Mexican-U.S. Fresh Tomato Trade: An Analysis of Volume, Prices and Transaction Costs

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Abstract: Tomato trade between the U.S. and Mexico has grown significantly during the past decade. Although the tariff reductions accorded under NAFTA may explain part of this increase, there are other supply and demand factors that affect trade flows. This study develops a U.S.-Mexico tomato trade model, with special focus on the interdependence between trading costs and the volume of Mexican imports. As expected, the exchange rate is a significant determinant of trading costs, but the level of tariffs was insignificant in both the trading and tomato supply equations. The shipping point price level and volume of imports also appear to affect these costs. For the import supply and demand models, there appears to be a significant share of imports that rely on previous levels of imports, rather than the expected economic factors (prices, income, and producer price index). We conclude that the structure and performance of the tomato trading market is changing, and may be more influential than tariff reductions in explaining increased trade flows.

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The cost and efficiency benefits of free trade are often cited in trade negotiations by those who support globalization of markets. Still, in some cases, there is a larger factor driving the need for globalization, as is the case with perishable fruit and vegetable products. Although the agricultural sector has historically been more protected, trade in fresh fruit and produce has grown tremendously over the past decade. As consumers in developed economies (primarily located in areas with seasonal production constraints) demand year-round fresh produce, the opportunities for semi-tropic and tropical countries to develop export markets have grown. Such trends are only exacerbated by trade liberalization.

The rapid growth in North American tomato trade prior to NAFTA is one clear example of this market trend. Although the United States is second in world tomato production, imports comprise around 20% of U.S. fresh tomato consumption. In short, fresh tomato imports are necessary to supplement Florida and California seasonal supplies. Currently, 95% of US imports are from Mexico (ERS, USDA), after a dramatic increase in imports after 1995.

Although tariff reductions are welcome cost-savings for those importing tomatoes to this country, it is only one of numerous factors affecting the level and characteristics of the tomato trade sector. As detailed in the United States International Trade Commission's (USITC) 1996 study on possible dumping in the US, there are several supply and demand shifts, as well as structural and performance factors, that may explain the trade patterns the US and Mexico have exhibited. It is also likely that tariff reductions will be overshadowed by such factors, creating a situation where trade liberalization receives credit for the larger forces shaping the trading sector.

The objective of this study is to model and estimate the impact of several economic and trade policy factors on the volume of fresh tomato imports from Mexico to the United States during the 1990's. We begin with a discussion of the literature on the U.S. and Mexican tomato industries, including trends, channels of distribution, market structure, as well as the role of NAFTA and exchange rates on tomato trade. Following the development of a basic, conceptual

trade model, the excess supply, excess demand, and trading costs for Mexican imports will be estimated. The paper will conclude with a discussion of the findings and description of future, intended research.

U.S. and Mexico Fresh Tomato Trade

Although the United States is second in world tomato production, imports comprise around 20% of U.S. fresh tomato consumption, while the U.S. exports only 9% of production. Fresh tomatoes are demanded year-round in the U.S., so fresh tomato imports are necessary to supplement Florida and California seasonal supplies. Currently, 95% of imports are from Mexico (ERS, USDA), while imports from other sources (Netherlands and Canada) remain consistently small, fluctuating between 0.2 to 0.8% of U.S. total consumption. Partially due to the Mexican peso devaluation and the beginning of NAFTA's tariff reduction, Mexican imports increased dramatically after 1995 (from 23% of U.S. production in 1994 to 40% in 1995). Although the U.S. exported some fresh tomatoes to Mexico in 1993 (22,038 tons), these exports decreased significantly after the economic crisis in Mexico.

Imports from Mexico have entered the U.S. every week in recent years, following a seasonal pattern (Figure 1). These imports have generally been vine-ripe round tomatoes (60.4%), although the shipments of cherry tomatoes and roma (plum) tomatoes have been increasing in recent years (Table 1). On the domestic side, the majority of Florida production is round mature green tomatoes (approximately 85%), with minor quantities of vine-ripe round and roma tomatoes. Tomato growers located in the Sinaloa and Baja California Peninsula regions of Mexico supply the majority of fresh tomatoes exported to the U.S., but they also supply domestic markets. Sinaloa, located in the Northwest part of Mexico, has two important tomato producing regions: Culiacan and Los Mochis. Shipments from Sinaloa normally peak between January and March, while the Baja California season stretches from June to November.

