The Impact of NAFTA on Agricultural Commodity Trade: A Partial Equilibrium Analysis.

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Abstract

This paper examines the effects of the North American Free Trade Agreement on agricultural commodity trade using extensive data. The data cover agricultural exports and imports between the U.S. and NAFTA partners over the extended period of 1989-2010. The commodities covered in our analyses include; corn, soy bean, cotton, wheat, fresh vegetables, poultry, dairy products, and red meats. Since the signing of the agreement, U.S. total agricultural commodity trade with NAFTA members has increased three-fold from $18 billion in 1994 to $61 billion in 2010. A partial equilibrium model, in which we derive each trading partner's excess demand and excess supply, is used to study the impact of NAFTA on trade, controlling for other trade-inducing variables such as exchange rates, tariffs, per capita incomes, and relative prices. Regression results show mixed effects of NAFTA on different commodities while graphical and counterfactual analyses indicate strictly positive effects.

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Introduction

The North American Free Trade Agreement (NAFTA) between the United States, Canada, and Mexico came into force January 1, 1994. With a population of 450 million and annual productivity of over 1.7 trillion dollars, NAFTA was well positioned to become the largest trading bloc in the world (U.S. Trade Representative, 1997). Since becoming operational, trade between U.S. and NAFTA members, particularly Mexico, has significantly increased in most sectors of their economies (Gould, 1998).

The availability of data means that the impact of NAFTA on trade among member countries can now be assessed. The Office of the US Trade Representative has estimated that U.S. goods and services trade with NAFTA members amounted to $1.6 trillion ($397 billion in exports and $438 billion in imports) in 2009, implying an overall trade deficit of $41 billion with NAFTA members and a services trade surplus of $28.3 billion. The U.S. maintains a goods trade deficit and services trade surplus with NAFTA members.

Data from the USDA Foreign Agricultural Service indicate that since the signing of the agreement, U.S. total agricultural commodity trade with NAFTA members has increased more than three-fold from $18 billion in 1994 to $61 billion in 2010 (USDA-FAS data). While all of this increased volume of trade cannot be attributed to NAFTA alone, evidence from other researchers has shown that the effect of NAFTA has generally been positive (Zahniser and Link, 2002; Zahniser and Roe, 2011). Other events pre- and post-NAFTA, such as Mexico's unilateral trade liberalization and exchange rate devaluation, the establishment of the WTO in 1995, and other bilateral trade agreements, could have accounted for some of the growth in trade (Agama

and McDaniel, 2002). Equally important contributory factors to the increased U.S.-Canada and U.S.-Mexico trade include weather conditions, changes in macroeconomic performance, population growth, exchange rate movement, evolving consumer preferences, and technological change (ERS, 1999).   The latest figures indicate that U.S. exports of agricultural commodities to NAFTA members totaled $31.4 billion and imports of $29.8 billion in 2010. The leading U.S. agricultural exports in 2010 were red meats, fresh/chilled/frozen ($2.7 billion), coarse grains ($2.2 million), fresh fruit ($1.9 billion), snack foods (excluding nuts) ($1.8 billion), and fresh vegetables ($1.7 billion). Among agricultural imports in 2010, the leading categories were fresh vegetables ($4.6 billion), snack foods (including chocolate) ($4.0 billion), fresh fruit (excluding bananas) ($2.4 billion), live animals ($2.0 billion), and red meats, fresh/chilled/frozen ($2.0 billion).

 NAFTA Agreement

Regional Trade Agreements (RTAs) are important to creating economic integration and thereby promoting trade among the members of the RTA. RTAs are multilateral agreements involving several countries that may or may not share any geographical boundaries. A number of free trade areas exist throughout the world, a few of which are the European Union, Southern Common Market (MERCOSUR), Common Market for Eastern and Southern Africa (COMESA), and Association of Southeast Asian Nations (ASEAN).

Bilateral trade agreements are also quite common and play a significant role in promoting trade between countries. The Canada-U.S. Trade Agreement (CUSTA), a precursor of NAFTA, was a bilateral trade agreement between Canada and the U.S., which came into effect January 1, 1989. This agreement gradually eliminated tariffs between the two countries while non-tariff

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barriers were gradually reduced. By January 1, 1998, all tariffs on goods traded between U.S. and Canada, with the exception of a few tariff rate quotas (TRQs), had been eliminated.

The provisions under CUSTA were absorbed into the North American Free Trade Agreement (NAFTA) which was implemented on January 1, 1994. In addition to the reduction of trade barriers already provided for under CUSTA, NAFTA agreement eliminated most nontrade barriers and a gradual reduction of tariffs between the U.S. and Mexico (Koo & Kennedy, 2005). While many tariffs were to be eliminated immediately following the implementation of the NAFTA agreement, others were to be phased out gradually over a 5-15 year period.   Under the agreement, all other tariffs and quotas were to be eliminated by January 1, 2008. NAFTA also provided guidelines on Sanitary and Phytosanitary (SPS) measures as a way for each member country to maintain and protect the lives or health of humans, animals, or plants in its territory.

Impacts of NAFTA on Trade

U.S. trade with NAFTA partners has seen a remarkable growth since the implementation of the NAFTA agreement. Estimates show that U.S. Trade with NAFTA partners has increased by 78% in real terms since 1993, and trade with Mexico alone has increased by 141%, compared to an average trade growth of 43% with the rest of the world during the same period (Hillberry and McDaniel, 2002). Using a decomposition analysis of trade growth offered by Hummels and Klenow (2002), Hillberry and McDaniel found that U.S. trade has increased both at the extensive and intensive margins. Their results show that post-NAFTA changes in U.S. trade with partners saw larger increases in quantities of goods traded in HTS[1] lines that were already traded as of

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[1] Harmonized Tariff Schedule

