefficients for the years 1986, 2000 and 2004 but an insignificant value in 1996. This difference in findings could be a reflection of the fact that that Vollrath, Gelhar and Hallahan (2007) were looking at specific points in time rather than a span of time and the smaller selection of countries used in their analysis of wheat trade.

The variable $NONWTO_i$ is significant at the five percent level in Regression 1 and at the one percent level in Regressions 2 and 3. This coefficient ranges from 0.307 to 1.489, and increases with each regression showing a 35.888 to 343.255 percent increase in wheat export for these nations. Kazakhstan, Russia and Ukraine are the only exporters classified under this variable. This implies that for these three nations, not being a member of the WTO has positive effect on their ability to move wheat. One explanation for this could be the lack of liberalization achieved by the WTO for agricultural goods. Because little has been done to reduce barriers for agriculture, there is not a negative implication for these nations relative to other exporters. Furthermore, the benefits of non-membership are amplified with the inclusion of trade agreements. This could indicate that because they are not engaged in multilateral negotiations, they are more heavily reliant on trade agreements. However, it is more likely that is variable is capturing the export capabilities and other qualities of these nations.

From the importer perspective, $NONWTO_j$ is significant at the one percent level for Regression 1 and Regression 2 but insignificant in Regression 3. The coefficient for Regression 1 is 0.801, signifying that when an importer is not a member of the WTO they will important, 122.676 percent more wheat than a WTO member. The coefficient is slightly larger in Regression 2. This signifies that WTO membership becomes more important to the trade of wheat when engaging in trade agreements. Similar to $NONWTO_i$, $NONWTO_j$ could be capturing

two effects. The first effect is the lack of trade liberalization accomplished by WTO negotiations for agricultural products. The second effect being that individual characteristics of this particular group of nations, not necessarily the work of the WTO, being reflected in this coefficient.

The final variable to be presented in this section is the annual qualitative variables. The years 2000, 2001 2002 and 2005 are all insignificant for all three regressions. The year 2003 is positive and significant at the five percent level in Regression 1 and Regression 2 and at the one percent level in Regression 3. Two thousand and four is positive and significant at the one percent level in Regression 1 and at the five percent level in Regression 3 but insignificant in Regression 2. Two thousand and six is positive and significant at the one percent level in Regression 1, at the ten percent level in Regression 2 and at the five percent level in Regression 3. The years 2007 and 2008 are consistently significant and positive at the one percent level in all three regressions. This indicates that a significantly higher volume of wheat was traded in 2007 and 2008, compared to 1999.

Now that the economic and qualitative results have been discussed, the following sections will focus on the inclusion of trade agreements into the regressions.

5.2.1 Trade Creation

The inclusion of up-to-date trade agreement variables is one of the main contributions of this analysis to wheat trade literature. Some work has been on analyzing the effects of trade agreement especially regional trade agreements such as Grant and Lambert (2005). However, little has been done with the study of bi-lateral agreements strictly between two nations or for a singular commodity.

This section discusses the inclusion of trade creation variables in Regression 2 and Regression 3. Table 14 presents the coefficients, standard errors and P-values for the trade

creation (*CTRADE*) qualitative variables included in Regression 2 and Regression 3. Table 12 presents the percent increase or decrease caused by implementation of a trade agreement. Trade creation qualitative variables were developed to note changes in wheat trade brought on by the introduction of a trade agreement between agreement partners. In Regression 2, over 78 percent (29of 37) of trade agreements had significant effects on wheat trade (Table 14).

Regression 2 includes 37 trade agreements recognized by the WTO. Twenty-two of the reported agreements resulted in positive and significant coefficients. However, seven agreements had negative and significant coefficients.

One percent level: Seventeen agreements are significant and positive at the one percent level. The bi-lateral agreement between Canada and Chile has the highest magnitude effect on the trade of wheat with a coefficient of 4.980. Therefore, when Canada exports to Chile, the quantity is almost 14454.321 percent higher than the quantity Canada would export to any other nation because of this agreement. All of the percentage change calculations can be found for the *CTRADE* variables in Table 12. Similar interpretations can be developed for the other agreements in this category. Several agreements between the EU and individual nations are classified in this significance level. One explanation for the high number of EU bilateral agreements could be the high degree of differentiation in the respective parties. Many of the agreements that show up in this category are between nations in different regions of the world, political structures and economic status. This implies that although commonalities between nations, like common languages, adjacency, and colonial heritage, encourage trade between nations, benefits from trade a gained from the diversity of nations involved in an agreement.

When the coefficient of *CTRADE* is negative, the trade of wheat is suppressed under the given agreement. Estimated coefficients that are significant at the one percent level and negative

range from -2.365 to -4.793 which translate to a -99.171 to -90.607 percentage difference for nations who engage in depressive trade agreements. An interesting observation in this category is that several of the nations are located in the Baltic region. This suppression of trade could be a result of homogeneity among nations in terms of location and maybe even factors like political structure and ability to produce. If these nations are homogenous, this will decrease their incentive to trade wheat relative to other goods because the product of an exporter is too similar to that of an importer. The EU is also classified as negative and significant at the one percent level. The sign of this analysis's result is opposite of the findings by Grant and Lambert (2005). However, this could be cause by the inclusion of nations into the EU. Grant and Lambert (2005) only use the EU-15[9] expansion which excludes Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia.

Five percent level: All three agreements in the five percent significance level are positive. These positive coefficients range from 0.851 to 1.750. The North American Free Trade Agreement (NAFTA) is classified in this category with a coefficient of 0.851, which implies a 134.173 percent increase in the quantity of wheat traded between the U.S., Canada, and Mexico than each of their other exporting partners. In comparison to Grant and Lambert's (2005) results of NAFTA with respect to wheat, these results are very similar as they found a percentage change at 152 percent.

Ten percent level: Three trade agreements are significant at the ten percent level for Regression 2. The bilateral agreements EU –Bosnia and Herzegovina and EU-Jordan are positive

[9] Austria, Belgium, Denmark, France, Finland, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden and United Kingdom.

with coefficients of 0.807 and 1.518 respectively. The bilateral agreement between Ukraine and Azerbaijan has a coefficient of -2.984.

Insignificant: The final category includes eight insignificant agreements. An insignificant variable indicates that the agreement has no measureable effect on the trade of wheat among agreement partners.