Although USITC reports fresh tomato imports from Mexico through 7 U.S. Custom Service Ports (Nogales, Arizona; Los Angeles, San Diego, and San Francisco in California; El Paso and Laredo in Texas; and Chicago, Illinois), virtually all imports from Mexico (99.9%) enter through Laredo (2.4%), Nogales (68.1%) and San Diego (29.5%) (Table 2). The Sinaloa region exports fresh tomatoes to the U.S. from December to June, primarily through Nogales, Arizona; yet, exports through Laredo, Texas increased considerably since 1994 (from 1,851 tons in 1994 to 12,479 tons in 1995, and 21,173 tons in 1996). It is also important to note that around 70-80% of shipments entering through Laredo are cherry tomatoes, rather than the vine-ripe round and plum tomatoes which make up the majority of shipments to other ports of entry. The tomato shipments entering through Laredo generally peak between May and September, whereas the majority of fresh tomatoes exported from the Baja California Peninsula, via San Diego, are shipped from June to December. Imports through San Diego increased 77% from 1994 to 1995, reaching their highest level in 1996 (Table 2).

The U.S. Market

U.S. consumption of fresh tomatoes is relatively stable across seasons. Overall consumption of fresh tomatoes increased consistently over the last decade (around 2% every year), with the largest increases between 1992 and 1993 (4.2%), and again between 1994 and 1995 (4%) (USITC). U.S. producers' share of domestic consumption has fallen from about 80% in 1993, to 68.6% in 1995. Fresh tomatoes do not have good substitutes in the market, so demand is relatively inelastic. USITC determined that the price elasticity of demand is in the range of 0.5 to 1.0. Although there may some distinction between tomatoes grown in each country, the elasticity of substitution between Mexican and domestic fresh tomatoes is still in the elastic range of 2 to 4 (USITC).

On the demand side, product differentiation has become a key factor for consumers' preferences. Historically, there have been three major types of tomatoes imported from Mexico. At the beginning of the 90's, Mexican producers adopted better technology and new varieties with increased yields, quality, and transportability (Plunket). The most common export tomatoes are Extended-Shelf-Life (ESL) vine ripe tomatoes, characterized by greater firmness and shelf life.

Recent years have seen a growth in demand for Mexican extended shelf life (ESL) vine ripe tomatoes, which receive a price premium because they are perceived as having higher quality than other tomatoes (Thompson and Wilson).

California and Florida are the largest tomato producing states in the U.S., representing 43% and 30% of fresh-market tomatoes from 1994-96. Florida's season goes from October to June, with the highest production during April and May, and again during November to January. California produces tomatoes in every season but winter, with the majority of its production marketed from June through November. The majority of Florida's crop goes to eastern terminal markets and Mexico's crop is shipped primarily into western markets. However, during some months, they compete for the same terminal markets. In 1994, Florida shipped tomatoes to 22 major U.S. terminal markets including 4 western cities (accounting for 13% of volume) while Mexico shipped to 9 eastern cities (accounting for 15% of volume), illustrating some cross continent shipping as the market dictates (Love and Lucier).

Distribution Channels and Transaction Costs

Domestic and imported vine ripe, mature green, roma, and cherry tomatoes are sold using similar channels of distribution. Domestic fresh tomatoes are generally shipped and marketed in different size containers; for mature greens, 10, 20, and 25-pounds flat/cartons, loose or in layers; for cherry tomatoes, 15 pound flats and 5-pound cartons; and for roma tomatoes, 25 pound cartons (USITC). Imported product from Mexico is packed in several configurations, including; 30 or 25 pound cartons, 2 layer 4 by 4, 5 by 5, and 5 by 6, and 3 layer 6 by 6 (AMS, USDA).

During the winter, the domestic product from Florida is graded, packed, and sold through intermediaries to distributors, retailers or food brokers. Between June and October, California fresh tomatoes are generally sold through the same channels and markets as winter tomatoes. In non-winter months, part of fresh tomatoes harvested in the states of Virginia, North and South Carolina are produced under contracts or joint venture arrangements with Florida based growershippers. Mexican tomatoes are similarly processed by growers and domestic packers, and offered for sale through importers and brokers to the same customers as U.S. fresh tomatoes. Recently, some Mexican growers have entered in alliances with U.S. based marketers to integrate some of the marketing functions.

Shippers sell fresh tomatoes to the wholesale terminal market buyers, usually by telephone and on a verbal agreement basis. Written contracts are not commonly used. In this analysis, we assume the competitive price for Mexican and U.S. fresh tomatoes is based on the import price at the port of entry and the U.S. shipping point price, respectively. Thus, a large share of the trading costs for the Mexican tomatoes is already accounted for, but there will still be differences in cross-country transportation costs, depending on the intended terminal market.

Transportation costs for fresh tomatoes from Mexico were estimated as a ratio of trading charges to custom value (Table 3). This ratio represents a percentage markup that increases the FOB price to arrive at the landed value price of tomatoes at the first port of entry to the U.S. (CIF price). Trading charges are the transportation costs and the aggregate international charges, insurance, and freight incurred in bringing the tomatoes from the Sinaloa region or the Baja California Peninsula to the U.S. These estimates were determined as a weighted average using the monthly data reported by the USITC from January 1992 to August 1999.