1993. This suggests that trade growth at the extensive margin was less than the intensive margin. Thus, U.S. industries that were exporting goods to NAFTA members before the Agreement are exporting more of those same goods, as opposed to more of new goods, post-implementation of the Agreement.
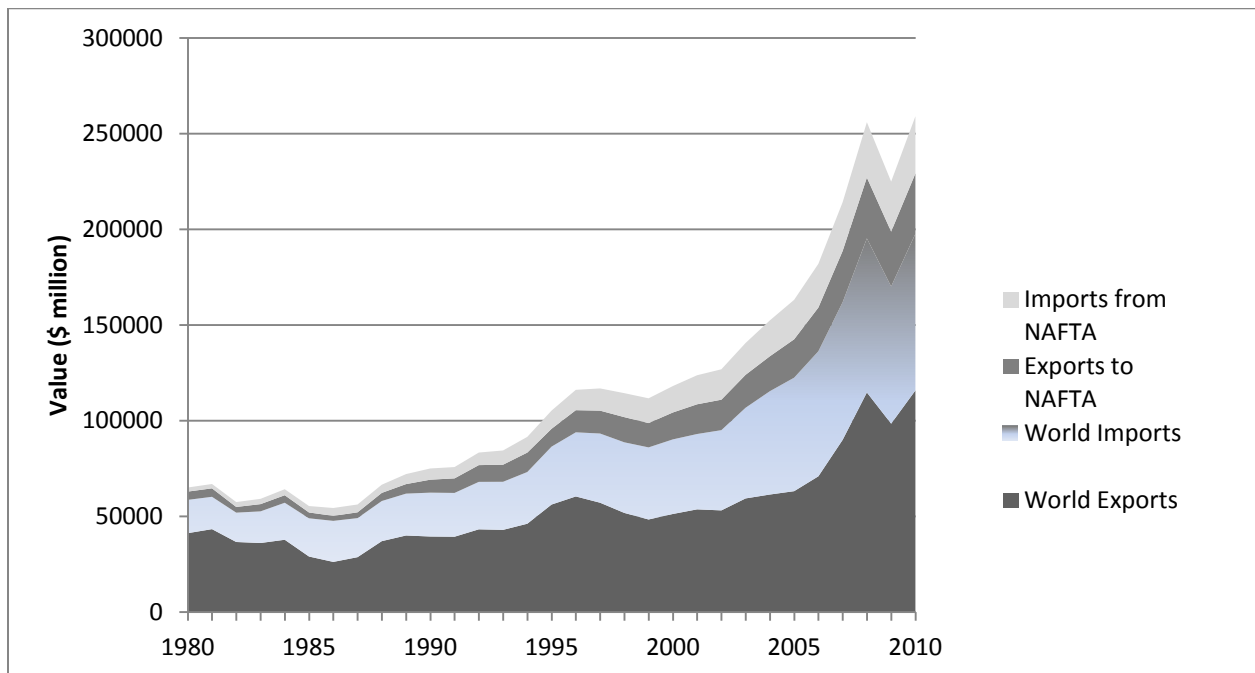
Since NAFTA implementation, U.S. agricultural trade with Canada and Mexico has more than tripled, even after accounting for recent economic downtown (Zahniser and Roe, 2011). NAFTA's effect on trade in the region varies by commodity and trading partner, with commodities that enjoyed the largest tariff reductions having the greatest increases in trade under the agreement (Zahniser and Roe, 2011). Zahniser and Link (2002) estimated that U.S. agricultural exports to Canada and Mexico combined increased by 59% between 1993 and 2000, while exports to the rest of the world grew by just 10% within the same period. Likewise, U.S. agricultural imports from Canada and Mexico increased by 86% compared to an increase of 42% from the rest of the world. Many agricultural commodities have seen increases in trade volumes following the implementation of NAFTA. Zahniser and Link (2002) and ERS (1999), found that the effect of NAFTA on U.S. agricultural commodity trade varies by commodity and trading partner, with the biggest increases occurring for those commodities that had the largest declines in tariff and non-tariff barriers.

The economic downturn of 2008/2009 affected agricultural trade in the NAFTA region, much like for other commodities in the region and globally. Figure 1 indicates the pattern of growth in U.S. agricultural trade within the NAFTA region and the rest of the world. Agricultural trade, both within NAFTA area and worldwide, took a hit during the recession but has since recovered at the beginning of 2010. The impact of NAFTA on the U.S. economy transcends increases in bilateral trade flows to increases in employment (ERS, 1999). Although

NAFTA's effect on employment is small, it has not been negative as opponents of the agreement feared (Burfisher et al., 2001). The ERS (1999) estimates show that under NAFTA, employment in crop and livestock production increased slightly (1.3 percent per annum, on average).

Envisaging displacement of workers as a result of the agreement, the U.S. government established the NAFTA-Trade Adjustment Assistance Program (NAFTA-TAA) to provide job training for displaced workers (Burfisher et al., 2001). The U.S. Department of Agriculture (1997) assessed the impact of NAFTA on rural employment in a general equilibrium model and found that U.S. rural employment in 1996 was 0.07 percent higher with NAFTA than it would have been without the agreement. Other studies also found a small positive or near-zero effect of NAFTA on employment (Hinojosa et al., 2000; International Trade Commission, 1997).

Figure 1: U.S. Agricultural Trade with NAFTA and world

Data Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics

Figure 2 indicates that U.S. agricultural trade with Canada held steady following implementation of the Agreement before rapidly increasing in the late 1990s. The fact that agricultural trade with Canada did not immediately increase is attributable to the CUSTA Agreement which had already been in effect since 1989, and the rapid increase in the late 1990s was due to the complete elimination of all tariffs with Canada in 1998. Essentially, NAFTA merely replaced CUSTA Agreement which had already made provisions for tariff reduction on most agricultural commodities; as such NAFTA's immediate effect on agricultural trade between U.S. and Canada was modest. As U.S. agricultural exports to Canada increased, so did imports from Canada, which implies that both countries have benefited from the implementation of the Agreement. What does seem somewhat apparent in the immediate aftermath of CUSTA implementation is that U.S. agricultural trade deficit with Canada gave way to surpluses, at least until 1996 (see Figure 2).

Figure 2: U.S. Agricultural Trade with Canada: All Commodities
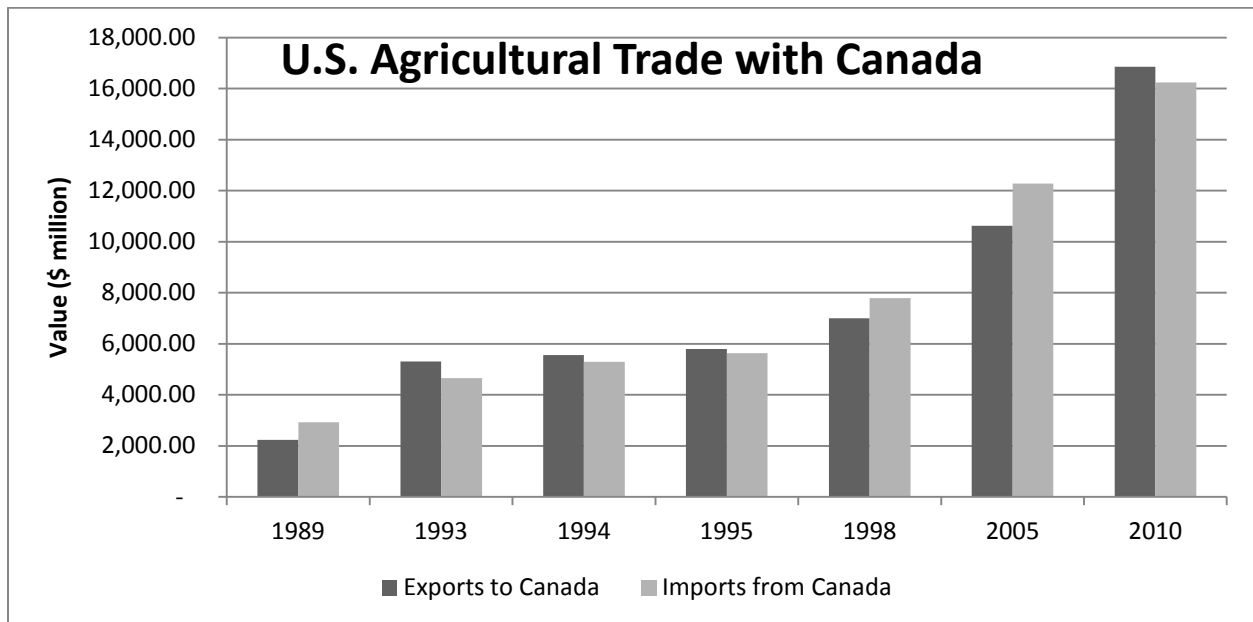
Data Source: Foreign Agricultural Service, USDA

A simplistic analysis of the impact of NAFTA on agricultural trade can be carried out by analyzing the pre-and post-NAFTA pattern of trade. Figure 3 presents the annual average values of exports of various agricultural commodities to Canada in the decade preceding and after NAFTA. Generally, post-NAFTA values are greater than their pre-NAFTA equivalent values. The commodities that have seen the most significant increases are grains, vegetables, and livestock and meats. The top three agricultural commodities with the greatest increases in value of exports to Canada are grains/feeds, vegetables, and livestock/meats.