Table 12 also shows the *CTRADE* Variables for Regression 3. Twelve *CTRADE* variables changed their degree of significance when trade diversion (*DTRADE*) variables were included in the regression. Eleven of the 12, decreased in significance, this indicates that the effects of the trade agreement became less impactful when *DTRADE* was introduced.

Trade creation is only one portion of the impact that trade agreements can have. The next section discusses the effect that a trade agreement can have on the market.

5.2.2 Trade Diversion

In this section, the results of the trade diversion variables in Regression 3 will be discussed. The inclusion of up-to-date trade diversion variables is a contribution that this analysis makes to wheat trade literature. Table 15 shows the coefficients, standard errors and P-values for the trade diversion variables included in Regression 3. Table 13 shows the non-linear transformation used to discover the percentage change for each of these variables.

Eleven *DTRADE* variables were not significantly different from zero, indicating that there was no measureable trade diversion as a result of these agreements. Sixteen of the 35 *DTRADE* variables had positive and significant coefficients. These coefficients indicate that despite decreased tariffs brought about by agreements, trade was not diverted from more efficient suppliers to agreement members. Using the agreement between the Canada and Chile as an example, the regression presents a coefficient of 6.778. This is modified to show that Chile

imports 87722.515 percent more from non-agreement members than from the Canada, thus the tariff relief provided for wheat by this agreement was not enough to warrant imports of wheat from the Canada. The EU exhibits a positive coefficient that is significant at the one percent level, 1.074. Again this is opposite of the findings of Grant and Lambert (2005) and the justifications for this are similar to those discussed for the *CTRADE* variable.

Inversely, when *DTRADE* coefficients are negative; this indicates that because of the trade agreement wheat is more likely to be purchased from an agreement member than a non-agreement member. One explanation of this is that the reductions in tariffs imposed by the trade agreement make the product from agreement members more competitive. Seven agreements in this study displayed trade diversion. For example, the agreement between Russian and the Ukraine has a coefficient of -0.861. After transforming this coefficient, it is clear the as a result of this trade agreement 57.728 percent of the wheat trade between Russian and the Ukraine is a result of trade diversion.

Although some of these agreements have an overall negative effect on wheat production, it is important to remember that when developing trade agreements wheat is not the only consideration. In trade, there are always benefits and costs. Trade agreements are only successful if the total benefits to each nations involved is greater than the costs, even if it means some producers are harmed due to an agreement. Wheat industry participants should evaluate the effects of each proposed trade agreement carefully to ensure that they are benefiting wheat producers accordingly. The next chapter will draw conclusions on these results and provide implication of these findings.

Chapter 6 - Implications and Conclusions

International wheat trade remains a complex interaction of economic, political and social factors that encourage or deter the movement of wheat from one location to another. A gravity model was developed to identify and quantify the determinants of international wheat trade from the time period 1999-2008, and the possibility of trade creation and trade diversion for relevant trade agreements was tested.

The regressions provided evidence that economic factors still play a major role in the trade of wheat. Domestic price plays a key role in the movement of wheat. All three regressions highlight that national income, transportation costs, exchange rate, inflation and importer population is important in determining the flow of wheat. Openness to trade and agriculture production variables were significant, and highlighted the commodity nature of wheat trade. It was shown that qualitative factors also play a key role in determining wheat trade. Sharing a common border and language (official or ethnic) are also positive factors in wheat trade. Colonial heritage does have some small impacts, negative for direct colonies and positive for nations sharing a common colonizer. Although these factors are important in determining the flow of wheat, there is little that commodity organization and policy making bodies can do to modify these attributes.

This analysis extends previous international wheat trade research through the inclusion of multilateral relationships and bilateral trade agreements. To highlight multilateral relationship, membership in the WTO was considered. This study showed that not being a member of the WTO is a positive factor in the trade of wheat. As stated earlier, this could be a result of a lack of liberalization accomplished through the current multilateral system for agricultural goods or highlight the attribution of nations not involved in the WTO. For WTO membership to have a

positive effect on the trade of wheat, this organization will need to further deplete trade barriers for agricultural goods among its members to make a significant impact.

The review of bilateral trade agreements added depth to this study by examining both trade creation and trade diversion for each applicable agreement. The estimated models show that nations which develop agreements with contrasting qualities from themselves are likely to see higher gains from free trade agreements. However, when nations engage in agreements with nations in a similar location or income structure, trade diversion occurs. This is an important consideration for policy making bodies considering engaging in trade agreements. The analysis also shows that trade agreements can also overcome factors that may have a negative impact on the trade of wheat such as distance or colonial relationships. Of course, wheat is not the only product that should be considered when developing a trade agreement. However, national wheat promotion boards need to seriously consider both the potential for positive and negative impacts of each proposed agreement.

This research was only able to evaluate a small portion of current trade issues facing wheat. Additional areas of research that would contribute to this study include: evaluating specific policy mechanisms, performing a more in depth evaluation of the Baltic region exporters, and discussion of the influence of environmental mandates.

As the face of international trade continues to evolve, there will be a need to continue to analyze the determinants of international wheat trade. Consumers, producers, wheat promotion boards, governments and international policy making bodies all need to be aware of the impacts that their actions are having on the flow of this staple commodity. By understanding the determinants of wheat trade, players in the wheat market can create a more transparent and fluid market.

