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Trade Creation and Trade Diversion in the North American Free Trade Agreement: The Case of the Agricultural Sector

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This paper examines the effect of the U.S.-Mexico trade agreement under the North American Free Trade Agreement (NAFTA). The results suggest that U.S. agricultural imports from Mexico have been responsive to tariff rate reductions applied to Mexican products. A one percentage point decrease in tariff rates is associated with an increase in U.S. agricultural imports from Mexico by 5.31% in the first 6 years of NAFTA and by 2.62% in the last 6 years of NAFTA. U.S. imports from Mexico have also been attributable to the pre-NAFTA tariff rates. Overall, the results indicate that the U.S-Mexico trade agreement under NAFTA has been trade creating rather than trade diverting.

Key Words: agricultural sector, NAFTA, panel data, tariffs, trade creation, trade diversion

JEL Classifications: F10, F15, Q17, Q18, C31, C33

1 The surge of free trade agreements (FTAs) has
2 raised the question of their effect on the countries included in the FTA and on the rest of the world (Bhagwati and Krueger; Krueger 1997). It is an issue that economists have long debated. The debate has divided economists between those who support FTAs and those who oppose them. The former group emphasizes trade-creating effects. By reducing (eliminating) trade barriers among members, FTA can improve resource allocation within a region and improve income for member countries. Production shifts toward the most efficient producers of specific commodities within the FTA and consumers are better off because they can purchase goods at lower prices. The latter group argues that FTAs are by definition discriminatory because they lower/eliminate barriers on internal trade while retaining barriers to trade with nonmembers and are, therefore, trade diverting. Even if an FTA results in internal trade creation, these proponents believe that such gains are likely to be outweighed by their trade-diverting effects. In general, one would expect an FTA to result in some amount of both trade creation and trade diversion (Krueger 1997; Venables). If the trade diversion is sufficiently large relative to the trade creation, the agreement could conceivably end up being harmful to the member countries.

The North American Free Trade Agreement (NAFTA) is one of the most comprehensive agreements in history. Like many other FTAs, the creation of NAFTA has been a subject of bitter discussions and division

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among politicians and economists, focusing on the effect that NAFTA might have on trade and economic welfare (Fukao, Okuba, and Stern). When NAFTA was being negotiated in the early 1990s, for example, many countries voiced concern that their exports to the United States (and, to a lesser extent, to Canada and Mexico) would be displaced by NAFTA exports, even though in many products and industries those countries could be more competitive than NAFTA producers (Lederman, Maloney, and Serven). From the viewpoint of Mexico, this trade diversion is also important because it would entail a loss of fiscal revenues from replacing imports from third countries subject to tariffs with duty-free imports from the United States or Canada.

Despite the growing concern of the debate, NAFTA was expected to create new trade among the member countries. Through progressive elimination of tariff and nontariff barriers, bilateral trade flows among the United States, Canada, and Mexico were expected to increase. A number of reports have shown evidence of increased trade flows. The Congressional Budget Office (CBO), for example, analyzed that by 2001, NAFTA had increased U.S. exports to Mexico by 11.3% and had increased U.S. imports from Mexico by 7.7% (CBO). On the other hand, the report also pointed out that the agreement had almost no effect on the U.S. trade balance with Mexico and little effect on the change in U.S. gross domestic product (GDP).

Considerable concern is also expressed about the welfare implications of increased trade among the NAFTA member countries. Agriculture is one of the sectors in which there is considerable concern about the potential effects of free trade agreements on domestic producers and consumers (Miljkovic and Paul). Before NAFTA implementation, for example, the effect of NAFTA on Mexican agriculture received a lot of rather pessimistic attention (Levy and van Wijnbergen). Recently, it has also become the subject of political controversy as a consequence of the liberalization of certain sensitive products for Mexico, which was implemented in January 2003 (Lederman, Maloney, and Serven).

Quantitative economic analysis of the potential effects of NAFTA has been done. However, few studies addressed whether new trade in the agricultural sector has been created at all. The objective of this study is to estimate and evaluate the benefits of NAFTA, emphasizing trade creation and trade diversion in the U.S-Mexico agreement. This is particularly important because the liberalization of U.S-Mexico trade is in an advanced stage. However, many crucial trade disputes remain between the two countries, such as in the case of sugar and high-fructose corn syrup and, notably, concern for the effect that NAFTA might have on trade and economic welfare.

To evaluate the effects of NAFTA, U.S. import demand functions from both Mexico and rest of the world (ROW) are analyzed.[1] Certain aspects make this study different from previous empirical work. First, it focuses on the agricultural products within the four-digit level of the Harmonized Tariff Schedule (HTS). More importantly, this study looks at commodities that were subject to the nonzero pre-NAFTA tariff rates. Second, this study also aims to measure the time-varying dimension by allowing the effects of tariff reduction to differ during the NAFTA period. Third, this study seeks to assess the differential effects of pre-NAFTA tariffs on the U.S. imports from Mexico. This is important because initial tariff rates are predetermined and are therefore useful for identifying the effect of tariff changes on trade flows (Clausing).

[1] Initially, we planned to estimate import demand for Mexico from the United States. However, because of data availability, especially the tariff rates for agricultural products set by the Mexican Government for U.S. agricultural products and the rest of the world, this analysis was not done. If such data were available, we would have been able to assess bilateral trade in a more complete setting. Because of such constraints, we focus on U.S. imports of selected agricultural products.