The mean transportation costs for fresh tomatoes that are imported through Laredo, Nogales and San Diego are 8.16, 8.59, and 1.70%, respectively. Cherry tomatoes have the lowest transportation costs in all three ports of entry. The highest cost (13.55%) among types of tomatoes and ports of entry was plum (roma) tomatoes imported via Laredo. Moreover, this entry port registered the highest variability in trading costs, with a coefficient of variation of 48.78% (compared with 30.66% and 44.85% for Nogales and San Diego) (Table 3).

The market integration literature contains several studies that argue that transaction costs are an important element in understanding the trade relationships between countries, especially when these costs are relatively high and volatile (Barrett; Baulch). This study will attempt to determine the role of various market factors on the level of transactions costs, while allowing them to vary as a "marketing margin" between excess supply and demand equations in the trade model developed. In short, we try to effectively integrate these costs in the determination of Mexican import volumes, as well as increasing our understanding of what affects the behavior of trading costs in this market.

Supply and Demand Factors

The factors that affect fresh tomato trade flows include per unit production costs, transportation costs, and exchange rates. Other factors not addressed directly in this study, including weather, domestic policy reforms and technological change, may also be important. In addition to the necessity of trade to accommodate year-round demand for fresh tomatoes, significant trade volume between the US and Mexico serves as a buffer when weather shocks affect fresh produce supplies. When occasional climatic shocks affect major tomato producing regions of the US, import flows can buffer the sharp price increases that would otherwise occur.

For Mexican producers, low wages are a favorable factor that contributes to low production costs. Alternatively, some imported inputs (such as irrigation equipment, boxes, seeds, and chemicals) are paid for in U.S. dollars, and thus, would suggest similar costs of production across the two countries. Yet, in order to reach the major U.S. terminal markets, Mexican product incurs higher transportation costs than U.S. supplies. As discussed previously, these costs represent a significant share of consumer price, and there is some volatility in the level of such costs. Finally, exchange rates represent another uncertain factor affecting Mexican inputs, prices and trade volume.

As one would expect with a perishable, seasonally-supplied product, prices change significantly from week to week, especially during the winter season. The monthly price series used in this study will not capture all these weekly price movements, but still illustrate the variable nature of tomato prices (Table 4). The price data presented in Table 4 do not show as clear of seasonal trends as one would expect; for example, the highest and lowest prices for each year fall in different months. The overall variability, as well as the changing nature and timing of price peaks and valleys, would suggest that a number of supply and demand factors affect the market for Mexican fresh tomatoes.

Market structure

Although the 1992 Census of Agriculture reports over 15,500 growers of tomatoes in the United States (including fresh market and processing producers), American fresh tomato production is dominated by about a thousand farms. In addition, the marketing channel for product moving into wholesale, retail and food services, is controlled by fewer than 50 shippers, who are often growers as well (Thompson and Wilson). In Mexico, about 12 growers' groups harvest the majority of tomato production for exports. CAADES is a group of 10 Mexican growers' associations, some of which are vertically integrated with a established distributorship in Nogales, Arizona. The majority of shipments from Sinaloa are handled by fewer than 80 distributors in Nogales. Moreover, it is estimated than only 5 distributors handle three fourths of fresh tomato imports (USITC).

According to Thompson and Wilson, only 38 grower-shippers of fresh tomatoes represented 70% of the fresh tomato production in California, Florida, and Sinaloa, in 1994. Most of them have adopted the extended shipping seasons with year-round marketing strategies. The grower-shippers based in Sinaloa, Florida, and California are trying to implement two-way, complementary trade. In short, the seasonal production patterns of participating growers are taken into account when establishing import and export flows, and some growers have begun to produce in multiple regions throughout the year to diversify production and marketing risks (Wilson, Thompson and Cook; Cook).

Given this structure and conduct, the market is more similar to an oligopolistic market than a perfectly competitive one (Thompson and Wilson). This implies higher trading charges and less trade flows than there would be if the market were in a competitive equilibrium. This has implications for any intended results from trade liberalization undertaken under the guises of NAFTA. Such conditions will also influence the estimation of trade flow and transactions costs since perfectly competitive outcomes should not be expected.

The Role of Trade Liberalization Policy and Exchange Rates

In the mid-1980's, the Mexican Government shifted its economic policies toward a more open economy. Subsequently, officials signed trade agreements, including the General Agreement on Tariffs and Trade (GATT) in 1986 and the North America Free Trade Agreement (NAFTA) between Canada, the United States, and Mexico that began in January 1994. Under NAFTA, all tariff and the non-tariff barriers to agricultural trade will be eliminated. Many tariffs were eliminated immediately, with others being phased out over a period of 5 to 15 years.