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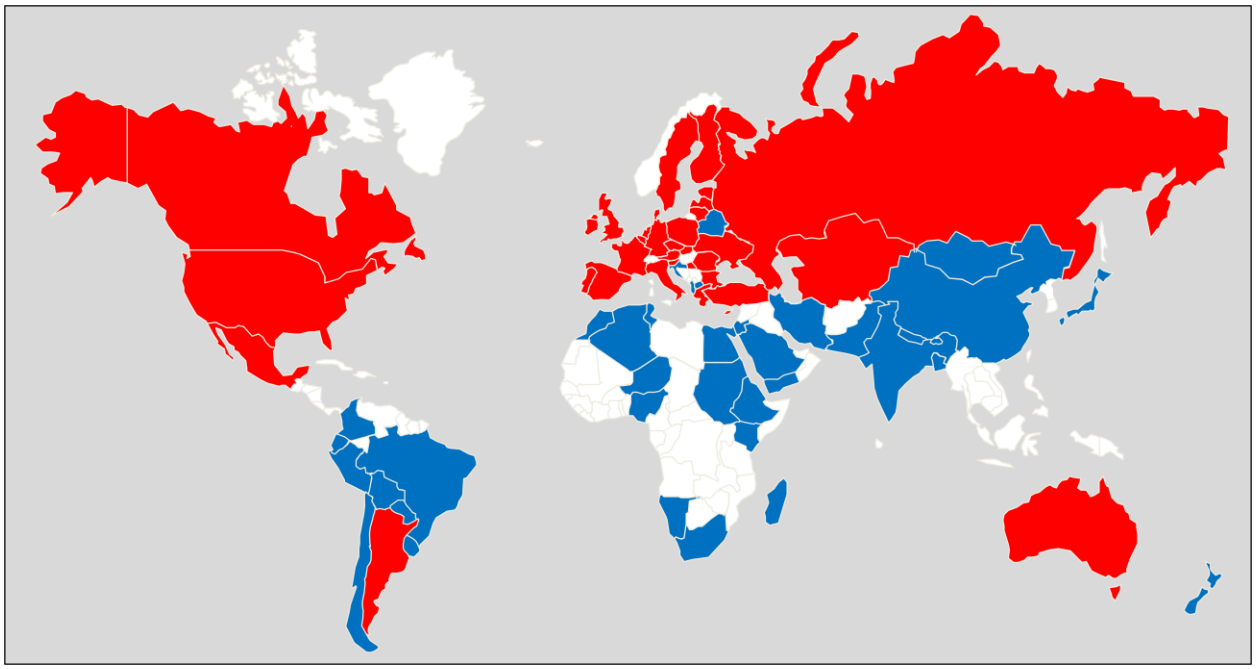
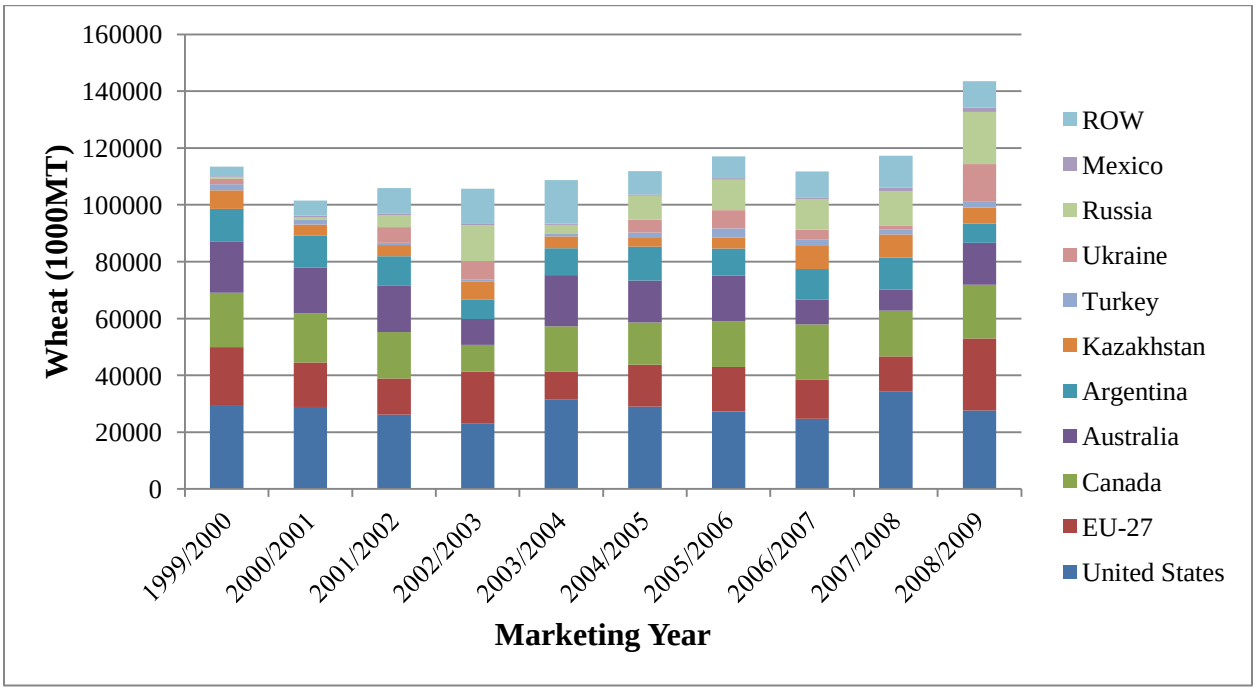
Figure 1. Map of Nations in Wheat Trade Analysis.



Red Nations indicate exporters included in analysis.
Blue nations indicate importers included in analysis.

Figure 2. Wheat Exporters 1999-2010.



Source: USDA/FAS, Production Supply and Distribution Online.

Table 1. Variable Definitions for Wheat-Specific Gravity Model.

Variable	*Units*	*Definition*	*Source*
X_{ij}	MT	Wheat traded between i and j in year t	Global Trade Information System
$Y_i(Y_j)$	Billions of 2005 USD	Gross Domestic Product	USDA/ERS
D_{ij}	Kilometers	Bilateral distance between economic centers	CEPII[10]
$P_i(P_j)$	USD/MT	Domestic price of wheat	UN/FAO
E_{ij}	$Currency_i/Currency_j$	Exchange rate	USDA/ERS
$I_i(I_j)$	Percentage	Inflation	USDA/ERS
$POP_i(POP_j)$	Millions	Total population	World Bank
PAG_i	Percentage	Share of exporters GDP that comes from value added agricultural production	World Bank
$PT_i(PT_j)$	Percentage	Sum of exports and imports of goods and services as a share of gross domestic product	World Bank
$Yi * PAG_i$	---	Interaction between GDP_i and PAG_i	
$(Yi * PT_i)$ $(Y_j * PT_j)$	---	Interaction between exporter income and percent trade	
CONTIG	1	Common border	CEPII
CLE	1	Common language	CEPII
CLO	1	Common official language	CEPII
COL	1	Colonial relationship	CEPII
CCOL	1	Common colonizer after 1945	CEPII
COL45	1	Colonial relationship after 1945	CEPII
$NONWTO_i$ $(NONWTO_j)$	1	Not a member of the WTO	World Trade Organization
YEAR	1	Year of transaction	
CTRADE	1	Trade agreement	World Trade Organization
DTRADE	1	Trade between trade agreement partner and a non-agreement partner	World Trade Organization

[10] CEPII is found in Grant and Lambert (2005) and Head, Mayer and Ries (2010).