A Brief Review of Welfare Analysis

Modern analysis of FTAs dates back to Viner, who drew the distinction between the trade-creating and trade-diverting effects of FTA formation. According to Viner, reducing tariff barriers through the formation of FTAs will not necessarily improve welfare. That is, whether a particular FTA (customs union) is a move in the right or in the wrong direction depends on the magnitude of trade creation and trade diversion (p. 44). This is in line with the trade argument in which the gains apply if all trade barriers are reduced. Because the purpose of an FTA is solely to reduce trade barriers among country members and retain them from nonmembers, it is basically partial and discriminatory; therefore, discrimination between sources of supply is not eliminated, it is just shifted (Venables). If a member of an FTA displaces higher cost domestic production of a good with imports of the good from another member of the FTA, there will be gains. Viner refers these gains as "trade creation." It is also possible, however, that a partner country production might displace lower cost imports from nonmember countries. This is called welfare-reducing "trade diversion." It is then noticeable that the benefit of an FTA as a whole derives from the portion of the new trade among the member countries (trade creation) and each particular portion of the new trade among the member countries that is a substitute for trade with nonmembers (trade diversion).

To illustrate the model, Figure 1 shows an analysis of a commodity between the United States and Mexico. S_{US} and D_{US} are, respectively, the domestic supply and demand curves for the United States. Initially, assume that the United States has a nondiscriminatory tariff t (as represented by the dotted arrow line) set on imports from both Mexico and ROW. The tariff raises the domestic supply prices to P_M^T for Mexico and P_{ROW}^T for ROW. Assuming that ROW is capable of supplying all the domestic demand for the United States, the entire quantity demanded, S_1D_1, is imported from ROW. The price paid by consumers is P_{ROW}^T and tariff revenue is given by the area C + E. The United States will not trade initially with Mexico because Mexican suppliers are not competitive.[2]

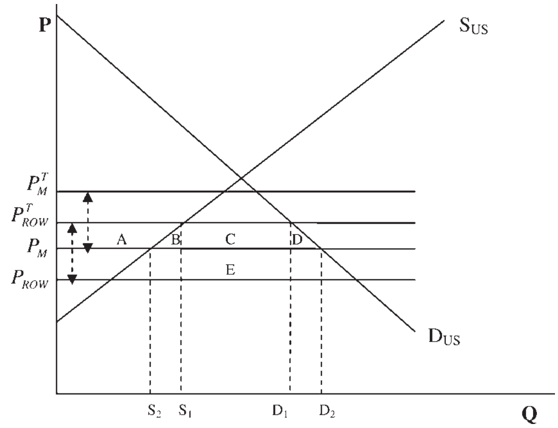

Figure 1. Trade Creation and Trade Diversion

Once the tariff is eliminated, as it should be under the NAFTA imposition, the Mexican duty-free price, P_M, is lower than the tariff-inclusive ROW price, P_{ROW}^T. The United States now purchases its imports from Mexico rather than from ROW at price P_M. With the lower price, imports would rise to S_2D_2, creating new trade shown by the area B + D. One should also note that the nondistorted (i.e., free trade) price in ROW is conceivably less than the Mexican price. Trade is substituted from a more efficient supplier (ROW) to a less efficient supplier (Mexico) because imports from Mexico replace those from the ROW. The agreement is said to be trade diverting. The United States loses the tariff revenue C + E, with E used to pay for the higher production cost in Mexico. Domestic consumers gain areas A + B + C + D, and domestic producers lose area A.

As Viner pointed out, whether an FTA will bring net benefits to the member countries depends on the relative magnitudes of trade creation and trade diversion. In practice, area

[2] For trade to exist, the domestic price, P_{US} (not shown in the graph), is constructed such that $P_{US} > P_{MEX} > P_{ROW}$. It is also assumed that ROW and Mexico do not trade with each other. This is true if Mexico applies a per unit tariff higher than $P_{MEX} - P_{ROW}$.

B + D of Figure 1 can be larger than area E, establishing the possibility that a wholly trade-diverting FTA can lead to the improvement of welfare (Panagariya).

Empirical Studies of Free Trade Agreements

Much empirical work has been devoted toward evaluating trade and welfare effects of FTAs. These studies have taken two main forms: computer simulation studies of the full general equilibrium effects of FTA membership and econometric studies of changes in trade flows (Burfisher, Robinson, and Thierfelder; Venables). The *ex ante* studies with computable general equilibrium (CGE) models use various simulation methods to analyze a calibrated model economy for a particular base year. Virtually most of the studies that analyze the effects of an FTA on member as well as nonmember countries have used a CGE model and find that trade agreements have been welfare improving; that is, trade creation outweighed trade diversion (Burfisher, Robinson, and Thierfelder; Kehoe and Kehoe; Krueger, 2000). For the case of NAFTA, all the models agree that NAFTA would provide positive gains to member countries. Although Mexico would enjoy the biggest gains, the United States would experience a marginal increase in the economy, and Canada would expect only minimal effects.

CGE-based FTA studies are not without criticism, however. Kehoe, for example, argues that the CGE model greatly underestimates the increases in trade resulting from NAFTA. The CGE model is also considered to lack detailed, up-to-date policy coverage and product disaggregation (Beghin and Aksoy). In response to these criticisms, researchers have used econometric methods with historical time series (and cross-sectional) data to analyze the effects of FTAs on trade flows and welfare. This approach seeks to quantify the changes in trade flows attributable to membership in an FTA and thereby identify trade creation and trade diversion. The most common approach is the gravity model, which regresses trade flows among trading partners on their respective economic size (i.e., GDP) and geographic distance as proxy for transportation costs. Dummy variables are typically used to capture the effects of various preferential trading agreements on trade flows. Some examples are studies given by Gould; Krueger (1999); Zahniser et al.; and Lederman, Maloney, and Serven. In general, these studies agree that NAFTA was not a trade-diverting agreement.