Figure 3: U.S. Agricultural Exports to Canada, Pre- and Post-NAFTA
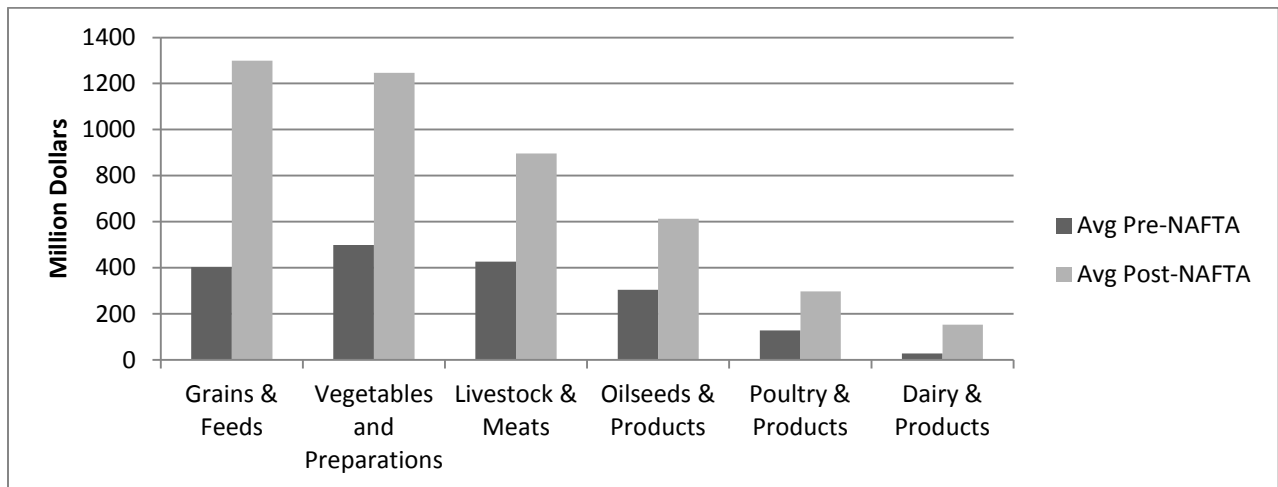
Data Source: Foreign Agricultural Service, USDA

Similar to exports, the imports of these agricultural commodities have significantly increased during the implementation phase of the Agreement. Figure 4 presents the comparison of average values of imports of selected commodities pre- and post-NAFTA. Annual average imports of vegetables, grains and oilseeds have increased by 473%, 215% and 268% respectively since 1994. By the same token, importation of dairy products, and livestock/meats from Canada increased by 760% and 131%, respectively, since NAFTA was signed.

Figure 4: U.S. Agricultural Imports from Canada, Pre- and Post-NAFTA
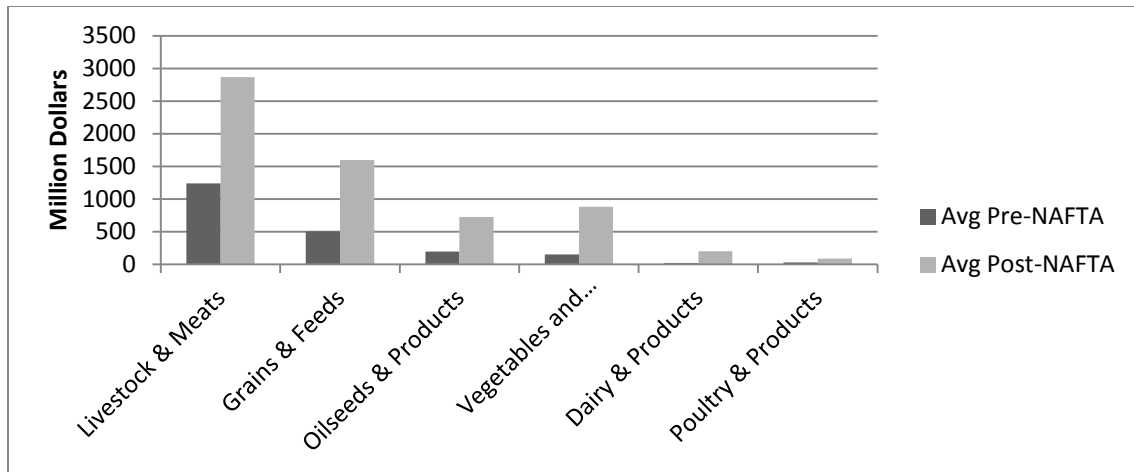
Figure 5 shows that U.S. agricultural trade with Mexico has enjoyed an increasing trend since the signing of the Agreement, buoyed by rapid increases in exports of grains and oilseeds. As a result of increased demand for meat in Mexico, poultry and hog producers rely heavily on importation of feed grains from the U.S. as feedstuffs. U.S. exports of feed grains and oilseeds to Mexico increased by 134% during NAFTA compared to the periods immediately before the Agreement came into force. Corn, wheat and rice exports to Mexico have quadrupled in the NAFTA era, which largely reflects the enhanced liberalization of agricultural trade provided by the NAFTA framework. With the exception of 1995, the U.S. maintains a trade surplus in agricultural commodities with Mexico both before and after NAFTA was implemented (Figure 5). Both partners appear to have gained from NAFTA; as U.S. increased its exports to Mexico, imports from Mexico increased by about the same margins.

Figure 5: U.S. Agricultural Trade with Mexico: All Commodities
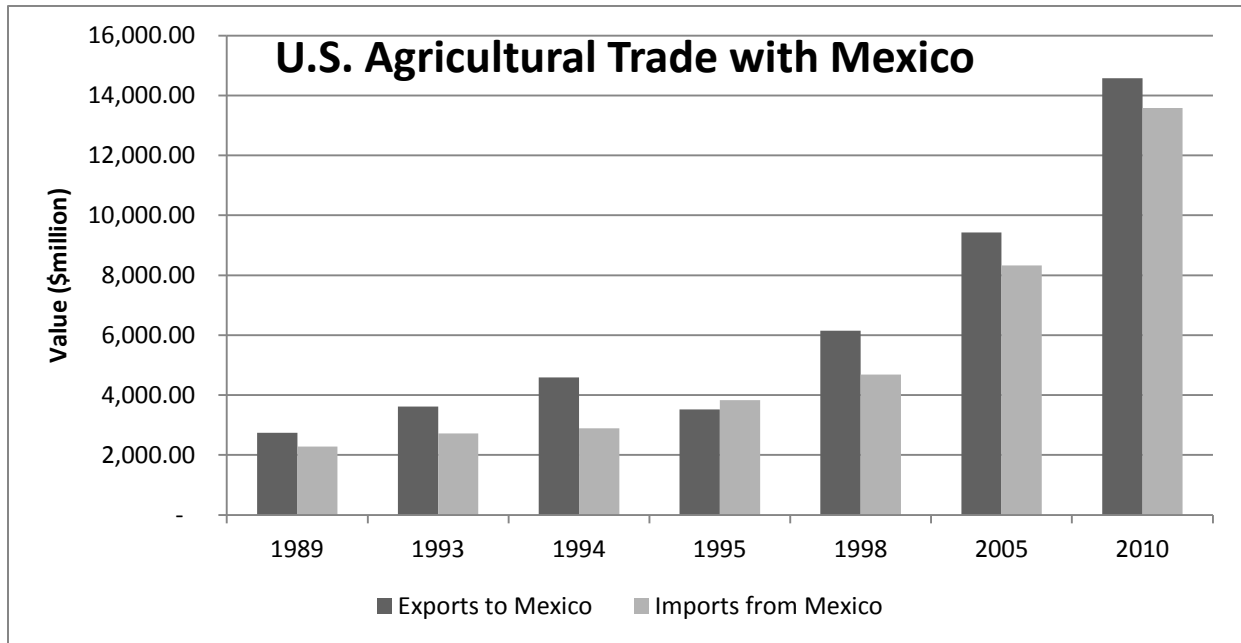
Data Source: Foreign Agricultural Service, USDA

Three of the agricultural commodities that saw significant increases in exports to Mexico are

grains and feeds, livestock and meats, and oilseeds and products (see Figure 6).