Table 2. Summary Statistics for Wheat Specific Gravity Model.

Variable	*Mean*	*Std. Dev.*	*Min*	*Max*
X_{ij}	135905	135905	1	7282273
Y_i	1,653.17	3,057.90	5.59	13,228.90
Y_j	676.72	1531.38	0.72	13,228.90
D_{ij}	3,535.89	3,908.74	59.62	19,263.88
P_i	148.82	64.51	55.9	655.1
P_j	210.74	144.31	48.4	1,583.80
E_{ij}	9.29	39.43	2.58E-5	764.39
I_i	81.08	18.47	15.08	105.74
I_j	80.9	17.71	4.2	127.52
POP_i	58.9	74.2	0.396	304
POP_j	51.3	141	0.388	1,320.00
PAG_i	3.97	3.28	0.36	15.86
PT_i	78.44	41.67	18.97	326.76
PT_j	82.6	40.18	18.97	326.76
(Y_i*PAG_i)	21.47	14.65	1.32	66
(Y_i*PT_i)	442.12	185.18	108.06	1,197.12
(Y_j*PT_j)	386.71	205.23	-23.11	1,197.12
CONTIG	0.163	-	0	1
CLE	0.145	-	0	1
CLO	0.128	-	0	1
COL	0.082	-	0	1
CCOL	0.024	-	0	1
COL45	0.029	-	0	1
$NONWTO_i$	0.110	-	0	1
$NONWTO_j$	0.146	-	0	1
2000	0.089	-	0	1
2001	0.092	-	0	1
2002	0.100	-	0	1
2003	0.097	-	0	1
2004	0.095	-	0	1
2005	0.103	-	0	1
2006	0.108	-	0	1
2007	0.105	-	0	1
2008	0.120	-	0	1

Table 3. List of Exporters and Number of Observations.

Exporter	*Number of Observations*
Argentina	264
Australia	197
Austria	201
Belgium	196
Bulgaria	189
Canada	387
Cyprus	11
Czech Republic	127
Denmark	150
Estonia	44
Finland	74
France	451
Germany	429
Greece	121
Hungary	234
Ireland	35
Italy	281
Kazakhstan	130
Latvia	98
Lithuania	118
Luxembourg	42
Malta	4
Mexico	67
Netherlands	178
Poland	168
Portugal	19
Romania	148
Russia	338
Slovakia	105
Slovenia	27
Spain	183
Sweden	189
Turkey	224
Ukraine	231
United Kingdom	223
United States	468

Table 4. List of Importers and Number of Observations.

Country	*Number of Observations*	*Country*	*Number of Observations*	*Country*	*Number of Observations*
Albania	79	France	169	Netherlands	205
Algeria	160	Georgia	50	New Zealand	36
Argentina	28	Germany	236	Niger	6
Armenia	31	Greece	142	Nigeria	76
Australia	24	Hungary	83	Norway	129
Austria	128	India	46	Pakistan	39
Azerbaijan	29	Iran	53	Paraguay	4
Bangladesh	66	Ireland	95	Peru	42
Belarus	67	Israel	111	Poland	141
Belgium	151	Italy	215	Portugal	126
Bhutan	1	Japan	59	Romania	99
Bolivia	28	Jordan	61	Russia	83
Bosnia/ Herzegovina	40	Kazakhstan	19	Saudi Arabia	30
Brazil	37	Kenya	54	Slovakia	62
Bulgaria	47	Kyrgyzstan	14	Slovenia	62
Canada	46	Latvia	68	South Africa	57
Chile	40	Lebanon	61	Spain	197
China	40	Lithuania	85	Sudan	64
Colombia	31	Luxembourg	47	Sweden	132
Croatia	57	Macedonia	49	Switzerland	164
Cyprus	79	Madagascar	20	Tajikistan	27
Czech Republic	80	Malawi	19	Tunisia	118
Denmark	143	Malta	49	Turkey	106
Ecuador	32	Mexico	25	Ukraine	84
Egypt	92	Moldova	43	U.K.	196
Eritrea	35	Mongolia	28	United States	80
Estonia	67	Morocco	138	Uruguay	13
Ethiopia	52	Namibia	21	Yemen	70
Finland	84	Nepal	4		

Table 5. Colonies and Dates of Independence Since 1900.

Austria	
Bosnia	1918†
Croatia	1918†
Slovenia	1918†
Ethiopia	
Eritrea	1993†
France	
Algeria	1962†
Madagascar	1960
Niger	1960
Morocco	1965
Tunisia	1956
Lebanon	1943
Germany	
Namibia	1918†
Poland	1918†
Greece	
Cyprus	–
Armenia	1920†
Lebanon	1920†
Yemen	1918
Albania	1912
Macedonia	1912†
Hungary	
Slovakia	1918†
Italy	
Eritrea	1941†
Netherlands	
South Africa	1902
Pakistan	
Bangladesh	1971†
Russia	
Armenia	1991
Azerbaijan	1991
Belarus	1991
Estonia	1991
Georgia	1991
Kazakhstan	1991
Kyrgyzstan	1991
Latvia	1991
Moldova	1991
Tajikistan	1991
Ukraine	1991
Lithuania	1991
Finland	1917
South Africa	
Namibia	1990†
United Kingdom	
Yemen	1967
Malawi	1964
Malta	1964
Kenya	1963
Cyprus	1960
Nigeria	1960
Sudan	1956
Eritrea	1952
Israel	1948
Bangladesh	1947
India	1947
Pakistan	1947
Jordan	1946
Egypt	1922
Ireland	1921†
South Africa	1910
New Zealand	1907
Australia	1901
Yugoslavia	
Bosnia	1995†
Slovenia	1991†

Colonizer, – =Current Colony, †=hostile separation
Source: Mayer, Head and Ries (2008)

Table 6. Summary Statistics for CTRADE Variables.