Similar to the CGE model, there are problems with the gravity approach. Clausing provided three points of weakness with regard to the gravity equation model. First, the use of dummy variables is considered to be inadequate in capturing the effects of preferential trade liberalization. Second, the gravity model does not indicate the extent of trade creation and trade diversion; hence, it is difficult to assess the net effects of the agreements. Third, the data used in the analyses, in most cases, was highly aggregate, such that it is difficult to exploit variations in the extent of trade liberalization across goods or industries (Clausing, p. 680).

An extension of the gravity approach has been used to assess the effect of FTAs on trade and welfare. Unlike the gravity model that takes the model as an *ad hoc* representation, the current approach is developed on the basis of a better grounded economic theory such as demand theory. The work of Karemera and Koo; Clausing; and Fukao, Okuba, and Stern are some examples. Karemera and Koo analyzed the trade effects of removing tariff and nontariff barriers between the U.S.-Canadian free trade agreements with the use of quarterly data from 1970 to 1987. They applied seemingly unrelated regression estimation technique to estimate the demand functions on the basis of the Standard International Trade Classification (United States) and Standard Industrial Classification (Canada). 3
They conclude that U.S. imports of Canadian goods were more sensitive to domestic and bilateral import prices than were Canadian imports of U.S. goods. They also find that tariff and nontariff elimination would increase bilateral trade volume across all commodities

traded, primarily trough trade creation and trade diversion.

Clausing was first to exploit tariff variation at the detailed commodity level with U.S. import data from 1989 to 1994. He finds that tariff liberalization was responsible for the growth in U.S. imports, with little evidence of trade creation. Fukao, Okuba, and Stern analyzed U.S. imports at the Harmonized System two-digit level and four-digit level for the period 1992–1998. They find that NAFTA tariff preferences had a significant effect on U.S. imports in 15 cases. Their results also show evidence of trade diversion, especially in U.S. imports of textiles and apparel products from Mexico.

Another similar approach that uses tariff data to examine trade effects is McDaniel and Agama, who estimated the effects of NAFTA on U.S. import demand for Mexican goods and Mexico's demand for U.S. exports. The results suggest that U.S. import demand for Mexican goods was responsive to tariff preferences, especially during the NAFTA years. Similarly, they find that Mexico's demand for U.S. exports was also responsive to the NAFTA preference.

Econometric Analysis

Empirical Specification

To evaluate the effects of NAFTA on trade flows between the United States and Mexico, we construct import demand functions for the United States from Mexico as well as from ROW. Our import demand functions are based on a simple demand framework. Consider the following log-linear demand specification

$$(1)\qquad \ln Q_{it} = \gamma_0 + \gamma_p \ln P_{it} + \gamma_z \ln Z_{it} + \gamma_d D,$$

where subscripts i and t represent various imported goods and time, respectively. In empirical applications, Q can take the form of quantity imported, the dollar volume of imported goods (e.g., Gould; Karemera and Koo), or import shares (e.g., Fukao, Okuba, and Stern). P is import price, and Z represents other variables that vary over time, such as exchange rates and income. In many applications, dummy variables D are also included to represent particular occurrences such as changes in policy regimes.

The imposition of tariffs, T_i, will increase the prices paid by consumers. With an *ad valorem* tariff, the price becomes $P_i(1 + T_i)$, and the import demand function in Equation (1) becomes

$$(2)\qquad \ln Q_{it} = \gamma_0 + \gamma_p \ln P_{it} + \gamma_p^* \ln(1 + T_i) + \gamma_z \ln Z_{it} + \gamma_d D.$$

Following Equation (2), the import demand specification of the U.S. agricultural products from Mexico takes the form

$$(3)\qquad \begin{aligned} \ln Q_{it}^{MEX} = {} & \alpha_0 + \alpha_1 \ln\left(1 + TR_{it}^{MEX}\right) \\ & + \alpha_2 DNAFTA_t + \alpha_3 TRDN_{1t} \\ & + \alpha_4 TRDN_{2t} + \alpha_5 DT_{1t} \\ & + \alpha_6 DT_{2t} + \alpha_7 \ln Y_t^{US} \\ & + \alpha_8 \ln PMEX_{it} \\ & + \alpha_9 \ln RER_t^{MEX} + u_{it}. \end{aligned}$$

We use the dollar value of U.S. imports from Mexico for the four-digit HTS level to represent Q_{it}^{MEX}. This is consistent with tariff rates data that are calculated on the basis of import duties and the dollar volume of imports. Previous empirical work (e.g., Gould; Karemera and Koo; McDaniel and Agama) also used the dollar volume of U.S. imported products. Y_t^{US} is the U.S. GDP at time period t, and TR_{it}^{MEX} are the tariff rates against the exporting country (Mexico) for the four-digit HTS level at period t. To take into account the lagged effect of tariff rates, we use lagged one-period tariff rates. Economic theory suggests that GDP will have a positive effect on the U.S. imports from Mexico and, conversely, tariff rates (TR_{it}^{MEX}) should have negative effect (i.e., a decrease in TR_{it}^{MEX} will induce more U.S. imports from Mexico).