Figure 6: U.S. Agricultural Exports to Mexico, Pre- and Post-NAFTA
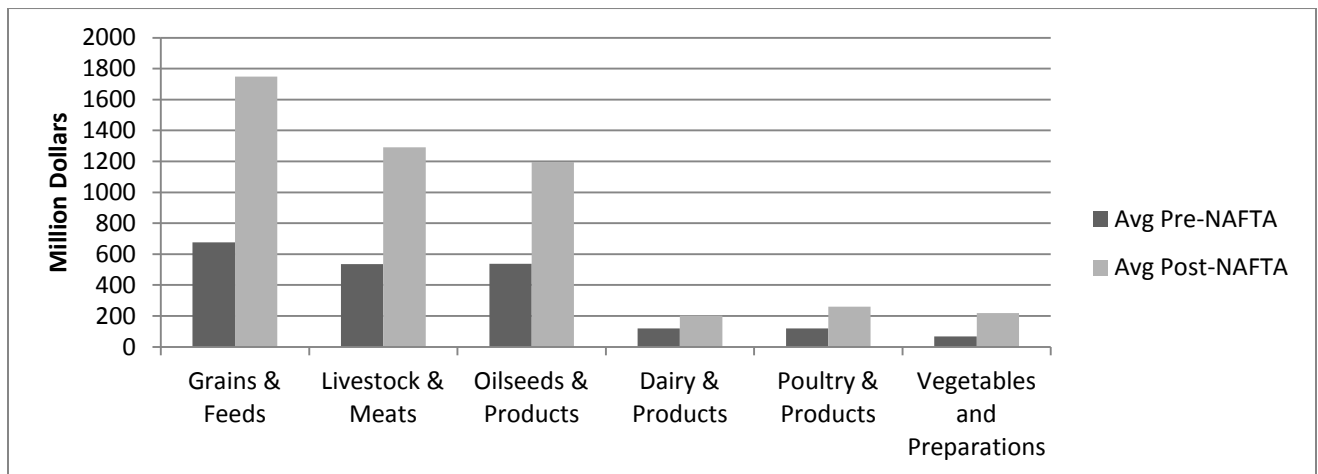
Data Source: Foreign Agricultural Service, USDA

Importation of vegetables from Mexico has significantly increased in the post-NAFTA period (Figure 7). Average annual value of vegetables imported into the U.S. from Mexico stands at $1.8 billion compared to $700 million in the period before NAFTA took effect. The amounts of livestock and meats, oilseeds, dairy and poultry products coming into the U.S. from Mexico, although insignificant, are higher in the post-NAFTA period compared to the period before.

Figure 7: U.S. Agricultural Imports from Mexico, Pre- and Post-NAFTA
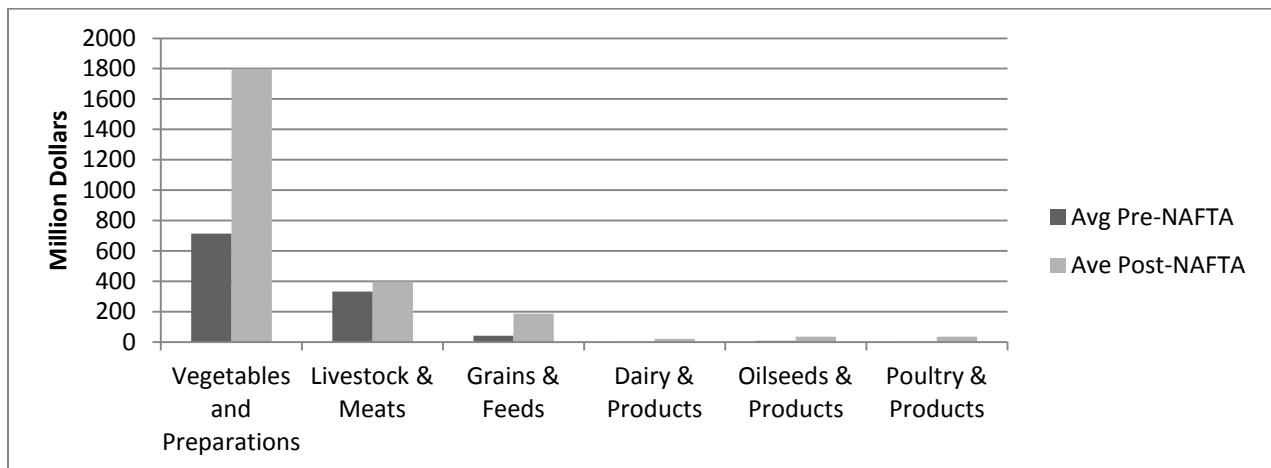
Data Source: Foreign Agricultural Service, USDA

Partial Equilibrium Analysis of U.S. Trade with NAFTA partners

To study the effect of NAFTA on US trade with other NAFTA partners, a partial equilibrium model is posited. Partial equilibrium, as opposed to general equilibrium, allows the study of the impact of a trade policy on one sector of the economy. Koo and Kennedy (2005) use partial equilibrium analysis to derive the import demand and export supply functions for a particular commodity or sector of the economy. The information derived from partial equilibrium analysis can be used by policy makers to estimate welfare effects (consumer and producer surpluses) associated with certain trade policies.

Import Demand Function

The import demand function can be derived as the excess domestic demand for a good. In this context, import demand for a particular commodity is defined at the points where the domestic quantity demanded of the good is greater than the domestic supply, as in Figure 8 below (Koo and Kennedy, 2005).

Algebraically, import demand is defined as;