CTRADE Variable	*Mean*	*Std. Dev.*	*Min*	*Max*
Armenia - Russia	0.002	-	0	1
Australia - New Zealand (ANZCERTA)	0.002	-	0	1
Canada - Chile	0.002	-	0	1
Chile - Mexico	0.002	-	0	1
Common Economic Zone (CEZ)	0.004	-	0	1
Commonwealth of Independent States (CIS)	0.017	-	0	1
EFTA - Turkey	0.003	-	0	1
EU	0.305	-	0	1
EU - Albania	0.003	-	0	1
EU - Algeria	0.008	-	0	1
EU - Bosnia and Herzegovina	0.003	-	0	1
EU - Croatia	0.006	-	0	1
EU - Egypt	0.003	-	0	1
EU - Israel	0.008	-	0	1
EU - Jordan	0.003	-	0	1
EU - Lebanon	0.003	-	0	1
EU - Macedonia	0.006	-	0	1
EU - Morocco	0.012	-	0	1
EU - Norway	0.014	-	0	1
EU - Switzerland - Liechtenstein	0.017	-	0	1
EU - Tunisia	0.011	-	0	1
EU - Turkey	0.011	-	0	1
Eurasian Economic Community (EAEC)	0.007	-	0	1
Georgia - Russia	0.002	-	0	1
Global System of Trade Preferences among Developing Countries (GSTP)	0.006	-	0	1
North American Free Trade Agreement (NAFTA)	0.008	-	0	1
Pacific Island Countries Trade Agreement (PICTA)	0.001	-	0	1
Protocol on Trade Negotiations (PTN)	0.010	-	0	1
Southern Common Market (MERCOSUR)	0.004	-	0	1
Turkey - Georgia	0.000	-	0	1
Ukraine - Azerbaijan	0.000	-	0	1
Ukraine - Belarus	0.000	-	0	1
Ukraine - Moldova	0.001	-	0	1
Ukraine - Russia	0.001	-	0	1
United States - Chile	0.001	-	0	1
United States - Israel	0.002	-	0	1
United States - Morocco	0.000	-	0	1

Table 7. Summary Statistics for DTRADE Variables.

DTRADE Variable	*Mean*	*Std. Dev.*	*Min*	*Max*
Armenia - Russia	0.003	-	0	1
Australia - New Zealand (ANZCERTA)	0.004	-	0	1
Canada - Chile	0.005	-	0	1
Chile - Mexico	0.006	-	0	1
Common Economic Zone (CEZ)	0.013	-	0	1
Commonwealth of Independent States (CIS)	0.047	-	0	1
EU	0.102	-	0	1
EU - Albania	0.001	-	0	1
EU - Algeria	0.004	-	0	1
EU - Croatia	0.001	-	0	1
EU - Egypt	0.005	-	0	1
EU - Israel	0.008	-	0	1
EU - Jordan	0.004	-	0	1
EU - Lebanon	0.004	-	0	1
EU - Macedonia	0.001	-	0	1
EU - Morocco	0.008	-	0	1
EU - Norway	0.007	-	0	1
EU - Switzerland - Liechtenstein	0.009	-	0	1
EU - Tunisia	0.007	-	0	1
EU - Turkey	0.006	-	0	1
Eurasian Economic Community (EAEC)	0.026	-	0	1
Georgia - Russia	0.006	-	0	1
Global System of Trade Preferences among Developing Countries (GSTP)	0.162	-	0	1
North American Free Trade Agreement (NAFTA)	0.016	-	0	1
Pacific Island Countries Trade Agreement (PICTA)	0.003	-	0	1
Protocol on Trade Negotiations (PTN)	0.117	-	0	1
Southern Common Market (MERCOSUR)	0.010	-	0	1
Turkey - Georgia	0.001	-	0	1
Ukraine - Azerbaijan	0.004	-	0	1
Ukraine - Belarus	0.009	-	0	1
Ukraine - Moldova	0.006	-	0	1
Ukraine - Russia	0.024	-	0	1
United States - Chile	0.005	-	0	1
United States - Israel	0.016	-	0	1
United States - Morocco	0.007	-	0	1

Table 8. List of Nations that are not members of the WTO.

Non-WTO Members	*Date of Accession into the WTO*
Albania	2000
Algeria	
Armenia	2003
Azerbaijan	
Belarus	
Bhutan	
Bosnia & Herzegovina	
China	2001
Croatia	2000
Eritrea	
Ethiopia	
Georgia	2000
Iran	
Jordan	2000
Kazakhstan	
Lebanon	
Macedonia	2003
Moldova	2001
Nepal	2004
Russia	
Saudi Arabia	2005
Sudan	
Tajikistan	
Ukraine	2008
Yemen	

Source: WTO.

Table 9. Robust Regression Results for Wheat Specific Gravity Model.

Variable	*Regression 1* *Base*			*Regression 2* *CTRADE*			*Regression 3* *CTRADE & DTRADE*		
	Coef.	*Std. Err.*	*P>|t|*	*Coef.*	*Std. Err.*	*P>|t|*	*Coef.*	*Std. Err.*	*P>|t|*
LNY_i	0.821	0.122	0.000	0.449	0.115	0.000	0.362	0.114	0.001
LNY_j	-0.713	0.056	0.000	-0.707	0.058	0.000	-0.306	0.068	0.000
LND_{ij}	-0.442	0.056	0.000	-0.203	0.061	0.001	-0.140	0.065	0.030
LNP_i	-3.928	0.230	0.000	-3.996	0.225	0.000	-3.666	0.219	0.000
LNP_j	2.165	0.123	0.000	2.548	0.136	0.000	1.903	0.154	0.000
$LNEX_i$	0.172	0.018	0.000	0.169	0.019	0.000	0.184	0.021	0.000
LNI_i	-0.895	0.225	0.000	-0.416	0.218	0.056	-0.379	0.213	0.076
LNI_j	0.929	0.197	0.000	0.560	0.199	0.005	0.366	0.218	0.094
$LNPOP_i$	-0.412	0.130	0.002	0.086	0.124	0.486	0.158	0.120	0.188
$LNPOP_j$	0.901	0.052	0.000	0.902	0.055	0.000	0.717	0.070	0.000
PAG_i	0.382	0.054	0.000	0.306	0.052	0.000	0.369	0.053	0.000
PT_i	-0.004	0.003	0.224	0.000	0.003	0.922	-0.002	0.003	0.474
PT_j	-0.028	0.003	0.000	-0.029	0.003	0.000	-0.017	0.003	0.000
(Y_i*PAG_i)	-0.086	0.011	0.000	-0.071	0.010	0.000	-0.090	0.011	0.000
(Y_i*PT_i)	-0.003	0.001	0.000	-0.003	0.001	0.000	-0.002	0.001	0.000
(Y_j*PT_j)	0.005	0.001	0.000	0.006	0.001	0.000	0.002	0.001	0.000
CONTIG	1.291	0.133	0.000	1.469	0.132	0.000	1.666	0.131	0.000
CLE	1.198	0.150	0.000	1.399	0.157	0.000	1.041	0.145	0.000
CLO	0.267	0.157	0.088	0.302	0.157	0.054	0.523	0.145	0.000
COL	-0.976	0.188	0.000	-0.737	0.188	0.000	-0.751	0.187	0.000
CCOL	0.896	0.265	0.001	1.255	0.285	0.000	1.247	0.287	0.000
COL45	0.093	0.294	0.753	-0.357	0.316	0.259	-0.122	0.321	0.704
$NONWTO_i$	0.307	0.129	0.018	0.569	0.139	0.000	1.489	0.163	0.000
$NONWTO_j$	0.801	0.193	0.000	0.825	0.193	0.000	0.173	0.204	0.396
2000	0.177	0.195	0.364	0.173	0.185	0.349	0.226	0.181	0.212
2001	0.099	0.192	0.608	0.061	0.183	0.740	0.072	0.180	0.689
2002	0.085	0.193	0.660	0.082	0.184	0.655	0.098	0.181	0.588
2003	0.505	0.201	0.012	0.488	0.191	0.011	0.591	0.188	0.002
2004	0.558	0.214	0.009	0.283	0.206	0.169	0.431	0.205	0.035
2005	0.168	0.214	0.433	-0.215	0.205	0.296	-0.041	0.205	0.843
2006	0.773	0.228	0.001	0.376	0.219	0.086	0.525	0.219	0.017
2007	1.893	0.304	0.000	1.355	0.294	0.000	1.556	0.298	0.000
2008	2.306	0.326	0.000	1.666	0.317	0.000	1.959	0.324	0.000
Constant	11.358	2.945	0.000	0.459	2.868	0.873	2.505	2.895	0.387
	R-squared = 0.2837			R-squared = 0.3459			R-squared = 0.4042		
	Root MSE = 3.1174			Root MSE = 2.9878			Root MSE = 2.8594		