U.S. tariffs on imports of fresh tomatoes from Mexico are set to phase out entirely over the 10 years period ending in 2003 (Table 5). A special agricultural safeguard provision was included in order to give protection against surges to certain sensitive products while tariffs are being phased out. United States considered seasonal imports of fresh tomatoes from Mexico as a sensitive product, therefore a seasonal tariff-rate quota (a TRQ, which grows at a compound 3percent annual rate) was designed. The quotas imposed have been reached and exceeded by more than 40% since NAFTA started, except in during 1999, where this difference was 27% (Table 6).

Since 1998, only the tomatoes that enter during the two TRQ seasons are subject to tariffs. Using a weighted average of the ratio U.S. duties to custom value for Mexican tomatoes entering the Ports of Laredo, Nogales, and San Diego, the average tariff was 6.51% in 1992. It has been decreasing steadily, reaching its lowest level of 2.29% in 1999. Note that the weighted average tariff was decreasing even before NAFTA was implemented (Table 7).

Since the average weighted tariff was decreasing before NAFTA, it could be argued that exchange rates have played a more important role in increasing trade flows. In December 1994, following the first year of NAFTA, the Mexican peso suffered a significant devaluation. It fell abruptly from 3.5 pesos per dollar to 5.54 pesos per dollar in two days. The Mexican peso devaluation made the external market more attractive than the domestic to Mexican producers.

While the first year of NAFTA saw lower tomato import levels than 1993 (6.4% less volume), after the peso devaluation, imports of fresh tomatoes increased dramatically (57.32% in volume). They reached their highest level in 1998, at approximately 733,049 metric tons (95% higher volume than 1994). Thus, it may not be appropriate to attribute the sharp increase in imports from Mexico to the trade liberalization measures implemented under NAFTA.

Because of increased imports after the peso devaluation, the American tomato producers asked the U.S. officials to conduct an antidumping investigation to determine whether fresh tomato imports were a threat to the U.S. tomato industry. The results of the USITC investigation were that there was no such injury or threat of injury to the U.S. tomato industry. Due to the dumping complaint, on October 28, 1996, the Department of Commerce and Mexican tomato growers arrived at an agreement, eliminating the need to implement dumping duties. Under this agreement Mexican tomatoes will no longer offer any imports at any price lower than \$5.75 per 25 pound carton (about \$0.21 per pound) FOB Nogales, San Diego, and Laredo (FAS, USDA).

The Model

In order to model the relationship between various economic and policy and flows of Mexican fresh tomato imports, a simultaneous equation system was designed. The structural model includes three behavioral equations and an identity, that represent the excess U.S. demand for Mexican fresh tomatoes, the Mexico excess supply for fresh tomatoes, and a trading cost function, that proxies for a stochastic representative of the transaction costs (Figure 2). The identity is the cif price for fresh tomatoes less the trading charges. The model assumes a competitive equilibrium, although it is possible that the fresh tomato market is structured as a non-competitive market (Thompson and Wilson, Jordan and VanSickle).

The excess demand equation specifies the quantity demanded in tons for Mexican fresh tomato imports (GTOQ_t^D) as a function of the weighted average price per kilogram of tomatoes

at the port of entry $(\text{GTPCIF}_{i})^{1}$, the average price of the U.S. mature green tomatoes (USMGP_{i}) , the average price of U.S. plum tomatoes (USPLP_{i}) , the average price of U.S. cherry tomatoes $(\text{USCHP}_{i})^{2}$, and U.S. disposable, per-capita income (PCY_{i}) . Two seasonal dummies variables (DS1A, DS3) were also included for Mexican fresh tomato imports (which mirror two of the trading periods delineated in the tariff reduction agreement discussed above). Since this study's objectives relate to understanding changes in levels of imports from Mexico, and significant, persistent trade volumes exist, the volume of imports during the same period the previous year was also included in the model (GTOQ_{t-12}) . So, the excess demand for Mexican tomatoes in the United States is modeled as:

(1) $\text{GTOQ}_t^D = f(\text{GTPCIF}_t, \text{USMGP}_t, \text{USPLP}_t, \text{USCHP}_t, \text{PCY}_t, \text{DS1A}_t, \text{DS3}_t, \text{GTOQ}_{t-12})$

The supply for Mexican fresh tomato exports (GTOQ_{t}^{S}) in tons is specified as a function of the price of imported fresh tomato at the border (GTPCIF_{t}), the real exchange rate calculated as pesos per dollar (MXRER_t), the Mexican producer price index (MXPPI_t) as a proxy for production costs, the Mexican price in dollars per kilogram of vine ripe tomatoes (MXVRP_t) at the Guadalajara, Mexico, wholesale market, the weighted average tariff of Mexican fresh tomatoes (GTTX_t), and like the excess demand equation, last year's import level (GTOQ_{t-12}). Thus, excess supply of Mexican tomatoes is modeled as:

(2) $\text{GTOQ}_t^S = f(\text{GTPCIF}_t, \text{MXRER}_t, \text{MXPPI}_t, \text{MXVRP}_t, \text{GTTX}_t, \text{GTOQ}_{t-12})$

Finally, trading costs are a function of the total volume of fresh tomatoes imported from Mexico (GTOQ_{*t*}), the real exchange rate represented by pesos per dollar (MXRER_{*t*}), the real weighted average tariff per kilogram for Mexican fresh tomatoes (GTTX_{*t*}), and the weighted average price at the shipping point for Mexican fresh tomatoes (GTPMX_{*t*}). So, the equation that represents the marketing sector in this trade model is:

¹ This price was determined dividing the total custom value (including import charges) for Mexican fresh tomatoes by the total volume imported. Import charges are all freight, insurance, and all the other expenditures required to bring fresh tomatoes from Sinaloa and Baja California in Mexico to the border.

(3) $GTCIF_t = f(GTOQ_t, MXRER_t, GTTX_t, GTPMX_t)$

The final equation is an identity, which equates the FOB price for Mexican fresh tomatoes (GTPMX_t) to the difference between the CIF price (GTPCIF_t) and the trading charges (GTCIF_t) represented in equation (3).

(4) $\text{GTPMX}_t = \text{GTPCIF}_t - \text{GTCIF}_t$

The expected results from the three equations model are based on the literature cited above, and the basic tenets of economic trade theory. In the excess demand and supply equations (1 & 2), the level of imports during the same month in the previous year is expected to have a positive relationship with current levels. Moreover, the coefficient on these variables will indicate the share of imports that could be based on institutional trading relationships with only slight impacts from the market-based variables.

For equation 1, the price variable (GTPCIF_{*i*}) is expected to have a negative impact on the quantity of Mexican fresh tomatoes demanded by U.S. intermediaries. According to the USITC, there is a moderate degree of substitution between domestic and imported tomatoes, although Mexican producers argue that imports from Mexico are complementary, since they cover seasonal shortfalls in U.S. production. It is not clear whether the price of U.S. mature green tomatoes to will have a positive or negative relationship with the volume imported, but since the end consumer of the two products are quite different, it is more likely that a substitute relationship will be found. Similarly, plum and cherry tomatoes may have either a substitute or complementary relationship with the quantity of imported Mexican tomatoes, depending on tastes and preferences of U.S. consumers. U.S. disposable per-capita income (PCY_{*i*}) is expected to have a positive relationship with the imports of fresh tomatoes. Finally, the USITC has divided the tariff charges for Mexican imports into three seasons (Table 5), and the seasons with lower

² The average shipping point price in Orlando, FL for the period from October to June and the wholesale market price in San Francisco, CA for the period from July to September. In the case of mature green and plum tomatoes, average price per kilogram is used, while cherry tom atoies are price per pint.

import levels (by definition) serves as a reference period, so the other two seasons are expected to have a positive relationship.

For the excess supply equation (2), the variables included were based on production theory, as well as possible trade considerations. Following production theory, the supply of Mexican tomatoes available to import to the U.S. should be positively related to price in the U.S. entry markets (GTPCIF variable). Since a Mexican peso devaluation would encourage Mexican producers to increase exports, a positive coefficient is expected on the real exchange rate (MXRER_{*t*}). Although many Mexican growers specialize in tomatoes for export markets, almost 50% of tomatoes do remain in the domestic market. Thus, the relationship between the price of vine ripe tomatoes in the Mexican market (MXVRP_{*t*}) and excess supply should be negative. Following production theory, as costs of production for Mexican growers (MXPPI_{*t*}) increase, the supply of tomatoes available to the world market should decline. Similarly, with higher trade tariffs, supply of Mexican imports to the U.S. market should decrease.

Although most studies allow for a fixed level of transaction costs to shift up the excess supply curve from the exporting country, this study allows for the trading costs to vary with market conditions. This allows us to test whether arguments presented in the market integration literature on the importance of these costs are important to this market. The relationship between trading charges (GTCIF_{*i*}) and the Mexican FOB price (GTPMX) and the volume of fresh tomato imports (GTOQ_{*i*}) is thought to be positive, since an increase in either variable represents an increase in demand for trading services. Since the real exchange rate (MXRER_{*i*}) may reduce the Mexican-based trading expenditures in dollar terms, it is expected to have a negative relationship with overall trading charges. Finally, there may be a positive relationship between tariffs (GTTX_{*i*}) and the marketing margin if there is a complementary relationship between these two factors which make up the entire difference between shipping point and entry prices.