DNAFTA is a dummy variable for NAFTA, which takes the value of 1 during the NAFTA period and 0 otherwise. *DNAFTA* might not only measure the effect of NAFTA, but also represents other events that are not accounted for in the model. $PMEX_{it}$ and RER_t^{MEX} are import prices for agricultural products from Mexico and real exchange rates (pesos per U.S. dollar), respectively. Because prices for imported commodities were not available, we use the unit value as a proxy for the border price. u_{it} is the random disturbance term. We will discuss the properties of u_{it} in the estimation procedures.

NAFTA agreements provided that tariff rates should be gradually reduced. Tariff rates for most agricultural products were immediately eliminated as NAFTA was implemented, whereas some remaining tariffs will have been phased out in 10–15 years. It is believed that the effect of tariff reductions differ during the NAFTA period. Notably, the earlier reductions would be expected to have greater effects. The effects would diminish as the tariff rates became closer to the phasing out period. To test this conjecture, we include $TRDN_{it}$, which is the multiplicative effects of tariff rates and the dummy variables, DN_{it}. This specification will allow the effect of tariff reductions to differ during the NAFTA period. We break up this effect into two different periods: the first 6 years and the second 6 years periods.[3] DN_{it} takes the following forms:

$$(4) \quad DN_{1t} = \begin{cases} 1 & \text{for observations between} \\ & \text{1994 and 1999} \\ 0 & \text{elsewhere,} \end{cases}$$

$$DN_{2t} = \begin{cases} 1 & \text{for observations from 2000 on} \\ 0 & \text{elsewhere.} \end{cases}$$

The above specification suggests that the effect of tariff rates can be observed as described in Equation (5),

$$(5) \quad \alpha = \alpha_1 + \alpha_3 TRDN_{1t} + \alpha_4 TRDN_{2t}.$$

DT is a dummy variable for pre-NAFTA tariff rates. Analysts argue that the effect of NAFTA is very small or perhaps negligible when the tariff levels before NAFTA were already low. DT is included to test whether different pre-NAFTA tariff rates have different effects on U.S. import demand from Mexico. To conduct this analysis, we split tariff levels into two categories, as shown in Equation (3). The DTs take the forms

$$(6) \quad DT_{1t} = \begin{cases} 1 & \text{if } TR_{it}^{MEX} \leq 10\% \\ & \text{for year} \leq 1993 \\ 0 & \text{elsewhere,} \end{cases}$$

$$DT_{2t} = \begin{cases} 1 & \text{if } TR_{it}^{MEX} \geq 15\% \\ & \text{for year} \leq 1993 \\ 0 & \text{elsewhere.} \end{cases}$$

We chose the 10% level upper bound for the DT_{1t} in a rather arbitrary way. We found that the average pre-NAFTA tariff rate (1989–1993) for the selected commodity groups was 8.25%. Therefore, an upper 10% was a reasonable approximation. The use of smaller bands might not be possible because the tariff differentials among commodity groups are small. We do not include tariff rates from 10% to 15% to avoid collinearity problems. We expect to have negative signs for these interaction terms.

The import demand for the U.S. agricultural products from ROW is constructed to measure the trade diversion that might occur during the implementation of NAFTA. The independent variables consist of the tariff rates set by the United States against ROW (TR_{it}^{ROW}), tariff rates against Mexico (TR_{it}^{MEX}), $DNAFTA$, GDP (Y_t^{US}), import prices from ROW ($PROW_{it}$), trade-weighted exchange index (RER_t^{ROW}), and quarterly dummy variables. We expect that an increase in TR_{it}^{ROW} would negatively affect the U.S. imports from ROW, and an increase in TR_{it}^{MEX} would positively affect the U.S. imports from

[3] It is possible to define yearly multiplicative effects to see the year-to-year effect of tariff reductions during the NAFTA period. However, this might cause collinearity problems. Besides, observing NAFTA year-to-year might not capture its effects, particularly in the early years of its implementation. It is then reasonable to have an even split of the time frame (6-year period) because we would be able to see whether the effects of trade agreements are front loaded or back loaded.

ROW. The central issue is overall on the coefficient of TR_{it}^{MEX}. If in fact trade diversion occurs, then TR_{it}^{MEX} must have a positive sign, meaning that a decrease in tariff rates against Mexico would reduce U.S. imports from ROW. With respect to *DNAFTA*, this variable may have a positive or negative sign. However, we expect that *DNAFTA* will have a positive effect because this variable captures not only NAFTA *per se* but also other events not included in the model.

Following the above discussion and Equation (2), the U.S. import demand from Row is written as

$$
\begin{aligned}
(7)\qquad \ln Q_{it}^{ROW} = {} & \beta_0 + \beta_1 \ln\left(1 + TR_{it}^{ROW}\right) \\
& + \beta_2 \ln\left(1 + TR_{it}^{MEX}\right) \\
& + \beta_3 DNAFTA + \beta_4 Y_t^{US} \\
& + \beta_5 PROW_{it} + \beta_6 RER_t^{ROW} \\
& + \beta_7 DQ_{1t} + \beta_8 DQ_{2t} + \beta_9 DQ_{3t} \\
& + u_{it},
\end{aligned}
$$

where Q_{it}^{ROW} is the dollar volume of U.S. imports from ROW of the four-digit HTS level at period t, DQ_{it} ($i = 1, 2, 3$) is the quarterly dummy variable, and other variables are as defined previously.

Estimation

Our empirical assessment of the specified equations is based on the panel data analysis. Within this framework, we are able to explore possible explanations for the heterogeneity in commodity groups or commodity characteristics. Potential reasons for the heterogeneity include different responses of import demand because of expected reductions in tariff rates (i.e., tariff schedules under NAFTA agreements and unobservable individual specific characteristics).