Table 10. Elasticities of Terms with Interaction Variables.

Variable	*Regression 1*	*Regression 2*	*Regression 3*
LNY_i	0.280	-0.070	-0.164
LNY_j	-0.270	-0.247	-0.100
PT_i	-0.020	-0.018	-0.016
PT_j	-0.001	-0.001	-0.004
PAG_i	-0.152	-0.131	-0.185

PT_i was insignificant in all three regressions.

Table 11. Percent increase/decrease in qualitative variables.

Variable	*Regression 1*	*Regression 2*	*Regression 3*
CONTIG	263.713 *	334.319 *	429.161 *
CLE	231.514 *	305.316 *	183.211 *
CLO	30.602 ***	35.308 ***	68.660 *
COL	-62.327 *	-52.148 *	-52.819 *
CCOL	144.995 *	250.759 *	247.882 *
COL45	9.697	-29.993	-11.471
$NONWTO_i$	35.888 **	76.735 *	343.255 *
$NONWTO_j$	122.676 *	128.262 *	18.903
2000	19.386	18.866	25.394
2001	10.374	6.268	7.439
2002	8.845	8.588	10.283
2003	65.686 **	62.856 **	80.527 *
2004	74.719 *	32.720	53.867 **
2005	18.297	-19.313	-3.990
2006	116.720 *	45.629 ***	69.106 **
2007	563.892 *	287.726 *	373.963 *
2008	903.778 *	429.273 *	609.112 *

*,**,*** denotes significance at the 1,5 and 10 percent level respectively.

Table 12. Percent increase/decrease in trade creation.

CTRADE Variable	*Regression 2*	*Regression 3*
Armenia - Russia	-7.219	134.547
Australia - New Zealand (ANZCERTA)	11448.723 *	16163.948 *
Canada - Chile	14454.321 *	61299886.826 *
Chile - Mexico	8977.991 *	2765.228 *
Common Economic Zone (CEZ)	59.602	23.331
Commonwealth of Independent States (CIS)	321.243 *	416.797 *
EFTA - Turkey	-99.171 *	-97.469 *
EU	388.850 *	391.422 *
EU - Albania	270.967 **	635.971 *
EU - Algeria	862.352 *	87.030 ***
EU - Bosnia and Herzegovina	124.142 ***	89.066
EU - Croatia	-48.157	-34.567
EU - Egypt	415.124 *	41.455
EU - Israel	586.902 *	435.961 *
EU - Jordan	356.181 ***	594.390 **
EU - Lebanon	-15.817	-29.062
EU - Macedonia	653.572 *	728.248 *
EU - Morocco	250.421 *	89.821 **
EU - Norway	142.528 *	231.757 *
EU - Switzerland - Liechtenstein	-90.573 *	-81.207 *
EU - Tunisia	1229.410 *	204.728 *
EU - Turkey	-31.589	-44.380
Eurasian Economic Community (EAEC)	-90.607 *	-91.478 *
Georgia - Russia	-74.313	-22.386
Global System of Trade Preferences among Developing Countries (GSTP)	-98.390 *	-98.492 *
North American Free Trade Agreement (NAFTA)	134.173 **	5.805
Pacific Island Countries Trade Agreement (PICTA)	-2.842	-4.831
Protocol on Trade Negotiations (PTN)	577.336 *	519.216 *
Southern Common Market (MERCOSUR)	475.599 **	132.512
Turkey - Georgia	687.872 *	3505.750 *
Ukraine - Azerbaijan	-94.939 ***	-93.764 ***
Ukraine - Belarus	-64.983	106.923
Ukraine - Moldova	-92.243 *	-87.990 ***
Ukraine - Russia	-97.707 *	-95.196 *
US - Chile	879.816 *	98.301
US - Israel	1512.481 *	310.288 **
US - Morocco	881.730 *	167.186

*,**,*** denotes significance at the 1,5 and 10 percent level respectively.

Table 13. Percent increase/decrease in trade diversion.