$$Q_m(P,Y) = Q_d(P, Y(P)) - Q_s(P) = Q_m (P, Y) \qquad (1)$$

Where $Q_m(.)$ is the quantity of the commodity imported as a function of domestic price P and income Y, $Q_d(.)$ is the domestic quantity demanded as a function of price P, and income Y, and $Q_s(P)$ is the quantity of the good supplied domestically at each price level. It can be proved that the import demand is inversely related to domestic price level, as derived in Figure 8 below.
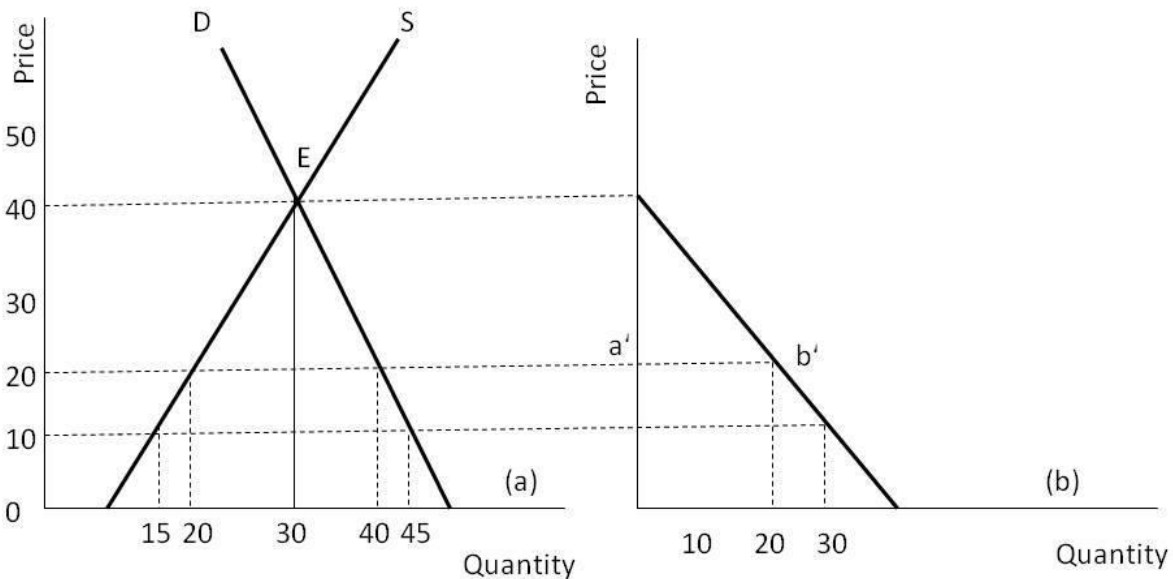
Figure 8: Derivation of import Demand curve

This inverse relationship between import demand and price can also be derived algebraically as;

$$\frac{\partial Q_m}{\partial P} = \frac{\partial Q_d}{\partial P} + \frac{\partial Q_d}{\partial Y} * \frac{\partial Y}{\partial P} - \frac{\partial Q_s}{\partial P} < 0 \qquad (2)$$

Where the first term on the right is negative by the law of demand, the second term is negative by assumption that the imported good in question is a normal good, such that $\partial Q_d / \partial Y > 0$ and $\partial Y / \partial P < 0$ because higher prices reduce the consumers real income. Lastly, $\partial Q_s / \partial P$ is positive by the law of supply.

From Figure 8, when the domestic price is $40 per unit, domestic quantity demanded is equal to domestic supply of 30 units, thus, the domestic market clears and import demand is zero. As the price falls to $20 per unit, domestic producers have less incentive to produce and therefore cut supply to 20 units while domestic demand increases to 40 units. The domestic excess demand of 20 units (40-20) is the import demand at the price of $20. As price further decreases to $10, import demand increases to 30 units (45-15).

Export Supply Function

The export supply function is derived as the horizontal difference between the domestic quantity supplied and domestic quantity demanded of a commodity at any given price. Export supply is positive when the domestic quantity supplied exceeds domestic quantity demanded, and this occurs at price levels at which the domestic price is higher than the international price, thus creating a surplus (excess supply) on the domestic market. The export supply (or excess supply) is zero at the point where the domestic and international prices of the commodity are equalized.

Export supply may be derived as;

$Q_x(P) = Q_s(P) - Q_d(P)$ (3)

Where Q_x (P) is the quantity of exports of the commodity as a function of price, Q_s and Q_d are domestic quantity supplied and domestic quantity demanded, respectively.

Empirical Models

Following Khan and Ross (1977) and Boylan et al. (1980), the import demand is specified as

$$M_t^* = f(Y_t, P_{mt}/P_{dt}); \tag{4}$$

Which can be linearized as;

$$M_t^* = \alpha_0 + \alpha_1 Y_t + \alpha_2 P_t + e_t \tag{5}$$

Where M_t^* is the desired quantity of imports, Y_t is the gross domestic product (or income), P_t is the relative price defined as the ratio of import price (P_{mt}) to domestic price (P_{dt}). A partial adjustment mechanism may be introduced into the model in equation 5 above (Doroodian et al., 1994). This is expressed as;

$$\Delta M_t = M_t - M_{t-1} = \delta(M_t^* - M_{t-1}) \tag{6}$$

Where M_t and M_{t-1} are actual quantities imported at time t and t-1 respectively, and δ is the coefficient of adjustment, such that; $0 \le \delta \le 1$. Substituting equation 5 into equation 6, and rearranging the terms yields the following dynamic import demand equation;

$$M_t = \delta\alpha_0 + \delta\alpha_1 Y_t + \delta\alpha_2 P_t + (1-\delta)M_{t-1} + \delta e_t \tag{7}$$

Partial equilibrium analysis is used to model U.S. import demand for agricultural commodities. The following equations represent the domestic market clearing conditions for each commodity;

$Q_d = Q_d\ (P,\ Y,\ e)$ (8)

$Q_s = Q_s\ (P,\ e, W)$ (9)

$Q_d = Q_s$ (10)

Assuming that there is a negative price differential between the domestic and international markets, the estimated excess demand or import demand is given as;

$M_t = Q_d - Q_s = M\ (P/P_t{}^*,\ e_t,\ Y_t,\ M_{t-i},\ W_t)$ (11)

This is estimated econometrically as;

$lnM_t = \alpha_0 + \alpha_1 ln(P/P_t{}^*) + \alpha_2 lne_t + \alpha_3\ lnY_t + \alpha_4 lnM_{t-i} + \alpha_5 NAFTA + \alpha_6 W_t + \varepsilon_t$ (12)

Where ln is the natural logarithm and t indexes time, M is the quantity of imports, P/P^* is the relative price (ratio of domestic to foreign prices), e is the real exchange rate defined as the price of foreign currency, Y is per capita income level, NAFTA is a dummy variable (=1 if year $\geq$ 1994), and W is a vector of other factors that may affect imports.

Following similar procedure as for the import demand, the estimated export supply function is derived as;

$X = Q_s - Q_d = X\ (P/P_t{}^*,\ e_t,\ X_{t-i},\ Y_t{}^*,\ Z_t)$ (13)

This is estimated as;

$lnX_t = \beta_0 + \beta_1 ln(P/P_t{}^*) + \beta_2 lne_t + \beta_3 lnY_t{}^* + \beta_4 lnX_{t-i} + \beta_5 NAFTA + \beta_6 Zt + u_t$ (14)

Where *ln* is the natural logarithm and t indexes time, X_t is the quantity of exports, Y_t^* is foreign country per capita income level, NAFTA is a dummy variable (=1 if year ≥ 1994), Z_t is a vector of other factors, and Q_s, Q_d, P and e are as previously defined.

Data and Unit Root Tests

Quarterly trade data (1989Q1:2010Q4) between U.S.-Canada and U.S.-Mexico are obtained from the Global Agricultural Trade System (GATS) maintained by the Foreign Agricultural Services (FAS) of the United States Department of Agriculture (USDA). The data comprise import and export values (measured in thousands of dollars) of major agricultural commodities traded between NAFTA partners: these include corn, cotton, wheat, soybeans, poultry products, dairy products, red meats, and vegetables. Gross national income per capita for the U.S., Canada, and Mexico are obtained from the Organization for Economic Cooperation and Development (OECD). Other data, including price indices, and exchange rates, are obtained from the Federal Reserve Bank of St. Louis.