The general panel data model can be written as (see Baltagi; Hsiao; Wooldridge)

$$
(8)\qquad y_{it} = \sum_{k=1}^{K} X_{itk}\beta_k + u_{it} \quad i = 1, \ldots, \quad N; \quad t = 1, \ldots, T,
$$

where N is the number of cross sections, T is the length of time series for each cross section, and K is the number of independent variables. The central feature of panel data analysis is the structure of error components u_{it}. The error components, u_{it}, can take different structures. The specification of error components can depend solely on the cross section to which the observation belongs or on both the cross section and time series. If the specification depends on the cross section, then we have $u_{it} = v_i + \varepsilon_{it}$; if the specification is assumed to be dependent on both cross section and time series, the error components follow $u_{it} = v_i + e_t + \varepsilon_{it}$. The term v_i is intended to capture the heterogeneity across individuals, and the term e_t is intended to represent the heterogeneity over time. In this study, we assume that the error components follow the former specification.

Furthermore, v_i and e_t can either be random or nonrandom, and ε_{it} is the classical error term with zero mean and homoscedastic covariance matrix. The nature of the error structures leads to different estimation procedures depending on the specification. Because our tests (Hausman's tests for random effects) show that the fixed effects model is preferred to the random effects model, our reports are only based on the fixed effects specification. Because of the presence of autocorrelation, the specified models are estimated under first-order autocorrelation. The lag lengths of tariff rates, prices, and exchange rates were based on Hall's general to specific procedure.

Data

According to the U.S. HTS, all of the products 4
found in Chapters 1–24, with the exception of fishery products in Chapters 3 and 16, are considered agricultural products. Certain other products outside of Chapters 1–24 are also considered agricultural products, particularly essential oils (Chapter 33), raw rubber (Chapter 40), raw animal hides and skins (Chapter 41), and wool and cotton (Chapters 51 and 52). We adopt this classification for the definition of agricultural sector. The data consist of the four-digit HTS system and

Table 1. Characteristics of Sample Data

Variable	Mean	SD	Minimum	Maximum
Q_{it}^{MEX} ($ thousand)	20,226	40,116	0	387,723
TR_{it}^{MEX} (1989–2005)[a]	0.039	0.055	0	0.378
TR_{it}^{MEX} (1989–1993)[a]	0.082	0.069	0	0.378
TR_{it}^{MEX} (1994–1999)[a]	0.033	0.041	0	0.249
TR_{it}^{MEX} (2000–2005)[a]	0.008	0.019	0	0.142
Y_t^{US} ($ billion)	5,230	646	4,367	6,436
RER_t^{MEX} (pesos/$)	10.45	1.34	8.59	15.04
$PMEX_{it}$ ($/MT)	688	612	87.8	5,332
Q_{it}^{ROW} ($ thousand)	41,013	67,998	0	531,288
TR_{it}^{MEX} (1989–2005)[a]	0.038	0.049	0	0.631
RER_t^{ROW}	100.4	19.6	63.5	129
$PROW_{it}$ ($/MT)	885	680	73.9	5,307

Source: Authors' calculation.

[a] Percent values can be obtained by multiplying the numbers by 100. For the purpose of estimation, we set the log values of Q to 0 when $Qs = 0$.

range from 1989–2005 in a quarterly basis. Because most agricultural products traded between the United States and Mexico were already subject to free trade before NAFTA was in effect (i.e., zero tariff rates), we did not use all the four-digit level classified under agricultural products. Instead, we selected commodity groups in which they were subject to nonzero tariff rates before the implementation of NAFTA. Our selection of the commodity groups was also based on the consistency of the data during the selected period. The main reason for the use of the nonzero tariff rates is to obtain variation in the tariff rates to help identify the effects of tariff liberalization.

The value of U.S. imports from Mexico is used to represent the quantity of import, and the applied U.S. tariff is based on detailed data on import duties collected. The tariff rates for each commodity classification are calculated as the ratio of calculated duties to customs value. The drawback of this approach is that tariff rates can only be observed when there is trade (Romalis). When there is no trade, we estimate the tariff rates by taking the average of two surrounding available tariffs. The customs value and calculated duties are extracted from the United State International Trade Commission database. Data on U.S. GDP are from the Bureau of Economic Analysis database and are converted into real values with the use of consumer price indices published by the Bureau of Labor Statistics. The unit values (border prices) for the four-digit HTS level were constructed from a USDA database. The Mexico-U.S. real exchange rates are from the USDA, and the trade-weighted exchange index is obtained from the Federal Reserve Bank.