Data and Estimation

The above equations were modeled with a monthly data series from September 1992 to August 1999. Data on the volume of Mexican fresh tomatoes, CIF and FOB fresh tomato prices, trading charges, and fresh tomato tariffs were constructed with information reported by USITC, while data on U.S. shipping point prices and the Mexican wholesale terminal market prices for fresh tomatoes are from the USDA Agricultural Marketing Service. The Mexican real exchange rate, the Mexican price producer index, and the U.S. disposable per-capita income were collected from publications of the Banco de Mexico and the Bureau of Economic Analysis within the U.S. Department of Commerce. All the price and tariff variables in the model are in real terms (deflated by consumer price index to a 1994 base price).

The structural model consists of four endogenous variables; one lagged endogenous variable, and ten exogenous variables. The model is identified by rank and overidentified by order. A two-stage least squares (2SLS) estimation procedure was conducted in EVIEWS to estimate the structural parameters.

Empirical Results

The estimated structural equations from the simultaneous equation system are shown in Table 8. Values of the goodness of fit measures (R^2) are 0.77, 0.84 and 0.75 for the first, second and third equation, respectively. In order to correct for serial correlation in the model, a first order autorregresive term was added to each equation. The problem persisted in the demand equation presented in this study. Based on Durbin Watson and Durbin-*h* statistics, the null hypothesis that there is no first order autocorrelation is rejected for equation 1, indicating a need for further modeling.

Unfortunately, many of the modeled relationships were insignificant in these estimations. This could be partly explained by the inclusion of a lagged dependent variable (to control for some autocorrelation issues and to more accurately measure changes in import levels). But, it could also indicate the imperfect market conditions do exist, and that institutional volumes matter more than prevailing market conditions.

All the coefficients have their anticipated signs, except the negative result on U.S. disposable per-capita income. Although it was expected that tomatoes may have a positive income elasticity in the U.S. market, the negative and insignificant finding suggests that there is little to no effect of increased spending power on tomato imports. Other results from the excess demand equation show that the U.S. price (GTPCIF) of Mexican fresh tomatoes has the expected, negative relationship with the quantity demanded by importers. As hypothesized, there is a significant, positive share of imports that can be explained from the previous year's levels. This results supports our prior argument that much of the trade in this market is related to institutionalized trading relationships. We did not have a clear expectation for the relationship between imports and U.S. plum (USPLP) and cherry tomato (USCHP) prices, and these variables were insignificant in the demand equation. Finally, the seasonal dummy variables S1A and S3 indicate the season running from November to June of the following year shows an increased quantity demanded for imports (relative to omitted reference period).

Differing from expectations, the quantity supplied of fresh tomatoes to the U.S. market from Mexico is insignificantly related to the entry market price of tomatoes (GTPCIF) and the real exchange rate (MXRER). As was the case in the excess demand equation, the GTOQ $_{t-12}$ variable shows a significant and positive effect from last year's levels on the volume imported. The results on the Mexican producer price index (MXPPI), the Mexican vine ripe tomato price (MXVRP), and the U.S. tariffs (GTTX) are all insignificant, but do have the negative signs expected in the model.

Arguably, the most interesting and informative results come from the marketing margin equation (3). The trading charges equation shows that the volume of fresh tomato imported from Mexico (GTOQ) and the fob price of those tomatoes (GTPMX) have a significant, positive influence on trading costs, indicating that the marketing sector reacts to shifts in the demand for

their services. It is interesting to note that the tariff variable had the expected positive, but insignificant effect on trading charges, reinforcing the idea that tariff reductions have not played a major role in trade trends. Finally, the real exchange rate had a significant, negative impact on the trading charges, which is consistent with the theory that most of those costs are incurred within the Mexican economy.

Conclusions and Future Research Goals

Tomato trade between the U.S. and Mexico has increased dramatically during the past decade, partially due to NAFTA and favorable exchange rate conditions. However, there are other supply and demand factors that appear to influence trade flows, including the marketing margin between Mexican shipping points and the U.S. ports of entry. Following the market integration literature, this study presents a U.S.-Mexico tomato trade model, with special focus on the interdependence between trading costs and the volume of Mexican imports.

As expected, the exchange rate is a significant determinant of trading costs, but the level of tariffs was insignificant in both the trading and tomato supply equations. The shipping point price level and volume of imports also appear to affect these costs. For the import supply and demand models, there appears to be a significant share of imports that rely on previous levels of imports, rather than the expected economic factors (prices, income, and producer price index). We conclude that the structure and performance of the tomato trading market may be changing. These industrial organization trends, together with competitive behavior in the U.S-Mexico marketing sector, maybe more influential than tariff reductions in explaining increased trade flows.