Time series data used in regression analysis should be stationary (Enders, 2004). A stationary time series is one that has a constant mean and variance over time (covariance stationary process). A violation of the stationarity assumption results in a spurious regression, in which the R^2 is high and t ratios appear to be significant but the output results have no economic meaning (Granger and Newbold, 1974). The Augmented Dicky-Fuller test, equation 15 below, proposed by Dicky and Fuller (1979; 1981), was performed to check presence of unit roots. The null hypothesis for the ADF unit root test consists of testing $\gamma = 0$ in equation 15 below. Failure to reject this null hypothesis signifies the presence of a unit root. By this definition, the tests show

that all variables are unit root processes, or integrated of order one, I(1). First differencing the variables, thus, achieves required stationary series, or I(0) processes.

$$\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{j=1}^{p} \beta_j \, \Delta y_{t-j} + \varepsilon_t \qquad\qquad 15$$

Results of Regression Analysis

Quarterly data, 1989Q1:2010Q4, of U.S. agricultural commodity trade with Canada and Mexico are used in the regression analysis. The analysis covers top agricultural commodities traded in the NAFTA area including corn, wheat, cotton, soy bean, poultry products, dairy products, red meats, and tomatoes. Tables 1 and 2 compare the pre-NAFTA and post-NAFTA average values of trade between the U.S. and Canada for the commodities covered in the regression analysis. The post-NAFTA average values traded are significantly higher than pre-NAFTA values. Similar analysis (not shown for brevity) of pre- and post-NAFTA trade between the U.S. and Mexico reveal the same findings as for U.S. –Canada trade.

Regression analyses show mixed findings regarding the direction of NAFTA effects on agricultural commodity trade between NAFTA partners. A number of econometric specifications were tried to determine if the mixed sign effects of NAFTA could be due to a misspecification, but all turned up almost similar results. Autocorrelation and heteroskedasticity were identified as potential issues that could be causing this mixed signs. Estimating the models in first differences did not change the signs. Consequently, we employed Prais-Winsten and Cochrane-Orcutt transformations to deal with the time series issues relating to autocorrelation.

In Tables 3A and 3B, the results of regression analyses of U.S. agricultural commodity trade with Canada are presented, while Tables 4A and 4B present similar regression analyses for U.S. – Mexico trade. Tables 3A and 4A show estimates of the export supply functions for U.S. exports to Canada and Mexico, respectively. The regression results show that since NAFTA's inception, U.S. corn and poultry products exports to Canada have significantly declined, while U.S. exports of corn to Mexico has significantly increased. U.S. dollar depreciation against the Canadian dollar increases U.S. exports of cotton to Canada, and in the same vein U.S. dollar depreciation against the Mexican Peso increases U.S. exports of poultry products to Mexico. Increases in gross national income per capita in Canada lead to increases in U.S. exports, while U.S. exports of corn to Mexico increases with increasing per capita incomes in Mexico. Other explanatory variables, namely, relative prices, average tariffs, and lending rates are shown to have mixed effects on U.S. exports to Canada and Mexico.

Similarly, Tables 3B and 4B show the estimated import demand functions for U.S. imports from Canada and Mexico, respectively. Table 3B shows the estimated import demand functions for U.S. imports of dairy products, poultry products, red meats, and wheat from Canada. The effect of NAFTA is negative and significant for wheat imports from Canada but insignificant for dairy, poultry and read meats. The income effect is positive and significant for poultry and red meats imports, while the exchange rate is insignificant, except for red meats, in which case, it has a positive effect, opposite of what we would expect for imports. The relative price effect is negative and significant for dairy products and wheat imports from Canada, indicating that lower domestic prices of these commodities results in an increased excess demand/import demand.

In Table 4B we present regression results of U.S. imports of dairy products, poultry products, red meats, and tomatoes from Mexico. The results show that U.S. imports of dairy products and fresh tomatoes have significantly increased under NAFTA than in the period preceding the agreement. The income and relative price effects are generally significant with the expected signs: Increases in U.S. per capita income increases the amounts of each commodity imported, which agrees with the assumption that these are normal goods. Also, lower domestic prices lead to increased domestic demand and, hence, higher import demand. The exchange rate effect is negative and significant with regard to the importation of fresh tomatoes from Mexico, which is to be expected. All things remaining constant, it is expected that an appreciation of the dollar increases the purchasing power of consumers; as such we would expect an increase in imports of tomatoes. In other words, a depreciation of the peso increases Mexican exports which implies an increase in U.S. imports. The lending rate and average tariff rate do not significantly affect the imports of dairy products, poultry products, red meats, and tomatoes from Mexico.

Counterfactual Analysis

The mixed findings from the regression analyses contradict the all-positive effects of NAFTA shown in Tables 1 and 2, as well as in the preceding graphical analyses. A plausible explanation for this could be the failure of the dummy variable (NAFTA=1 for years>1994) to pick up the true effect of NAFTA on traded commodities in a regression analytic framework. An alternative to the regression analyses, then, is to perform counterfactual analyses, whereby, we compare the realized trade values (for each commodity) to what would have obtained, had NAFTA not come into existence.

Essentially, with counterfactual analyses, we aim to answer the question: What would have been the path of U.S. agricultural trade with Canada and Mexico had NAFTA not existed? To do this, we would have to assume that NAFTA did not exist at all, and then, using the historical trade data up until 1993, forecast the trend that trade in each commodity would have taken without the NAFTA agreement.   This is implemented by conducting a three-period moving average forecast of trade for ten years beyond 1993. Comparing these forecasted no-NAFTA trade data to the actual (or realized) data post-NAFTA reveals that NAFTA indeed had a positive effect on the trade of most of these commodities. Figures 8 and 9 present a graphical summary of the counterfactual analyses for different commodities. These graphs compare the pre-NAFTA, forecast (No NAFTA), and the post-NAFTA averages for each commodity. What is clear from these graphs is that for almost all the commodities, post-NAFTA averages are higher than both the pre-NAFTA and forecasted values.

The no-NAFTA (or forecasted) scenario averages show that some commodities would have seen increases in trade, but by fewer margins than what was realized after NAFTA's implementation. For example, U.S. trade in poultry products, meats and vegetables with Canada is forecasted to be higher than the case before NAFTA came into existence. Similarly, U.S. trade in cotton, wheat, meats, soybeans, and vegetables with Mexico are higher in the forecasted scenario than pre-NAFTA case, indicating that trade in these commodities would have continued an upward trend whether or not NAFTA existed. Overall, however, post-NAFTA averages are significantly higher than pre-NAFTA or forecasted averages, an indication of the positive effect that NAFTA had on trade between the U.S. and NAFTA partners.

Summary and Conclusion

This paper presents the findings of an investigation into the effects of the North American Free trade Agreement (NAFTA) on agricultural commodity trade between U.S.-Canada on the one hand, and U.S.-Mexico on the other hand. Using quarterly data from 1989 to 2010, we explore, using different approaches, the trends in agricultural commodity trade between NAFTA partners. Overall agricultural trade has been increasing since the inception of the agreement, as tariff and non-tariff barriers were gradually dismantled. By 2008, all tariffs on agricultural commodities were eliminated, thus, allowing unfettered trade among the signatories of the agreement.

Graphical analyses of the trends in trade indicate that most of the agricultural commodities have enjoyed increased trade, with post-NAFTA average quantities traded far exceeding pre-NAFTA averages. Regression analysis, however, show mixed effects of NAFTA on trade, which is attributed to the inability of the dummy variable for NAFTA to pick up the true effect of the agreement. The regression results show that since NAFTA's implementation, U.S. exports of corn and poultry products to Canada significantly decreased, while U.S. exports of corn to Mexico significantly increased. At the same time, while U.S. importation of tomatoes from Mexico significantly increased following NAFTA, imports of wheat and poultry products from Canada significantly decreased.