DTRADE Variable	*Regression 3*	
Armenia - Russia	218.641	**
Australia - New Zealand (ANZCERTA)	-30.829	
Canada - Chile	87722.515	*
Chile - Mexico	-99.834	*
Common Economic Zone (CEZ)	-84.897	*
Commonwealth of Independent States (CIS)	-70.810	*
EU	192.673	*
EU - Albania	516.152	***
EU - Algeria	455.488	*
EU - Croatia	748.900	*
EU - Egypt	203.149	*
EU - Israel	251.875	***
EU - Jordan	573.937	*
EU - Lebanon	551.948	*
EU - Macedonia	714.527	*
EU - Morocco	110.934	*
EU - Norway	-34.707	
EU - Switzerland - Liechtenstein	-32.204	
EU - Tunisia	281.307	*
EU - Turkey	-43.329	
Eurasian Economic Community (EAEC)	-3.921	
Georgia - Russia	7.769	
Global System of Trade Preferences among Developing Countries (GSTP)	322.824	*
North American Free Trade Agreement (NAFTA)	-97.839	*
Pacific Island Countries Trade Agreement (PICTA)	-79.303	
Protocol on Trade Negotiations (PTN)	102.206	*
Southern Common Market (MERCOSUR)	-94.384	*
Turkey - Georgia	969.193	*
Ukraine - Azerbaijan	-29.694	
Ukraine - Belarus	659.552	*
Ukraine - Moldova	60.514	
Ukraine - Russia	-57.728	***
US - Chile	-97.344	*
US - Israel	-10.217	
US - Morocco	20.681	

*,**,*** denotes significance at the 1,5 and 10 percent level respectively.

Table 14. Robust Trade Creation Coefficients for Wheat Specific Gravity Model (Regression 2 and Regression 3).

CTRADE Variable	*Regression 2*			*Regression 3*		
	Coef.	*Std. Err.*	*P>|t|*	*Coef.*	*Std. Err.*	*P>|t|*
Armenia - Russia	-0.075	0.725	0.918	0.852	0.863	0.323
Australia - New Zealand (ANZCERTA)	4.749	0.401	0.000	5.092	0.412	0.000
Canada - Chile	4.980	0.227	0.000	13.326	1.777	0.000
Chile - Mexico	4.508	0.430	0.000	3.355	0.395	0.000
Common Economic Zone (CEZ)	0.468	0.682	0.493	0.210	0.708	0.767
Commonwealth of Independent States (CIS)	1.438	0.337	0.000	1.642	0.466	0.000
EFTA - Turkey	-4.793	0.519	0.000	-3.677	0.598	0.000
EU	1.587	0.137	0.000	1.592	0.162	0.000
EU - Albania	1.311	0.536	0.014	1.996	0.542	0.000
EU - Algeria	2.264	0.339	0.000	0.626	0.359	0.081
EU - Bosnia and Herzegovina	0.807	0.467	0.084	0.637	0.435	0.143
EU - Croatia	-0.657	0.489	0.179	-0.424	0.491	0.388
EU - Egypt	1.639	0.482	0.001	0.347	0.462	0.453
EU - Israel	1.927	0.351	0.000	1.679	0.603	0.005
EU - Jordan	1.518	0.879	0.084	1.938	0.864	0.025
EU - Lebanon	-0.172	0.740	0.816	-0.343	0.729	0.638
EU - Macedonia	2.020	0.341	0.000	2.114	0.359	0.000
EU - Morocco	1.254	0.233	0.000	0.641	0.290	0.027
EU - Norway	0.886	0.341	0.009	1.199	0.362	0.001
EU - Switzerland - Liechtenstein	-2.362	0.326	0.000	-1.672	0.348	0.000
EU - Tunisia	2.587	0.246	0.000	1.114	0.273	0.000
EU - Turkey	-0.380	0.370	0.305	-0.587	0.401	0.143
Eurasian Economic Community (EAEC)	-2.365	0.626	0.000	-2.463	0.703	0.000
Georgia - Russia	-1.359	0.900	0.131	-0.253	0.937	0.787
Global System of Trade Preferences among Developing Countries (GSTP)	-4.129	0.994	0.000	-4.194	0.964	0.000
North American Free Trade Agreement (NAFTA)	0.851	0.406	0.036	0.056	0.368	0.878
Pacific Island Countries Trade Agreement (PICTA)	-0.029	0.388	0.941	-0.050	0.390	0.899
Protocol on Trade Negotiations (PTN)	1.913	0.522	0.000	1.823	0.505	0.000
Southern Common Market (MERCOSUR)	1.750	0.687	0.011	0.844	0.556	0.129
Turkey - Georgia	2.064	0.253	0.000	3.585	0.473	0.000
Ukraine - Azerbaijan	-2.984	1.533	0.052	-2.775	1.686	0.100
Ukraine - Belarus	-1.049	1.388	0.450	0.727	1.462	0.619
Ukraine - Moldova	-2.557	0.900	0.005	-2.119	0.814	0.009
Ukraine - Russia	-3.775	0.645	0.000	-3.036	0.960	0.002
US - Chile	2.282	0.460	0.000	0.685	0.583	0.240
US - Israel	2.780	0.239	0.000	1.412	0.655	0.031
US - Morocco	2.284	0.590	0.000	0.983	0.619	0.112

Table 15. Robust Trade Diversion Coefficients for Wheat Specific Gravity (Regression 3).

DTRADE Variable	*Regression 3*		
	Coef.	*Std. Err.*	*P>|t|*
Armenia - Russia	1.159	0.592	0.050
Australia - New Zealand (ANZCERTA)	-0.369	1.283	0.774
Canada - Chile	6.778	1.327	0.000
Chile - Mexico	-6.398	1.257	0.000
Common Economic Zone (CEZ)	-1.890	0.512	0.000
Commonwealth of Independent States (CIS)	-1.231	0.451	0.006
EU	1.074	0.202	0.000
EU - Albania	1.818	1.072	0.090
EU - Algeria	1.715	0.651	0.009
EU - Croatia	2.139	0.552	0.000
EU - Egypt	1.109	0.385	0.004
EU - Israel	1.258	0.645	0.051
EU - Jordan	1.908	0.519	0.000
EU - Lebanon	1.875	0.407	0.000
EU - Macedonia	2.097	0.576	0.000
EU - Morocco	0.746	0.251	0.003
EU - Norway	-0.426	0.488	0.383
EU - Switzerland - Liechtenstein	-0.389	0.431	0.367
EU - Tunisia	1.338	0.319	0.000
EU - Turkey	-0.568	0.628	0.366
Eurasian Economic Community (EAEC)	-0.040	0.509	0.937
Georgia - Russia	0.075	0.546	0.891
Global System of Trade Preferences among Developing Countries (GSTP)	1.442	0.169	0.000
North American Free Trade Agreement (NAFTA)	-3.835	0.339	0.000
Pacific Island Countries Trade Agreement (PICTA)	-1.575	1.515	0.299
Protocol on Trade Negotiations (PTN)	0.704	0.189	0.000
Southern Common Market (MERCOSUR)	-2.880	0.530	0.000
Turkey - Georgia	2.369	0.686	0.001
Ukraine - Azerbaijan	-0.352	0.559	0.529
Ukraine - Belarus	2.028	0.526	0.000
Ukraine - Moldova	0.473	0.589	0.422
Ukraine - Russia	-0.861	0.447	0.054
US - Chile	-3.628	0.794	0.000
US - Israel	-0.108	0.567	0.849
US - Morocco	0.188	0.327	0.565

Appendix

Table A.1. List of Trade Agreements Enforced According to the WTO.