The results presented in this paper are part of research in process, so there are still several steps to complete to achieve the proposed goals. One of these goals are to determine the effect of trade factors on price and volume of imports across different types of Mexican fresh tomatoes (vine ripe, plum and cherry tomatoes). We may also try to account for the effect of noncompetitive behavior on these markets, emphasizing the role of transaction costs and the exchange rate. Additional analysis will be undertaken to determine the impact of transaction

costs on intra-US tomato trading through a market integration analysis.

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Table 1. Shipments of Fresh Tomatoes Imported from Mexico by Type

(Percentage)								
Туре	1995	1996	1997	1998	1999	Weighted		
						Average		
Cherry	6.9	6.1	5.9	6.8	7.6	6.6		
Plum (Roma)	27.1	31.3	32.1	36.5	38.9	33.0		
Other	66.0	62.6	61.9	56.7	53.5	60.4		

Source: USITC

Table 2: Fresh Tomatoes: Imports from Mexico	by Custom Service Port
(1000 of Ka)	

			0/	
Year	Laredo	Nogales	San Diego	Total
1992	1,523	98,974	82,611	183,108
1993	2,167	290,467	107,484	400,118
1994	1,851	264,484	109,599	375,934
1995	12,479	385,124	193,830	591,433
1996	21,173	440,759	222,463	684,395
1997	16,773	457,839	185,118	659,730
1998	22,634	490,428	219,987	733,049
1999 ^{1/}	19,544	360,031	86,487	466,062
Total	98,144	2,788,106	1,207,579	4,093,829

1/ Considers only 8 months, from January to August. Source: USITC

Table 3. Fresh Tomatoes: Mean and Standard Deviation of
Transportation Costs/Custom Value (in percentage terms)

Port of Entry and	Standard	Mean	Coefficient of
Type of Tomato	Deviation	moan	Variation
Type of Tolliato	Deviation		(Std Dev /Mean)
Larada			(Std. Dev./Wearr)
Laredo			
Cherry	1.33	6.84	19.47
Plum (Roma)	4.70	13.55	34.69
Other	10.30	9.72	106.4
Total	3.98	8.16	48.78
Nogales			
Cherry	2.80	7.34	38.21
Plum (Roma)	3.17	8.63	36.77
Other	2.82	8.88	31.73
Total	2.63	8.59	30.66
San Diego			
Cherry	0.80	1.38	58.25
Plum (Roma)	0.84	1.80	46.59
Other	0.78	1.79	43.66
Total	0.76	1.70	44.85

Source: USITC

(\$ per kg)								
Months	1992	1993	1994	1995	1996	1997	1998	1999
January		1.22	1.35	0.89	0.72	0.64	0.78	1.42
February		0.88	1.54	1.01	0.64	0.66	0.62	0.78
March		0.89	0.59	0.62	0.64	1.11	0.86	0.58
April		0.75	0.62	0.64	1.57	0.78	0.79	0.63
May		1.18	0.63	0.66	1.81	0.74	0.67	0.61
June		1.21	0.65	0.61	1.56	0.70	0.68	0.65
July		0.55	0.77	0.57	0.56	0.63	0.62	0.64
August		0.57	0.82	0.57	0.47	0.64	0.63	0.62
September	0.59	0.70	0.78	0.57	0.47	0.57	0.63	
October	0.60	0.67	0.69	0.57	0.55	0.60	0.75	
November	0.85	0.50	0.85	0.60	0.58	0.74	0.92	
December	0.97	0.66	1.03	1.01	0.63	0.98	1.22	

Table 4. Real Weighted Average CIF Price for Mexican Fresh Tomatoes (S nor kg)

Source: USITC

Table 5. The U.S. Phaseout Schedule and Safeguard Quotas for Fresh Tomatoes

Item	Season	Base Tariff	Phaseout	Safeguard Base ^{1/}
Tomatoes	Mar 1-July 14	4.6 cents/kg	10years	165,500 mt
Tomatoes	July 15-August 31	3.3 cents/kg	5 years	N/A
Tomatoes	September 1-November 14	4.6 cents/kg	5 years	N/A
Tomatoes	November 15-February 28/29	3.3 cents/kg	10 years	172,300 mt
Cherry tomatoes	May 1-November 30	3.3 cents/kg	5 years ^{2/}	N/A
Cherry tomatoes	December 1-April 30	3.3 cents/kg	Immediate	N/A

1/ Increases 3% annually, compounded. N/A = not applicable.

2/ Duty free on January 1, 1998.

Source: HTSUSA (2000), p.XXII 99-89; and FAS, ERS, USDA.