More robust estimation approaches, other than the dummy-variable approach, might accurately capture the positive effects observed in the graphical analyses. A counterfactual approach, using pre-NAFTA data to forecast the trends in trade, assuming NAFTA had not existed, shows that increases in trade would have been far less than what we observed in the actual data after NAFTA came into existence.

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Table 1: Pre- and Post-NAFTA Analysis of U.S. Exports to Canada

Exports	Avg. Pre-NAFTA (Value $mil)	Avg. Post-NAFTA (Value $mil)	Difference (Value $mil)
Corn	15635.75	57461.74	41825.99*
Cotton	14888.15	16616.7	1728.55*
Wheat	507.1	1110.5	603.4*
Soya bean	10574	23004.39	12430.39*
Vegetables (fresh)	142125.3	271677.8	129552.5*
Dairy Products	11392.9	65656.48	54263.58*
Poultry Products	46813.5	97236.56	50423.06*
Red Meats	92702.75	194819.8	102117.05*

*=Difference statistically significant at 95%

Table 2: Pre- and Post-NAFTA Analysis of U.S. Imports from Canada

Imports	Avg. Pre-NAFTA (Value $mil)	Avg. Post-NAFTA (Value $mil)	Difference (Value $mil)
Corn	4297.6	8802.03	4504.43*
Wheat	30067.7	88222.53	58154.83*
Soya bean	4983	12430.59	7447.59*
Vegetables (fresh)	24313	144306.5	119993.5*
Dairy Products	7963.45	68261.18	60297.73*
Poultry Products	9167.9	36694.14	27526.24*
Red Meats	160764.9	416805.8	256040.9*

*=Difference statistically significant at 95%

Table 3A: Regression Analysis of US Ag. Exports to Canada

Variable	lncorn	lncotton	lnsoy	lnpoultry
Nafta	−.844** (0.384)	0.425 (0.369)	−0.818 (0.608)	−0.202** (0.098)
lnexcaus	0.963 (0.592)	1.947*** (0.667)	1.44 (0.916)	−0.389** (0.157)
lnGNI^{can}	5.673*** (1.842)	2.75* (1.635)	6.61** (2.52)	−0.156 (0.409)
lnlendrate^{can}	−0.537* (0.285)	0.815*** (0.277)	−0.634 (0.401)	−0.012 (0.067)
lntariffrev^{can}	2.067*** (0.551)	0.293 (0.489)	0.311 (0.742)	0.169 (0.133)
lnrelpr	−20.88*** (7.02)	20.42*** (7.26)	−4.847 (9.878)	−3.407* (1.739)
lntrend	−0.054 (0.323)	0.623* (0.321)	−0.44 (0.376)	0.309*** (0.059)
lncorn$_{t-1}$	0.486*** (0.110)			
lncorn$_{t-2}$	−0.327*** (0.106)			
lncotton$_{t-1}$		0.552*** (0.110)		
lncotton$_{t-2}$		−0.018 (0.104)		
lnsoy$_{t-1}$			0.416*** (0.111)	
Constant	−49.47*** (17.93)	−28.72* (16.44)	−58.02** (24.91)	12.40*** (4.204)
Observations	85	85	85	87
R-squared	0.75	0.75	0.63	0.89
DW^a	1.94	1.95	2.04	1.83
DW^b	1.97	1.95	1.98	1.95

[a] Original DW statistic, [b] DW statistic after Prais-Winsten/Cochrane-Orcutt transformation, *** $p<0.01$, ** $p<0.05$, * $p<0.1$, Standard errors in parentheses

Table 3B: Regression Analysis of US Ag. Imports from Canada

Variable	lndairyp	lnpoultry	lnrmeats	lnwheat
Nafta	−0.168 (0.163)	−0.056 (0.075)	−0.055 (0.066)	−0.604*** (0.217)
lnexcaus	−0.002 (0.543)	−0.226 (0.146)	0.485*** (0.145)	−0.227 (0.346)
$lnGNI^{us}$	−1.98 (1.846)	1.358* (0.749)	1.536** (0.732)	−3.11* (1.81)
$lnlendrate^{us}$	0.197 (0.141)	−0.063 (0.057)	0.038 (0.045)	0.057 (0.144)
$lntariffrev^{us}$	0.718 (0692)	−0.718* (0.349)	−0.262 (0.290)	2.458** (0.994)
lnrelpr	−8.584** (3.637)	−0.173 (1.374)	1.129 (1.333)	−27.12*** (5.616)
lntrend	0.186 (0.155)	0.061 (0.053)	0.055 (0.049)	0.311* (0.156)
$lnpoultry_{t-1}$		0.654*** (0.092)		
$lnrmeats_{t-1}$			0.555*** (0.105)	
$lnwheat_{t-1}$				0.403*** (0.095)
Constant		−9.311 (9.725)	−10.43 (7.142)	35.76* (20.02)
Observations	87	86	86	86
R-squared	0.08	0.98	0.98	0.83
DW^a	1.16	2.16	2.15	2.11
DW^b	2.28	2.09	2.01	2.01

[a] Original DW statistic, [b] DW statistic after Prais-Winsten/Cochrane-Orcutt

transformation, *** p<0.01, ** p<0.05, * p<0.1, Standard errors in parentheses

Table 4A: Regression Analysis of US Ag. Exports to Mexico

Variable	lncorn	lnsoyb	lnwheat	lnpoultry
Nafta	1.244*** (0.239)	0.288 (0.351)	−0.501 (0.552)	0.007 (0.184)
lnexmeus	0.340 (0.426)	−0.798 (0.719)	−1.856 (1.122)	1.059*** (0.286)
$lnGNI^{mex}$	3.111** (1.346)	1.515 (2.349)	0.394 (3.704)	−1.558 (1.272)
lnrelpr	1.096*** (4.08)	0.996** (0.499)	0.497 (0.799)	−0.602 (0.642)
$lntariffrev^{mex}$	−0.699*** (0.211)	−0.590** (0.28)	−0.542 (0.445)	0.364* (0.213)
$lnlendrate^{mex}$	0.133 (0.116)	−9.3E−06 (0.201)	−0.205 (0.315)	0.122 (0.086)
lntrend	−1.317*** (0.312)	−0.344 (0.313)	1.035** (0.512)	0.455** (0.204)
$lncorn_{t-1}$	0.783*** (0.105)			
$lncorn_{t-2}$	−0.251** (0.099)			
Constant	−16.51 (11.71)	3.683 (20.31)	10.51 (31.97)	
Observations	85	87	87	87
R-squared	0.91	0.56	0.65	0.18
Dw[a]	2.13	2.19	2.22	1.06
Dw[b]	1.93	2.06	2.58	2.3