Summary statistics of the sample data are presented in Table 1. As shown, the range of import values was quite wide, from $20 million to $388 million (for commodities imported from Mexico) and from $41 million to $531 million (for commodities imported from ROW). The average tariff rates from 1989 to 2005 for commodities imported from Mexico and ROW were approximately the same, with values of 3.9% and 3.8%, respectively. The average pre-NAFTA tariff for Mexican products entering the United States (1989–1993) was 8.2%. In the first 6 years of NAFTA, this value was about 3.3%, and in the last 6 years 0.8%. 5

Results

U.S. Imports from Mexico

Table 2 presents the econometric results for U.S. import demand from Mexico. Specification 1 shows the effects of tariff rates on U.S. imports by controlling NAFTA and allowing 6

Table 2. Effects of Tariff Rates and NAFTA on U.S. Imports from Mexico

	Specification 1	Specification 2
Tariff rates Mexico, α_1	−2.425 (0.821)**	−3.693 (0.754)***
DNAFTA, α_2	0.436 (0.108)***	—
Tariff rates × DN_{1t}, α_3	−2.884 (1.326)**	—
Tariff rates × DN_{2t}, α_4	−0.196 (1.728)	—
Tariff dummy 1, α_5	−0.296 (0.122)**	−0.179 (0.118)
Tariff dummy 2, α_6	−0.446 (0.159)**	−0.506 (0.158)**
Income, α_7	1.407 (0.097)***	1.552 (0.089)***
Border price, α_8	−0.378 (0.077)***	−0.439 (0.076)***
Exchange rates, α_9	−0.155 (0.259)	−0.398 (0.250)
Intercept, α_0	−0.9985 (0.111)***	−1.052 (0.1121)***
R^2	0.58	0.58
F-statistics for fixed effects test	66.44	65.32
No. of time series	66	66
No. of cross sections	35	35
Total observations	2,310	2,310

Note: Numbers in parentheses are estimated standard errors.
** Significant at the 5% level.
*** Significant at the 1% level.

the effects to differ during the NAFTA period. Specification 2 reports the effect of tariff rates without controlling NAFTA. In general, most of the estimated coefficients are significant and posses the expected signs, with the exception of exchange rates. The *F*-statistics for testing the joint significance of the individual (group commodity) effects strongly suggest the presence of an individual heterogeneity in the data.

Before turning to the detailed discussion of the tariff and its effect on the U.S. imports from Mexico, we will give a quick evaluation of the income, exchange rates, and price variables. As shown in Table 2, the coefficients of income are found to be significant in each specification, with values of 1.4 and 1.6 for Specification 1 and Specification 2, respectively. These suggest that U.S. agricultural imports from Mexico are income elastic. We also found that border price is significant in both specifications, suggesting that price is an important factor of U.S. agricultural imports; however, the magnitude of its parameter shows that U.S. agricultural imports from Mexico are price inelastic. With respect to exchange rates, we found negative signs, contrary to expectation. However, they are not significant. The insignificance of exchange parameters can partly be explained because U.S.-Mexico trade has been established such that U.S. importers did not consider exchange rate as the determining factor.

Specification 1 of Table 2 shows the effects of tariff rate reduction on U.S. imports from Mexico. As shown, the coefficient of tariff rates is negative and significant. Controlling NAFTA and other variables, the estimated parameter shows that a one percentage point decrease in the tariff rates against Mexico would increase U.S. imports of agricultural products by 2.4%. Note that this estimate indicates the effect of tariff rates during the whole period of the study. When considering the multiplicative effects, the sum of α_1 and α_3 indicates the effects of tariff rate reductions for the period 1994–1999, and the sum of α_1 and α_4 shows the effects of tariff reductions for the period 2000–2005. The effects of tariff rates during the 12 years of NAFTA is represented by the sum of α_1, α_3, and α_4. As can be seen, the coefficient of α_3 is significant and negative as expected. This means that the effects of tariff reductions during the first 6 years has been a 5.31% increase of every one percentage point decrease in tariff rates against Mexico.

The coefficient of α_4 is negative and not significant. The relatively low parameter estimate is as expected because of the declining effects of tariff reductions. The insignificant parameter might be justified by the fact that some of the commodities have been subject to trade liberalization (zero tariff rates) or at least have experienced a period of low tariff level. Hence, any reduction of tariff levels in this period might not significantly affect U.S. imports from Mexico, as indeed was shown in this study. Regardless of significance level, the effects of tariff reductions on U.S. imports from Mexico have been an increase of 2.62% during the last 6 years of NAFTA and 5.5% during the NAFTA period. By estimating the model without NAFTA dummy variable and its associated multiplicative effects, we found a slightly lower magnitude of the effects of tariff reductions. As shown in Specification 2, the coefficient of α_1 is negative and significant at -3.69%. This indicates that a one percentage point reduction in tariff rates has increased U.S. imports from Mexico by 3.69%.

Other important results are also given in Table 2. Researchers argue that the effects of NAFTA could be subject to the tariff levels before NAFTA implementation. Our specification enables us to track such effects in that it can show the different effects of tariff levels before NAFTA. The coefficients of α_5 and α_6 in the two specifications clearly show that the lower the pre-NAFTA tariff rates, the lower the effect on the increase of U.S. imports from Mexico as tariff rates are reduced. From Specification 1, U.S. agricultural imports from Mexico during the NAFTA period were approximately 26% higher than pre-NAFTA for group commodities with pre-NAFTA tariff rates less than 10%. On the other hand, this figure was 37% for commodities that fall into the category of pre-NAFTA tariff rates greater than 15%.[4]

Finally, the effect of *DNAFTA* on U.S. agricultural imports from Mexico was significant. U.S. imports from Mexico during NAFTA were 54% higher than the entire period of analysis. However, one should note that these coefficients do not explain the effect of NAFTA *per se* because this variable captures not only NAFTA but also other events that are not accounted for in the model.

U.S. Imports from ROW

One way to investigate the presence of trade diversion can be done by regressing U.S. imports from ROW on tariff rates set by the United States against Mexico. A positive sign of this variable indicates that trade diversion exists. Table 3 reports the econometric results for U.S. import demand from ROW. Specification 1 shows estimation results for U.S. import demand from ROW with tariff rates against Mexico that is intended to determine whether trade diversion occurred while controlling for NAFTA. It also provides estimates of NAFTA dummy variables to test whether U.S. imports from ROW increased during the NAFTA period. These two variables can be used jointly to justify whether trade diversion indeed occurred. Similarly, Specification 2 gives estimates of the effects of both tariff rates against ROW and tariff rates against Mexico on U.S. imports from ROW without controlling for NAFTA.