Table 6. Growth of the Seasonal Quotas for Fresh Tomatoes from Mexico in the **Transitional Period**

Year	Safeguard Quota Quantity entered from March 1 to July 14 inclusive ^{1/}	Actual quantity entered from March 1 to July 31 ²	Safeguard Quota Quantity entered from November 15 to the last day of February of the	Actual quantity entered from November 1 to the last day of
			(Metric tons)	following year ⁴
1994	165,500	NA	No limit ^{5/}	NA
1995	170,465	246,022	172,300	256,923
1996	175,579	292,031	177,469	275,843
1997	180,846	281,102	182,793	273,285
1998	186,272	357,531	188,277	224,987
1999	191,860	245,041	193,925	
2000	197,616		199,743	
2001	203,544		205,735	
2002	209,650		211,907	
2003			218,264	

NA = Information not available.

1/ Beginning in calendar year 2003 quantitative limitations shall cease to apply on such qualifying goods.2/ Because the data was available in monthly basis the quantities are considering the period from March 1 to July 31.

3/ Beginning in calendar year 2003, quantitative limitations shall cease to apply on such goods.
4/ These quantities represent the period from November 1 to the last day of February of the following year

5/ Entered from January 1, 1994, to February 28, 1994.

Source: HTSUSA (2000), p.XXII 99-73; and USITC.

Туре	1992	1993	1994	1995	1996	1997	1998	1999 2/
Laredo								
Cherry	NA	NA	NA	0.61	0.34	0.22	0.00	0.00
Plum	NA	NA	NA	10.54	8.73	6.23	4.84	4.51
Other	NA	NA	NA	7.58	3.52	2.91	2.16	1.92
Total	11.74	9.89	2.05	7.09	4.14	2.80	1.71	1.70
Nogales								
Cherry	NA	NA	NA	0.59	0.12	0.11	0.00	0.00
Plum	NA	NA	NA	4.53	3.65	3.45	2.99	3.49
Other	NA	NA	NA	4.58	3.33	2.83	3.59	2.45
Total	5.65	4.89	4.70	3.89	3.24	2.81	2.99	2.77
San Diego								
Cherry	NA	NA	NA	1.59	0.58	0.26	0.00	0.00
Plum	NA	NA	NA	5.06	3.87	3.61	2.91	2.81
Other	NA	NA	NA	5.03	3.10	3.50	2.61	2.38
Total	6.93	5.90	3.79	4.51	3.06	3.23	2.41	1.11
Total								
Cherry	NA	NA	NA	1.37	0.47	0.24	0.00	0.00
Plum	NA	NA	NA	4.94	3.97	3.35	2.62	3.11
Other	NA	NA	NA	5.06	3.39	3.04	2.65	2.74
Total	6.51	6.11	4.22	4.61	3.20	2.82	2.34	2.29

Table 7. U.S. Tariffs on Mexican Tomatoes (Percentage of FOB Price^{1/})

 1/ Calculated as weighted average of duties to custom value.

 2/ The year 1999 includes only through August.

 Source: USITC

Table 8. Estimated Structural Equations for Fresh Market Tomato Model

(1) U.S. demand for Mexican fresh tomato imports $\text{GTOQ}_{t}^{D} = 192,964.7 - 41,657.13\text{GTPCIF}_{t}^{*} + 13,779.24\text{USMGP}_{t} - 1,089.74\text{USPLP}_{t}$ (1.728)(2.004)(1.501)(0.082)- 74.876USCHP_t - 8.129PCY_t + 0.841GTOQ $*_{t-12}$ + 8,250.22DS1A_t (0.062)(7.782)(1.493)(1.244)+10,469.67DS3_t (1.576) $R^2 = 0.77$ Durbin-*h* = 2.777 (2) Mexico supply of fresh tomatoes to the United States $\text{GTOQ}_{t}^{S} = 19,972.10 + 15,485.73\text{GTPCIF}_{t} + 61,724.76\text{MXRER}_{t} - 61,451.65\text{MXPPI}_{t}$ (1.350)(0.191)(1.309)(0.191)- 14,024.73MXVRP_t - 23,093.07GTTX_t + 0.769GTOQ*_{t-12} (1.376)(0.116)(9.185) $R^2 = 0.84$ Durbin-*h* = 0.043 (3) Trading charges $\text{GTCIF}_{t} = 0.004 + 0.0000005 \text{GTOQ}_{t}^{*} - 0.00008 \text{MXRER}_{t}^{*} + 0.088 \text{GTTX}_{t}$ (0.375) (8.255)(1.959)(0.557)+ 0.023GTPMX*, (2.876) $R^2 = 0.75$ DW = 1.81

Note: t-values in parentheses. Asterisk indicates statistical significance at the 0.10 level.



Figure 2. Trade for Fresh Tomatoes with Trading Charges: US and Mexico