[a] Original DW statistic, [b] DW statistic after Prais-Winsten/Cochrane-Orcutt

transformation, *** p<0.01, ** p<0.05, * p<0.1, Standard errors in parentheses

Table 4B: Regression Analysis of US Ag. Imports from Mexico

Variable	lndairyp	lnpoultry	lrmeats	lntomato
Nafta	0.492** (0.188)	0.512 (0.899)	−0.761 (0.582)	0.482*** (0.144)
lnGNI^{us}	5.349** (2.04)	26.05** (9.944)	−6.384 (6.414)	2.439** (0.906)
lnexmexus	−0.009 (0.342)	0.584 (0.488)	1.436 (1.646)	−5.366** (2.44)
lnrelpr	−1.140*** (0.347)	−3.981** (1.543)	−1.582 (1.209)	−0.900* (0.513)
lntariffrev^{us}	−2.148* (1.214)	−1.094 (4.882)	−4.926 (2.967)	
lnlendrate^{us}	−0.011 (0.162)	−0.71 (0.795)	0.612 (0.533)	
lntrend	−0.103 (0.197)	2.012** (0.867)	3.515*** (0.893)	
lndairyp$_{t-1}$	0.567*** (0.083)			
Constant	−49.69** (21.53)	−277.5** (105.9)	66.4 (67.66)	−7.13 (7.37)
Observations	87	87	87	29
R-squared	0.57	0.79	0.66	0.81
Dw^a	1.92	1.78	1.31	0.964
DW^b	2.04	2.05	1.38	1.74

^{a} Original DW statistic, ^{b} DW statistic after Prais-Winsten/Cochrane-Orcutt

transformation, *** p<0.01, ** p<0.05, * p<0.1, Standard errors in parentheses

Variables: excaus=U.S.-Canada real exchange rate ($US/$can), exmeus=U.S.-Mexico real exchange rate ($US/peso)

GNI=Gross national income per capita, Lendrate=Domestic lending rate (cost of borrowing)

Tariffrev=Average tariff revenues collected (proxy for tariff rate), Relpr=Relative price (domestic/foreign price ratio)

Figure 8: Counterfactual Analyses of U.S.-Mexico Ag. Trade (With and Without NAFTA)
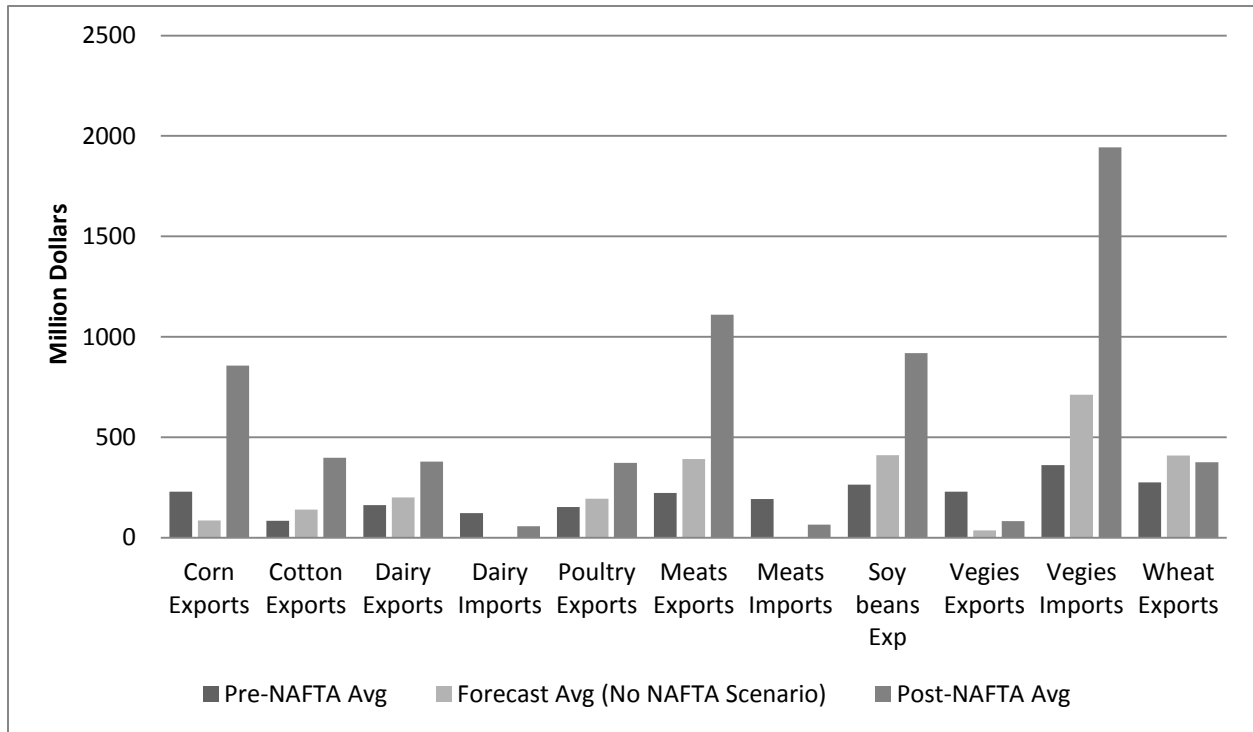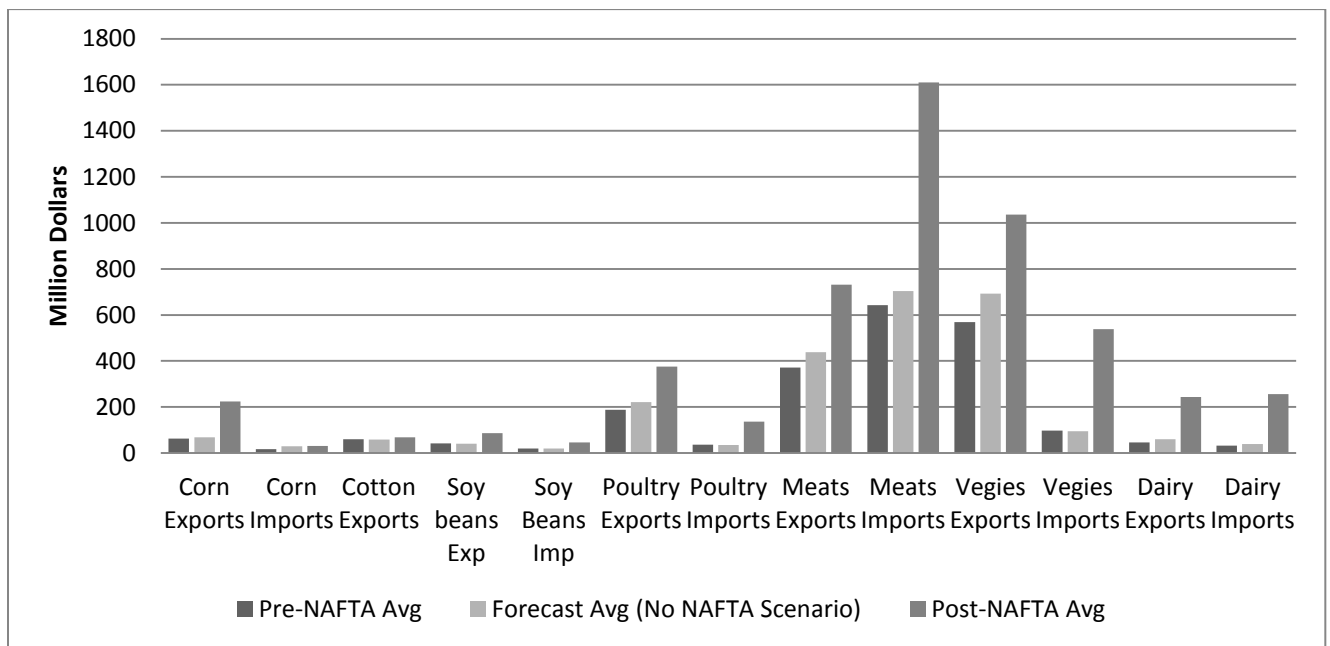

Figure 9: Counterfactual Analyses of U.S.- Canada Ag. Trade (With and Without NAFTA)

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