Except for tariff rates against Mexico, exchange rates, and NAFTA dummy variables, all coefficients are significant at reasonable levels. They also possess expected signs. The coefficient of determination is 0.77 and the *F*-statistics for fixed effects tests show the presence of heterogeneity in commodity characteristics. The seasonal dummy variables show significant differences in U.S. imports from ROW from quarter to quarter. In all cases, the U.S. imports from ROW in the fourth quarter are higher than the first three quarters.

The U.S. agricultural import demand from ROW seems to be income elastic with a magnitude of 2.4. It is surprising that the

[4] Our interpretation of the coefficient of dummy variables is based on suggestions by Kennedy. Suppose that $\hat{c}$ is the estimate of a dummy variable coefficient c; its effect on the dependent variable (which is a log value) is given by $g^* = \exp[\hat{c} - \frac{1}{2} v(\hat{c})] - 1$, where $v(\hat{c})$ is an estimate of the variance $\hat{c}$. See also Halvorsen and Palmquist for interpretation of the coefficient of dummy variables in semilogarithmic equations.

Table 3. Effects of Tariff Rates and NAFTA on U.S. Imports from ROW

	Specification 1	Specification 2
Tariff rates ROW, β_1	−1.484 (0.766)*	−1.475 (0.763)*
Tariff rates Mexico, β^2	0.942 (0.586)	0.898 (0.583)
DNAFTA, β_3	0.094 (0.114)	—
Income, β_4	2.441 (0.526)***	2.413 (0.525)***
Border price, β_5	−0.169 (0.056)**	−0.167 (0.056)**
Exchange rates, β_6	−0.057 (0.391)	0.131 (0.317)
Dummy quarter 1, β_7	−3.822 (1.268)***	−4.028 (1.126)***
Dummy quarter 2, β_8	−1.737 (0.517)***	−1.823 (0.508)***
Dummy quarter 3, β_9	−0.831 (0.168)***	−0.859 (0.166)***
Intercept, β_0	−10.724 (1.895)***	−11.313 (1.857)***
R^2	0.77	0.77
F-statistics for fixed effects test	166.45	166.16
No. of time series	66	66
No. of cross sections	35	35
Total observations	2,310	2,310

Note: Numbers in parentheses are estimated standard errors.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1%.

NAFTA dummy variable is not significant at any reasonable level, even though it has the expected sign. If it were significant, we could have expected that U.S. agricultural imports from ROW in the first 12 years of NAFTA were 9.1% higher than they would have been without NAFTA. Strong income effects in the United States likely negate this result. Similarly, we also found that exchange rates are not significant. The use of the trade-weighted exchange rate index, which was calculated on the basis of U.S. major trading partners, might contribute to the insignificance parameter.

The estimated results for the coefficients of tariff rates against ROW suggest that a one percentage point reduction in tariff rates against ROW is associated with a 1.5% increase in U.S. agricultural imports from ROW. This is clearly less than one third of the effects of tariff reductions against Mexico on U.S. agricultural imports from Mexico (Specification 1 of Table 2). This evidence suggests that the United States gives more preference to Mexican agricultural products than ROW agricultural products. This is not surprising given that the United States and Mexico are tied to the NAFTA agreements, along with other advantages such as geographical proximity. The parameter estimates of tariff rates against Mexico are positive. As previously stated, a positive sign of tariff rates indicates the presence of trade diversion. However, because these coefficients are not significant, we would argue that there is no significant evidence that NAFTA has caused trade diversion in the agricultural sector, particularly as a result of the United States and Mexico trade agreements.

Trade Creation and Trade Diversion

As previously discussed, the net benefit of an FTA as a whole derives from the portion of the new trade among the member countries (trade creation) and each particular portion of the new trade among the member countries which is a substitute for trade with nonmembers (trade diversion). The regression results show that tariff reductions during the NAFTA period had significant effects on U.S. imports from Mexico, whereas the coefficient of tariff rates against Mexico regressed on U.S. imports from ROW was not significant, even though it has a positive sign. Before concluding that NAFTA has affected trade

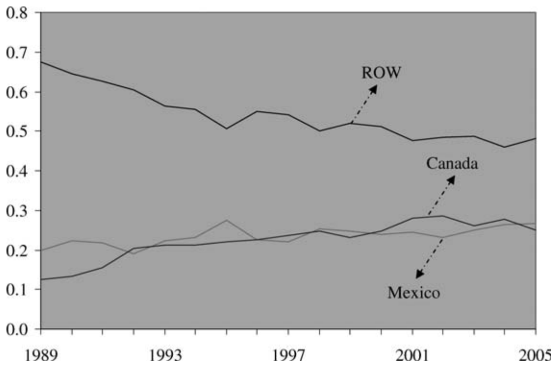

Figure 2. Shares of Real U.S. Imports from Country of Origin

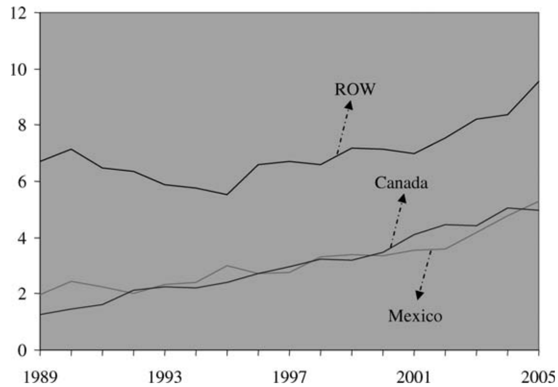

Figure 3. U.S. Real Imports from Country of Origin ($ Billion)

flows, it would be informative to highlight the changes in U.S. imports from NAFTA countries and ROW.