Trade Agreement	*Date of entry into force*	*Countries Included in agreement and Dataset*
Armenia - Russia	25-Mar-93	Armenia and Russia
Australia - New Zealand (ANZCERTA)	01-Jan-83	Australia and New Zealand
Canada - Chile	5-Jul-97	Canada and Chile
Chile - Mexico	1-Aug-99	Chile and Mexico
Common Economic Zone (CEZ)	20-May-04	Belarus, Kazakhstan, Russia and Kyrgyzstan[11]
Commonwealth of Independent States (CIS)	30-Dec-94	Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Ukraine
EU - Albania	01-Dec-06	Albania, Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom
EU - Algeria	1-Sep-05	Algeria, Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom
EU - Bosnia and Herzegovina	1-Jul-08	Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom

[11] Also known as the Kyrgyz Republic

Trade Agreement	*Date of entry into force*	*Countries Included in agreement and Dataset*
EU - Croatia	01-Mar-02	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom
EU - Egypt	1-Jun-04	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom
EU - Macedonia[12]	01-Jun-01	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Macedonia, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom
EU - Israel	1-Jun-00	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom
EU - Jordan[13]	1-May-02	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Jordan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom

[12] Also know as Former Yugoslav Republic of Macedonia.

Trade Agreement	*Date of entry into force*	*Countries Included in agreement and Dataset*
EU – Lebanon	1-Mar-03	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lebanon, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom
EU - Morocco	1-Mar-00	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Morocco, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom
EU - Norway	1-Jul-73	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom
EU - Switzerland - Liechtenstein	1-Jan-73	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom
EU - Tunisia	1-Mar-98	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Tunisia and the United Kingdom

Trade Agreement	*Date of entry into force*	*Countries Included in agreement and Dataset*
EU - Turkey	1-Jan-96	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Turkey and United Kingdom
EU[14]	1-Jan-07	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom
EFTA - Turkey	1-Apr-92	Norway, Switzerland and Turkey
Eurasian Economic Community (EAEC)	8-Oct-97	Belarus, Kazakhstan, Kyrgyzstan, Russia and Tajikistan
Georgia - Russia	10-May-94	Georgia and Russia
Global System of Trade Preferences among Developing Countries (GSTP)	19-Apr-89	Algeria, Argentina, Bangladesh, Bolivia, Brazil, Chile, Colombia, Ecuador, Egypt, India, Iran, Mexico, Morocco, Nigeria, Pakistan, Peru, Sudan and Tunisia,
North American Free Trade Agreement (NAFTA)	1-Jan-94	United States, Canada and Mexico
Pacific Island Countries Trade Agreement (PICTA)	13-Apr-03	Australia and New Zealand
Protocol on Trade Negotiations (PTN)	11-Feb-73	Bangladesh, Brazil, Chile, Egypt, Israel, Mexico, Pakistan, Paraguay, Peru, Romania, Tunisia, Turkey, and Uruguay
South Pacific Regional Trade and Economic Cooperation Agreement (SPARTECA)	1-Jan-81	Australia and New Zealand
Southern Common Market (MERCOSUR)	29-Nov-9	Argentina, Brazil, Paraguay and Uruguay
Turkey - Georgia	1-Nov-08	Turkey and Georgia
Ukraine - Azerbaijan	2-Sep-96	Ukraine and Azerbaijan
Ukraine - Belarus	11-Nov-06	Ukraine and Belarus
Ukraine - Moldova	19-May-05	Ukraine and Moldova
Ukraine - Russia	21-Feb-94	Ukraine and Russia

[14] Nations are included by EU enlargement date.

United States - Chile	1-Jan-04	United States and Chile
Trade Agreement	*Date of entry into force*	*Countries Included in agreement and Dataset*
United States - Israel	19-Aug-85	United States and Israel
United States - Morocco	1-Jan-06	United States and Morocco

Table A.2. Robust Regression Results with the Inclusion of FUEL.

Variable	*Coef.*	*Std. Err.*	*P>|t|*
LNY_i	0.821	0.122	0.000
LNY_j	-0.713	0.056	0.000
LND_{ij}	-0.442	0.056	0.000
LNP_i	-3.928	0.230	0.000
LNP_j	2.165	0.123	0.000
$LNEX_i$	0.172	0.018	0.000
LNI_i	-0.895	0.225	0.000
LNI_j	0.929	0.197	0.000
$LNPOP_i$	-0.412	0.130	0.002
$LNPOP_j$	0.901	0.052	0.000
PAG_i	0.382	0.054	0.000
PT_i	-0.004	0.003	0.224
PT_j	-0.028	0.003	0.000
(Y_i*PAG_i)	-0.086	0.011	0.000
(Y_i*PT_i)	-0.003	0.001	0.000
(Y_j*PT_j)	0.005	0.001	0.000
CONTIG	1.291	0.133	0.000
CLE	1.198	0.150	0.000
CLO	0.267	0.157	0.088
COL	-0.976	0.188	0.000
CCOL	0.896	0.265	0.001
COL45	0.093	0.294	0.753
$NONWTO_i$	0.307	0.129	0.018
$NONWTO_j$	0.801	0.193	0.000
2000	-0.435	0.184	0.018
2001	-0.311	0.179	0.082
2002	-0.357	0.178	0.046
2003	-0.139	0.162	0.389
2004	-0.453	0.158	0.004
2005	-1.319	0.184	0.000
2006	-0.968	0.174	0.000
2007	0.013	0.152	0.934
2008	(omitted)		
FUEL	1.373	0.194	0.000
Constant	7.385	2.615	0.005
	R-squared = 0.2837		
	Root MSE = 3.1174		