Figure 2 shows the shares of U.S. imports of the selected four-digit level HTS from Canada, Mexico, and ROW from 1989 to 2005. As the figure shows, U.S. imports from Mexico increased sharply immediately after NAFTA's inception, before experiencing a slight decrease in 1996 and 1997. The share of U.S. imports from Canada increased gradually, with a slight decrease in 2003. The share of U.S. imports from Mexico increased from 21% to 29% between 1989 and 2005. During the same period, the share of U.S. imports from Canada increased from 11.6% to 21%. In general, we can conclude that the share of U.S. imports from both Mexico and Canada trended upward during the NAFTA period, suggesting that NAFTA has been trade creating. Meanwhile, the share of U.S. imports from ROW has degraded continually since 1989. Notably, U.S. imports from ROW declined from 67.1% in 1989 to 50% in 2005. One should note that these figures were based on the selected commodity groups (i.e., product groups that were subject to nonzero pre-NAFTA tariff rates).

The increase in the share of U.S. imports from Mexico and Canada accompanied by a decrease in the share of U.S. imports from ROW has raised the question whether the United States shifted away its imports from ROW to the NAFTA members. It is very important to respond to such concern because if in fact the United States did shift its imports at the expense of ROW, there was clearly trade diversion. Figure 3 might clarify the issue. As depicted in this figure, U.S. agricultural imports from Mexico, Canada, and ROW increased substantially from year to year with a slight decline in particular years. In general, the trend of U.S. imports from NAFTA members and ROW suggest that the United States did not shift its imports away from ROW. The decline in the share of U.S. imports from ROW was particularly that U.S. imports from NAFTA members grew faster than those from ROW.

Historical data show evidence that U.S. agricultural imports from Mexico have increased since the inception of NAFTA. But to what degree the increase is attributable to NAFTA is difficult to examine. Other important factors have also been responsible for the increase. Krueger (1999, 2000), for example, noted that the economic growth and the change in exchange rates were responsible for the growth in trade flows in the NAFTA region. However, although such other factors are of full consideration, we argue that NAFTA has been trade creating. Our conclusion is also supported by regression results. As shown in Table 2 and the discussions that follow, tariff rate reductions have had a positive effect on U.S. imports from Mexico. This effect is even higher during the NAFTA period compared with the average of the entire period. The other regression results in

Table 3 clearly indicate that reductions in tariff rates against Mexico did not significantly lower U.S. imports from ROW, suggesting that trade diversion did not occur to a significant degree.

If, however, one still believed that trade diversion existed because the sign of TR_{it}^{MEX} in Equation (7) was positive, we still argue that NAFTA has been net trade creating because the absolute magnitude of the coefficient TR_{it}^{MEX} in Equation (7) is far below the coefficient that measures the effects of TR_{it}^{MEX} on U.S. imports from Mexico.

Conclusions

In this paper, we estimated U.S. agricultural import demand functions from both Mexico and ROW and examined the trade creation and trade diversion that might have occurred in the U.S.-Mexico agreements under NAFTA with the use of panel data of 35 selected four-digit levels of HTS from 1989 to 2005. The 35 commodity groups were selected on the basis of tariff rates that were not subject to zero tariff rates before NAFTA. The use of more disaggregated data and the nonzero pre-NAFTA tariff rates has enabled us to examine the variations of tariff rates and also reduce bias that might have occurred if we included the zero pre-NAFTA tariff rates in the analysis.

The results suggest that U.S. agricultural imports from Mexico have been responsive to tariff rate reductions applied to Mexican products. A one percentage point reduction in tariff would increase U.S. agricultural imports from Mexico by 2.4% in the entire period. Results also show that during NAFTA, a one percentage point decrease in tariff rates would increase U.S. agricultural imports from Mexico by 5.31% in the first 6 years of NAFTA and by 2.62% in the last 6 years of NAFTA. The overall effect would be a 5.5% increase in U.S. imports from Mexico for a one percentage point decrease in tariff rates. The increase in U.S. imports from Mexico has also been attributable to the pre-NAFTA tariff rates. Higher pre-NAFTA tariff levels would result in a higher percent increase in U.S. agricultural imports from Mexico as tariff rates are reduced. Similarly, U.S. imports from ROW have also been significantly affected by tariff rates applied to ROW. The effect, however, is lower compared with Mexico. We also found that U.S. agricultural imports from Mexico during NAFTA were approximately 54% higher than the entire period. Conversely, U.S. imports from ROW were not significantly higher because of NAFTA.

Overall, we conclude that there is significant evidence that the U.S.-Mexico trade agreement under NAFTA has been trade creating rather than trade diverting. However, one should note that these conclusions are based only on evaluation of U.S. agricultural imports from Mexico and from selected agricultural products. This finding is especially important given arguments by Caribbean and other countries that U.S.-Mexico trade has diverted commercial sales. The extent to which these results might be applicable to other agreements, such as the Central America–Dominican Republic Free Trade Agreement, is limited because each case must be verified empirically.

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